Collegio Carlo Alberto

The Apparent Diversification Discount

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Abstract

Our model highlights the impact of bankruptcy on (true and apparent) firm value. We show that the pricing of diversified firms suffers from a survivorship bias, due to their lower mortality relative to focused ones. This difference in mortality is able to turn a *true* diversification premium, deriving from saved bankruptcy costs, into an *apparent* diversification discount. Such apparent discount is larger the larger is the true premium due to coinsurance across diversified units. We show how this insight contributes to explain value paradoxes in diversified companies such as multi-unit groups, multi-segment conglomerates, and parent companies.

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1. Introduction

Diversified business groups and conglomerates are common corporate organizations, generating a total value added of 28 US$ trillion in over 200 countries (Altomonte and Rungi, 2013; Herring and Carmassi, 2009). Despite the relevance of diversified firms, the link between their economic role and their market value remains an open question in finance. On the one hand, a large literature argues that diversification distorts investment choices, thereby lowering the value of diversified firms below that of specialized, stand-alone ones. On the other hand, recent empirical investigations cast doubts on a causal link between investment inefficiency and the observed discount on diversified firms.

This paper sheds new light on the nature of the diversification discount. We develop a framework where firm diversification increases value because coinsurance saves on bankruptcy costs, as in Boot and Schmeits (2000) and Lewellen (1971). We thus set aside the change in incentives highlighted in the prior literature. In our framework, diversified firms should trade at a relative premium with respect to stand-alone firms. However, what we observe in databases are the stronger stand-alone firms, which were able to survive to industry downturns, while the weaker ones failed and disappeared from databases. Therefore, one ends up comparing the relative value of diversified firms with respect to the best stand-alone firms, thus measuring a relative discount for diversified firms. Such discount is only *apparent,* as it is purely due to the survivorship selection. The first, and main, insight of our paper, then, is that a survivorship bias is the source of an *apparent* discount for value-increasing diversified firms.

While this insight is straightforward once made explicit, it also applies to subtle differences across types of diversified firms. We juxtapose conglomerate organizations to parent-subsidiary structures (also known as business groups), where parent and subsidiary firms have separate legal liability. In a conglomerate, an unprofitable unit may drag the profitable units into bankruptcy, because they are jointly liable for their debt obligations. Thus, bankruptcy costs in conglomerates may exceed the ones of stand-alone firms, due to contagion, as discussed in Banal, Ottaviani and Winton (2013) and Leland

(2007), implying that the true excess conglomerate value relative to stand-alone firms is positive only if coinsurance benefits exceed contagion costs. Business groups avoid instead contagion because the parent company enjoys limited liability for its subsidiaries' debt obligations. At the same time, a group affiliate may support other affiliates, thus providing the coinsurance benefits that are open to conglomerate units. For these reasons, the true value of business groups exceeds that of both equally diversified conglomerates and less diversified stand-alone firms. However, groups *appear* to trade at a discount relative to both types of firms because of the survivorship bias. The second insight of our paper is that a survivorship bias distorts the relative price of diversified firms, punishing those organizations that survive more often to industry downturns.

Our main insight carries over to other relative pricing puzzles[1]. We show that the survivorship bias may contribute to explain why the parent company trades at a discount relative to its stand-alone valuation. This *apparent* discount originates from the parent surviving more often thanks to the dividend receipts from its subsidiaries. Clearly, a listed subsidiary provides a smaller dividend to its parent company, thereby reducing the parent company survival in industry downturns. The pricing implication of this reasoning is that the apparent discount of the parent company, induced by the survivorship bias, is lower in pyramidal groups than in private groups, and disappears when subsidiaries are spun-off.

Our model also implies that the *true* profit volatility in groups is lower than the one of the stand-alone units. Some previous studies of the diversification role of groups examine whether such lower volatility appears in the data, finding mixed results (He et al., 2013; Khanna and Yafeh, 2005). Our reasoning implies that the *apparent* profit volatility of surviving groups exceeds the one of surviving

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[1] A summary of the early, but ongoing, debate on the conglomerate discount appears in Maksimovic and Phillips (2007). See Cornell and Liu (2001) on the parent company discount. See also Almeida, Park, Subrahmanhyam and Wolfenzon (2011) and references in Khanna and Yafeh (2007) on value and profitability of group affiliates.

independent companies, due to the survivorship bias. Thus, the bias may also explain why there is so little evidence on the risk- sharing role of groups.

As a by-product, our pricing model clarifies the subtle link between diversification, contagion and the *true* cost of debt. It shows that diversified firms always enjoy a lower interest rate than the one charged to specialized companies (as in Hann et al., 2013). The paradox is that conglomerates may enjoy a lower interest rate even when they destroy value with respect to (focused) stand-alone firms. The reason is that lenders anticipate a larger recovery-upon-default due to the contagion of healthy segments. We thus highlight that conglomerate diversification may counterintuitively reduce both the interest rate and conglomerate value below the ones of focused firms. This is due to a transfer of lenders' wealth across states of nature. Previous papers highlight instead that conglomerate diversification implies a transfer of wealth between lenders and shareholders (Kim and McConnell, 1977; Mansi and Reeb, 2002) due to lower profit volatility.

The rest of the paper proceeds as follow. Section 2 presents our model, focusing on bankruptcy costs. Section 3 derives the true and apparent relative firm value and the relationship between the diversification discount and the survival skills of conglomerates and groups. In Section 4 we present our robustness checks. Conclusions follow. Appendix A highlights the origins of the corporate limited liability embedded in business groups and reports about its enforcement by courts. All proofs are in Appendix B.

1.1 RELATED LITERATURE

This paper provides new insight into the diversification-value controversy, bringing into this arena the known problem of survivorship bias in empirical finance. We know that databases, including COMPUSTAT, contain only those companies that are currently viable entities. Thus, they exclude companies that filed for bankruptcy or have otherwise ceased to exist. Banz and Breen (1986) observe that this induces an ex-post-selection bias that disturbs the comparison of returns between different

types of firms, such as firms with low and high price/earnings. Kothari, Shanken and Sloan (1995) show that ex-post selection overstates the excess return on high book-to-market portfolios. Brown, Goetzmann and Ross (1995) highlight how survival distorts return predictability and the equity premium. Our model shows that it biases our inference on the relative value of diversified and focused organizations. We thus suggest a plausible explanation for the most puzzling aspect of the controversy, namely the existence of a large discount for diversified firms in the raw data together with the difficulty in associating it to a blatant inefficiency.

In this light, the closest paper on the diversification discount is Gomes and Livdan (2014), which also considers the discount as consistent with the neoclassical view of efficient firm diversification. Gomes and Livdan stress that diversification helps the search for better productive opportunities, while we point to its role in saving bankruptcy costs. They argue that the conglomerate discount reflects the endogenous selection of less productive firms into diversified conglomerates. We claim that it is, at least in part, a pure artifact of the data.

Our argument generalizes to settings where other features of diversified firms cause a *true* diversification discount or premium. These may stem from the internal capital market (Almeida et al., 2011; Rajan, Servaes and Zingales, 2000; Stein, 2002), from employee incentives (Cestone and Fumagalli, 2005; Fulghieri and Sevilir, 2011), as well as production decisions (Alonso, Dessein and Matouschek, 2015). However, a *true* value discount for diversified firms may also stem from coinsurance of units, distorting effort incentives of unit managers (Boot and Schmeits, 2000). Our general point is that any *true* discount (or premium) due to such motives is upward (downward) *biased* by enhanced survival.

Last, but not least, our paper relates to the literature on bailouts between members of business groups. Several papers highlight the role of the parent company in providing both informal and formal support in groups (see Gopalan Nanda and Seru (2007) and Kolasinsky (2009)), with the exception of groups involved in project financing (Shah and Thakor (1987)). Our model recognizes that internal dividends

are a vehicle for the internal support of the parent. This makes explicit the similarity between the coinsurance function of groups and conglomerates, as long as the parent company fully owns its subsidiary. As in Luciano and Nicodano (2014), we study the pricing implications of coinsurance and corporate limited liability, focusing however on the survivorship bias rather than tax distortions.

2. The Model

An entrepreneur chooses how to organize two production units in order to maximize their value. Each unit funds itself through debt. The organizations do not alter the operating profits of each unit, but differ in the extent of support that each can provide to the other one, as well as in the extent of liability for the debt of the other unit. This affects both credit conditions and profits, net of funding costs, to each organization.

2.1. Cash Flows and Bankruptcy Costs

Each unit, indexed by $i = (A, B)$, raises an amount of debt, $D_i = 1$, to invest in a project at the initial time $(t = 0)$. The operating profit of each unit is realized in $t = 1$. It will be High, and equal to $X_i > 0$, with probability $p_i \in (0, 1)$, and it will be Low, and equal to zero, with probability $(1 - p_i)$. We define four states of the world, {HH, LL, HL, LH}, where the first (second) letter in each pair refers to the profit of unit A (B). Our choice of values implies that each unit has insufficient operating profits in state L to honor its own debt obligations. Without support, it defaults, and the future profit of unit i, $K_i > 0$, is lost.[2]

Finally, we assume that the profit of unit A, in state HL, exceeds combined debt repayment of the two units, whereas the profit of unit B is lower than the combined service of debt. We will later assess that payoffs satisfy these restrictions.

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[2] Hennessy and Whited (2007) estimate bankruptcy costs in the range of 8%-15% of capital for US Compustat firms, while Leland (2007) calibrates them to 23% for BBB-rated firms.

2.2. ORGANIZATIONAL STRUCTURES

The entrepreneur chooses among three organizations: stand-alone firms, business groups and conglomerates. Stand-alone firms operate separately. Each is independently liable to competitive lenders, who require a rate R_i. Given the assumptions concerning cash flows, firm A defaults in states {LH} and {LL} while firm B defaults in {HL} and {LL}.

In a conglomerate, segments A and B belong to the same firm. They are therefore jointly liable *vis-à-vis* lenders. The conglomerate defaults in state {LL}, when both units either have zero profits, and in state {LH}, when segment A drags the profitable segment B into bankruptcy. However, there are coinsurance benefits in state {HL}, because profits from segment A save B from insolvency. Thus, the conglomerate organization allows for coinsurance, while stand-alone companies do not, but it suffers from contagion. So far, we are following the setup of Boot and Schmeits (2000) without incentive problems, adding instead the assumption of asymmetric profits. This assumption makes contagion possible, a feature that is prominent in other analyses of conglomerate mergers such as Banal, Ottaviani and Winton (2013) and Leland (2007).

We now extend the analysis to groups. In a group, the incorporation of companies is separate and lenders fund them individually. The parent company (B) owns its subsidiary (A) and receives dividends that allow the parent to meet its debt obligations when the former is profitable and the latter is not, in state {HL}. Despite this ownership link, the parent company B enjoys corporate limited liability vis-à-vis the debt obligations of unit A. This limit on liability implies that unit A selectively defaults in state {LH}.[3] Thus, the group organization allows for diversification, as in conglomerates, without incurring into contagion costs. In the first part of our analysis, we assume that the parent company (B) owns 100% of the shares of its subsidiary (A).

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[3] This is the situation when Indian groups fail to provide support to ailing subsidiaries (Gopalan et al., 2007).

It is worthwhile discussing a few features of our model. First, a maintained assumption is that the costs of mergers prevent them from occurring. At the other extreme, if such costs are negligible, the provision of support becomes possible for a profitable stand-alone company through acquisitions of an insolvent one (as in Fluck and Lynch, 1999). Second, corporate limited liability is central to the argument that groups save on bankruptcy costs. Courts may occasionally repeal corporate limited liability asking the parent company to meet its subsidiary debt obligations. Appendix A reports on court practice in several jurisdictions, that usually "pierce the corporate veil" in case of fraud, only. Third, in the model, both conglomerate and group support takes the form of a transfer from A to B, only. We could enlarge this minimalist state space to define an additional state in which B rescues A from bankruptcy and more generally to eliminate asymmetries in profits. These algebraic complications do not affect the key insight concerning the cost of credit and value in each organization – to which we turn in the next section.

2.3. COINSURANCE, CONTAGION AND THE TRUE COST OF DEBT

We now determine the interest factors charged by the lenders, assuming risk-neutrality and a zero risk-free rate. Lenders of stand-alone firms, $i = A, B,$ receive the debt repayment in state {H} and collect nothing in state {L}. It follows that the interest factor for unit i, R_i, satisfying the lenders' zero expected profit condition, $1 = (1 - p_i) * 0 + p_i R_i$, is equal to:

$$R_i = p_i^{-1}. \tag{1}$$

Conglomerate's lenders receive the debt repayment in state {HH} and {HL}. They also recover the cash flow X_B in state {LH}, when segment A drags segment B into bankruptcy, but B is profitable. Thus, the interest factor for the Conglomerate (C) is equal to:

$$R_C = p_A^{-1}[2 - p_B(1 - p_A)X_B] \tag{2}$$

This factor solves the zero profits condition, that requires the value of debt at $t = 0$, $(D_A + D_B) = 2$, to equal the expected total profits of the conglomerate, $[p_A\, p_B + p_A\, (1- p_B)]\, R_C + p_B\, (1- p_A)\, X_B$. Thus, lenders collect R_c when either both segments are successful, an event that has probability $p_A\, p_B$, or when segment A only is successful, with probability $p_A\, (1- p_B)$.

Turning to the group, lenders charge to the subsidiary A the same interest rate of the corresponding stand-alone firm (like in equation *1*), $R_{A\in G} = R_A$. This result holds because the subsidiary defaults in the same states of the world as the stand-alone firm. The cost of borrowing for the parent B is, instead, lower than the corresponding cost of unit B when stand-alone, thanks to the possibility of support in state {HL}:

$$R_{B\in G} = [p_B + p_A(1-p_B)]^{-1} \tag{3}$$

Indeed the parent B defaults in state {LL}, only, since there is a dividend transfer from A to B in state {HL}. It avoids bankruptcy in state {LH} thanks to its corporate limited liability.

We now rank the borrowing costs across the different organizational structures.

Proposition 1 - *Assume costly bankruptcy. Then the interest rate paid by a conglomerate is lower than the one paid by the group affiliates, which is, in turn, lower than in the corresponding stand-alone firms.*

Groups pay a lower interest rate on debt with respect to stand-alone firms. Such overall improvement in credit conditions is due to the positive probability of the coinsurance state (LH) when subsidiary dividend allows the parent to survive. In turn, the conglomerate pays a lower cost of debt with respect to groups, because lenders anticipate recovering positive cash flow (XB) when the profitable segment B defaults due to contagion. In other words, reduction in the interest factor stems from either lower bankruptcy costs (thanks to coinsurance) or higher bankruptcy costs (due to contagion). Both conglomerates and groups have lower borrowing costs with respect to stand-alone firms, thanks to coinsurance. However, groups have a higher cost of debt than conglomerates because A's lenders have

no claim to B's profits. We can now make explicit the restrictions on asymmetric cash flows, underlying the derivations of the previous equations. The assumption that profits in state H allow to service debt implies that the cash flow in state H, X_i, exceeds the total debt repayment, that is $X_i \geq p_i^{-1}$ for each unit i. Recall now that the subsidiary, A, selectively defaults in state LH while the parent company, B, receives support by A in state HL. This holds if the profit of unit A, X_A, exceeds both units' debt, that is:

$$X_A \geq max(R_C, R_{A \in G} + R_{B \in G}) \tag{4}$$

A sufficient condition is that $X_A \geq p_A^{-1} + p_B^{-1}$, since the highest cost of debt is the one of the stand-alone firms by Proposition 1. The profit of unit B, X_B, must in turn fall short the combined interest factor:

$$X_B < min(R_C, R_{A \in G} + R_{B \in G}) \tag{5}$$

Restriction (5) implies $X_B < 2/[p_A + p_B(1-p_A)]$, since the lowest cost of debt is the one in conglomerates, by Proposition 1. The next section computes the value of each organization. We will show that a lower cost of debt in conglomerates does not imply that they have the highest value, completing the reasoning in Hann et al. (2013). Moreover, we will derive the average ex-post value that an econometrician estimates when (s)he does control for differential survival.

3. The *Apparent* Diversification Discount

3.1. THE TRUE VALUE OF DIVERSIFICATION

The value of each organization coincides with profit after the service of debt, thanks to the zero risk-free rate assumption. It is straightforward to show that it is respectively equal to: $\pi^I = (X_A + K_A) p_A + p_B (X_B + K_B) - 2$ for two stand-alone firms; to $\pi^C = (X_A + K_A + K_B) p_A + p_B X_B - 2$ for a conglomerate; and $\pi^G = (X_A + K_A) p_A + (X_B + K_B) p_B + K_B (1 - p_B) p_A - 2$ for a group.

We now compare them, in order to assess both the true diversification discounts as well as the effects of coinsurance and limited liability on firm value. Some easy algebra (in Appendix C) leads to the following statement:

Proposition 2: *Assume costly bankruptcy. Then:*

a. Groups have the highest true value.

b. The group premium relative to conglomerates represents the value of corporate limited liability. The one relative to two stand-alone firms represents the value of coinsurance. They are, respectively, equal to $K_B (1-p_A) p_B$ and $K_B (1- p_B) p_A$.

c. Conglomerate excess value relative to stand-alone firms is positive if, and only if, contagion costs are lower than diversification gains ($p_B < p_A$).

This proposition highlights the economic role of diversified firms, that increases firm value. Absent bankruptcy costs, there should be no discount or premium because the differential survival ability of organizations does not affect firm value. With bankruptcy costs, statement (a) indicates that groups trade at a premium relative to both conglomerates and focused firms, because they best protect firm activity. This result abstracts from incentive problems that may reduce (minority) shareholders' value relative to the stand-alone case. It also abstracts from higher value due to tax distortions (as in Luciano and Nicodano, 2014). These assumptions allow highlighting, in Statement (b), the connection between the excess group value and avoided bankruptcy costs. Corporate limited liability saves future profits (K_B) from being lost in the bankruptcy procedure due to contagion. This happens with probability *(1-p_A) p_B*, which is the probability that unit B, while solvent by itself, is unable to provide support to the insolvent one. Coinsurance allows saving unit B from insolvency. This occurs with probability *(1-p_A) p_B*, which is the probability that B is insolvent but unit A generates enough profits to support it. Statement (c) indicates that the excess value of conglomerates is positive only if contagion problems

are limited. It is not a new result, reminding of previous insight due to Banal et al. (2013) without tax distortions and Leland (2007) with tax distortions.

The following section explains how a true diversification premium becomes an apparent diversification discount.

3.2 SURVIVORSHIP BIAS

We now show that group affiliates and conglomerates appear to trade at a discount relative to stand-alone companies if the econometrician does not account for survival. We thus address the methodology of several papers investigating the excess value of multi-unit firms. These papers typically match single-unit to multi-unit firms, *when all of them are alive* and appear in the database. The survivorship bias originates from three facts. First, datasets do not contain information on bankrupt firms. Second, both group affiliates and conglomerates exploit diversification in order to survive during industry downturns. Third, the econometrician does not control for the survival ability of different organizations.

In order to be able to infer the *apparent* value of each organization, we must ask whether the state is high or low when the econometrician finds firms in her dataset. This will determine the chances of observing a high or a low cash flow. Let us, therefore, start with stand-alone units. The probability of state {H}, when the econometrician notes that a stand-alone firm is present in her dataset, is 1. Indeed, a stand-alone unit goes bankrupt and exits from the database in state {L}. It follows that the apparent value of a stand-alone is equal to the high cash flow realizations net of the debt repayment, that is:

$$V_i = X_i + K_i - R_B \qquad i=A,B \tag{6}$$

We now determine the probability of being in a good or bad state when the econometrician observes a parent or a subsidiary firm in the dataset. The probability of state H, when the subsidiary A is alive, equals one because affiliation does not influence the default of the subsidiary. On the contrary, the state is H with probability equal to $[p_B + (1- p_B) p_A]^{-1} p_B$, and low with probability equal to $[p_B + (1 - p_B) p_A]^{-1}(1- p_B) p_A$ when the parent company, B, appears in the dataset. This occurs because B survives in low

states, when it generates zero cash flows, thanks to the subsidiary support. The econometrician, therefore, estimates the value of the parent company B as being equal to:

$$[(X_B + K_B - R_B \in_G) \, p_B + (K_B - R_B \in_G)(1 - p_B)p_A] \tag{7}$$

The apparent parent value, (7), is always lower than the apparent value of an independent unit, (6), that is:

$$[p_B + (1 - p_B) \, p_A]^{-1} \, [(X_B + K_B - R_B \in_G) \, p_B + (K_B - R_B \in_G)(1 - p_B)p_A] < K_B + X_B - R_B \equiv X_B > p_B^{-1} \tag{8}$$

It follows that parent companies appear to trade at a discount, while in reality, they are saving on dissipative bankruptcy.

We now carry out a similar comparison between conglomerates and stand-alone units, when an econometrician observes all units in operations. The probability of state {HH}, conditional on observing both stand-alone companies alive, is one. On the contrary, the probability of state {HH} conditional on observing a conglomerate is lower, because of the conglomerate ability to survive when A rescues B. Such probability is equal to $Pr[HH / (HH+LH)]$, that is:

$$p_A \, p_B \, /[\, p_A \, p_B + (1 - p_B) \, p_A]^{-1} \equiv p_B < 1. \tag{9}$$

The probability of state {LH} is $(1 - p_B)$. Thus, the estimated value of the conglomerate equals:

$$p_B(X_B + K_B + X_A + K_A - R_c) + (1 - p_B)(K_A + X_A + K_B - R_c) \equiv (K_B + X_A + K_A - R_c) + p_B X_B. \tag{10}$$

Let us now compare equations (7) and (10). The conglomerate appears to have a lower market value with respect to stand-alone firms if

$$X_B > (R_A + R_B - R_C) \, (1 - p_B)^{-1}, \text{ that is if:} \tag{11}$$

$$X_B > p_B^{-1}$$

This inequality always holds, since the profit in each unit always exceeds the value of its debt by assumption. Thus, conglomerates trade at an apparent discount relative to stand-alone whether or not they save on bankruptcy costs. The survivorship bias is, therefore, tricky when it comes to conglomerates. We know already the rationale for the apparent discount when conglomerates save on bankruptcy costs, that is, when $p_B < p_A$. When the opposite holds, contagion cancels segment B with positive profits more often than it saves segment A with zero profits. Hence, a profitable segment disappears from the database, thereby contributing all the same to the conglomerate discount.

In summary, the survivorship bias affects both conglomerates and business groups. However, the Appendix shows that the diversification discount for business groups is more severe because the group survives more often when profitability is low. The analyst will thus observe a lower value for groups in operations than for conglomerates in operation. We summarize our results as follows:

Proposition 3: *Assume an econometrician matches groups and conglomerates to the corresponding stand-alone firms, conditional on available data. Then the value of matched groups appears lower than the value of matched conglomerates, which appears, in turn, lower than the value of stand-alone firms.*

This proposition implies that comparing average market values of different organizations lead to the wrong inference concerning their relative efficiency. This is not due to distortions in market prices: prices are rational, and there are no limits to arbitrage. The wrong inference derives from the different survival ability of organizations, which investors, analysts and econometrician alike fail to consider.

Our proposition provides the same rationale for puzzling discounts uncovered by empirical analysis, concerning different types of diversified organizations. The same rationale may also be able to explain the apparent excess profit volatility of groups (see Khanna and Yafeh, 2005). Three empirical studies contain promising signals that align with our theory. If the hypothesis of survivorship bias is true, there should be an inconsistency between ex-ante predictions and ex-post measurement. Lamont and Polk (2001) find that larger conglomerates discounts - obtained with a matching procedure - predict higher

realized returns. However, both standard risk factors, as well as liquidity or arbitrage impediments, are unable to explain such a pattern. According to our model, the higher realized returns are the gain from coinsurance (net of contagion). In turn, the ex-post diversification discount they find appears because of the survivorship bias inherent in the standard measurement method. Second, an analysis that accounts for defaulted units - and is, therefore, free from survivorship bias– should reveal that diversified firms outperform during industry distress. Gopalan and Xie (2011) measure the average discount on multi-units firms just before and during unexpected industry distress. Thus they take into account the disappearance (through delisting, i.e. bankruptcies, mergers, etc.) of weak stand-alone firms. They find that the average conglomerate discount reduces from 20% the year before industry distress to 6.9% in the three years after industry distress. This suggests a fair value of coinsurance equal to 13.1%, conditional on industry distress. Third, survey data should not be subject to selection bias. Accordingly, it appears that diversification creates value when the analyst uses survey data to estimate ex-ante returns (see Hann et al., 2013).

4. Robustness

This section qualifies previous results. It suggests that the apparent discount is larger when unit B is able to support unit A (section1). It then suggests other modifications to relative pricing that derive from partial ownership of the subsidiary (section 2) and non-contractible managerial effort (section 3).

4.1. PARENT COMPANY BAILOUTS AND SUBSIDIARY PRICING.

Parent companies often support their subsidiaries, without being subject to contractual guarantees. For example, they write "comfort letters" assuring subsidiaries' lenders that they would assist them in distress. These letters do not undermine their limited liability, because they are legally unenforceable, but allow the parent company to choose whether to honor them ex post (Boot et al., 1993). Our model set-up allows only the subsidiary to support its parent through dividends. Consequently, the subsidiary

does not suffer from the survivorship bias. It is, however, easy to add a state of nature with parent profits that are larger than the sum of debt obligations for both units. In that state, the parent shareholders would honor their comfort letters. The survivorship bias in groups would then become more severe relative to stand-alone firms. The pricing relationship with respect to conglomerates would be qualitatively unaltered, as long as division B may both rescue and contaminate division B in some states of the world.

4.2 DIVERSIFICATION BENEFITS IN PYRAMIDAL GROUPS

Previous sections deal with groups with fully owned subsidiaries, which are common in several jurisdictions, as mentioned in Appendix A. However, pyramidal groups with listed subsidiaries are also common (see La Porta et al. (1999)). This section investigates the consequences of partial subsidiary ownership for the diversification role of groups and their pricing, continuing to sidestep the expropriation of minority shareholders taking place with separation of ownership from control. A simple argument implies that the listing of affiliates does not, in general, improve, and may worsen, group survival thereby reducing both the true premium and the apparent discount.

Let the parent firm own a percentage, γ, of subsidiary equity. Then the dividends it receives from the subsidiary reduce to γX_A. Lower dividends increase the costs of parent debt, as lenders anticipate a higher default probability. Let variable λ account for the bailout probability, we assume that it might assume two values, conditional to the realization of cash flow of units A and B:

$$\lambda = 1 \qquad\qquad \gamma X_A \geq (R_{A \in G} + R_{B \in G}) \qquad\qquad (11)$$

$$\lambda = 0 \qquad\qquad \gamma X_A < (R_{A \in G} + R_{B \in G}) \qquad\qquad (12)$$

We can determine the threshold value of γ, which we indicate with γ^*, such that $\lambda = 1$:

$$\gamma > \gamma^* = (R_A + R_B) X_A^{-1} = (p_A)^{-1}[p_B + p_A(1 - p_B)]^{-1} X_A^{-1}. \qquad\qquad (13)$$

Since X_A is always greater than $(R_A + R_B)$, the right-hand-side of this equation is always lower than one. This result indicates that coinsurance is no longer possible, in a pyramidal group, if the parent ownership share falls short of γ^*. In such a case, both the cost of debt and the value are equal across group affiliates and stand-alone firms. Consequently, the group will not suffer from the survivorship bias.

4.3 EFFORT PROVISION, CONTAGION AND OUTSIDE FUNDING.

The previous sections show that diversified firms suffer from an apparent discount when they reduce bankruptcy costs with respect to stand-alone firms. It also establishes that the discount is larger on groups than on conglomerates, *provided coinsurance and contagion do not distort managerial incentives*. This section discusses the robustness of this result once the probability of success for unit A becomes endogenous and non-contractible, expanding on the analysis of Boot and Schmeits (2000). They assume that managerial effort increases the success probability of unit A, but imposes on it a monitoring cost. Lenders will exert "market discipline," trying to detect the true probability of success of the unit. Boot and Schmeits (2000) point out that there are negative incentive effects in conglomerates, due to coinsurance. Effort provision in conglomerates is lower than in stand-alone firms for all levels of market discipline because Manager A does not fully internalize the positive consequences of his effort provision on unit B.

Our model reinforces their insight, because unit A may also contaminate unit B with manager A enjoying a lower funding cost rather than incurring a penalty. Such contagion is not present in a group thanks to the limited liability of each unit. These agency costs tend to diminish the survival skills of diversified firms, especially in conglomerates. Thus, the apparent diversification discount will fall as the relevance of managerial moral hazard grows, thereby reducing the true diversification premium.

5. Conclusion

There is conflicting evidence on the performance of diversified organizations. While owners choose diversified organizations for their firms, several works find that corporate diversification reduces firm value. This paper proposes a resolution of this conflict going back to an old economic rationale for diversification, which is enhanced firm survival. We point out that the diversification discount may artificially arise in empirical analysis because of the better survival skills of diversified organizations. This pricing paradox is due to a known problem of existing databases, namely the ex-post selection bias. Databases do not contain price information on stand-alone firms that disappeared in a downturn due to defaults and mergers, while they do include the diversified affiliates that survived. Thus, ex-post relative average price does not reflect relative firm value because such measurement does not control for selection bias.

Our pricing model shows that the implied apparent diversification discount, conditional on databases that cancel out bankrupt firms, is even larger for groups than for conglomerates, because of their better survival skills. An extensive literature considers such discount as true, relating it to the possibility of using minority shareholders' resources to the benefit of the controlling party. Our paper points out an alternative reason for group discounts, which rests in the ability to avoid contagion thanks to their corporate limited liability. Corporate limited liability is a persistent legal provision of groups across several jurisdictions, which policy-makers consider a benefit of the group organization (see Winter et al., 2002).

This reasoning leads to conclude that the economic function of diversification, consisting in limiting dissipative bankruptcy costs, is hard to detect in the data. We leave it to future work to correct the survivorship bias, downsizing the empirical estimates of the diversification discount and possibly turning it into a premium - thereby explaining owners' preferences for diversification.

Appendix A. Corporate Limited Liability in Groups around the World

In our model, groups save on bankruptcy costs because they enjoy corporate limited liability. This feature allows them to avoid contagion among affiliates. This Appendix sheds light on the way such provision emerged in the US. It also informs on its enforcement in the US and selected EU countries, as well as on the type of group organization that prevails. Courts may in fact "pierce the corporate veil," that is repeal corporate limited liability asking the parent company to meet its subsidiary debt obligations.

In the US, the legal theories of the separate legal personalities of corporations (entity law) and the limited liability of shareholders applied to parent and subsidiary corporations. After the first Limited Liability Act in 1855, the courts expanded the concept of limited liability to protect each layer in the group from the liability of the junior company. Successively, legislators added further layers of limited liability on top of the primary limitation on the liability of the ultimate individual investor, for the obligations of the parent company. In time, the law created the possibility for judicial escape in cases of abuse. This safety valve was the doctrine of "piercing of the corporate veil." U.S. courts now impose liability on the parent when it is possible to prove the lack of separate existence of the subsidiary, and that the plaintiff has been a victim of conduct "akin to fraud" through the parent's use of such dominated corporation (Blumberg 1989). However, the justification for piercing the corporate veil remains obscure, according to Easterbrook and Fischel (1985). Special regulations - such as the Public Utility Holding Company Act of 1935 and the Investment Company Act of 1940 - have restricted group activities in the US during and after the New Deal. There are also adverse tax provisions allowing consolidation of income statements only if subsidiaries are at least 80% owned (Kandel et al., 2016). Despite these obstacles, in the US group-like organizations are active in family firms (Villalonga and Amit, 2008), in financial conglomerates (Herring and Carmassi, 2009), in innovative firms and venture

capital (Allen, 1998; Sahlman, 1990) and multinationals (Altomonte and Rungi, 2013). Since 1995, subsidiaries of non-financial groups have accounted for 13% of total US debt issues (Kolasinski, 2009).

As far as continental Europe is concerned, the group form is common in several countries (see Aganin and Volpin, 2005; Barca and Becht, 2001). In the UK, as the top fifty listed companies have on average 230 subsidiaries. Courts strictly adhere to the corporate entity doctrine and are reluctant to pierce the corporate veil. They consider that a company should be able to limit its risk by the use of a subsidiary, but it should not use this device to impose unreasonable risks on others. There is a presumption of no abuse if each company internalizes the risk, as in a contractual relationship.

In the Netherlands, groups are also common since there are no legal or tax obstacles. There is usually a listed company at the top and private companies as subsidiaries. As far as limited liability is concerned, the trend in case law is not towards an automatic liability of a parent company vis-à-vis the subsidiary's creditors. Rather, its liability depends on showing some further act on its part (Timmermann, 1996). As far as Switzerland is concerned, at least fifty percent of registered companies were group affiliated. Subsidiaries tend to be 100% owned. The legal basis is also the entity law. No compensation is, therefore, possible for a debtor by a claim he has against another company in the same group (Duey, 1996).

Thus, the starting point in every major jurisdiction, including also Germany, France, Italy or Belgium, remains the separate legal status and the separate liability of each company within the group for its debts and only its debts (Hadden, 1989). Nevertheless, there has been a general trend towards imposing liability on parent companies for the debts of insolvent subsidiaries, when the insolvency resulted from some fault on the part of the parent company.

Appendix B. Proofs

This section gathers proofs of propositions in the main body of the paper.

Proposition 1- *Borrowing costs.*

We first need to prove that $R_c < R_A + R_B$, that is: $(p_A)^{-1} [2 - p_B (1 - p_A) X_B] < (p_A)^{-1} + (p_B)^{-1}$. This simplifies to: $p_B [2 - p_B (1 - p_A) X_B] < p_A + p_B$; that reduces to: $- p_B^2 (1 - p_A) X_B < p_A - p_B$; that is: $p_B^2 (1 - p_A) X_B > p_B - p_A$ or $X_B > (p_B - p_A)[p_B^2 (1 - p_A)]^{-1}$.

This inequality always holds because the threshold level of the cash flow, $x_B = (p_B - p_A)[p_B^2 (1 - p_A)]^{-1}$, is lower than the minimum level required for unit B cash flow (see Equation 6) when successful, that is: $(p_B - p_A)[p_B^2 (1 - p_A)]^{-1} < (p_B)^{-1}$. This inequality reduces to:

$$(p_B - p_A)[p_B (1 - p_A)]^{-1} < 1, \text{ or } (p_B - p_A) < p_B (1 - p_A), \text{ that is } -1 < - p_B \text{ or } p_B < 1.$$

This inequality always holds by assumption. We now need to show that the combined cost of debt is lower for business groups, that is:

$$R_G < R_A + R_B$$

Recall that the interest factor in unit A is the same for both organizational forms, $R_{A \in G} = R_A$. Then the following must hold:

$$R_{B \in G} < R_B \equiv [p_B + p_A (1 - p_B)]^{-1} < (p_B)^{-1} \equiv p_A (1 - p_B) > 0.$$

This inequality is always satisfied.

Finally, we need to show that the cost of debt for business groups is lower than the conglomerate case, that is $R_A + R_{B \in G} < R_C$. This inequality becomes:

$$(p_A)^{-1}[2 - p_B (1 - p_A) X_B] > (p_A)^{-1} + [p_B + p_A (1 - p_B)]^{-1} \equiv (p_A)^{-1} [1 - p_B (1 - p_A) X_B] > [p_B + p_A (1 - p_B)]^{-1}$$

$$\text{that is: } (p_A)^{-1} [- p_B (1 - p_A) X_B] > [p_B + p_A (1 - p_B)]^{-1} - (p_A)^{-1},$$

or: $- (p_A)^{-1} [p_B (1- p_A)X_B] > - (p_A)^{-1} \{ 1 - p_A[p_B + p_A (1- p_B)]^{-1}\}$.

This expression simplifies to:

$[p_B (1- p_A)X_B] < 1 - p_A[p_B + p_A (1- p_B)]^{-1}$ or $[p_B (1- p_A)X_B] < p_B (1- p_A) [p_B + p_A (1- p_B)]^{-1}$

that is: $X_B < [p_B + p_A (1- p_B)]^{-1}$

This last inequality never holds because profits for unit B, when successful, are sufficient to repay its own debt by assumption. The difference between the cost of borrowing of conglomerates and business groups equals: $p_B (1- p_A)[X_B - R_{B \in G.}]$. Recall that the minimum level for X_B is $(p_B)^{-1}$. It follows that the cost of borrowing in business groups exceeds the one of conglomerates by, at least, $[p_B + p_A(1- p_B)]^{-1}[p_B + p_A(1- 2p_B)]^{-1} > 0$.

Proposition 2 *- Firm value.*

The combined profits of the two stand-alone units are equal to:

$$\pi^I = (X_A + K_A- R_A)\, p_A + p_B (X_B+ K_B - R_B) = (X_A + K_A)\, p_A + p_B (X_B+ K_B) - 2 \tag{B.1}$$

In turn, conglomerate profits, $\pi^C(m),$ are equal to:

$$\pi^C = (X_A + K_A + X_B+ K_B - R_C)\, p_A\, p_B + (X_A + K_A + K_B - R_C)\, p_A\, (1- p_B) =$$

$$= p_A\, p_B\, X_B + (X_A + K_A + K_B - R_C)\, p_A = (X_A + K_A + K_B)\, p_A + p_B\, X_B - 2. \tag{B.2}$$

Group profits are equal to:

$$\pi^G = (X_A+ K_A + X_B + K_B - R_A - R_{B \in G})\, p_A\, p_B + (X_A + K_A + K_B - R_A - R_{B \in G})\, (1- p_B)\, p_A +$$

$$+ (X_B + K_B - R_{B \in G})\, p_B\, (1- p_A) = (X_A+ K_A)p_A - 1 + p_B\, X_B + (K_B - R_{B \in G})[p_A p_B (1- p_A)] =$$

$$= (X_A+ K_A)\, p_A + (X_B + K_B)\, p_B + K_B (1- p_B)\, p_A - 2 \tag{B.3}$$

We write Equation (B.3) using Equation (B.1) as:

$$\pi^G = \pi^I + K_B (1- p_B)\, p_A \tag{B.4}$$

Similarly, we write Equation *(B.3)* using Equation *(B.2)* as:

$$\pi^G = \pi^C + K_B\,(1\text{-}\,p_A)\,p_B. \qquad\qquad (B.5)$$

This proves Part (a) of Proposition 2.

As for Part (b), the value increase relative to conglomerates (stand-alone companies) in (B.5) ((B.4)) determines the benefits of corporate limited liability (coinsurance).

Finally, equating (B.4) and (B.5) and rearranging terms we find that conglomerate profits are higher than stand-alone firms' are if the diversification effect prevails on the contagion effect:

$$p_B\,K_B < p_A\,K_B \quad \equiv\ p_A > p_B$$

This proves Part (c). In turn, group profits when parent B does not own 100% of the subsidiary are:

$$\pi^G = (X_A + K_A + X_B + K_B - R_A - R_{B\in G})\,p_A\,p_B + (X_A + K_A + K_B - R_A - R_{B\in G})\alpha\,p_A\ -p_B\,p_A\,\alpha\,(X_A + K_A + K_B - R_A -$$

$$R_{B\in G})\ + (X_B + K_B - R_{B\in G})\,p_B\ - p_B\,p_A(X_B + K_B - R_{B\in G})$$

This reduces to π^I if $\alpha = 0$, and to (B.3) if $\alpha = 1$.

Proposition 3 *- Survivorship Bias and Conglomerate Discount.*

We need to prove that survivorship bias generate a discount for groups and conglomerates. This entails showing that the value of a conglomerate in operation is higher than the value of two group affiliates in operations. We first prove the inequality in equation (8), implying that groups trade at an apparent discount vis-à-vis stand-alone firms:

$$[p_B + (1\text{-}\,p_B)\,p_A]^{-1}\ [(X_B + K_B - R_{B\in G})p_B + (K_B - R_{B\in G})(1\text{-}\,p_B)p_A] < K_B + X_B - R_B,\ that\ \text{reduces to:}$$

$$p_B\,X_B + p_B\,K_B - p_B\,R_{B\in G} + (1\text{-}\,p_B)\,p_A\,K_B - R_{B\in G}(1\text{-}\,p_B)p_A\ < (K_B + X_B - R_B)\,(R_{B\in G})^{-1},\ \text{which is equal to: } p_B$$

$$X_B + p_B\,K_B + (1\text{-}\,p_B)\,p_A\,K_B - R_{B\in G}(R_{B\in G})^{-1} < (K_B + X_B - R_B)\,(R_{B\in G})^{-1},\ \text{that is:}$$

$$p_B\,X_B + p_B\,K_B + (1\text{-}\,p_B)p_A\,K_B - 1 < p_B K_B + p_A K_B - p_B\,p_A\,K_B + p_B X_B + p_A X_B - p_B\,p_A X_B - 1 - (1\text{-}\,p_B)p_A\,(p_B)^{-1}$$

This results in $p_A\,(1 - p_B)\,X_B\ -(1\text{-}\,p_B)p_A\,(p_B)^{-1} > 0,\ \text{or } X_B > p_B^{\,-1}.$

We now need to prove the inequality in (11), implying that conglomerates trade at an apparent discount relative to stand-alone firms:

$(K_B + X_A + K_A - R_c) + p_B X_B. < X_B + K_B + X_A + K_A - R_A - R_B$; *that is:* $-R_c + p_B X_B. < X_B - R_A - R_B$

that is: $(1 - p_B) X_B > (R_A - (\frac{1}{2}) R_C) + (R_B - (\frac{1}{2}) R_C)$;

that is $(1 - p_B) X_B > (p_A)^{-1} - (2p_A)^{-1} [2 - p_B (1 - p_A) X_B] + (p_B)^{-1} - (2p_A)^{-1} [2 - p_B (1 - p_A) X_B]$; that is:

$p_B p_A (1 - p_B) X_B > p_A - p_B [2 - p_B (1 - p_A) X_B] + p_B$; *or* $p_B p_A X_B - p_B^2 p_A X_B - p_B^2 X_B + p_B^2 p_A X_B > p_A - p_B$

which simplifies to $p_B p_A X_B - p_B^2 X_B > p_A - p_B$, or $X_B > p_B^{-1}$.

Finally, we compare the price of a group to that of a conglomerate when both are alive. The value of the conglomerate in operation is equal to:

$p_B (X_B + K_B + X_A + K_A - R_c) + (1 - p_B)(K_A + X_A + K_B - R_c) = (K_B + X_A + K_A) - R_c + p_B X_B$

whereas the value of the group in operations is equal to:

$p_B (X_B + K_B - R_B \in_G) + (1 - p_B)(K_B - R_B \in_G) + X_A + K_A - R_A = (X_A + K_A + K_B) - R_A - R_B \in_G + p_B X_B.$

Then the difference between the two expressions is equal to $R_B \in_G + R_A - R_c$, which is always positive because we know that $R_B \in_G + R_A > R_c$.

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