Buyout Activity:
The Impact of Aggregate Discount Rates

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ABSTRACT

Buyout booms form in response to declines in the aggregate risk premium. We document that the equity risk premium is the primary determinant of buyout activity rather than credit-specific conditions. We articulate a simple explanation for this phenomenon: a low risk premium increases the present value of performance gains and decreases the cost of holding an illiquid investment. A panel of U.S. buyouts confirms this view. The risk premium shapes changes in buyout characteristics over the cycle, including their riskiness, leverage, and performance. Our results underscore the importance of the risk premium in corporate finance decisions.

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Since their emergence in the 1980s, buyouts have been a powerful means to alter firm incentives. But the use of buyouts has varied widely over time. In the U.S., peak years experience close to 100 public-to-private buyout transactions while trough years experience as few as 10. We propose a simple explanation for these fluctuations: buyout activity responds to changes in the aggregate risk premium. The discount rate affects firm valuations and in turn the decision of whether to engage in a buyout deal. We document that this integrated view of capital markets provides a detailed and powerful account of buyout cyclicality. Our elementary explanation is in stark contrast to existing literature that focuses on the role of credit-specific conditions.

Empirically, variation in buyout activity is better explained by changes in the risk premium than by credit market conditions. Figure 1 illustrates how buyout activity decreases when the aggregate risk premium is high and increases when it is low. This factor alone explains over 30% of the total variation in buyout activity, more than three times the variation explained by credit market conditions. To derive additional testable hypotheses at the firm level, we present a model linking the buyout decision to a single time-varying cost of capital. We show that the characteristics of buyout targets and their variation across high- and low-risk premium episodes uniquely reflect our mechanism.

We investigate the impact of the risk premium on buyout decisions through the central trade-off of performance gains versus the cost of providing incentives. In particular, a buyout brings better management to the firm at the cost of compensating the acquirer for holding skin in the game. The risk premium affects both sides of this trade-off. On the performance side, the gains are muted when the risk premium is high: following the Gordon growth model intuition, the gains of a buyout increase with the difference between the firm's growth rate and the discount rate.[1] On the other hand, providing incentives to the acquirer is costly: she has to bear excess risk to be duly motivated to implement changes at the target. When the risk premium increases, that is, when the marginal willingness to bear risk decreases, the willingness to bear this excess risk also decreases and compensating the acquirer becomes more costly.

Using a panel of nonstrategic public-to-private deals from 1982 to 2011, we document a novel set of facts regarding the quantity and nature of buyout activity. Our simple explanation, focused on the risk premium, provides a unified explanation of these facts, whereas credit-centric hypotheses are difficult to reconcile with our results. At the aggregate level, buyout activity is negatively related to the market-wide risk premium. This relation is robust to the inclusion of market signals corresponding to common hypotheses in the literature: credit market conditions (Axelson et al.

[1] The NPV of a cash flow stream starting at X, growing exponentially at rate g, and discounted at rate r is $X/(r-g)$.

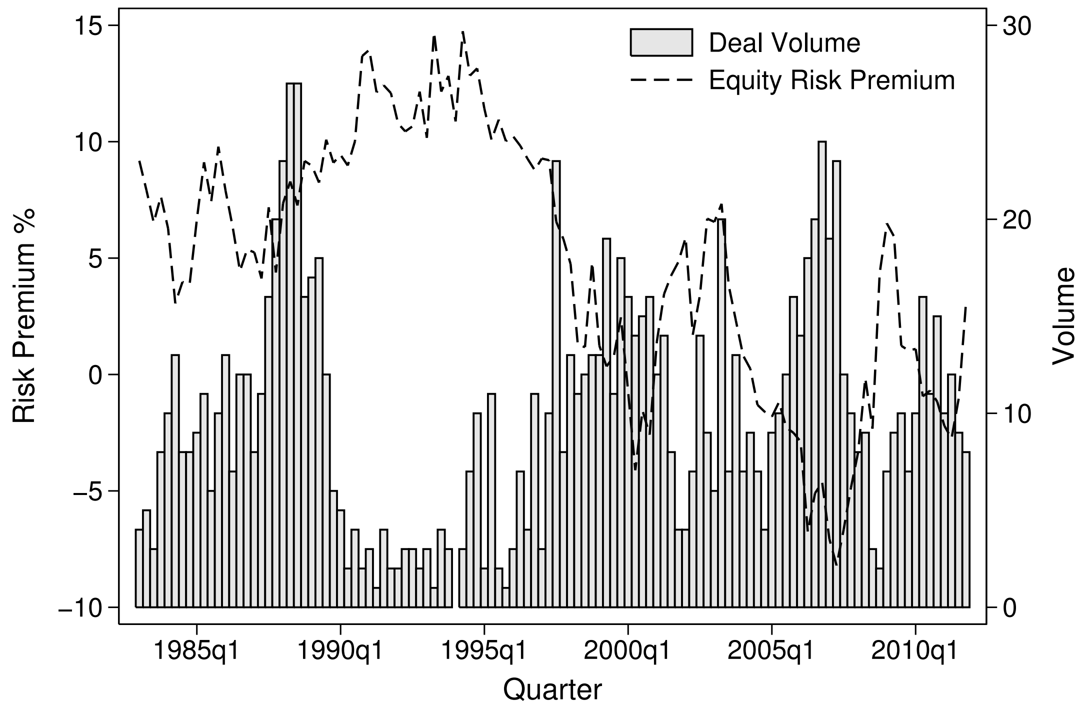


Figure 1. Time series of buyout volume and aggregate risk premium. Figure 1 plots quarterly deal volume of buyout transactions. The equity risk premium is predicted using annual returns for a three-year period using D/P, cay, and the three-month T-bill as factors.

(2013)) or measures of debt-equity mispricing (Kaplan and Strömberg (2009)). The risk premium explains as much as 30% of the variation in activity whereas credit factors alone explain only up to 10%. Consistent with our emphasis on fundamental conditions, market expected growth is also positively related to buyout activity. Finally, our theory rationalizes the correlation between buyout activity, leverage, deal pricing, and subsequent returns, as documented, for instance, in Axelson et al. (2013).

While these aggregate facts strongly suggest that the risk premium is the primary driver of buyout activity, we also exploit the cross-section of firms to further distinguish the risk premium from alternative hypotheses. First, riskier firms have a higher cost of capital and greater illiquidity costs, making them undesirable buyout targets. Using panel data, we confirm that the propensity of a firm to be bought out is sensitive to risk characteristics. Firms with high market beta or high idiosyncratic volatility are less likely targets.

Going further, the role of risk characteristics varies over time. The greater the systematic risk of the firm (i.e., beta), the more sensitive the cost of capital to changes in the risk premium. In addition, the illiquidity costs of high-beta firms are more sensitive to changes in the risk premium. Hence, among buyout targets, we expect fewer high-beta firms when the risk premium is high. Congruent with this prediction, we show that the distribution of buyout firms' betas shifts towards lower values during periods associated with a high risk premium. In contrast, the idiosyncratic risk of buyout targets does not change with the risk premium—a fact consistent with our theory. These results distinguish our thesis from an explanation premised on changes in debt capacity that predicts that both systematic risk and idiosyncratic risk vary with the buyout cycle.

A second set of tests focuses on the impact of the risk premium in the cross-section of firms. Firms with greater potential performance improvements should be more sensitive to the risk premium. We proxy for higher potential gains using three measures of agency problems—a corporate governance index, an estimate of industry competition, and a measure of cash flows—and find supportive evidence. Firms with poor corporate governance are more sensitive to changes in the risk premium, as are firms with more potential for a "free cash-flow" problem. In addition, our framework suggests that it is less costly to compensate the acquirer when it is easier to resell the firm, and thus the buyout activity of more liquid firms should be less sensitive to changes in the risk premium. We measure the ease of exit for acquirers using average industry-level M&A or IPO transaction activity and find that more liquid industries are less sensitive to movements in the risk premium. These results are robust to the inclusion of controls for credit market conditions. The evidence confirms a unique role for the aggregate risk premium in shaping the costs and benefits of buyout activity.

The fundamental trade-off that we emphasize for buyouts is standard in corporate finance and can be generalized to other corporate transactions. We document the correlation between deal activity and the risk premium for M&A and IPO activity. M&A activity responds negatively to the risk premium, but less so than buyouts. This behavior is consistent with the view that the performance channel matters for M&A deals but that buyouts are also subject to the illiquidity channel, which increases their sensitivity. For IPOs, the model suggests that the two channels counteract each other, and hence we do not find a strong response to the risk premium empirically.

Our paper's emphasis on aggregate discount rates is unique in the buyout literature. Kaplan and Strömberg (2009) outline the history of aggregate private equity activity, but a systematic explanation for buyout waves has remained elusive. Closest in spirit to our paper, Martos-Vila, Rhodes-Kropf, and Harford (2012) provide an explanation for the dynamics of financial versus strategic acquisition activity. Their analysis focuses on mispricing in the debt market rather than changes in aggregate prices. These explanations are not mutually exclusive, however. Both aggregate fundamentals and relative misvaluation can play a role. Motivated by our empirical findings, Malenko and Malenko (2015) provide an alternative theoretical model for the role of variation in the risk premium for buyout activity. Rather than our basic trade-off, they emphasize the ability of private-equity-owned firms to borrow against their sponsors' reputation with creditors and externalities in sponsor reputation due to club formation.

A number of papers isolate specific events that impact buyout activity. Using cross-sectional evidence, Shivdasani and Wang (2011) argue that the advent of structured credit improved access to capital for buyout investors. Similarly, the emergence of the high-yield market likely stimulated activity, as Kaplan and Stein (1993) observe important changes in the structure of deals during this period. Particular innovations in financial markets do indeed matter. For instance, discount rates fail to capture the intensity of the boom in the 1980s. Nevertheless, aggregate forces are first-order contributors to oscillations in activity and thus should be taken into account when quantifying other hypotheses.

The literature on cross-sectional determinants of buyouts is more developed (Bharath and Dittmar (2010), Opler and Titman (1993)), but few papers focus on risk measures. Ewens, Jones, and Rhodes-Kropf (2013) emphasize the role of exposure to diversifiable risk in the private equity decision. Sorensen, Wang, and Yang (2013) consider the pricing of idiosyncratic risk by limited partners (LPs) and build corresponding performance measures. In the context of this cross-sectional literature, we highlight that the role of these characteristics, influenced by changes in the aggregate risk premium, varies strongly over the cycle.

Our underlying theory of a buyout relies on an agency conflict between the LPs and general partners of a fund. Our model is parsimonious and designed to emphasize the role of the aggregate risk premium. Axelson, Strömberg, and Weisbach (2009) provide an in-depth analysis of the role of agency frictions in shaping buyout contracts and investments. Others follow a similar approach (Martos-Vila, Rhodes-Kropf, and Harford (2012), Ewens, Jones, and Rhodes-Kropf (2013), and Malenko and Malenko (2015)), but their analysis does not consider aggregate discount rates.

More generally, we contribute to the broader literature emphasizing the role of time-varying discount rates for corporate decisions. This literature is based on the insight that changes in discount rates affect the cost of capital, which is an important parameter for evaluating investments. Time-variation in the discount rate has been shown to affect investment, as in Barro (1990), Cochrane (1991), and Berk, Green, and Naik (1999), and other forms of financial activity (for a survey, see Cochrane

(2011)). For instance, Pastor and Veronesi (2005) consider the role of pricing conditions for IPOs. This paper is the first to apply this idea to buyout activity. Furthermore, we introduce a novel channel through which changes in the aggregate risk premium impact financial decisions, namely, the illiquidity channel.

In Section 1, we document a robust relation between buyout activity and the risk premium. We present our model of buyout transactions in Section 2. In Section 3 we test several additional predictions on the timing and composition of buyout activity. We consider the implications of our approach for other types of corporate transactions in Section 4. Finally, we conclude in Section 5.

1 The Aggregate Dynamics of Buyout Activity

In this Section we first discuss our main hypothesis, which holds that buyout activity is determined by the aggregate cost of capital, and contrast it with the credit market view. We then describe the behavior of buyout activity and examine its relation with capital market conditions. The results show that a high aggregate risk premium is a strong negative predictor of buyout activity and has greater explanatory power than the relative cost of debt.

1.1 Potential Determinants of Buyout Activity

1.1.1 Aggregate Discount Rates

An important empirical fact about capital markets is that the cost of risky capital, or the risk premium, varies over time (Fama and French (1988), Campbell and Shiller (1988a)). Consistent with integrated capital markets, this variation is coordinated across debt and equity financing (Fama and French (1989)). Buyouts are a type of investment that lead to operational changes in firms (e.g., Davis et al. (2014)). When the risk premium is large, future gains are discounted more and as a consequence investments are less attractive (e.g., Barro (1990)). Also, concentrated, illiquid positions—like those involved in buyout transactions—are particularly unattractive to investors when the risk premium is high. These two forces predict that both buyout activity and buyout prices are negatively correlated with the risk premium.

Our central finding is that this hypothesis is empirically important. We develop further testable hypotheses related to this mechanism in Section 2.

1.1.2 Credit Market Conditions

In contrast to our approach, a more commonly emphasized factor in the buyout decision is the cost of debt rather than common changes in the cost of capital; see, for example, Axelson et al. (2013). Underlying this view is the notion that buyout investors exploit mispricing in securities markets such that low borrowing costs facilitate a transfer to buyout investors (see Baker and Wurgler (2002)). Another motivation is that, to mitigate overinvestment tendencies, buyout investors can only raise debt once they have obtained initial funding from their limited partners and hence, they are particularly sensitive to the cost of debt (Axelson, Strömberg, and Weisbach (2009)). When debt is "cheap," transforming equity-financed firms into debt-financed firms is more profitable, thus buyouts are more attractive to investors. This view has implications for both the intensive and the extensive margin of deals. On the intensive margin, conditional on a deal occurring, cheaper credit should coincide with greater deal leverage and higher takeout valuations. As for the extensive margin, advantageous credit conditions should correspond to periods with more buyout activity.

The extant literature on buyouts primarily tests implications on the intensive margin of this theory. Most prominently, Axelson et al. (2013) relate the price and leverage of buyout deals to yields on high-yield debt. While Kaplan and Strömberg (2009) hypothesize that booms and busts in buyout activity are related to credit market conditions, we are the first to provide a systematic analysis of extensive margin fluctuations with respect to credit conditions and the risk premium.

1.2 Data

1.2.1 Buyout Activity

Our sample of U.S. buyouts comes from *Thomson Reuters SDC M&A* data. We identify public-to-private buyout transactions as completed deals for public targets that are described as a "leveraged buyout" or "management buyout." Because the *SDC* descriptor misses some notable buyout deals, we screen for additional transactions by including firms purchased by private financial acquirers where the acquisition is made for "investment purposes." We check each of these transactions to verify that the purchaser is indeed a private equity firm. Announcement dates determine the timing of the transaction.

We begin our analysis in the fourth quarter of 1982, the starting point of consistent activity. The resulting sample of buyouts includes 1,143 deals between 1982Q4 and 2011Q4. Table 1 summarises quarterly buyout activity in our sample. On average there are 9.8 deals per quarter. The quarterly average asset value of targets is $8.7bn

Table 1
Aggregate Summary Statistics

Table 1 presents quarterly summary statistics for buyout activity and aggregate factors for 117 quarters from 1982Q4 to 2011Q4. The value of deals is in 2010 dollars. *Volume / Public Firms (bps)* is the volume of buyouts scaled by the number of public firms in bps. $\hat{rp}_{OLS}$ is the predicted market excess return using D/P, cay, and the three-month T-bill as factors. *EBITDA Spread* is the difference between the median public firm EBITDA/EV and the yield on a composite index of high-yield bonds. *HY Spread* is the yield on a composite index of high-yield bonds less the three-month T-bill. *GZ Spread* is the excess bond premium as measured by Gilchrist and Zakrajšek (2012).

	Obs.	Mean	Median	Max	Std. Dev.
Buyout Activity					
Volume (No. of Deals)	117	9.8	9.0	27.0	6.1
Volume / Public Firms (bps)	117	18.7	17.3	51.1	11.8
Asset Value ($ mm)	117	8,717	4,189	78,533	13,298
Enterprise Value ($ mm)	107	5,396	1,119	74,098	11,369
Log Assets	117	7.93	8.34	11.27	1.96
Aggregate Factors					
$\hat{rp}_{OLS}$ (%)	117	4.82	5.82	14.75	5.53
EBITDA Spread	117	-2.20	-2.02	1.73	1.86
HY Spread	117	11.54	11.14	19.51	2.69
GZ Spread	117	1.90	1.58	7.82	1.10

and the enterprise value (i.e., the transaction value) is $5.4bn.[2] Both measures of value—book assets and enterprise value—are skewed toward higher values.

The discount rate channel that we have in mind is agnostic as to firm size, and thus the volume of deals is our preferred measure of buyout activity. To account for the changing number of potential targets, we measure *Volume* using the number of deals scaled by the number of public firms in *COMPUSTAT* in the prior quarter. On average 0.19% of public firms are taken private each quarter in our sample period. We also construct a value-based measure of buyout activity, where we focus on book assets as book assets are both consistently reported and independent of pricing. We define *Value* as the logarithm of total target assets in 2010 dollars to reduce skewness.

[2]A key reason enterprise value averages less than book assets is that enterprise values are less consistently reported than asset values.

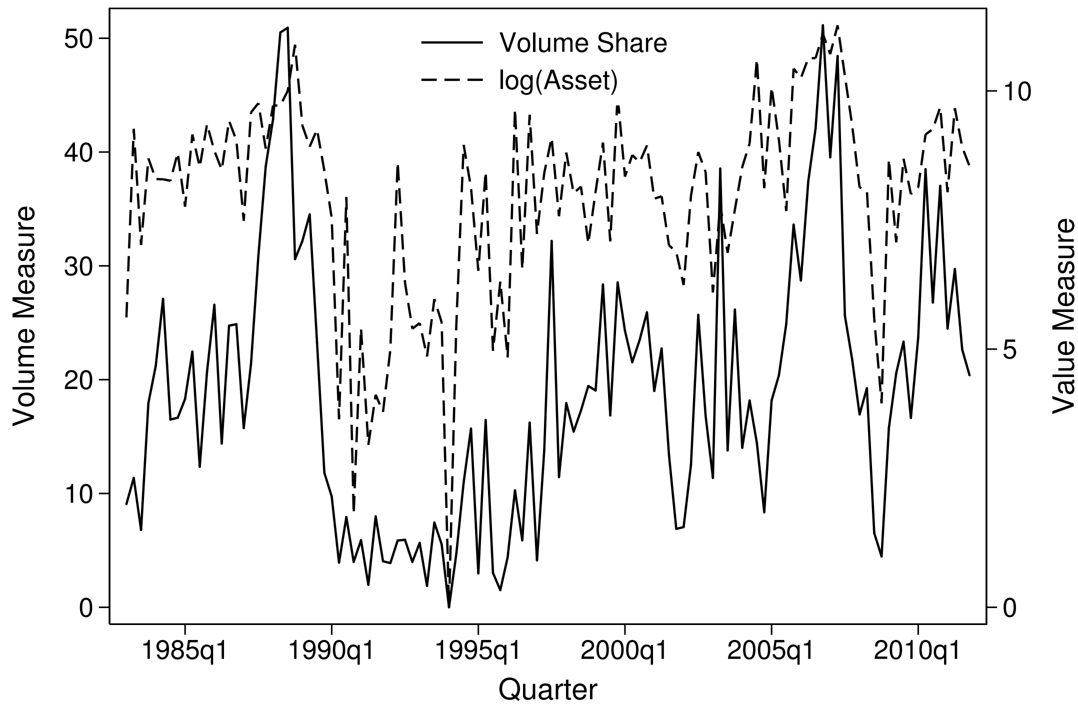


Figure 2. Time series of buyout activity measures. Figure 2 plots time-series variation in buyout activity. The volume-based measure is quarterly deal volume as a fraction of public firms (in bps). The value-based measure is the log of target assets (in 2010 millions of dollars).

In the Internet Appendix,[3] we demonstrate that our findings are similar using many alternative measures of activity.

Figure 2 illustrates the fluctuations in our buyout activity measures. Following the initial boom of the late 1980s with 20 to 30 deals a quarter (approximately 50bps of activity), the 1990s experienced little activity with less than five deals per quarter (10bps). Two spikes in activity occurred in the following years, one in the 1997 to 2000 period, and another around 2005 to 2007. Following a halt in activity aorund the financial crisis of 2008, 2010 saw a modest rebound. This variation in number

[3]The Internet Appendix is available in the online version of the article on the *Journal of Finance* website.

of deals are coincides with variation in the value of deals, with the two measures having a correlation of 74%. The average log value of activity is 8.3 or \$4.1bn dollars, with *Value* varying between 7.0 (\$1.1bn) at the 25th percentile to 9.2 (\$9.5bn) at the 75th percentile. While not the focus of our study, other dimensions of the buyout transaction appear to experience cyclical variation. For instance, Axelson et al. (2013) document variation, albeit more modest, in the composition of financing. In their sample the ratio of debt to enterprise value varies between 61% and 78% between the 25th and 75th percentiles. They also show that deals originating in a boom experience lower subsequent returns than those originating in periods of low activity. We revisit these quantities and their relation to our main hypothesis in Section 2.

1.2.2 Capital Market Conditions

Aggregate Risk Premium. We measure the aggregate risk premium using an estimate of expected excess equity returns. We employ three factors previously shown to predict excess returns: the dividend-price ratio, cay, and the three-month T-bill yield.[4] The dividend-price ratio is constructed using *CRSP* data on monthly returns. The variable cay is an empirical proxy for the log consumption-wealth ratio.[5] Interest rates are constant maturity rates according to the Federal Reserve's H.15 release.

The predictive regression is estimated quarterly from 1954Q1 to 2010Q3. The dependent variable is the annualized return of the value-weighted market portfolio over the next three years ($R^e_{M,t+1}$) in excess of the current three-month T-bill yield. We use a three-year horizon to capture the longer-term nature of private equity investments.[6] The regression yields the coefficients

$$\mathbb{E}(R^e_{M,t+1}) = -.76 + \underset{[1.03]}{(2.89)}(D/P)_t + \underset{[0.59]}{(2.54)}cay_t + \underset{[0.38]}{(-0.97)}(\text{T-Bill})_t. \quad (1)$$

For the buyout sample period, we calculate the predicted market return as a measure of the risk premium in the economy, $\hat{rp}_{OLS}$. This measure is a projection of equity returns on predictive factors and thus information in equity markets must explain the behavior of the predicted variable.

Credit Market Conditions. We compare the explanatory power of our aggregate measure of the risk premium to several credit market factors that other researchers show are important to explaining buyout activity. Axelson et al. (2013) find that the yield on

[4]For more details on D/P see Campbell and Shiller (1988b), Fama and French (1988), and Cochrane (2008), on cay see Lettau and Ludvigson (2001), and on the term structure of interest rates see Campbell (1987), and Fama and French (1989).

[5]We construct cay as in Lettau and Ludvigson (2001). We download the data from Martin Lettau's website (`http://faculty.haas.berkeley.edu/lettau/data_cay.html`).

[6]Our primary findings are similar if we use a one-year or five-year horizon.

the *Merrill Lynch High Yield Index* less *LIBOR* is correlated with leveraged buyouts, EV/EBITDA ratios, and leverage. Using a composite of the Merrill Lynch high-yield bond indices, we construct a similar measure less the yield on the three-month T-bill (*HY Spread*). Kaplan and Strömberg (2009) suggest that firms' ability to finance profitably with high-yield debt is an important determinant of buyout activity. We construct their proposed measure, *EBITDA Spread*, as the median EBITDA/EV ratio for *COMPUSTAT* firms less the yield on our composite high-yield bond index. We also consider a measure of the excess premium in corporate bonds (*GZ Spread*), which has been shown to predict future macroeconomic activity (Gilchrist and Zakrajšek (2012)). Statistics for these variables are summarized in Table 1.

Not surprisingly, these measures are correlated with the equity risk premium, $\hat{rp}_{OLS}$. In particular, *HY Spread* has a positive correlation with the risk premium of 55%, because the aggregate discount factor is reflected in both debt and equity markets. This observation is consistent with evidence that the same factors price excess returns for both stocks and bonds (see, for example, Fama and French (1993)). Given this correlation, *EBITDA Spread* is negatively correlated with the risk premium (-36%). Finally, *GZ Spread* is also negatively correlated with our risk premium measure (-32%), although it is positively correlated with the spread on the high-yield index.[7]

1.3 Risk Premium or Credit Factors?

Figure 1 illustrates the negative covariation between buyout activity and the risk premium over time. The decline in activity in the early 1990s corresponds to a high risk premium while the spikes in activity around 2000 and 2007 correspond to periods of lower expected returns. The modest rebound in volume in 2010 also matches a subsiding risk premium. The one boom that does not correspond as cleanly is that in the late 1980s.

To assess the importance of capital market factors, we compare the statistical significance and explanatory power of the risk premium to those of credit market variables. We estimate the relation between activity and discount rates using OLS, where activity is either the volume or value-based measure:

$$Activity_t = \alpha + \lambda_{rp}\hat{rp}_t + \gamma'(\textbf{Credit Factors})_t + u_t. \tag{2}$$

We include quarterly dummy variables to account for seasonality. Given the persistence of independent variables, we estimate Newey-West standard errors lagged over

[7]Correlations are detailed in Internet Appendix Table IAI.

the prior four quarters.[8]

The risk premium measure is negatively correlated with the volume of buyout activity and explains significantly more variation than debt spread measures (Table 2, Panel A). In column (1), the univariate coefficient on the risk premium is negative and statistically significant at the 1% level, consistent with the discount rate hypothesis. And as conjectured by credit-centric stories, *EBITDA Spread* is positively correlated with buyout activity while *HY Spread* is negatively correlated with buyout activity, as seen in columns (2) and (4), respectively. Both of these findings are significant at the 10% level. We note, however, that comparing statistical significance of these coefficients is not a test of their relative importance nor do these results account for the fact that the time-series variation in spreads is correlated.

To better assess the relative importance of these factors we compare their R^2s and the impact of a one-standard-deviation change in their value. We find that the risk premium accounts for 31.7% of the variation in deal activity (column (1)) and the economic magnitude of the risk premium coefficient is meaningful—a one-standard-deviation increase in the risk premium decreases the volume of activity by 34%. In contrast, no credit market factor alone accounts for more than 8% of the variation in buyout activity (columns (2), (4), and (6)) and all three credit measures together explain 10.7% of this variation (column (8)). Similarly, a one-standard-deviation change in any single credit factor accounts for *at most* a 15% change in activity.[9]

To verify that the risk premium coefficient is robust to credit spreads, we consider the risk premium in the presence of each credit factor (columns (3), (5), and (7)). In each case, the coefficient on the risk premium retains its magnitude and statistical significance whereas the coefficients on the credit factors are attenuated when included in isolation with the risk premium. Column (9) considers an even stronger challenge to the risk premium as we include all three credit factors at once. Again, the risk premium retains its magnitude and is statistically significant at the 1% level.

We obtain similar results when we consider a value-based measure of buyout activity (Panel B). The risk premium explains 31% of buyout activity whereas all three factors explain no more than 8.7% of such activity. One notable difference using the value-based measure is that the coefficient on *GZ Spread* is statistically significant and negative conditional on the risk premium (column (7)) but not in isolation (column (6)). Hence, some specifications suggest a role for credit markets—not as a substitute for the discount rate explanation but rather as a complement with a smaller role. Across both the volume and the value specifications, the dominant factor in buy-

[8]Technically the sample is censored at zero, though this only binds once in 1993. The coefficient estimates are quantitatively similar in a Tobit specification, but this limits the ability to make straightforward R^2 comparisons.

[9]We say "at most" because each of the credit factors contains variation attributable to the aggregate risk premium.

out activity is the risk premium: the risk premium measure explains 2.5 to 10 times the variation that credit factors explain, the risk premium is negative and statistically significant, and the coefficient estimates on the risk premium are robust to the inclusion of credit measures as controls.

We find a similarly significant coefficient on the risk premium in the early buyout waves of 1982 to 1991 as in the later waves of 1992 to 2014. However, the R^2 is lower in the earlier period (16%) than in the later period (54%). The lower explanatory power in the 1980s is consistent with an initial burst in activity facilitated by the development of the buyout investment technology (Figure 1).

We use another method to link buyout activity and the risk premium. If buyout decisions do indeed reflect agents' expectations about the level of the risk premium, then buyout activity should predict future stock returns. A monthly regression of annualized excess returns for the next three years on the volume measure of buyout activity from July 1982 to September 2010 yields[10]

$$R^e_{M,t+1} = 10.52 + \underset{[0.28]}{(-0.65)}(Volume_t) + \varepsilon_{t+1}, \tag{3}$$

demonstrating that buyout activity has statistically significant predictive power for long-term stock market returns.

Robustness. In the Internet Appendix, we find that the above conclusions are robust to other measures of buyout activity, additional credit metrics, and alternative estimates of the risk premium. Table IAII considers six different measures of buyout activity. The first three are alternative value measures namely, the log of enterprise value in a quarter, the log of buyout assets to total public assets, and the log share of buyout enterprise value to total public enterprise value. The latter three are measures of activity based on a matched sample to account for time-variation in firm composition. For example, if potential buyout targets vary over time, our results may proxy for changes in firm type. Across all of these measures of buyout activity, the magnitude and statistical significance of the risk premium holds and is not affected by the inclusion of credit variables. In addition, the explanatory power of the risk premium is 1.5 to 5 times that of the credit factors.

We focus our analysis on public-to-private buyout activity for several reasons: there is more information about transactions with public targets, it is possible to consider a counterfactual set of similar firms, and the change in funding is particularly dramatic from public-to-private. However, the discount rate may play a role in private-to-private buyout transactions as well. In Table IAIII we repeat the analysis of Table 2 using the private-to-private buyout volume from *Thomson SDC*. Again,

[10] The standard errors are Newey-West with autocorrelation over the prior 36 months and the R^2 is 0.11.

Table 2
Explaining Buyout Activity: Aggregate Risk Premium versus Credit Market Factors

Table 2 presents coefficient estimates from regressing quarterly buyout activity on estimates of the aggregate risk premium, credit spreads, and credit market factors from 1982Q4 to 2011Q4. The dependent variable in Panel A is the volume of activity (the number of deals scaled by the number of public firms in bps) and in Panel B is the value of activity (the log asset value of deals). $\hat{rp}$ is the predicted market excess return using D/P, cay, and the three-month T-bill as factors. *EBITDA Spread* is the difference between the median public firm EBITDA/EV and the yield on a composite index of high-yield bonds. *HY Spread* is the yield on a composite index of high-yield bonds less the three-month T-bill. *GZ Spread* is the excess bond premium as measured by Gilchrist and Zakrajšek (2012). Quarter dummies are included to account for seasonality. Standard errors in parentheses are calculated using Newey-West (four lags). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

	Panel A: Volume of Activity								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\hat{rp}$	-1.17***		-1.14***		-1.26***		-1.22***		-1.50***
	(0.25)		(0.25)		(0.24)		(0.25)		(0.24)
EBITDA Spread		1.50*	0.27					1.01	2.10*
		(0.81)	(0.48)					(0.99)	(1.09)
HY Spread				-1.07*	0.34			-0.59	1.92**
				(0.63)	(0.42)			(0.93)	(0.97)
GZ Spread						1.21	-0.76	1.82*	-1.17
						(1.34)	(0.72)	(1.08)	(0.95)
Observations	117	117	117	117	117	117	117	117	117
R^2	0.317	0.074	0.319	0.077	0.322	0.031	0.322	0.107	0.360
	Panel B: Value of Activity								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\hat{rp}$	-0.20***		-0.19***		-0.19***		-0.21***		-0.23***
	(0.039)		(0.038)		(0.041)		(0.036)		(0.038)
EBITDA Spread		0.28*	0.077					-0.0066	0.16
		(0.16)	(0.11)					(0.16)	(0.13)
HY Spread				-0.24**	-0.022			-0.25*	0.13
				(0.11)	(0.088)			(0.13)	(0.12)
GZ Spread						0.10	-0.24**	0.20	-0.26*
						(0.21)	(0.12)	(0.19)	(0.15)
Observations	117	117	117	117	117	117	117	117	117
R^2	0.330	0.091	0.335	0.126	0.331	0.024	0.346	0.138	0.353

the risk premium strongly forecasts activity, explains more variation than the credit factors alone, and is robust to their inclusion. It is difficult to directly compare these results with public-to-private activity, however, because we have no way of controlling for the set of potential targets.

In Table IAIV, we consider three alternative measures of the risk premium, namely, a rolling measure that eliminates look-ahead bias, a measure that excludes the T-bill yield as a factor to eliminate any form of credit-specific predictor, and a risk premium estimate that assumes perfect foresight by using actual future excess returns on the market portfolio. We test these alternative risk premia for both the volume and the value measures of buyout activity. The risk premium is always significant and explains between 11.3% and 23.7% of buyout activity. In five of the six specifications the risk premium R^2 exceeds that for the credit factors alone and in each of the six specifications the risk premium coefficient is robust to the inclusion of the credit factors. Our results are therefore robust to using alternative measures of the risk premium.

Finally, in Table IAVI we explore additional credit metrics, including the corporate bond spread, aggregate market leverage, book leverage, and the change in credit standards as measured by the *Federal Reserve Senior Loan Officer Survey*. For both volume- and value-based measures of activity, the risk premium accounts for a sizable portion of the variation, and the R^2 is well in excess of that using the credit metrics alone. Again, the role of the risk premium is not attenuated by the inclusion of alternative credit metrics.

1.4 The Three Fundamental Components of Valuation

Our central argument is that aggregate changes in the valuation environment affect the decision to enter a buyout. Thus far we have focused our analysis on the most important driver of prices, the risk premium. However, the risk premium is not the only component of valuation. Following Campbell and Shiller (1988a) and subsequent work, we decompose aggregate valuations into expected future returns and expected future earnings growth. Further, we separate expected future returns into the risk premium and a risk-free component. We then study how fluctuations in buyout activity can be ascribed to these three distinct components.

We follow the standard approach of representing the joint dynamics of these quantities by a vector autoregression (VAR), which results in a simple representation of expectations. We include the same variables as in Campbell and Ammer (1993), augmented by cay of Lettau and Ludvigson (2001).[11] We estimate the dynamics of

[11]Our VAR specification includes the following seven variables: excess returns, risk-free rate, earnings growth, dividend-price ratio, cay, the change in the three-month yield $y_t^{(3m)} - y_{t-1}^{(3m)}$, the slope

Table 3
VAR Summary Statistics

Table 3 contains quarterly summary statistics for the 117 quarters from 1982Q4 to 2011Q4. r_f is the annual risk-free yield at a three-year horizon. $\hat{rp}_{VAR}$ is the annual expected market excess return for the next three years based on a VAR. $\hat{g}_{VAR}$ is annual expected S&P earnings growth for the next three years based on a VAR.

	Mean	Median	Max	Std. Dev.
r_f	5.6	5.6	13.5	2.9
$\hat{rp}_{VAR}$ (%)	5.2	6.4	14.4	5.3
$\hat{g}_{VAR}$ (%)	6.3	8.5	58.6	15.8

the VAR on a long sample that runs from 1972Q1 to 2012Q4. We extract a time-series forecast for two components: stock market excess returns, $\hat{rp}_{VAR}$, and earnings growth, $\hat{g}$, for the next three years. For the third component, the risk-free rate, we directly observe the three-year Treasury yield.[12]

For each component we construct annualized rates; Table 3 summarizes the resulting estimates. The predicted risk premium from the VAR is remarkably similar to our OLS measure with a correlation coefficient of 0.89. Future earnings growth is also positively correlated with the OLS measure. A potential concern with time-series analysis is the persistence of the variables. While the quarterly autocorrelations of the risk premium and earnings growth are below 0.4, that of the risk-free rate is 0.96. This high persistence limits our ability to draw strong inferences about the role of the risk-free rate.

Consistent with valuation predictions, Table 4 shows that buyout activity is negatively related to the risk premium component and positively related to expected earnings growth for both the volume and the value of activity. Columns (1) and (4) consider the VAR risk premium alone and find coefficients of similar magnitude as our OLS estimates in the prior section. In addition, the explanatory power exceeds that of the credit factors by a factor of least 1.5 (see Table 2). When we add expected earnings growth to the specification in columns (2) and (5), we find a positive and statistically significant relation between buyout activity and earnings growth. The impact of

between the 10-year and one-month yield $y_t^{(10y)} - y_t^{(1m)}$, and the one-month yield minus its moving average over the previous 12 months $y_t^{(1m)} - 1/12 \sum_{\tau=t-12}^{t-1} y_\tau^{(1m)}$.

[12]Constant-maturity three-year yields are obtained from the Federal Reserve Board FRB H.15 release.

Table 4
OLS: Buyout Activity on Discount Rates and Growth

Table 4 contains coefficient estimates from regressing quarterly buyout activity on the components of a Campbell-Shiller decomposition at a three-year horizon from 1982Q4 to 2011Q4. The dependent variable in Columns (1) to (4) is the volume of activity (the number of deals scaled by the number of public firms in bps) and in Columns (5) to (8) is the value of activity (the log asset value of deals). $\hat{rp}$ is the annual expected market excess return for the next three years based on a VAR. $\hat{g}$ is annual expected S&P earnings growth for the next three years based on a VAR. r_f is the annual risk-free yield at a three-year horizon. *EBITDA Spread* is the difference between the median public firm EBITDA/EV and the yield on a composite index of high-yield bonds. *HY Spread* is the yield on a composite index of high-yield bonds less the three-month T-bill. *GZ Spread* is the excess bond premium as measured by Gilchrist and Zakrajšek (2012). Quarter dummies are included to account for seasonality. Standard errors in parentheses are calculated using Newey-West (four lags). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

	Volume				Value			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{rp}$	-0.88***	-1.20***	-1.41***	-1.09***	-0.18***	-0.22***	-0.26***	-0.14**
	(0.33)	(0.33)	(0.32)	(0.37)	(0.053)	(0.051)	(0.054)	(0.060)
$\hat{g}$		0.23***	0.30***	0.25**		0.031***	0.047***	0.035***
		(0.072)	(0.095)	(0.10)		(0.010)	(0.012)	(0.010)
rf			0.82	2.65**			0.17**	0.66***
			(0.57)	(1.14)			(0.068)	(0.12)
EBITDA Spread				1.46				0.041
				(1.19)				(0.15)
HY Spread				-0.83				-0.51***
				(1.26)				(0.17)
GZ Spread				5.43***				1.26***
				(1.97)				(0.24)
Observations	117	117	117	117	117	117	117	117
R^2	0.176	0.247	0.277	0.348	0.247	0.296	0.345	0.457

earnings growth is smaller than that of the risk premium. A one-standard-deviation change in expected growth has approximately half the impact of a similar change in risk premium (17% to 25% for volume, 6% to 9% for value).

The risk-free rate estimates are more difficult to interpret. The risk-free yield is positive but statistically indistinguishable from zero for *Volume* (3) and positive for *Value* (7). A simple discount rate argument would predict a negative relation with activity. As discussed earlier, the persistence of the risk-free rate makes statistical inference unreliable. In addition, to the extent that the risk-free rate proxies for economic conditions, this further complicates interpretation (e.g., Stock and Watson (1999) show that periods of high risk-free rates coincide with economic growth). Augmenting these factors with the credit measures in columns (4) and (8) does little to alter the estimated coefficients.

Robustness. In Table IAVII we consider three alternative proxies for market expectations and examine their relation with the volume of buyout activity. The first is an alternative VAR forecast based on aggregate dividends rather than earnings. The second uses survey-based estimates of earnings growth from *Thomson Reuters IBES* data in conjunction with the OLS risk premium from Section 1.3. The third assumes perfect foresight and replaces forecasts and surveys with realized future growth and equity returns. The message is consistent across these specifications: the aggregate risk premium is the largest explanatory factor, expected growth enters positively, and the risk-free rate is generally positive but frequently indistinguishable from zero.

The evidence in this section strongly suggests that the risk premium is the most important driver of buyout activity. To further test this explanation against alternative hypotheses, we introduce a parsimonious theory of the buyout decision that provides a clear rationale for the role of aggregate valuation conditions.

2 A Simple Model of the Buyout Transaction

We develop a two-period model that relates the buyout decision to the aggregate risk premium. Our theory relies on two key mechanisms. First, performance improvements generated by buyout deals are valued using a net present value (NPV) rule.[13] When the risk premium is large, the cost of capital lowers valuations and fewer projects are undertaken. Second, because of an agency problem, the general partner (GP) has to bear excess risk to be duly motivated to implement changes in the firm. When the risk premium increases, that is, when the marginal willingness to bear risk decreases, the willingness to bear this excess risk also decreases and compensating the GP becomes more costly.

The model not only provides a precise rationale for the results in Section 1, but also allows us to make additional empirical predictions. We rationalize the positive correlation of buyout activity with deal leverage, as well as the positive correlation between pricing and subsequent returns. Moreover, we develop further insights into the changing characteristics of buyout targets as the risk premium fluctuates, providing additional predictions that we test in Section 3.

[13] The private equity industry explicitly incorporates an NPV rule by relying on DCF models to assess potential investments.

2.1 Setup

There are two periods. At time 0, an acquirer (the GP) considers a firm (the target) for a buyout deal. The target's output is realized at time 1 and is unknown as of time 0. The following describes the distribution of firm output:

$$\tilde{Y} = \mu + \beta\varepsilon_m + \varepsilon_i, \tag{4}$$

where μ is the average output, ε_m is an aggregate shock, and ε_i is an idiosyncratic shock. The shock variables are independent from each other and are normally distributed with mean zero and variances σ_m^2 and σ_i^2, respectively. The loading β captures the target's exposure to systematic risk. The target's outcome at time $t = 1$ is contingent upon the GP's actions.

(i) If she decides not to acquire the target, output is $\tilde{Y}$.
(ii) If she implements a buyout deal and improves management of the target, output is $p_H\tilde{Y}$ with $p_H > 1$.
(iii) If she implements the deal without improving management, output is $p_L\tilde{Y}$, with $\Delta p = p_H - p_L > 0$. She receives a private benefit linear in output: $b\tilde{Y}$.

The GP must find a contractual arrangement with outside investors, that is, financial markets, to finance the deal. We assume that the GP's action is not directly contractible. An agency friction is therefore present: without a stake in the firm, the GP does not implement managerial changes and instead chooses to collect her private benefit. We now introduce assumptions about how those agents make decisions.

Preferences of the GP. The GP has initial wealth W_0. She can invest in either public markets or buyout target. She has constant absolute risk aversion (CARA) preferences over consumption with risk aversion γ: $-\mathbb{E}[-\exp(-\gamma C)]$. If consumption is normally distributed, this utility function corresponds to a mean-variance evaluation, $\mathcal{U} = \mathbb{E}[C] - \frac{\gamma}{2}\text{var}[C]$.

Cost of Capital on Public Markets. We assume no-arbitrage on financial markets, hence there is a stochastic discount factor. We also assume that the stochastic discount factor loads solely on the aggregate risk factor, ε_m, and the risk premium for exposure to the market is $\bar{R}_m^e = \mathbb{E}_0[R_m^e]$, which is proportional to the market risk σ_m^2.[14] Risk-free claims are discounted at the rate $1 + r_f$. Therefore, the cost of capital is

[14]These assumptions arise exactly if we assume that buyout transactions constitute an infinitesimal part of an economy where total output is exposed to ε_m and all investors have CARA preferences. Investors may have heterogeneous risk aversions that are different from the GP. While we focus on variation in the risk premium that is driven by changes in aggregate risk, all of our predictions also hold for a change in risk premium in response to a proportional change in risk aversion in the economy. In other words, we are agnostic as to the source of variation in the risk premium: quantity or price of risk.

determined by the capital asset pricing model (CAPM). For instance, the price of a payoff $1+\beta\varepsilon_m+\varepsilon_i$ is $\mathbf{NPV}(1+\beta\varepsilon_m+\varepsilon_i)=(1-\beta\bar{R}^e_m)/(1+r_f)$. We detail the equivalence to a standard discounted cash flow (DCF) analysis in Appendix A. Current owners of the target and outside investors value their claims using this cost of capital because these claims are traded on competitive markets.

2.2 Solution

A buyout of the target occurs if the GP and outside investors find an arrangement that is valuable to both. To determine whether such contracts exist, we first derive the minimum cost of providing incentives to the GP. We then verify whether the net returns to outside investors of the buyout deal are positive under such an arrangement.

GP's Outside Option. If the GP does not engage in the buyout, she invests her wealth in public markets. Without loss of generality, she chooses her portfolio investment between the risk-free rate (θ_0), a zero-cost portfolio that pays off the market excess return (θ_m), and a zero-cost portfolio that loads on idiosyncratic risk (θ_i). Given her absolute risk aversion γ, her utility is

$$\mathcal{U}_{\text{outside}} = \max_{(\theta_0,\theta_m,\theta_i)} \theta_0 + \theta_m \bar{R}^e_m - \frac{\gamma}{2}(\theta_m^2\sigma_m^2 + \theta_i^2\sigma^2). \tag{5}$$

Her budget constraint is $\theta_0 \cdot \frac{1}{1+r_f} + \theta_m \cdot 0 + \theta_i \cdot 0 \leq W_0$, which gives θ_0^*. Her position in the market is determined by the price of market risk and her risk aversion, $\theta_m^* = \bar{R}^e_m/(\gamma\sigma_m^2)$. Idiosyncratic risk is not compensated by a risk premium, and thus her optimal allocation is zero, $\theta_i^*=0$. Given our assumptions about pricing, investments in the outside option do not depend on market conditions.

Cost of Incentives. The GP will only invest in the deal and implement productive changes if she is adequately incentivized to do so. Outside investors must design a contract such that the GP implements changes that exceed the value of private benefits—the incentive compatibility constraint (IC). The contract must also incentivize the GP to partake in the buyout deal rather than invest in her outside option—the individual rationality constraint (IR).

For simplicity we restrict ourselves to linear contracts. A contract features a fixed component k_0 and a variable component that is proportional to the target's output, with coefficient k_1 controlling its riskiness. Outside investors minimize the cost of providing incentives to the GP, the agent.[15] To find the cheapest contract, outside

[15]For most of our analysis we consider whether feasible deals exist, so bargaining power or the surplus sharing rule is irrelevant.

investors solve

$$\min_{\{k_0,k_1\}} \mathbf{NPV}(k_0 + k_1 p_H \tilde{Y}) - W_0 \tag{6}$$

$$= \min_{\{k_0,k_1\}} \left(k_0 + k_1 p_H(\mu - \beta \bar{R}^e_m)\right) / (1 + r_f) - W_0 \tag{7}$$

under IC and IR constraints

$$\mathcal{U}(k_0 + k_1 p_H \tilde{Y}) \geq \mathcal{U}(k_0 + k_1 p_L \tilde{Y} + b\tilde{Y}) \qquad \text{(IC)} \tag{8}$$

$$\mathcal{U}(k_0 + k_1 p_H \tilde{Y}) \geq \mathcal{U}_{\text{outside}} \qquad \text{(IR).} \tag{9}$$

The IC constraint reduces to a lower bound on the slope of the incentive contract, $k_1 \geq b/\Delta p$. Indeed, the GP must have a large enough stake in the firm that her returns from exerting action p_H rather than p_L dominate her private benefit of not implementing the changes b.

To understand the IR constraint, it is helpful to represent the payoff as an equivalent portfolio invested in the risk-free asset, market excess return, and idiosyncratic risk:

$$\begin{cases} \theta_0 = k_0 + k_1 p_H(\mu - \beta \bar{R}^e_m) \\ \theta_m = k_1 p_H \beta \\ \theta_i = k_1 p_H. \end{cases} \tag{10}$$

Recall that the utility is linear in θ_0 and quadratic in the two risky components θ_m and θ_i. Hence, the IR constraint is equivalent to the difference with the optimal portfolio θ^*:[16]

$$\theta_0 - \theta_0^* \geq \frac{1}{2} \bar{R}^e_m \frac{1}{\theta_m^*} (\theta_m - \theta_m^*)^2 + \frac{1}{2} \gamma \sigma_i^2 \theta_i^2. \tag{11}$$

Under this form, the left-hand side of the constraint coincides with the objective function and the right-hand side with the cost to the GP for bearing risk that deviates from her outside option. The first term is the cost of holding an excessive amount of aggregate risk $(\theta_m - \theta_m^*)^2$, which is proportional to the risk premium $\bar{R}^e_m$. The second term comes from bearing idiosyncratic risk.

We can now solve for the optimal contract. We assume that to incentivize proper management of the firm, the agent must receive excessive amounts of risk relative to

[16]We are using the observation that if $f(x) = ax^2 + bx + c$ with the extremum reached at x^*, then $f(x) - f(x^*) = a(x - x^*)^2$.

her outside option.[17] Therefore, increasing the loading k_1 on the firm's output tightens the right-hand side. In turn, the principal minimizes the slope of the contract such that the IC constraint binds: $k_1^* = b/\Delta p$. The fixed payment k_0 is then kept just high enough to ensure participation, that is, to satisfy the IR constraint:

$$k_0^* + k_1^* p_H(\mu - \beta \bar{R}_m^e) - W_0(1 + r_f) = \frac{1}{2}\bar{R}_m^e \frac{1}{\theta_m^*}(k_1^* p_H \beta - \theta_m^*)^2 + \frac{1}{2}\gamma\sigma_i^2 k_1^{*2} p_H^2. \tag{12}$$

2.3 When Do Deals Occur?

PROPOSITION 1. *A buyout deal occurs if it yields positive returns net of the GP's compensation. This translates into the following condition:*

$$\underbrace{(p_H - 1)\left(\mu - \beta \bar{R}_m^e\right)}_{\textit{Performance channel}} \geq \underbrace{\frac{1}{2}\bar{R}_m^e \frac{1}{\theta_m^*}(k_1^* p_H \beta - \theta_m^*)^2 + \frac{1}{2}\gamma\sigma_i^2 k_1^{*2} p_H^2}_{\textit{Illiquidity channel}}. \tag{13}$$

The deal surplus is:

(i) decreasing in expected market return $\bar{R}_m^e$ (via the performance and illiquidity channels),
(ii) decreasing in the market risk exposure β (via the performance and illiquidity channels if $k_1^* p_H \beta > \theta_m^*$),[18]
(iii) decreasing in idiosyncratic volatility (via the illiquidity channel).

Performance channel. The left-hand side of condition (13) is the performance channel. It corresponds to the net value of the cash flow gains from improving management. During periods of a high risk premium, cash flows are discounted more and this value is lower, which decreases the likelihood of a deal.

Illiquidity channel. The right-hand side of (13) is the illiquidity channel.[19] It represents the monetary cost of compensating the GP for taking excessive amounts of

[17]Formally, the condition is $\sigma_m^2 p_H \beta(k_1 p_H \beta - \theta_m^*) + \sigma_i^2 k_1 > 0$ at $k_1 = b/\Delta p$. Two different sufficient conditions for this relation to hold are that the agent bears excessive amounts of aggregate risk, $k_1 p_H \beta > \theta_m^*$, or that idiosyncratic risk is large relative to aggregate risk, $\sigma_i^2 \gg \sigma_m^2$. Both assumptions are likely to hold empirically. We discuss the first more precisely later in this section.

[18]In other words, the illiquidity channel is impacted by market exposure if the GP has to bear more aggregate risk than under her outside option. If we assume that her outside option is entirely invested in the equity market, and leverage is 70% post-buyout and 35% pre-buyout (consistent with the evidence in Axelson et al. (2013)), then this condition holds as long as the pre-buyout equity β is larger than 0.5, which holds for most firms.

[19]We use the term illiquidity to mean the inability to trade out of a position. In our framework, illiquidity arises as a contractual solution to the agency problem. It differs from the inability to find a buyer on short notice in the case of an adverse shock.

risk relative to her outside option. The greater the risk premium, the larger the cost of this deviation. Indeed, the equilibrium risk premium corresponds to the marginal cost of bearing risk. Similarly, the illiquidity cost is the total cost of deviating from the optimum. Both quantities are driven by the convexity of the utility function—here determined by γ—and the risk facing the investor. In other words, periods in which investors do not want to bear risk at the margin correspond to periods in which investors require large compensation for bearing excessive risk.

The main restriction we imposed on the contracting space is the absence of benchmarking to the market. While in practice buyout contracts (and compensation contracts more broadly) are not typically benchmarked, we consider the impact of relaxing this assumption in Appendix B. Clearly, this change has no impact on the performance channel. If the market exposure β is known at the time of contracting, then the contract brings the GP back to her optimal loading on aggregate risk. However, in the more realistic case where the target's β is not known at the time of contracting, we show that the GP always ends up with an inappropriate amount of aggregate risk, maintaining an illiquidity cost that is increasing in the risk premium.[20]

2.4 Predictions

Changes in aggregate conditions affect the surplus of each potential deal. We are able to derive several empirical predictions related to the aggregate facts documented in Section 1. We also focus on how particular firms are impacted by aggregate conditions.

PREDICTION 1. *Buyout activity is larger in times of a low risk premium.*

The risk premium prediction is driven by the performance and illiquidity channels. Table 4 confirms this prediction by demonstrating a significant negative correlation between the risk premium and buyout activity. The combined impact of the two channels helps explain the observed sensitivity.

The model also yields additional predictions about the composition of buyout waves. We show that firms' risk characteristics impact their likelihood of being a deal target.

PREDICTION 2. *A firm is more likely to be a buyout target if it has (i) low market beta or (ii) low idiosyncratic risk.*

[20] Ewens, Jones, and Rhodes-Kropf (2013) also assume that the target's characteristics are unknown at the time of contracting. However, they find empirical support for this assumption studying the role of idiosyncratic risk. We draw novel implications for the role of the risk premium.

The negative impact of the market beta comes through both channels, whereas idiosyncratic risk only affects the illiquidity channel. The distinct roles of these two types of risk, systematic and idiosyncratic, are a novel prediction of our model.

Beyond their unconditional impact, risk characteristics interact with aggregate conditions. Changes in the risk premium affect not only the quantity but also the composition of buyouts.

PREDICTION 3. *Over time, (i) firms with high market beta are more sensitive to fluctuations in the risk premium, and (ii) firms with large potential performance gains (high p_H) are more sensitive to the risk premium.*

The first interaction comes from both channels, whereas the second is due to the performance channel alone. Interestingly, such a result is not present for idiosyncratic risk. This difference allows us to distinguish our approach from an explanation of buyout waves related to changes in debt capacity. Section 3.3 considers the role of risk characteristics in the data, and Section 3.4 examines the changing composition of buyouts.

The structure of outside financing between debt and equity is not pinned down in our theory: all capital is provided at the public markets' cost of capital. However, a natural way to implement outside financing is to split between an equity claim proportional to the GP's payoff and a safer debt claim.[21] In this case, leverage is determined by the slope of the contract k_1^*. To understand variation in leverage, we extend the model in Appendix B to allow for heterogeneity across targets. High-leverage deals are only feasible when it is relatively cheap to compensate the acquirer for her levered position, that is, when the risk premium is low. Our framework therefore predicts that the leverage of the average buyout is higher in times of a low risk premium and high deal activity.

PREDICTION 4 (Leverage). *Buyouts are more levered in times of a low risk premium.*

Axelson et al. (2013) study fluctuations in buyout leverage concomitant with variation in mispricing measures. More generally, they find that leverage covaries positively with fluctuations in aggregate buyout activity. The above prediction demonstrates that this result can be explained in a model in which there is no notion of mispricing between debt and equity.

[21]Such an approach is similar to that in Axelson, Strömberg, and Weisbach (2009), who focus on a particular contractual implementation in an environment where outside capital is also provided at an exogenous cost irrespective of debt and equity.

The model further implies that the pricing of targets and the performance of private equity investments vary over the buyout cycle. All investors, controlling and non-controlling, receive the standard compensation for risk in the public markets, which is larger, when the risk premium is high. The GP receives additional compensation for her excess risk, which also positively varies with the risk premium. These variations in returns are reflected in the transaction price: higher future returns are related to a lower transaction price.

PREDICTION 5 (Returns and deal pricing). *(i) When the risk premium is low, outside investors and the acquirer receive lower expected returns on their private equity investments. (ii) The acquirer receives positive abnormal returns after adjusting for the market pricing of risk, and those abnormal returns are larger in times of a high risk premium. (iii) When the risk premium is low, the transaction price is high.*

Recent literature on private equity returns largely confirms these inferences (Kaplan and Schoar (2005), Robinson and Sensoy (2013a), Harris, Jenkinson, and Kaplan (2014)). Buyout fund returns exhibit cyclical patterns consistent with our first prediction: investments in "hot" deal markets suffer from lower returns. These findings are in direct contradiction with a credit market view whereby buyout investors optimally time credit market conditions to obtain high returns in booms, as pointed out by Axelson et al. (2013). Given the GPs receive fees and carried interest in addition to their ownership stake, their returns will be higher on average and covary with the fund (e.g., Metrick and Yasuda (2010), Robinson and Sensoy (2013b)). On deal pricing, Axelson et al. (2013) document higher valuation ratios (EV/EBITDA) for buyout deals in periods of high activity.

3 The Composition of Buyout Activity

Our theory provides a precise rationale for the link between the risk premium and buyout activity. It also delivers insights into the types of firms targeted by buyout investors across episodes of high and low risk premiums. In this section we use a panel data set of public firms to document that the composition of buyout activity reflects the forces of our model. Our results further emphasize the role of the risk premium in the buyout decision and taken together cannot be reconciled with alternative views of the buyout cycle.

3.1 Data

We construct a quarterly panel of U.S. public companies using annual accounting data from *COMPUSTAT* and quarterly share price information from *CRSP*. As we are looking to exploit accounting data, we exclude the financial industry as defined by the Fama-French 12 classification. Once a firm announces a buyout, they exit our sample. Bias resulting from the exit of buyout firms is small, given the low number of deals relative to the number of public firms. The resulting unbalanced panel of 501,176 firm-quarters tracks 14,386 unique firms over 117 quarters and contains 1,043 deal firm-quarters, where a deal firm-quarter is defined as the quarter of a buyout announcement.

We use this panel to consider cross-sectional predictions related to the risk characteristics of firms. The model predicts that firms with greater volatility will be less attractive targets. We proxy for volatility using the monthly return volatility over the past two years, $\sigma(R^e)$, as well as an accounting-based metric, the standard deviation of EBITDA, $\sigma(EBITDA/Assets)$. The model ascribes different roles to systematic and idiosyncratic risk. We estimate the market regression to calculate each firm's market beta, β, and the volatility of residuals, $\sigma(\varepsilon)$, as measures of systematic and idiosyncratic risk. We unlever these equity-based measures of risk, as the model specifies total firm risk.[22] We trim the top and bottom 1% of accounting ratios and the top and bottom 5% of market-based risk measures to reduce the impact of large outliers on our analysis.

Our theory is not meant to be comprehensive on the determinants of what makes a good buyout in the cross-section. Rather, our model focuses on the elements of a deal that relate to risk and discount rates. Therefore, we consider several firm characteristics that Opler and Titman (1993), and more recently, Bharath and Dittmar (2010), identify as empirically important to explaining which types of firms are bought out or go private: cash flow (*EBITDA/Assets*), capital intensity (*CapEx/Sales*), costs of financial distress (*R&D/Sales*), liquidity (*Turnover*), payout policy (*Dividend Dummy*), and net leverage (*Net Debt/Assets*).[23] In addition, we control for firm size (*log(Assets)*). Table 5 provides sample summary statistics. The broad picture is consistent with prior findings in the literature: deal firms are more profitable, spend less on capital expenditures and research and development, are less liquid, and have higher net debt than the average public firm. A comparison of deal firm-quarters to the full panel of firm-quarters demonstrates that the average buyout has lower risk across the set of risk proxies.

[22] Both β and $\sigma(\varepsilon)$ are unlevered by rescaling by $\frac{1}{1+(1-\tau)*\frac{Debt}{Mkt\ Cap}}$, where we assume $\tau = 35\%$.

[23] We also note the book-to-market of firms, although this is not a factor in our analysis, as it is a pricing factor.

Table 5
Summary of Firm-Quarters: Full Sample and LBO Firm-Quarters

Table 5 contains summary statistics for the sample of firm-quarters from 1982Q4 to 2011Q4. *Assets* are book assets in 2010 dollars. Accounting ratios are trimmed at the 99% level. *Dividend Dummy* is equal to one if the firm pays a dividend. $\sigma(R)$ is the standard deviation of the prior two years of monthly returns. $\sigma(EBITDA/Assets)$ is the standard deviation of the EBITDA-to-assets ratio over the observable life of a firm. β is the unlevered market beta of the firm based on the lagged two years of monthly returns. $\sigma(\varepsilon)$ is the standard deviation of the unlevered residuals from the market regression. Unlevered betas and residuals are trimmed at the top and bottom 5% to remove extreme outliers. *Deal Dummy* is equal to one if a firm announces a deal in the upcoming quarter.

	All Firm-Quarters				LBO Firm-Quarters			
	N	Mean	Median	Std. Dev.	N	Mean	Median	Std. Dev.
Deal Dummy	501,176	0.002	0.000	0.046	1,043	1.000	1.000	0.000
Firm Characteristics								
Assets (mm)	501,176	$2,027	$155	$12,728	1,043	$978	$211	$2,960
log(Assets)	501,176	5.19	5.04	2.13	1,043	5.48	5.35	1.59
EBITDA/Assets	487,597	0.05	0.11	0.22	1,031	0.11	0.13	0.15
CapEx/Sales	485,577	0.14	0.04	0.39	1,030	0.07	0.03	0.17
R&D/Sales	485,195	0.16	0.00	0.84	1,030	0.03	0.00	0.18
Net Debt/Assets	494,072	0.07	0.11	0.36	1,035	0.14	0.18	0.35
Turnover	488,367	1.15	0.63	1.89	1,036	1.05	0.59	3.73
Dividend Dummy	501,176	0.32	0.00	0.46	1,043	0.31	0.00	0.46
Book/Market	484,578	0.74	0.55	0.71	998	0.94	0.74	0.79
Risk Proxies								
$\sigma(R)$	431,467	15.83	13.44	10.69	963	14.26	12.25	8.22
β	387,071	0.88	0.78	0.65	899	0.78	0.69	0.59
$\sigma(\varepsilon)$	430,077	11.65	9.24	9.61	959	9.44	8.01	6.72
$\sigma(EBITDA/Assets)$	488,410	0.12	0.08	0.14	992	0.08	0.05	0.08

3.2 The Role of Aggregate Factors

Before analyzing cross-sectional heterogeneity in buyout propensity, we revisit the role of aggregate factors. The panel specification allows us to explicitly control for changes in firm composition. We cannot observe the surplus from going private, but the likelihood of a firm being a target is increasing in the difference between their private and public valuation. We use a dummy variable equal to one for the firm-quarter of a deal announcement and estimate the likelihood of a firm going private via OLS conditional on the risk premium and credit-market conditions at the beginning of the quarter:

$$Deal_{it} = \alpha_i + \lambda_{rp}\hat{rp}_t + \gamma'(\textbf{Credit Factors})_t + \epsilon_{it}. \quad (14)$$

Firm fixed effects capture heterogeneity across firms. Standard errors are two-way clustered, by firm and quarter, and are robust to arbitrary serial correlation within a bandwidth of one year.[24]

The panel introduces significant additional variation to the exercise: we are predicting no only when deals occur but also which firms are targeted. Consequently, R^2 comparisons are not all that informative, but we can verify the sign, statistical significance, and robustness of the discount rate measures conditional on firm-level controls. Consistent with the aggregate results of Section 1, Table 6 demonstrates that a higher risk premium lowers the probability of a deal even in the presence of credit controls and firm fixed effects. This result is true for both the reduced-form risk premium, $\hat{rp}_{OLS}$, in columns (1) and (3), and the VAR estimates, in columns (4) and (5). The latter also demonstrates a positive relation between earnings growth and deal likelihood. The risk premium and growth rate results are consistent with Prediction 1. In contrast to the aggregate tests, the risk-free rate is negatively correlated in this specification and statistically significant. However, we reiterate that the risk-free rate coefficients are unreliable because the risk-free rate is highly persistent.

Among credit controls, *GZ Spread* is positive and statistically significant at the 1% level in columns (2) and (3), but it does not attenuate the risk premium. The positive correlation—the higher the risk premium in bonds, the more buyout activity—is not consistent with the aggregate results in Table 4 nor is it easily reconciled with a simple credit story of buyout activity. We confirm these results by considering credit factors in isolation and in a Probit specification (Table IAVIII and IAIX).[25]

3.3 The Role of Risk Characteristics

The remaining columns of Table 7 consider the role of risk characteristics in the cross-section of firms. According to our framework, riskier firms are relatively more costly to acquirers and therefore less likely to be targeted. Greater systematic risk decreases the surplus via both the performance and illiquidity channels, while idiosyncratic risk increases the cost of a deal to private investors via the illiquidity

[24]The estimator is intended to account for autocorrelation in common disturbances (like changes in the risk premium) across the panel.

[25]The one exception is that the risk-free rate is positive in the Probit specification.

Table 6
Deal Likelihood and Discount Rates

Table 6 contains coefficient estimates from regressing quarterly deal indicator (*Deal*) on the risk premium, credit market factors, and firm fixed effects from 1982Q4 to 2011Q4. $\hat{rp}_{OLS}$ is the predicted market excess return using D/P, cay, and the three-month T-bill as factors. $\hat{rp}_{VAR}$ is the annual expected market excess return for the next three years based on a VAR. $\hat{g}_{VAR}$ is annual expected S&P earnings growth for the next three years based on a VAR. r_f is the annual risk-free yield at a three-year horizon. *EBITDA Spread* is the difference between the median public firm EBITDA/EV and the yield on a composite index of high-yield bonds. *HY Spread* is the yield on a a composite index of high-yield bonds less the three-month T-bill. *GZ Spread* is the excess bond premium as measured by Gilchrist and Zakrajšek (2012). Quarter dummies are included to account for seasonality. Standard errors in parentheses are two-way clustered by firm and quarter. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

	(1)	(2)	(3)	(4)	(5)
$\hat{rp}_{OLS}$	-2.39***		-1.59***		
	(0.28)		(0.35)		
$\hat{rp}_{VAR}$				-0.61***	-0.57***
				(0.11)	(0.13)
$\hat{g}_{VAR}$				0.11***	0.12***
				(0.031)	(0.032)
rf				-4.16***	-2.98***
				(0.47)	(1.01)
EBITDA Spread		-1.11	0.36		-0.088
		(1.98)	(2.36)		(2.26)
HY Spread		-5.24***	-2.63		-0.90
		(1.37)	(1.72)		(1.93)
GZ Spread		10.4***	7.83***		3.65
		(1.42)	(1.35)		(2.41)
Firm FE	X	X	X	X	X
Observations	501,176	501,176	501,176	501,176	501,176
R^2	0.064	0.064	0.064	0.064	0.064

channel. We estimate the likelihood of a firm going private via OLS conditional on firm risk factors and controls:

$$Deal_{it} = \alpha + \lambda_\beta \beta_{it} + \lambda_\sigma \sigma(\varepsilon)_{it} + \gamma' \mathbf{Controls_{it}} + \epsilon_{it}. \tag{15}$$

The risk characteristics exhibit time-variation, and this variation may be correlated with other factors, particularly discount rates. We therefore include time fixed effects to focus the analysis on cross-sectional differences between firms rather than time-series differences in firm risk estimates. We also consider specifications that control for firm-level characteristics using industry fixed effects and the firm variables discussed earlier (cash flow, capital intensity, etc.). Standard errors are two-way clustered, by firm and quarter, and are robust to arbitrary serial correlation within a bandwidth of one year.

Consistent with Prediction 2, Table 7 shows that several proxies for risk are negatively correlated with deal likelihood. Columns (1) to (3) include quarter fixed effects and (4) to (6) include firm-level controls. Both stock return volatility and cash flow volatility decrease the likelihood of a deal (columns (1) and (2)), even when controlling for other factors (columns (4) and (5)) at the 1% significance level. Market beta and idiosyncratic risk decrease the likelihood of a deal in both specifications (columns (3) and (6)) at the 1% significance level. Again, we verify our findings in a nonlinear probability specification in the Internet Appendix (Table IAX).

These results are consistent with our model. But they can also be explained by a credit-based narrative whereby risk increases the probability of default, which limits debt capacity and reduces the attractiveness of the firm to buyout investors. To further separate these explanations we turn to cyclical variation in the role of firm risk and characteristics.

3.4 The Composition of Buyouts over the Cycle

To directly test the channels outlined in the model, we consider whether the composition of buyout firms varies with the risk premium in the manner outlined in Prediction 3. Firms with high betas are particularly sensitive to changes in the risk premium, as a decline simultaneously increases performance gains and lowers illiquidity costs. We go on to test each channel independently by exploring predictions constrained to only one channel. The performance channel predicts that firms with greater potential for improvement are more sensitive to changes in the discount rate. The illiquidity channel predicts that more illiquid firms should be more sensitive to the risk premium. We find empirical support for both mechanisms.

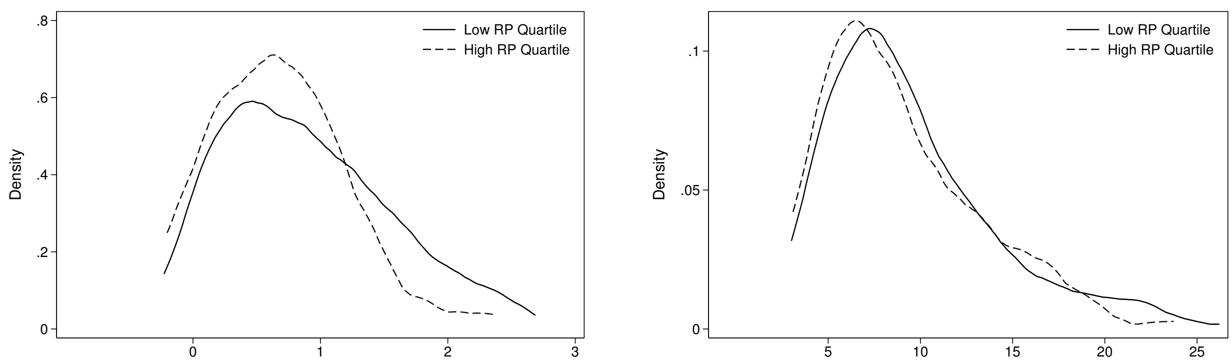
Table 7
Deal Likelihood and Firm Risk Characteristics

Table 7 contains coefficient estimates from regressing quarterly deal indicator (*Deal*) on firm risk characteristics, cross-sectional controls, and time fixed effects from 1982Q4 to 2011Q4. $\sigma(R)$ is the s.d. of the monthly stock price over the past two years. $\sigma(\frac{EBITDA}{Assets})$ is the s.d. of the firm's EBITDA/Assets ratio. β is the unlevered market beta of the firm based on the lagged two years of monthly returns. $\sigma(\varepsilon)$ is the s.d. of the unlevered residuals from the market regression. Unlevered betas and residuals are trimmed at the top and bottom 5% to remove extreme outliers. Columns (1) to (3) contain time fixed effects, and columns (4) to (6) contain firm-level controls (*log(Assets)*, *EBITDA/Assets*, *CapEx/Sales*, *R&D/Sales*, *Net Debt/Assets*, *Turnover*, *Dividend Dummy*), industry fixed effects (Fama-French 12), and time fixed effects. Standard errors in parentheses are two-way clustered by firm and quarter. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

	(1)	(2)	(3)	(4)	(5)	(6)
$\sigma(R)$	-0.31***			-0.28***		
	(0.11)			(0.088)		
$\sigma(\frac{EBITDA}{Assets})$		-49.2***			-45.3***	
		(8.20)			(7.66)	
β			-5.14***			-5.16***
			(1.34)			(1.38)
$\sigma(\varepsilon)$			-0.47***			-0.56***
			(0.15)			(0.11)
Time FE	X	X	X	X	X	X
Firm Controls				X	X	X
Industry FE				X	X	X
Observations	431,467	488,410	387,071	402,189	451,080	362,885
R^2	0.001	0.001	0.001	0.001	0.001	0.002

3.4.1 The Riskiness of Buyout Targets

As the risk premium declines, firms with higher betas are more likely to satisfy the positive surplus condition, equation (13). Indeed, if we compare the distribution of deal betas for low- and high-quartile risk premium observations, as shown in Figure 3, Panel A, the low-quartile distribution exhibits more mass above one, whereas the high-risk premium observations are more concentrated below one. This pattern is consistent with a rising cutoff as buyout investors exhibit an increased willingness to purchase higher-beta firms.



Panel A. Betas

Panel B. Idiosyncratic Risk

Figure 3. Density of LBO risk measures in low and high risk premium periods. Panel A plots the kernel density of unlevered beta for buyout transactions in the top and bottom quartiles of the risk premium. Panel B plots the kernel density of idiosyncratic risk (the s.d. of unlevered residuals from the market regression) for buyout transactions in the top and bottom quartiles of the risk premium. Unlevered betas and residuals are trimmed at the top and bottom 5% to remove extreme outliers. The risk premium is predicted using annual returns for a three-year period using D/P, cay, and the three-month T-bill as factors.

The sensitivity of target betas to the risk premium could also be consistent with a credit market story in which credit investors are more willing to take risks in boom times and less willing during busts. If "hot" credit markets drive this pattern we would expect to see a similar shift in idiosyncratic risk. Our model predicts that deals are less likely the higher the idiosyncratic risk, but that idiosyncratic risk does not directly interact with expected market returns. Hence, our characterization of the discount rate channel suggests that the standard deviation of the idiosyncratic risk measure should be relatively insensitive to changes in the risk premium.[26] Figure 3, Panel B demonstrates that the peak density of our idiosyncratic risk measure is slightly higher during periods of low risk, but the difference is markedly less pronounced than the shift in beta. Further, the direction of this shift is not uniform over the distribution.

We formally test the correlation between target risk and the risk premium by regressing our measures of risk for buyout firms (buyout firm-quarters) on measures of buyout activity or the risk premium. On average, deal betas should be higher when activity is high because this is when the risk premium is low. In fact, there

[26]We thank an anonymous referee for suggesting this comparison.

is a statistically significant positive relation between target betas and the level of buyout activity, as shown in Table 8 Column (1). We go a step further and verify that our proxies for the risk premium are negatively related to the average deal beta in columns (2) and (3).

The idiosyncratic risk of the target is negatively correlated with buyout activity (column (4)), which is at odds with the "hot" credit markets hypothesis. Idiosyncratic risk is negatively related to the risk premium measures but the coefficients are not statistically significant (columns (5) and (6)). Taken together, the results demonstrate that targets have higher betas during periods of greater deal activity or lower risk premia and that the idiosyncratic risk of buyout targets is relatively unchanged in response to valuation conditions. As a whole this evidence favors our discount rate hypothesis rather than the credit market story.

Another way to interpret Prediction 3 is that a firm's propensity to be a buyout target varies more with the risk premium the higher a firm's beta. To test this and other predictions that interact with the risk premium, we consider an alternative regression specification in which we estimate how the elasticity of deal activity to the risk premium varies across firms and in response to the risk premium. To do so, we form portfolios by sorting firms into quartiles based on the characteristic of interest, in this case beta. Quartiles are calculated for each quarter t. We then calculate buyout activity relative to the sample of firms in portfolio j, $Activity_{jt}$. Finally, we scale this level of activity by the average level of activity over time in the portfolio, $\overline{Activity_j}$ and we regress rescaled activity for the high- and low- quartile portfolios on time fixed effects, τ_t, a dummy indicating the high quartile for the characteristic of interest, X_{jt}, and an interaction with the risk premium:

$$\frac{Activity_{jt}}{\overline{Activity_j}} = \lambda_X X_{jt} + \lambda_{X \times rp}(X_{jt} \times \hat{rp}_t) + \tau_t + \epsilon_{jt}. \tag{16}$$

The coefficient of interest, $\lambda_{X \times rp}$, is the difference in sensitivity to the risk premium between the high and low quartiles. Given that the unconditional relation between activity and the risk premium is negative, a negative coefficient would suggest that the high quartile is more sensitive to changes in the risk premium while a positive coefficient would suggest that the high quartile is less sensitive. Since activity is rescaled, the coefficient on the dummy variable, λ_X, cannot be easily interpreted. Standard errors are two-way clustered by portfolio and quarter.[27] While a simple

[27] Time fixed effects absorb aggregate time-series variation. An alternative formulation without time fixed effects but with the risk premium as a regressor yields similar conclusions.

Table 8
Beta on LBO Activity, Discount Rates, and Growth

Table 8 contains coefficient estimates from regressing risk measures for LBO firm-quarters on LBO activity, discount rates, and growth measures from 1982Q4 to 2011Q4. In columns (1) to (3) unlevered beta is the dependent variable. In column (4), the dependent variable is the s.d. of the unlevered residuals from the market regression, $\sigma(\varepsilon)$. *Volume %* is the volume of buyouts scaled by the number of public firms. $\hat{rp}_{OLS}$ is the predicted market excess return using D/P, cay, and the three-month T-bill as factors. $\hat{rp}_{VAR}$ is the annual expected market excess return for the next three years based on a VAR. $\hat{g}_{VAR}$ is annual expected S&P earnings growth for the next three years based on a VAR. r_f is the annual risk-free yield at a three-year horizon. Unlevered betas and residuals are trimmed at the top and bottom 5% to remove extreme outliers. Standard errors in parentheses are calculated over time using Newey-West (four lags). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	β			$\sigma(\varepsilon)$		
	(1)	(2)	(3)	(4)	(5)	(6)
Volume %	0.0070***			-0.032*		
	(0.0025)			(0.019)		
$\hat{rp}_{OLS}$		-0.018***			-0.017	
		(0.0064)			(0.067)	
$\hat{rp}_{VAR}$			-0.0056*			-0.0050
			(0.0029)			(0.022)
$\hat{g}_{VAR}$			0.0022***			0.0050
			(0.00054)			(0.0084)
rf			0.0023			-0.28***
			(0.0076)			(0.087)
Observations	899	899	899	898	898	898
R^2	0.019	0.026	0.024	0.007	0.000	0.043

approach, we believe it makes clear that we are comparing the differential response of firms to the risk premium based on a characteristic.[28]

The model predicts that high-beta stocks will be more sensitive to changes in the risk premium. We consider two portfolios, a portfolio of high-quartile betas and a portfolio of low-quartile betas, where the characteristic is a dummy variable indicating a high-quartile beta. In Table 9, Panel A column (1), the negative coefficient on

[28]In Table IAXI we draw similar conclusions when we exploit the entire cross-section of firms by forming portfolios based on the underlying characteristic and then regressing activity for these portfolios on an interaction with the average value of the characteristic in the portfolio.

the interaction term implies that high-beta stocks have greater sensitivity to the risk premium; the difference is statistically significant at the 5% level.

The specification in equation (16) helps alleviate some identification concerns regarding the pure time-series approach of Section 1. While we make an effort to control for the primary competing explanations of buyout activity, namely, credit-market-specific conditions, we cannot explicitly address all possible alternative explanations. The inclusion of time fixed effects mitigates this issue. The fixed effects absorb aggregate shocks that have a common impact across firm types. The only alternative explanations left on the table are aggregate factors correlated with the risk premium that have a similar differential impact across firms with different characteristics X_{jt}. Hence, we believe the results of this section regarding beta, as well as the two sections hereafter, strongly support the role of the risk premium in shaping buyout cycles.

3.4.2 Performance Channel

We go one step further and consider evidence directly related to specific channels. Firms with greater potential for improvement, higher values of p_H in the model, should be more sensitive to changes in the discount rate via the performance channel. The potential for earnings improvement is difficult to directly observe, however, so we use two proxies for the potential benefits of a firm, appealing to the agency literature for inspiration. The first proxy is the governance index of Gompers, Ishii, and Metrick (2003), GIM. This index uses a firm's governance rules to measure shareholder rights. Unfortunately this metric is only available for a subset of larger firms beginning in 1990.

The second proxy is based on the the free cash flow hypothesis of Jensen (1986), which states that managers with more free cash flow will invest it in negative NPV projects. We measure firms' exposure to the free cash flow problem (FCF) using FCF scaled by assets. A caveat in interpreting these results as direct evidence of the performance channel is that we must assume that these measures are uncorrelated with the illiquidity of the deal.[29]

The third proxy for performance is the competitiveness of a firm's industry. Giroud and Mueller (2010) find that firms in noncompetitive industries perform worse when laws are put in place to limit takeovers while firms in competitive industries perform no differently under the same circumstances. Hence, competition acts as a disciplining force that improves management and limits the potential for improvement. Using

[29]One potential mechanism is that bigger improvements take more time to implement. We are not aware of any evidence to this effect with respect to the particular measures we consider.

Table 9
Elasticity of Buyout Activity to the Risk Premium – High-Low Comparisons

Table 9 contains coefficient estimates estimating the differential sensitivity of high- and low-quartile portfolios to changes in the risk premium. Specifically, we regress deal activity scaled by its average on a dummy variable indicating the high quartile for a given characteristic, and interaction of the dummy with the risk premium, and time fixed effects from 1982Q4 to 2011Q4. $\hat{rp}$ is the predicted market excess return using D/P, cay, and the three-month T-bill as factors. In Panel A the portfolios and top-quartile dummies are based on the following: β, the unlevered market beta of the firm, GIM, the governance index of the firm (Gompers, Ishii, and Metrick (2003)), $FCF/Assets$, FCF/Assets, and HHI, the HHI of sales for public firms in the three-digit SIC code. In Panel B the portfolios and top-quartile dummies are based on M&A and IPO activity in a Fama-French 48 industry. Activity is based on a three-year moving average. Volumes are scaled by the number of public firms in the industry, with values scaled by the value of public firms in the industry. Standard errors in parentheses are two-way clustered by portfolio and quarter. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Panel A: Performance Proxies				
	(1)	(2)	(3)	(4)
Characteristic (X):	β	GIM	FCF/Assets	Industry HHI
$(X)\hat{rp}$	-0.026*	-0.058**	-0.0085	-0.044***
	(0.014)	(0.025)	(0.017)	(0.015)
Time FE	X	X	X	X
Observations	234	174	234	234
R^2	0.015	0.030	0.001	0.028
Panel B: Illiquidity Proxies				
	(1)	(2)	(3)	(4)
Characteristic (X):	M&A Vol.	M&A Val.	IPO Vol.	IPO Val.
$(X)\hat{rp}$	0.060***	0.015	0.021*	0.024*
	(0.014)	(0.013)	(0.013)	(0.013)
Time FE	X	X	X	X
Observations	234	234	234	234
R^2	0.085	0.006	0.012	0.015

data on public firms from *COMPUSTAT*, we construct their measure of competition the Herfindahl Index (*HHI*) of sales at the three-digit SIC code level.

Estimates of the role of these proxies in Table 9 are consistent with the model's predictions. The governance index is increasing in the weakness of shareholder rights; a higher GIM implies greater potential for improvement. The interaction term in Column (2) indicates that higher GIM firms are more sensitive to changes in the risk premium at the 5% significance level. Column (3) considers the profitability measure, $FCF/Assets$, and finds that firms with more cash flow are more sensitive to changes in the risk premium but the coefficient is statistically indistinguishable from zero. In Column (4), we find that firms in less competitive industries (high *HHI* quartile) are more sensitive to changes in the risk premium at the 1% significance level. These results, along with the alternative specifications in the Internet Appendix (Table IAXI), are consistent with our model predictions of the model and support the performance channel as a mechanism for variation in buyout activity.

3.4.3 Illiquidity Channel

We also test whether the role of the risk premium flows through the illiquidity channel by considering heterogeneity in liquidity across firms. While the model assumes that the illiquidity of the buyout contract lasts one period, we can relax this assumption and think about some firms being easier to exit than others.[30] The longer the acquirer has to hold onto the firm, the greater the illiquidity costs. Periods of a high risk premium reduce the attractiveness of an illiquid firm more so than a liquid firm. The time during which the firm's ownership is illiquid has no impact on the performance channel so long as we believe that the aggregate performance gains are independent from their ease of exit. We focus on measures that have no strong reason to exhibit such a correlation.

We develop several proxies for the duration of investment using industry differences in the liquidity of assets. We consider the volume and value of M&A and IPO activity to proxy for the ease with which assets in a particular industry are traded. Using data from *Thomson SDC*, we compile a list of all completed M&A transactions with reported values and a list of IPOs. We organize this activity into Fama-French 48-industry classifications and scale the number of deals by the number of public firms in the industry. Similarly, we scale the enterprise value of activity by the enterprise value of public firms in the industry. We calculate three-year moving averages of industry activity to reflect persistent liquidity conditions, and not the current level of liquidity, which may also be driven by the risk premium.

Following the specification in equation (16), we regress the scaled activity measure for high- and low-quartile portfolios on time fixed effects, the high-quartile dummy,

[30] One can extend the model to account for this heterogeneity by changing the horizon at which the acquirer receives his payoff as a function of firm value.

and the interaction between the risk premium and the high-quartile dummy. In Table 9, Panel B, the elasticity of activity to the risk premium is decreasing in M&A measures of activity (columns (1) and (2)), the former at the 1% significance level. The volume and value of IPO activity are positive (columns (3) and (4)), at the 10% significance level. Overall, deal activity in more liquid industries is less sensitive to variation in the risk premium. These predictions are distinct from the performance channel above and speak directly to sensitivity of investors to liquidity concerns.

In the Internet Appendix (Table IAXII), we repeat this analysis using credit market controls to ensure that these differences are not explained by changes in credit spreads. The sign and significance of our coefficients are similar in the presence of these additional controls.

4 Other Corporate Transactions

The two channels of our model reflect a basic trade-off in corporate finance between productivity gains due to organizational changes and the funding structure necessary to implement these changes. In this section, we consider the implications of this trade-off for other types of corporate finance activity: mergers and IPOs. We document the relation between fluctuations in activity and the risk premium and conclude that they broadly match the predictions of our theory.

4.1 Mergers

M&A deals increase future earnings by exploiting synergies between the acquirer and the target, echoing the performance channel for buyouts. But unlike buyout deals, the typical M&A transaction does not meaningfully change the liquidity of the acquirer. Thus, M&A activity should respond negatively to the risk premium, though we predict the sensitivity to be lower than for buyouts.

We consider M&A deals for public targets as reported by *Thomson SDC* beginning in 1981Q1.[31] The resulting sample includes 5,913 deals. Like our core analysis, we standardize activity over time by scaling the number of deals by the number of public firms and the asset value of deals by the total value of public assets. To compare magnitudes across different left-hand-side variables, we take the log of activity and estimate a time-series regression of activity on our base risk premium, which reveals the (semi-)elasticity of activity to the risk premium.

[31]We focus on transactions where 100% of the equity in the firm is purchased and the deal value is disclosed by *Thomson*. These two restrictions effectively minimize small transactions for minority interest or assets. We find similar results when we consider M&A activity for private targets as well.

The results in Table 10, Panel A demonstrate that the volume of M&A activity (column (1)), is negatively related to an increase in the risk premium at the 1% significance level. A one-percentage-point increase in the risk premium corresponds to a 5.4% decrease in M&A activity. A similarly constructed measure for LBOs finds an elasticity of 8.5% on the risk premium.

We repeat the analysis controlling for two alternative explanations emphasized in the literature on M&A activity. The first explanation emphasizes the availability of credit as the main driver of activity in the time series; see, for instance, Harford (2005) or Maksimovic, Phillips, and Yang (2013). We use various sets of controls for credit market conditions. In column (2), we consider the measures we use for buyout activity: *HY Spread*, *EBITDA Spread*, and *GZ Spread*. Dittmar and Dittmar (2008) argue that changes in economic growth drive a wedge between debt and equity. Column (3) documents this effect by adding realized GDP growth to the analysis; again the role for the risk premium is broadly unchanged.

The second explanation considers the role of investor sentiment; see, for instance, Rhodes-Kropf and Viswanathan (2004), Rhodes-Kropf, Robinson, and Viswanathan (2005), and Lamont and Stein (2006). Following this work, we control for sentiment using the discount on closed-end funds (Lee, Shleifer, and Thaler (1991)) and the sentiment index of Baker and Wurgler (2006). As shown in column (4), these measures capture some of the variation in activity but do not drive out the predictive power of the risk premium. In column (5), we consider all six candidate variables for M&A activity against our measure of the risk premium. Across each of these specifications, the risk premium is a negative and statistically significant predictor of M&A activity.

The typical response of M&A to the risk premium is smaller than that of buyouts, consistent with the lack of a liquidity channel. In columns (6) and (7) we consider the elasticity of the ratio of buyouts to M&A activity to the risk premium. In line with the findings of Martos-Vila, Rhodes-Kropf, and Harford (2012), buyout activity is 3.2% more responsive to the risk premium than M&A activity. In column (7) we find that the differential response is robust to controlling for alternative explanations of M&A activity.[32] When we repeat this analysis on the asset value of M&A targets, in Table 10 Panel B, we obtain similar conclusions and higher magnitudes.

4.2 IPOs

Initially, IPOs appear to be the opposite of buyouts. A public offering moves a firm from an illiquid private ownership to public capital markets. Moreover, dispersion of control in the new structure exacerbates agency problems. A naive interpretation

[32]See Internet Appendix Table IAXIII for specifications with individual controls.

Table 10
Elasticity of Corporate Transaction Activity to the Risk Premium

Table 10 contains coefficient estimates from regressing quarterly M&A activity involving public targets on the risk premium. In Panel A, the dependent variable in columns (1) to (5) use the log of the ratio of M&A deals to the number of public firms. Columns (6) and (7) use the log of the ratio of LBO volume to M&A volume. Column (9) considers the log of the ratio of IPO deals to the number of public firms. Panel B repeats these measures using asset values. In Panel B, Columns (1) to (5) use the log of the ratio of total assets for M&A targets to the assets of public firms. (6) and (7) use the log of the ratio of LBO assets to M&A assets. Columns (9) considers the log of the equity value of the IPO to total public market capitalization. $\hat{rp}_{OLS}$ is the predicted market excess return using D/P, cay, and the three-month T-bill as factors. *EBITDA Spread* is the difference between the median public firm EBITDA/EV and the yield on a composite index of high-yield bonds. *HY Spread* is the yield on a composite index of high-yield bonds less the three-month T-bill. *GZ Spread* is the excess bond premium as measured by Gilchrist and Zakrajšek (2012). *GDP Growth* is the year-on-year growth rate of U.S. real GDP. *CE Fund Discount* is the discount on a closed-end fund. *Sentiment* is a measure of sentiment from Baker and Wurgler (2006). The M&A sample ranges from 1981Q2 to 2011Q4. The LBO sample ranges from 1982Q4 to 2011Q4. IPO activity ranges from 1981Q2-2011Q4. Each regression also includes quarter dummy variables to account for seasonality. Standard errors in parentheses are calculated over time using Newey-West (four lags). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel A: Volume

	M&A					LBO / M&A		IPO
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{rp}_{OLS}$	-0.054***	-0.052***	-0.054***	-0.054***	-0.052***	-0.032**	-0.054***	0.0087
	(0.0062)	(0.0065)	(0.0061)	(0.0078)	(0.0071)	(0.015)	(0.018)	(0.026)
EBITDA Spread		0.058*			0.033		0.14**	
		(0.033)			(0.038)		(0.070)	
HY Spread		0.027*			0.0040		0.15**	
		(0.015)			(0.025)		(0.061)	
GZ Spread		0.00024			-0.015		0.13	
		(0.047)			(0.040)		(0.082)	
GDP Growth			-0.55		-0.82		13.9***	
			(2.44)		(2.75)		(3.96)	
CE Fund Discount				0.015*	0.014		0.010	
				(0.0083)	(0.0100)		(0.020)	
Sentiment				0.059	0.064		-0.12	
				(0.081)	(0.073)		(0.097)	
Observations	123	123	123	120	120	116	113	164
R^2	0.456	0.488	0.457	0.475	0.491	0.079	0.242	0.007

Panel B: Value

	M&A					LBO / M&A		IPO
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\hat{rp}_{OLS}$	-0.048**	-0.11***	-0.049**	-0.056***	-0.11***	-0.10***	-0.080***	0.041
	(0.021)	(0.023)	(0.021)	(0.021)	(0.028)	(0.030)	(0.028)	(0.033)
EBITDA Spread		0.097			0.14*		0.12	
		(0.080)			(0.086)		(0.099)	
HY Spread		0.19***			0.19***		-0.011	
		(0.053)			(0.066)		(0.10)	
GZ Spread		-0.40***			-0.23*		0.18	
		(0.11)			(0.14)		(0.15)	
GDP Growth			18.4***		13.6**		16.7**	
			(5.15)		(6.10)		(7.80)	
CE Fund Discount				0.039	0.045*		0.028	
				(0.032)	(0.026)		(0.032)	
Sentiment				0.46*	0.18		0.050	
				(0.27)	(0.20)		(0.21)	
Observations	117	117	117	114	114	116	113	164
R^2	0.062	0.207	0.187	0.143	0.297	0.174	0.230	0.032

of our hypothesis for buyouts would therefore predict a positive link between the risk premium and IPOs. We explore this idea empirically. We consider IPO activity recorded in *Thomson SDC* since 1970Q1—again taking the log of activity relative to the size of the public market. We find that IPO activity does not respond to changes in the risk premium (Table 10, column (9)).The lack of a strong relation is true for both volume- and value-based measures of IPO activity, in Panels A and B.

Perhaps our empirical findings are unsurprising in light of a more acute interpretation of what constitutes an IPO transaction. For instance, in a survey of IPOs Mikkelson, Partch, and Shah (1997) note that 85% of firms cite financing growth as their main reason to go public.[33] Thus, an IPO often includes an investment component, suggesting a negative role for the risk premium rather than the positive link implied by "reverse-buyout" logic. IPOs not only face different investment opportunities, but also have a direct impact on employees of the firm that have been paid with equity, leading to another alternative channel for the risk premium.[34] In contrast to our results, Pastor and Veronesi (2005) find a role for the risk premium by using a more structural analysis to account for variation in the risk premium and uncertainty.

Overall, fluctuations in merger activity negatively co-vary with the risk premium, but mergers are less sensitive than buyouts, consistent with our framework. IPO activity does not fluctuate with the risk premium. While outside the scope of this paper, these results suggest that there are important differences between IPOs and buyouts. A more in-depth study of these differences using the cross-section of deals could shed more light on the relevance of our approach in the context of these transactions.

5 Final Remarks

In this paper we show that changes in the aggregate risk premium explain buyout waves. Using a simple model of a buyout transaction, we reproduce the salient features of buyout cycles. At the aggregate level, total activity is high when the aggregate risk premium is low. Consistent with the literature on buyouts, boom markets are characterized by high deal leverage and low returns to private equity investors. We document a novel set of facts regarding the composition of buyout targets over the cycle, further supporting the importance of the risk premium for buyout activity. For instance, high-beta firms are more likely to enter a transaction in periods of a low risk premium. Taken together, these facts are difficult to reconcile with a view of buyouts driven by debt market conditions.

[33]They find that 85% of the firms intend to use the proceeds of the IPO to raise working capital, and 64% intend to use the proceeds to finance capital expenditures.

[34]Thanks to an anonymous referee for suggesting the latter.

We believe our approach provides a backdrop against which to evaluate the choices of GPs and LPs. In this paper, we take a simple view of the participants in a private equity deal. In practice, there is significant cross-sectional heterogeneity in private equity funds. They vary in age, size, and past success—characteristics that shape their investment style. These characteristics might impact their response to changes in the risk premium. Similarly, private equity firms associate themselves with different LPs (Lerner and Schoar (2004)), perhaps strategically, and we suspect that variation in the risk premium could affect these choices as well.

More generally, the empirical success of our approach suggests that it be used to study other types of corporate decisions. The importance of the risk premium for asset prices is well studied, but the role of the risk premium in corporate decisions is less understood – in particular, corporate financial decisions. Much like buyouts, other corporate decisions exhibit significant cyclicality. Given the prominent role that the risk premium plays for the buyout cycle, the risk premium's ability to coordinate corporate activity more broadly represents a promising avenue for further research.

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Appendix A. Deriving the Cost of Capital

Pricing on public markets follows the CAPM.

1. Sure payoffs of one are discounted at the risk-free rate: $\textbf{NPV}(1) = 1/(1 + r_f)$.
2. Risky market exposure of $1+R_m = 1+r_f+\bar{R}^e_m+\varepsilon_m$ is discounted using the risk premium: $\textbf{NPV}(1 + R_m) = 1$.
3. Idiosyncratic risk ε_i is not priced: $\textbf{NPV}(\varepsilon_i) = 0$.

Pricing is additive, and the Law of One Price holds: $\textbf{NPV}(aX + bY) = a\textbf{NPV}(X) + b\textbf{NPV}(Y)$ for any constants a and b and payoffs X and Y.

To understand the equivalence with the standard discounted cash flow valuation, consider a cash flow that pays one on average and loads on the aggregate risk factor, ε_m. The payoff at time 1 is $P_1 = 1 + \beta^{\text{CF}}\varepsilon_m$, where β^{CF} represents the cash flow exposure of the claim to aggregate risk. Our model of pricing gives the initial price

$$P_0 = \frac{1 - \beta^{\text{CF}}\bar{R}^e_m}{1 + r_f}. \tag{A17}$$

Alternatively, one can focus on returns. The return on that claim given the initial price P_0 is

$$R_a = \frac{P_1}{P_0} - 1 = \frac{1}{P_0} + \frac{\beta^{\text{CF}}}{P_0}\varepsilon_m - 1 = \frac{1}{P_0} + \beta^{\text{R}}\varepsilon_m - 1, \tag{A18}$$

where $\beta^{\text{R}} = \beta^{\text{CF}}/P_0$ is the return exposure of the claim to aggregate risk. Expected returns are given by $\mathbb{E}(R_a) = \frac{1}{P_0} - 1$. According to the CAPM, we estimate the expected return from its covariance with the market excess return R^e_m:

$$\mathbb{E}(R_a) = r_f + \frac{\text{Cov}\left(R_a, R^e_m\right)}{\text{Var}\left(R^e_m\right)}\bar{R}^e_m = r_f + \beta^{\text{R}}\bar{R}^e_m. \tag{A19}$$

Using this cost of capital to discount expected cash flow, following DCF valuation, we obtain

$$P_0^{\text{DCF}} = \frac{1}{1 + r_f + \beta^{\text{R}}R^e_m}. \tag{A20}$$

It is immediate to verify that $P_0 = P_0^{\text{DCF}}$. Hence, valuations follow the classic DCF formula with risk adjustment.

Appendix B. Model Extensions

A. Allowing for Benchmarking

We extend the contracting space to allow for the benchmarking of contracts. To do so we allow contracts to have a component depending on the market structure parameterized by

k_2. The payout to the private equity investor becomes $k_0 + k_1 p_H \tilde{Y} + k_2(\bar{R}_m^e + \varepsilon_m)$. Following equation (10), we represent the payoff as a portfolio:

$$\begin{cases} \theta_0 = k_0 + k_1 p_H(\mu - \beta \bar{R}_m^e) \\ \theta_m = k_1 p_H \beta + k_2 \\ \theta_i = k_1 p_H. \end{cases} \tag{B21}$$

This market loading k_2 is costless to provide to outside investors because $(\bar{R}_m^e + \varepsilon_m)$ is a zero-cost portfolio. It does not affect the IC constraint as the GP receives it independent of its management decision. The only effect is in the IR constraint through the first term of the right-hand side of equation (13), the cost of bearing an inadequate amount of market risk. The optimal choice of k_2 is then clearly to cancel out this term, so that the net exposure θ_m coincides with θ^*. This corresponds to $k_2 = 1 - k_1 p_H$.

Once the illiquidity cost of excess market risk disappears, the condition for the feasibility of a deal becomes

$$(p_H - 1)\left(\mu - \beta \bar{R}_m^e\right) \geq \frac{1}{2}\gamma \sigma_i^2 k_1^{*2} p_H^2 \sigma_i^2. \tag{B22}$$

Benchmarking with Pre-Contracting. While benchmarking of contracts is useful, it is not always possible given the timing of private equity contracting. Similarly to Ewens, Jones, and Rhodes-Kropf (2013), we assume that the contract has to be specified before the target is known. There are two equally likely targets with market exposure $\underline{\beta}$ and $\bar{\beta}$ that are otherwise identical.

We look for a pre-specified contract where both outside investors and the GP benefit by participating. The problem is

$$\min_{(k_0,k_1)} k_0 + k_1 p_H(\mu - \beta \bar{R}_m^e) - W_0(1 + r_f) \tag{B23}$$

$$\text{s.t. } k_1 \geq b/\Delta p \qquad \text{(IC)} \tag{B24}$$

$$k_0 + k_1 p_H \left(\mu - \frac{\underline{\beta} + \bar{\beta}}{2}\bar{R}_m^e\right) - W_0(1 + r_f) \geq$$
$$\frac{1}{4}\gamma\sigma_m^2\left[(k_1 p_H \underline{\beta} + k_2 - \theta_m^*)^2 + (k_1 p_H \bar{\beta} + k_2 - \theta_m^*)^2\right] + \frac{1}{2}\gamma\sigma_i^2 k_1^2 p_H^2 \sigma_i^2. \qquad \text{(IR)} \tag{B25}$$

The optimal choice of k_2 minimizes the illiquidity cost but does not reach zero. The condition for such an arrangement to be feasible is

$$(p_H - 1)\left(\mu - \frac{\underline{\beta} + \bar{\beta}}{2}\bar{R}_m^e\right) \geq \frac{1}{2}\gamma\sigma_m^2 (k_1^* p_H)^2 \left(\frac{\underline{\beta} + \bar{\beta}}{2}\right)^2 + \frac{1}{2}\gamma\sigma_i^2 k_1^{*2} p_H^2 \sigma_i^2. \tag{B26}$$

We see that the illiquidity channel is still present through inadequate amounts of aggregate risk, and that this cost increases with the risk premium. The reason for this effect is that while benchmarking is optimal, it cannot simultaneously eliminate the illiquidity costs for the two potential deals. One might argue that if the risk premium becomes large enough, it is preferable to pursue contracts whereby only some of the deals are undertaken. While we do not explicitly consider this case, it is consistent with our main argument: a larger risk premium lowers the number of deals undertaken through the illiquidity channel.

B. Variation in Deal Leverage

To consider variation in deal leverage, we allow for heterogeneity across deals. The GP now has various possibilities for diversion across buyout deals, parameterized by b: some firms offer more private benefits than others. For a type b deal, the GP receives private benefit b, keeping all other parameters constant across deals. From the IR constraint, the leverage needed to provide incentives increases with the level of diversion b: the slope of the buyout contract is $k_1 = b/\Delta p$. We show that deals with higher private benefits b need a lower risk premium to generate positive returns net of fees. We define the surplus of deal $F(\cdot)$, of type b, as

$$F(b, \bar{R}^e_m) = (p_H - 1)(\mu - \beta \bar{R}^e_m) - \frac{1}{2}\gamma\sigma^2_m(k_1(b)^* p_H \beta - 1)^2 - \frac{1}{2}\gamma\sigma^2_i k_1(b)^{*2} p^2_H. \tag{B27}$$

Since F is smooth, by the implicit function theorem it is enough to show that at break-even point $\bar{R}^{e*}_m$, where $F(0, \bar{R}^{e*}_m) = 0$, we have $\partial_b F(0, \bar{R}^{e*}_m) < 0$. Taking the derivative of F with respect to b, we have

$$\partial_b F(0, \bar{R}^{e*}_m) = -\gamma \frac{p_H}{\Delta p}\left(\beta\sigma^2_m\left(\beta p_H \frac{b}{\Delta p} - 1\right) + \sigma^2_i \frac{b}{\Delta p}\right) \leq 0. \tag{B28}$$

Since the derivative is negative this concludes the proof. We have shown that deals that require higher leverage will only be realized in times of lower risk premium. In other words, some deals will have higher leverage in times of a lower risk premium.

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