Financial Synergies and the Optimal Scope of the Firm:

Implications for Mergers and Structured Finance

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Firm Scope and Synergies

- The optimal grouping of activities into firms, or ***optimal firm scope***, has long been an important topic in economics
  - Most studies have focused on ***operational synergies***
    - Economies (or dis-economies) of scope in production
    - Pricing power related to scope
    - Managerial benefits or costs to larger scope
  - Firms that combine activities that have ***zero operational synergies*** are often termed *"conglomerate" mergers*
    - Often explained behaviorally, e.g. managerial empire-building
    - But others have maintained there may be ***purely financial synergies*** that justify combination.

Objectives of This Paper

- This paper examines the question of ***purely financial synergies*** in conglomerate mergers
  - Do they exist?
  - Are they always positive (or always negative)?
  - What determines their size?
  - Are their magnitudes likely to be significant?
  - Can they explain activities such as structured finance?
    - Asset securitization
    - Project finance
- Note: financial synergies and operational synergies are not mutually exclusive!

Optimal Scope: How Should Activities be Grouped into Firms?

- ***"Activity"***: indivisible asset(s) producing cash flows
  - Cash flows may be negative (following Scott (1977), Sarig (1985))
  - Ownership can be transferred
- ***"Firm"***
  - Bankruptcy-remote unit that owns one or more activities (corporation or SPE)
  - Issues debt, equity. Debt has senior claim to firm's cash flows
  - Firm has limited liability (avoids negative cash flows)
- ***"Optimal"***
  - Maximizes total value of activities, including gains to leverage
- ***The Key Problem we address:***
  - Incorporate and lever activities *separately*, or *jointly*?

Intellectual Roots of Financial Synergies

- ***Modigliani-Miller*** *(1958):* In "pure" world, no taxes etc.:
  - Leverage doesn't matter: *no financial synergies*
    ➔ No benefits to mergers that have zero operational synergies
- ***Lewellen*** *(1971):* nonsynergistic mergers, but adds taxes
  - Mergers lower default probability ➔ higher "debt capacity" ➔ greater leverage, tax benefits, value. No formal model
  - Concludes that *financial synergies are always positive* ➔ *purely* ***financial synergies can't explain structured finance!***
  - But overlooked potential *benefits of separate capital structures*
- ***Two benefits to separation vs. combination (merger)***:
  - Separate limited liability shelters (Scott 1977, Sarig 1985)
  - Separate capital structures (leverage ratios)
    - Not examined previously—need solvable optimal capital structure model

Structured Finance: A Decision about Scope

- Structured Finance includes ***Asset Securitization***, ***Project Finance.*** Choice to use is choice of ***scope***.
- Structured finance has grown rapidly in US (see table below) and in Europe
- Yet finance theory has yet to explain adequately!

	Agency	Non-Agency	Non-Mtge.	
YEAR	**MBS**	**MBS**	**ABS**	**TOTAL**
2000	2,491.8	669.3	1,071.8	4,232.9
2001	2,830.2	776.4	1,281.2	4,887.8
2002	3,158.3	862.1	1,543.2	5,563.6
2003	3,488.1	1,046.0	1,693.7	6,227.8
2004	3,547.3	1,490.2	1,839.2	6,876.7

All Numbers in $ Billion
Source: The Bond Market Association

Structured Finance

- ***Key elements of structured finance***
  - *Assets (or "activity") owned by a firm (the "sponsor") are sold to a* ***Special Purpose Entity /Vehicle*** (SPE/SPV)
    - Sole purpose of SPE is to collect and disperse activities' cash flows
    - Activities typically require little management
    - Typically SPE is a trust, sometimes a corporation
    - SPE is "bankruptcy remote" from sponsoring firm
  - *The SPE issues securities backed by the assets' cash flows*
    - Examples: mortgage-backed securities (MBS), asset-backed (ABS)
    - Debt "tranches" with different seniorities, plus "equity" (5% -15%)
  - *Funds raised are used to repay sponsor for assets transferred*

The Puzzle of Structured Finance

- ***No obvious <u>operational</u> synergies in asset transfers***
- ***Possible explanations for structured finance***

  - Regulatory (reduce capital requirements). But non-bank use, too.

  - ***Purely Financial:***
    - ***Cheaper financing*** (but more expensive for remaining assets? Modigliani-Miller suggests that will be the case)
    - ***Greater leverage*** (Reason given by many in business, but is total leverage increased? Lewellen says no!)

- ***Is there a legitimate "purely financial" explanation?***

  This relates back to the question of

  "Is There an Optimal *Financial* Scope to the Firm?"

Preview of Conclusions

- Financial synergies to merger can be positive or negative.
  Two Sources of Synergies:
  - ***"LL" Effect*** (always < 0): Loss of separate limited liability
  - ***Leverage Effect*** (+ or -) : Separation can give higher tax benefits
- Financial synergies are more likely to favor merger when:
  - Correlation of activities is low (better risk diversification)
  - Volatility of individual activities is low (lesser *LL* effect)
  - Firms have similar volatility, default costs (less loss of advantage to firm's having different leverage ratios)

  Opposite cases: **separation is better**
- Negative synergies can be of greater magnitude (12-25%)
  - Provides rationale for structured finance, including

    asset securitization, ***project finance***

A Two-Period Model of Capital Structure

- ***Value of Debt with Principal P*** (*X* = random future value with p.d.f. *dF(X)*)

$$D_0(P) = \frac{P\int_{X^d}^{\infty} dF(X) + (1-\alpha)\int_{0}^{X^d} X\ dF(X) - \tau\int_{X^Z}^{X^d}(X - X^Z)dF(X)}{1+r_T}$$

where X^d = default level, X^Z = zero tax level, τ = tax rate, α = default cost fraction

- ***Value of Equity***:

$$E_0(P) = \frac{1}{1+r_T}\left(\int_{X^d}^{\infty}(X-P)\,dF(X) - \tau\int_{X^d}^{\infty}(X - X^Z)dF(X)\right)$$

- ***Value of Firm***:

$$v_0(P) = E_0(P) + D_0(P)$$
$$= V_0 + TS(P) - DC(P)$$

where V_0 = *value of* ***unlevered*** *firm*
$TS(P)$ = *expected PV of* ***tax savings*** *from leverage*
$DC(P)$ = *expected PV of* ***default costs***
Note: $TS(P) - DC(P)$ = ***value of leverage.***

Optimal Capital Structure

- **Choose *P = P** to maximize total firm value**

$$v_0(P) = E_0(P) + D_0(P)$$

- Define $v_0^* = E_0(P^*) + D_0(P^*)$

$$= V_0 + TS(P^*) - DC(P^*)$$

- Assume future value X is normally distributed N(Mu, Std**)**
- We get closed form solutions for $D_0(P)$, $E_0(P)$, and $v_0(P)$
- We then numerically optimize $v_0(P)$ to find optimal P^*
  - Excel's Solver does easily
  - Note ***P* also maximizes leverage benefits*** *TS(P) – DC(P) (since V_0 constant)*

An Example (typical firm)

Base case parameters (calibrated for BBB-rated firm)

Normally distributed future cash flows; risk-neutral valuation

Riskfree rate	r_f = **5%** (risk neutrality ➔ expected asset return μ)
Horizon	T = **5 yrs** (average debt duration)
Annual Volatility	σ = **22%** (Schaefer &Strebulaev 2004)
Default costs	α = **23%** (implied by Moody's 49% recovery rate)
Tax rate	τ = **20%** (John Roberts, 2000 & 2003)

Implications (see also Appendix 2)

- Optimal Leverage L = **51.82%**
- Debt interest rate r = **6.23%**
- Tax savings of leverage TS = **2.32**
- Expected default costs DC = **0.89**

Capitalized leverage benefits = **8.21%**

Mergers and Financial Synergies

- Assume Operational Cash Flows are Additive:

$$X_M = X_1 + X_2 \;\rightarrow\; X_{0M} = X_{01} + X_{02}.$$

- With separate activity cash flows normally distributed,
  future cash flows of *merged firm* will also be normal, with

$$Mu_M = Mu_1 + Mu_2$$

$$Std_M(\rho) = (Std_1^2 + Std_2^2 + 2\rho\, Std_1\, Std_2)^{0.5}$$

- Diversification: lower merged risk when correlation ρ is low.
- Given Mu_i and Std_i, can compute P_i^*, v^*_I, i = {1, 2, M}
- Then compare v_M^* **vs.** $v_1^* + v_2^*$.

Measures of Synergies

- **Financial synergies are determined by**

$$\Delta = v_M^* - v_1^* - v_2^*$$

Measure 1:	$\Delta \,/\, (v_1^* + v_2^*)$	(% total value)
Measure 2:	$\Delta \,/\, v_2^*$	(% of target firm value)
Measure 3:	$\Delta \,/\, E_2^*$	(% of target firm equity)

- ***Capitalizing T-period benefits to infinite horizon***:
  - Benefits Δ received every T years starting at $t = 0$ have value $Z\,\Delta$ where $Z = (1 + r^T) / r^T$. Benefits multiplied by Z in what follows.
- ***Benefits can be decomposed into two sources***
  - Loss of separate firms' limited liability **("*LL* Effect)**, always < 0.
  - Gains (or losses) from leverage, the **"Leverage Effect"**
    - Leverage Effect = changes in (tax savings less default costs)

Mergers of Symmetric Firms

- Mergers of symmetric "typical" firms (with $\rho = 0.20$) provide very small purely financial benefits
  - Measure 1 = 0.60%, Meas. 2 = 1.2%, Meas. 3 = 2.5%
  - Insufficient to overcome likely merger fees
  - Is this disappointing?
- But mergers of identical firms are not always optimal!
- **Separation** is desirable ($\Delta < 0$) if
  - Volatilities are high (negative *LL* Effect important)
  - Correlation is high (diversification and Leverage Effect small)
  - Propositions 1 & 2 of paper make this more precise

Mergers of Asymmetric Firms

- Now consider activities that *differ* in characteristics
  - Firm 1 has ***base case parameters***
  - Firm 2 differs only in ***volatility***
  - Figure 6 shows how results depend on activity 2's volatility
  - Figure 7 shows Leverage vs. *LL* effects
- Very different volatilities ➔ keep separate!
- Same for very different default costs ➔ keep separate!
  - Figure 9 in paper

Merger Benefits as a Function of Firm 2 Risk

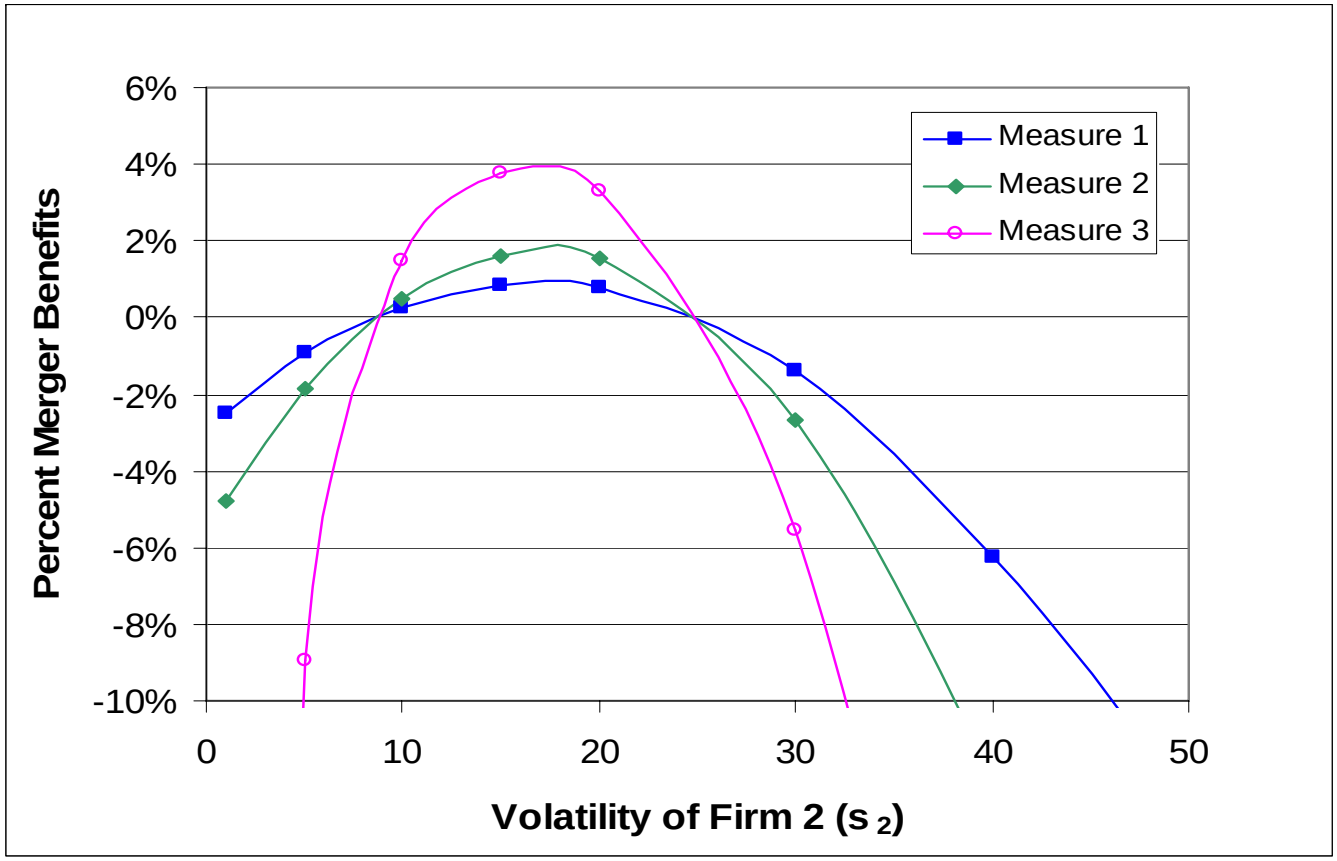

Figure 6. Merger benefits with asymmetric volatility.

The lines plot three different measures of the value of merging two firms of equal asset value, as a function of the annualized volatility of Firm 2. The annualized volatility of Firm 1 is 22%. The assumed debt maturity and time horizon are T = 5 years, the risk-free interest rate is r = 5%, the effective corporate tax rate is τ = 20%, default costs are α = 75%, and the correlation between cash flows is 0.

Decomposition of Merger Benefits
and Counter-Example to Lewellen

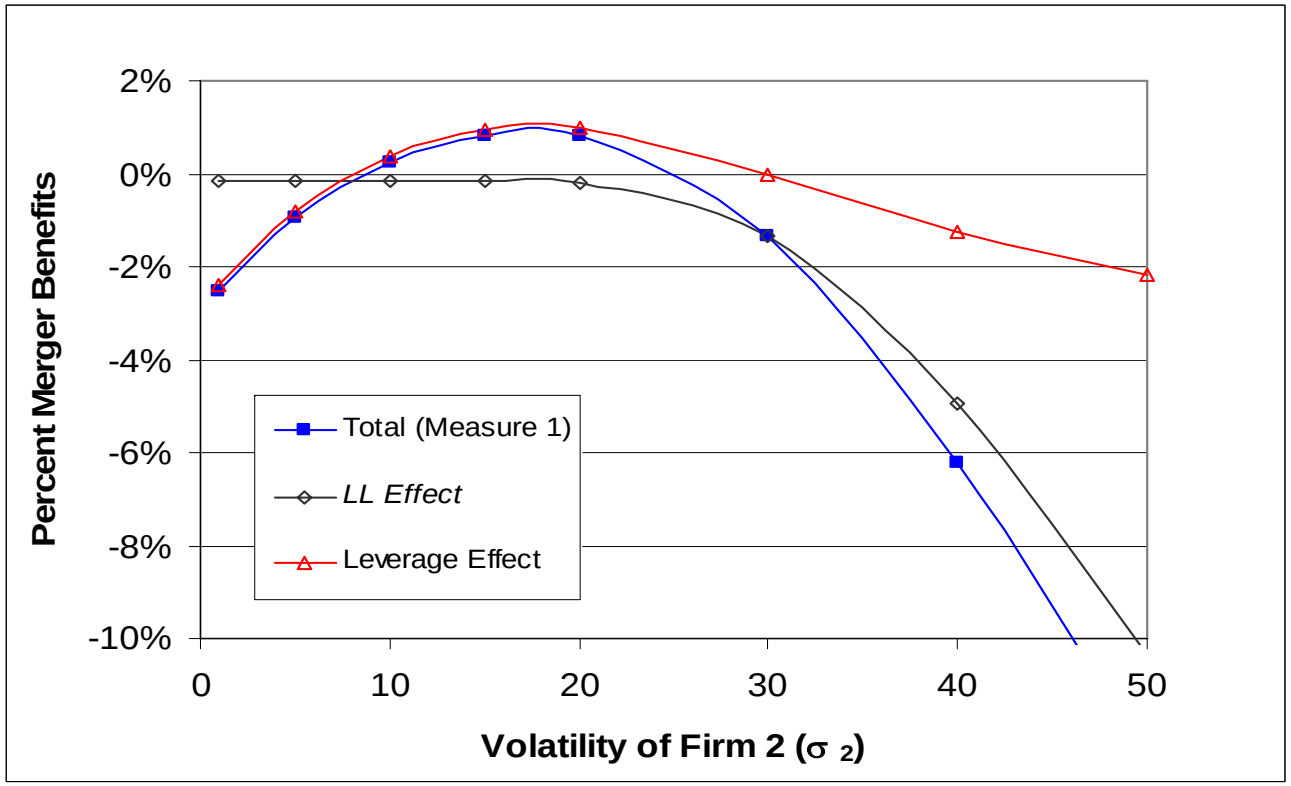

Figure 7. Decomposition of merger benefits with asymmetric volatility.

The lines plot the loss of separate limited liability (*LL)* effect, the Leverage effect, and their combined total effect (Measure 1) from merging two firms of equal asset value as a function of the annualized volatility of Firm 2. It is assumed that the debt maturity and time horizon is 5 years, the risk-free interest rate is 5%, the effective corporate tax rate is 20%, the default costs of both firms is 23%, the annualized volatility of Firm 1 is 22%, and the correlation of cash flows is 0.20. The assumed debt maturity and time horizon are T = 5 years, the risk-free interest rate is r = 5%, the effective corporate tax rate is τ = 20%, default costs are α = 23%, and the correlation between cash flows is 0.20. Note that Measure 1 values here are identical to Measure 1 values in Figure 6.

Benefits to Securitization: An Example

- ***Base case***: "Average" firm securitizes 25% of assets that have volatility 4.0%, ρ = 0.50 with other assets whose vol. = 28.6%.

  Leverage ratio: Before, 52%. After, 83% ***/*** 51%.

  Yield spread: Before, 123 bp. After, 4 bp. ***/*** 251 bp.

- ***Benefits:*** 13.6% of assets securitized (costs ~ 6%?).

  2/3rd from leverage effect,

  1/3rd from Sarig effect.

- ***Now Lower SPV Default Costs:*** to 5%

  Leverage rises from 83% to 88%

  But benefits rise only from 13.6% to 14.4%.

. . .Contrary to Gorton & Souleles (2005),

Lower default costs don't seem to be major source of benefits

Conclusions

1. Financial synergies can be positive or negative.
   Two sources of synergies:
   - ***LL Effect*** (always < 0):
     - Loss of separate limited liability (more important at high vols.)
   - ***Leverage Effect*** (+ / -) :
     - Negative if separate leverage ratios highly different

- Financial synergies are more likely to be positive (i.e. favor merger) when:
  - Correlation of activities is low (diversification)
  - Volatility of individual activities is low (*LL* Effect minimal)
  - Firms have similar volatility, default costs (leverages the same)

Opposite cases: Synergies are negative and separation is preferred

Conclusions (p. 2)

3. Negative synergies can be of greater magnitude (12-25%)
   - Provides rationale for ***asset securitization***, ***project finance,*** when volatilities of structured assets differ from firm's other activities
   - Primary explanation is different:

     Asset Securitization (low risk): Leverage effect
     Project Finance (high risk): *LL* effect

4. A rule of thumb (though not exact):
   - Positive synergies ➔ greater leverage with merger
   - Negative synergies ➔ greater leverage when separation

5. Paper also examines other issues:
   - ***Optimal size*** of target firm
   - Effects of mergers on leverage
   - Differential benefits to debt & equity holders (if debt noncallable)

Appendix 1

Table I

Base-case Parameters

This table shows the parameter values chosen for the base case.

Variable	Symbols	Values
Annual Risk-free Rate	r	5.00%
Time Period/Debt Maturity (yrs)	T	5.00
T-period Risk-free Rate	$r_T = (1 + r)^T - 1$	27.63%
Capitalization Factor	$Z = (1 + r_T)/r_T$	4.62
Unlevered Firm Variables		
Expected Future Operational Cash Flow at T	Mu	127.63
Expected Operational Cash Flow Value (PV)	$X_0 = Mu/(1+r)^T$	100.00
Cash Flow Volatility at T	Std	49.19
Annualized Operational Cash Flow Volatility	$Std/(X_0 T^{0.5})$	22%
Tax Rate	τ	20%
Value of Unlevered Firm w/Limited Liability	V_0	80.05
Value of Limited Liability (after tax)	$(1 - \tau)L_0$	0.05

Appendix 2

Table II
Optimal Capital Structure

This table shows the optimal leverage for the firm and the resulting gains to leverage given the base-case parameters and a default cost α = 23% (consistent with a recove rate on debt of 49.3%). The annual volatility of the firm is σ = 22%, the time horiz is T = 5 years, the risk-free interest rate is r = 5%, and the tax rate is τ = 20%.

Variable	Symbols	Values
Default Costs	α	23%
Optimal Zero-coupon Bond Principal	P^*	57.1
Default Value	X^d	67.7
Breakeven Profit Level	X^Z	14.9
Value of Optimal Debt	D_0^*	42.2
Value of Optimal Equity	E_0^*	39.2
Optimal Levered Firm Value	$v_0^* = D_0^* + E_0^*$	81.47
Optimal Leverage Ratio	D_0^*/v_0^*	51.8%
Annual Yield Spread of Debt (%)	$(P^*/D_0^*)^{1/T} - 1 - r$	1.23%
Recovery Rate	R	49.3%
Tax Savings of Leverage (PV)	TS_0	2.32
Expected Default Costs (PV)	DC_0	0.89
Value of Optimal Leveraging	$v_0^* - V_0$ (or $TS_0 - DC_0$)	1.42
Capitalized Value of Optimal Leverage	$Z(v_0^* - V_0)/V_0$	8.21%