

7492478-poison-pill-dilution-in-takeover-options

SUMMARY: This paper introduces a new method for valuing poison pills, specifically focusing on their impact on takeover options. The authors incorporate poison pills directly into the valuation of stock-for-stock takeover bids, addressing the dynamic nature of dilution when both firms' share prices are stochastic and the takeover agreement contains optionality, a walk-away barrier, or a collar. The paper connects shareholder rights plans to exchange-option valuation, providing a new dynamic framework that distinguishes the value of individual merger claims from the bidder's aggregate cost of obtaining control. The model covers both flip-in and flip-over poison pills, including NOL pills, and applies to ratio-barrier and collared takeover options. The authors derive closed-form formulas for these structures, ensuring transparency and practical applicability.

METHOD: The study uses a combination of theoretical analysis and closed-form formulas to value poison pills within the context of takeover options. The authors consider both flip-in and flip-over poison pills, as well as NOL pills, and apply their models to ratio-barrier and collared takeover options. The models incorporate stochastic share prices and optionality, walk-away barriers, and collars. The valuation framework is based on the Margrabe option structure, which is extended to include knock-in and knock-out provisions written on the ratio of two asset prices. The authors derive formulas for both flip-in and flip-over poison pills, as well as NOL pills, and apply them to the specific takeover option structures.

KEY FINDINGS:

- The paper provides a new framework for valuing poison pills within the context of takeover options, distinguishing the value of individual merger claims from the bidder's aggregate cost of obtaining control.
- The models incorporate stochastic share prices and optionality, walk-away barriers, and collars, providing a more comprehensive valuation of poison pills.
- The paper derives closed-form formulas for both flip-in and flip-over poison pills, as well as NOL pills, and applies them to ratio-barrier and collared takeover options, ensuring transparency and practical applicability.

IMPLICATION FOR TRADING: The findings of this paper have significant implications for traders and investors involved in mergers and acquisitions. By providing a more accurate valuation of poison pills, the paper offers a clearer understanding of the economic incidence of dilution in stock-for-stock takeover bids. This information can be used to make more informed decisions regarding the use of takeover options and poison pills in merger and acquisition strategies. Additionally, the closed-form solutions developed in the paper can be used to quickly and accurately value these takeover options, aiding in the decision-making process for both buyers and sellers in M&A transactions.

Poison Pill Dilution in Takeover Options

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Abstract

To our knowledge, this is the first paper to incorporate poison-pill dilution directly into contingent-claims valuation of stock-for-stock takeover bids. Existing studies analyze pills primarily through deterrence, bargaining, governance, and shareholder-wealth effects. Those approaches generally treat dilution through static share-count or ownership calculations. They do not value the resulting claims when both firms' share prices are stochastic and the takeover agreement contains optionality, a walk-away barrier, or a collar. This omission matters because stock-for-stock bids are claims on the relative value of two firms: volatility, correlation, time to completion, contractual barriers, and payoff convexity all affect the economic incidence of dilution. By connecting shareholder-rights plans to exchange-option valuation, the paper provides a new dynamic framework that distinguishes the value of an individual merger claim from the bidder's aggregate cost of obtaining control.

Keywords: Risk arb, Margrabe option; poison pill; flip-in pill; flip-over pill; shareholder rights plan; dilution; takeover option; exchange option; ratio barrier; collar.

JEL Classification: G13; G34.

1 Introduction

A poison pill, formally known as a shareholder rights plan, is a takeover defense designed to make an acquisition substantially more costly once a bidder crosses a specified ownership threshold. In the common flip-in structure, shareholders other than the triggering bidder receive the right to purchase additional target shares at a substantial discount. Exercise of those rights increases the number of target shares outstanding and dilutes the bidder's ownership interest. A flip-over provision instead gives eligible rightsholders an entitlement involving shares of the surviving acquirer and can dilute the acquirer shares delivered in the transaction. This paper values both flip-in and flip-over poison pills within plain, ratio-barrier, and collared takeover-option specifications. The expression "poison pill" is not merely an informal label used in financial commentary; it is established terminology in both practitioner literature on mergers and acquisitions and academic research on takeover defenses (Malatesta and Walkling, 1988; Ryngaert, 1988; Comment and Schwert, 1995; Gaughan, 2017; DePamphilis, 2021). The term is therefore used throughout this paper alongside the more formal expression "shareholder rights plan."

1.1 Forms of poison pills and the scope of the model

Poison pills differ in both their economic purpose and their contractual operation (Gaughan, 2017; DePamphilis, 2021). A *flip-in pill* permits target shareholders other than the triggering bidder

to acquire target shares at a discount. It therefore dilutes the bidder within the target company. Some plans instead, or additionally, contain an *exchange feature* under which the target board may exchange each outstanding right for a specified number of target shares. Although the legal mechanics differ, both structures can produce the same economic object required by the present model: an increase from N to $N + x$ target shares and a corresponding proportional reduction in the value of each target share.

A *flip-over pill* gives rights holders the ability to acquire shares of the surviving acquirer at a discount after a merger or other specified business combination. Its primary dilution therefore falls on the acquirer’s shareholders rather than on the target shares before settlement. An *NOL pill* is adopted principally to protect net operating loss carryforwards by discouraging ownership changes that could restrict their tax use. An NOL pill commonly employs flip-in mechanics, often with a relatively low trigger, so it can enter the model when its exercise can be represented by the same target-share dilution factor. Finally, labels such as *dead-hand*, *slow-hand*, or continuing-director provisions refer mainly to restrictions on which directors may redeem or amend a pill. They affect the probability and timing of redemption or exercise, rather than defining a separate dilution payoff.

The closed-form takeover-option formulas developed below directly incorporate flip-in pills and exchange features that can be summarized by a known proportional target-share dilution factor δ . They also apply to an NOL pill to the extent that it has the same dilution mechanics. A separate section derives the corresponding flip-over formulas when the provision can be summarized by a known proportional acquirer-share multiplier γ . Redemption restrictions, multiple trigger levels, cash or debt distributions, uncertain exercise prices, state-dependent share entitlements, and negotiated changes to the exchange ratio remain outside the basic model unless their effects can be reduced to fixed multipliers and pill-state probabilities. This scope preserves transparent closed form solutions.

Margrabe (1978) derived a closed-form formula for an option to exchange one traded asset for another. This structure is a natural starting point for stock-for-stock merger consideration, where the offer exchanges shares in the acquiring company for shares in the target company. Haug and Haug (2002) extended the Margrabe formula to include knock-in and knock-out provisions written on the ratio of the two asset prices. Haug (2026) applies that ratio-barrier framework to collared takeover bids with walk-away clauses.

1.2 Historical background and related literature

The modern shareholder rights plan emerged during the hostile-takeover wave of the early 1980s. American corporate lawyer Martin Lipton and his colleagues developed the device as a way to prevent a bidder from bypassing the target board and acquiring control directly from shareholders. In its familiar flip-in form, the plan distributes rights that become exercisable after a bidder crosses a specified ownership threshold. All holders other than the triggering bidder may then acquire target securities at a substantial discount, sharply diluting the bidder’s ownership percentage (Gaughan, 2017; DePamphilis, 2021).

The early empirical literature examined whether pills protect bargaining power or entrench managers. Malatesta and Walkling (1988) and Ryngaert (1988) document the market reaction, ownership characteristics, and wealth effects associated related to use of poison pills. Brickley, Coles, and Terry (1994) connect the adoption decision and its valuation consequences to board composition. Using a broader set of modern antitakeover measures, Comment and Schwert (1995) find little evidence of strong takeover deterrence and report that higher offer premiums can offset deterrence effects. In a sample of unsolicited bids, Heron and Lie (2006) find that pills are associated with bid increases and higher final bids, but not with a lower probability that the target is ultimately acquired.

Sokolyk (2011) further shows that individual antitakeover provisions need not have uniform effects on acquisition outcomes.

The broader governance literature places poison pills within bundles of shareholder-rights restrictions. Cremers and Ferrell (2014) assemble three decades of governance data and report a negative association between restrictions on shareholder rights and firm value, with the relation emerging after the judicial validation of poison pills and other defenses in 1985. Karpoff, Schonlau, and Wehrly (2017) emphasize that endogeneity must be addressed when defense indices are used to measure takeover deterrence. The legal and practical mechanics of pills, staggered boards, redemption, and defensive bargaining are also treated in established M&A references such as Gaughan (2017) and DePamphilis (2021).

The frequency of poison pills has varied substantially over time. In the historical sample assembled by Cremers and Ferrell (2014), only about 2% of firms had adopted a pill before 1985, whereas approximately 11% of firms added one in an average year during the period of rapid governance change from 1985 through 1989. Using Deal Point Data, Klingsberg, Tiger, and Bieber (2020) report that 91 companies in the Russell 3000, or 3.0% of the index, had a pill in force on April 12, 2020.

For merger arbitrage, the relevant literature focuses on deal-completion risk, nonlinear downside exposure, and limits to arbitrage. Mitchell and Pulvino (2001) characterize the risk and return of merger arbitrage, while Baker and Savasoglu (2002) model limited arbitrage in mergers. Practitioner treatments such as Kirchner (2016) discuss how deal terms, hostile tactics, litigation, financing, and regulatory events affect the merger spread. These studies make poison-pill adoption or redemption relevant to the probability, timing, and terms of completion, but they do not derive a dilution adjustment to an exchange-option formula.

The corporate-finance literature studies poison-pill adoption, deterrence, bargaining, and shareholder wealth (Malatesta and Walkling, 1988; Ryngaert, 1988; Comment and Schwert, 1995; Heron and Lie, 2006). In this paper the focus is on how does a known potential issuance of x additional target shares enter a option to exchange one asset for another (Margrabe option) when management's poison-pill decision is uncertain?

The existing poison-pill, takeover-defense, and merger-arbitrage literatures do not adjust the Margrabe option to exchange one asset for another for a state-contingent poison-pill dilution event. Nor do they carry such an adjustment into ratio-barrier (target options with walk-away possibilities) or collared exchange options. Prior analyses recognize dilution in the direct corporate-finance sense: discounted shares or rights reduce the bidder's ownership percentage, increase the number of shares that must be overcome, and alter bargaining leverage and takeover cost. What is missing is the incorporation of that dilution into a contingent-claims framework in which both firms' share prices are risky, the payoff contains a positive part, and contractual barriers or collars can be present. This paper gives a derivative-pricing bridge between the institutional dilution mechanism and the exchange-option formulas used for stock-for-stock takeover consideration.

This bridge is important for corporate finance because stock-for-stock consideration transfers relative-price risk between two groups of shareholders. A poison pill changes both the value of the target share delivered into the exchange and the aggregate number of claims that the bidder may have to acquire. Treating dilution only as static arithmetic can therefore miss option convexity, correlation between bidder and target shares, time to completion, and the effect of walk-away barriers or collars. Closed-form benchmarks make these channels observable separately, provide checks for numerical or strategic models, and give boards, advisers, merger arbitrageurs, and shareholders a common valuation language for distinguishing per-share claim value from whole-deal control cost.

Conditional on the pill state, a constant proportional dilution leaves the target share price lognormal and preserves the Margrabe type formulas. The unconditional value is therefore a

two-state mixture. This tractability is lost when the governance event and the relative stock-price process interact.

Notation overview

Because the paper uses extensive notation, we provide an overview that readers can refer to throughout the article to clarify the meaning of each symbol.

Table 1 defines the recurring notation. Symbols used only in a single calculation are also defined where they first appear. A subscript 0 denotes the valuation date, a subscript t denotes time t , and a subscript $\mathcal{T}$ denotes the settlement date.

Table 1: Notation and definitions

Symbol	Definition
$t, \mathcal{T}, \tau$	Current time, settlement time, and remaining time to settlement, $\tau = \mathcal{T} - t$.
A_t, T_t	Pre-pill prices of one acquirer share and one target share.
q	Fixed number of acquirer shares offered for each target share; qA_t is the stock consideration per target share.
r	Continuously compounded risk-free rate.
q_A, q_T	Continuous dividend yields of the acquirer and target shares.
b_A, b_T	Acquirer and target costs of carry, $b_A = r - q_A$ and $b_T = r - q_T$.
σ_A, σ_T	Volatilities of the acquirer and target shares.
$W_{A,t}, W_{T,t}, \rho$	Brownian motions driving the two share prices and their instantaneous correlation.
σ_X	Relative-price volatility, $\sigma_X = \sqrt{\sigma_A^2 + \sigma_T^2 - 2\rho\sigma_A\sigma_T}$.
$\mathbb{Q}, \mathbb{E}^{\mathbb{Q}}$	Pricing measure and expectation under that measure.
$\Phi(\cdot)$	Standard normal cumulative distribution function.
X_t	Undiluted takeover ratio, $X_t = qA_t/T_t$.
H, h	Contractual ratio-barrier level and the barrier argument supplied to the Haug–Haug formula.
$B, \mathbf{1}_B$	A specified barrier event and its indicator.
N, x, η	Pre-pill target shares, new target shares issued, and their subscription price as a fraction of the pre-pill target price.
δ	Target-share multiplier after flip-in exercise, $\delta = (N + \eta x)/(N + x)$.
$Z, D(Z), p$	Flip-in indicator; state multiplier with $D(0) = 1$ and $D(1) = \delta$; and priced exercise probability $p = \mathbb{Q}(Z = 1)$.
N_A, y, η_A	Pre-exercise acquirer shares, new acquirer shares issued, and their subscription price as a fraction of the pre-exercise acquirer price.
γ	Acquirer-share multiplier after flip-over exercise, $\gamma = (N_A + \eta_A y)/(N_A + y)$.
$J, K(J), p_F$	Flip-over indicator; state multiplier with $K(0) = 1$ and $K(1) = \gamma$; and priced exercise probability $p_F = \mathbb{Q}(J = 1)$.
S_1, S_2, S	Generic exchange-option assets and their time-zero ratio, $S = S_1/S_2$.
b_1, b_2, b	Costs of carry of S_1 and S_2 , and their difference $b = b_1 - b_2$.

Continued on next page

Table 1 continued

Symbol	Definition
$c(s, k, \tau, r, b, \sigma)$	Black–Scholes–Merton call value with spot s , strike k , maturity τ , rate r , carry b , and volatility σ .
$\mathcal{M}, \mathcal{M}^B$	Plain Margrabe value and the applicable Haug–Haug knock-in or knock-out Margrabe value. Superscripts DI , DO , UI , and UO mean down-and-in, down-and-out, up-and-in, and up-and-out.
F, C	Lower and upper collar levels. The standard regime has $F \leq 1 < C$; a binding lower floor has $1 < F < C$.
λ	Total target-side multiplier in an exchange-option leg: D , FD , or CD , as applicable.
G_T, G_0	Conditional collar payoff at settlement and its time-zero value; superscripts identify barrier or flip-over cases.
$\Pi_0^{T,B}$	Time-zero value of a target share paid only on barrier event B .
$\mathbb{Q}^T, \mu, z, u$	Target-share measure; log drift of X_t under that measure; and log distances from a down or up barrier.
m, q_{eff}	Additional acquirer shares purchasable per original target share and the effective exchange coefficient including that entitlement.
D_j, K_k, π_{jk}	Flip-in and flip-over multipliers in joint state (j, k) , where $j, k \in \{0, 1\}$, and its probability $\pi_{jk} = \mathbb{Q}(D = D_j, K = K_k)$.
V, V^B	Generic time-zero plain and barrier values in the formula-summary table.
$V_{PP}, V_{FO}, V_{FI+FO}, V_{\text{collar}}$	Values with a flip-in pill, a flip-over pill, both provisions, or a collar; a superscript B denotes the corresponding barrier value.
ΔC_{net}	Incremental acquisition cost net of cash paid into the target when the flip-in rights are exercised.
$(a)^+$	Positive part, $\max(a, 0)$.

2 Market Model and Dilution Convention

Let A_t and T_t denote the acquirer and target share prices before the pill adjustment. Under a pricing measure $\mathbb{Q}$, assume

$$\frac{dA_t}{A_t} = (r - q_A) dt + \sigma_A dW_{A,t}, \quad \frac{dT_t}{T_t} = (r - q_T) dt + \sigma_T dW_{T,t}, \quad (1)$$

$$d\langle W_A, W_T \rangle_t = \rho dt, \quad \sigma_X = \sqrt{\sigma_A^2 + \sigma_T^2 - 2\rho\sigma_A\sigma_T}. \quad (2)$$

The fixed exchange ratio is q , so qA_t is the stock consideration for one target share. The corresponding costs of carry are $b_A = r - q_A$ and $b_T = r - q_T$.

Let N be the number of target shares before the pill and x the number issued upon exercise of the rights. If the new shares are issued at the fraction η of the contemporaneous pre-pill target price, conservation of equity value gives

$$\delta = \frac{N + \eta x}{N + x}, \quad 0 \leq \eta < 1. \quad (3)$$

For a zero-price issuance, $\delta = N/(N + x)$. For a proportional-price rights issue, the diluted target share is δT_t . This convention isolates per-share dilution. It does not model the bidder's loss of voting control, exclusion from the rights, taxes, financing, or a change in total firm value.

Let Z be the pill indicator, with $Z = 1$ when dilution occurs, and write $D(0) = 1$ and $D(1) = \delta$. Let $p = \mathbb{Q}(Z = 1)$. The closed forms below assume that Z is independent of the Brownian price shocks and is known no later than settlement. If the event is not spanned by traded securities, no-arbitrage does not uniquely determine p : a physical probability produces an expected-value estimate, while a market price requires a risk-neutral or otherwise priced probability.

3 The Poison-Pill Extended Margrabe Formula

For assets S_1 and S_2 with cost-of-carry parameters b_1 and b_2 , define

$$\mathcal{M}(S_1, S_2) = S_1 e^{(b_1 - r)\tau} \Phi(d_1) - S_2 e^{(b_2 - r)\tau} \Phi(d_2), \quad (4)$$

where

$$d_1 = \frac{\log(S_1/S_2) + (b_1 - b_2 + \frac{1}{2}\sigma_X^2)\tau}{\sigma_X \sqrt{\tau}}, \quad d_2 = d_1 - \sigma_X \sqrt{\tau}.$$

The formula above is the option to exchange one asset for another, first published by [Margrabe \(1978\)](#).

Proposition 1 (Binary dilution). *For the state-contingent payoff $(qA_\tau - D(Z)T_\tau)^+$,*

$$V_{PP} = (1 - p)\mathcal{M}(qA_0, T_0) + p\mathcal{M}(qA_0, \delta T_0). \quad (5)$$

Proof. Condition on Z . In each state $D(Z)$ is constant, so $D(Z)T_t$ remains a geometric Brownian motion with the same return volatility and cost of carry as T_t . Margrabe's formula applies state by state. Taking the $\mathbb{Q}$ -expectation over Z gives the result. $\square$

The mixture must be taken after applying the positive-part payoff. In general,

$$V_{PP} \neq \mathcal{M}(qA_0, [(1 - p) + p\delta]T_0).$$

Convexity prevents replacement of the random dilution state by its mean. Under the per-share payoff convention, $\delta < 1$ raises the exchange-option value in the dilution branch because the target share surrendered at completion is worth less. This sign does not imply that a pill benefits the acquirer: a whole-company model may require the bidder to purchase more shares, making acquisition cost rise with $N + x$.

3.1 Plain Margrabe values across probability and dilution

Table 2 shows the plain poison-pill Margrabe value when the probability of exercise varies along one axis and the percentage reduction in the target's per-share value varies along the other. The inputs are $A_0 = 50$, $q = 1.30$, $T_0 = 62$, $r = 4\%$, $q_A = 1.5\%$, $q_T = 0.5\%$, $\sigma_A = 24\%$, $\sigma_T = 32\%$, $\rho = 0.40$, and $\tau = 0.75$ years. The bidder therefore offers stock consideration worth $qA_0 = 65$ per target share, a 4.84% premium to the target's current market price. Thus $\sigma_X = 31.39\%$, $b_A = r - q_A$, and $b_T = r - q_T$. If d denotes the dilution percentage, then $\delta = 1 - d$ and every table entry is

$$V_{PP}(p, d) = (1 - p)\mathcal{M}(qA_0, T_0) + p\mathcal{M}(qA_0, (1 - d)T_0).$$

The table isolates the option value of one target share. It does not measure the bidder's total expenditure for control, which can increase because the pill creates additional shares or rights.

Table 2: Plain poison-pill Margrabe value per target share

Pill probability p	Dilution of target value per share d			
	0%	10%	20%	30%
0%	8.14	8.14	8.14	8.14
25%	8.14	9.03	10.16	11.48
75%	8.14	10.82	14.19	18.16
100%	8.14	11.72	16.21	21.49

3.2 Certain exercise of the poison pill

When the pill is certain to be exercised, $p = 1$, the undiluted branch disappears. The plain formula reduces to

$$V_{PP} = \mathcal{M}(qA_0, \delta T_0). \quad (6)$$

Likewise, for a barrier written on the undiluted takeover ratio,

$$V_{PP}^B = \mathcal{M}^B(qA_0, \delta T_0; H/\delta). \quad (7)$$

For the standard collar $F \leq 1 < C$, the certain-exercise value becomes

$$V_{\text{collar}, PP} = \mathcal{M}(qA_0, \delta T_0) - \mathcal{M}(qA_0, C\delta T_0), \quad (8)$$

or $G_0^B(\delta)$ when the contractual barrier applies. Thus certainty does not create a new pricing problem; it simply leaves the diluted conditional state.

4 Haug–Haug Knock-In and Knock-Out Claims

[Haug and Haug \(2002\)](#) place a continuously monitored barrier on $S_t = S_{1,t}/S_{2,t}$ that can be used to take into account walk-away possibilities takeover options. Write $S = S_1/S_2$ for the time-zero ratio, let $b = b_1 - b_2$, and let $c(s, k, \tau, r, b, \sigma)$ denote the Black–Scholes–Merton call function. Their down-and-in Margrabe call can be written

$$\mathcal{M}^{DI}(S_1, S_2; H) = S_2 e^{(b_2 - r)\tau} \left(\frac{S}{H} \right)^{1 - 2b/\sigma_X^2} c\left(\frac{H^2}{S}, 1, \tau, 0, b, \sigma_X \right), \quad (9)$$

when the initial ratio lies above the lower barrier H . Down-and-out follows from in–out parity, $\mathcal{M}^{DO} = \mathcal{M} - \mathcal{M}^{DI}$. Haug and Haug also give the upper-barrier expressions. Denote any applicable in or out value by $\mathcal{M}^B(S_1, S_2; h)$, where h is measured in units of S_1/S_2 .

Proposition 2 (Binary dilution with a ratio barrier). *Suppose the contractual barrier is written on the undiluted takeover ratio $X_t = qA_t/T_t$ at level H . Then*

$$V_{PP}^B = (1 - p)\mathcal{M}^B(qA_0, T_0; H) + p\mathcal{M}^B(qA_0, \delta T_0; H/\delta). \quad (10)$$

Proof. Conditional valuation gives a Haug–Haug claim in each state. In state D , the internal ratio is $qA_t/(DT_t) = X_t/D$; hence the contractual crossing $X_t = H$ occurs at the internal ratio H/D . Summing the conditional prices gives the result. $\square$

If the covenant instead monitors the observed post-pill ratio $qA_t/[D(Z)T_t]$ at the same numerical level H , no barrier rescaling is required. In–out parity continues to hold state by state and for the mixture. A knock-out already breached has zero value; the corresponding knock-in reduces to the no-barrier mixture.

Because monitoring includes time zero, the untriggered-state formulas are applied only when $X_0 > H$ for a down barrier or $X_0 < H$ for an up barrier. Otherwise, the knock-out value is zero and the knock-in value equals the corresponding no-barrier value. For an up-and-out exchange leg, let λ denote the total target-side multiplier; thus $\lambda = D$ for the basic leg and $\lambda = FD$ or $\lambda = CD$ for the corresponding collar legs. The displayed Haug–Haug closed form also requires the transformed barrier $H/\lambda > 1$. If $H \leq \lambda$, every path that finishes in the money must first cross the upper barrier; hence the up-and-out value is zero and the up-and-in value is the vanilla exchange-option value. These piecewise conditions prevent extrapolation of a closed form outside its admissible domain.

5 Collared Takeover Options

For lower and upper collar levels $F \leq 1 < C$, [Haug \(2026\)](#) writes the standard collared payoff as a call spread. Conditional on dilution multiplier D ,

$$G_{\mathcal{T}}(D) = (qA_{\mathcal{T}} - DT_{\mathcal{T}})^+ - (qA_{\mathcal{T}} - CDT_{\mathcal{T}})^+. \quad (11)$$

Without a barrier,

$$V_{\text{collar,PP}} = (1 - p)G_0(1) + pG_0(\delta), \quad (12)$$

$$G_0(D) = \mathcal{M}(qA_0, DT_0) - \mathcal{M}(qA_0, CDT_0). \quad (13)$$

Let the barrier be written on the undiluted contractual ratio $X_t = qA_t/T_t$ at level H . The first leg uses internal ratio X_t/D and barrier H/D ; the cap leg uses $X_t/(CD)$ and barrier $H/(CD)$. Consequently,

$$G_0^B(D) = \mathcal{M}^B(qA_0, DT_0; H/D) - \mathcal{M}^B(qA_0, CDT_0; H/(CD)), \quad (14)$$

$$V_{\text{collar,PP}}^B = (1 - p)G_0^B(1) + pG_0^B(\delta). \quad (15)$$

If the barrier is defined on the post-pill ratio, replace H/D and $H/(CD)$ by H and H/C , respectively.

For the binding lower-collar regime $1 < F < C$, the conditional payoff is

$$G_{\mathcal{T}}(D) = (F - 1)DT_{\mathcal{T}} + (qA_{\mathcal{T}} - FDT_{\mathcal{T}})^+ - (qA_{\mathcal{T}} - CDT_{\mathcal{T}})^+. \quad (16)$$

Without a barrier, its conditional value is

$$G_0(D) = (F - 1)DT_0e^{(b_T - r)\tau} + \mathcal{M}(qA_0, FDT_0) - \mathcal{M}(qA_0, CDT_0). \quad (17)$$

For a barrier event B written on the undiluted contractual ratio $X_t = qA_t/T_t$, define the target-share barrier claim

$$\Pi_0^{T,B}(X_0; H) := e^{-r\tau} \mathbb{E}^{\mathbb{Q}}[T_{\mathcal{T}} \mathbf{1}_B] = T_0 e^{-q_T \tau} \mathbb{Q}^T(B), \quad (18)$$

where $\mathbb{Q}^T$ is the target-share measure, defined by

$$\left. \frac{d\mathbb{Q}^T}{d\mathbb{Q}} \right|_{\mathcal{F}_{\mathcal{T}}} = \frac{e^{-r\tau} e^{q_T \tau} T_{\mathcal{T}}}{T_0}.$$

Under this measure, the log drift of X_t is $\mu = b_A - b_T - \frac{1}{2}\sigma_X^2$. For an initially untriggered down barrier, let $z = \log(X_0/H) > 0$; then

$$\mathbb{Q}^T(DO) = \Phi\left(\frac{z + \mu\tau}{\sigma_X\sqrt{\tau}}\right) - e^{-2\mu z/\sigma_X^2} \Phi\left(\frac{-z + \mu\tau}{\sigma_X\sqrt{\tau}}\right), \quad \mathbb{Q}^T(DI) = 1 - \mathbb{Q}^T(DO). \quad (19)$$

For an initially untriggered up barrier, let $u = \log(H/X_0) > 0$; then

$$\mathbb{Q}^T(UO) = \Phi\left(\frac{u - \mu\tau}{\sigma_X\sqrt{\tau}}\right) - e^{2\mu u/\sigma_X^2} \Phi\left(\frac{-u - \mu\tau}{\sigma_X\sqrt{\tau}}\right), \quad \mathbb{Q}^T(UI) = 1 - \mathbb{Q}^T(UO). \quad (20)$$

Thus the complete conditional binding-floor value is

$$G_0^B(D) = (F - 1)D\Pi_0^{T,B}(X_0; H) + \mathcal{M}^B(qA_0, FDT_0; H/(FD)) - \mathcal{M}^B(qA_0, CDT_0; H/(CD)). \quad (21)$$

The unconditional no-barrier or barrier value is the $(1 - p, p)$ mixture of the corresponding $D = 1$ and $D = \delta$ formulas. If the barrier is instead defined on the post-pill ratio, the barrier event and its target-share claim must also be evaluated state by state on X_t/D .

6 Flip-Over Provisions and Acquirer-Share Dilution

A flip-over provision operates differently than the flip-in provision. After a merger or another specified business combination, eligible rightsholders may acquire shares of the surviving acquirer at a discount (Gaughan, 2017; DePamphilis, 2021). The resulting issuance in a flip over poison pill will dilute the acquirer shares rather than the target share in a flip-in pill. The contractual right received by an eligible target shareholder and the value of an already specified number of merger shares are distinct claims. This section first values the latter and then states when the former can be folded into the same closed form.

Let N_A be the number of acquirer shares immediately before exercise of the flip-over rights, including any merger shares already issued if the contractual sequence requires it, and let y new acquirer shares be issued. If each new share is purchased for the fraction η_A of the contemporaneous pre-exercise acquirer price, conservation of equity value gives the post-issuance multiplier

$$\gamma = \frac{N_A + \eta_A y}{N_A + y}, \quad 0 \leq \eta_A < 1. \quad (22)$$

Thus the post-flip acquirer share price is γA_t . This is the acquirer-side analogue of the target multiplier δ . It assumes that the issuance transfers value between shareholder groups but does not otherwise change total firm value.

Let J denote the flip-over state, define $K(0) = 1$ and $K(1) = \gamma$, and let $p_F = \mathbb{Q}(J = 1)$. Assume that J is independent of the Brownian price shocks, that its state is known no later than settlement, and that γ is constant conditional on exercise.

Proposition 3 (Plain Margrabe value with a flip-over provision). *For the state-contingent payoff*

$$(K(J)qA_T - T_T)^+, \quad (23)$$

the time-zero value is

$$V_{FO} = (1 - p_F)\mathcal{M}(qA_0, T_0) + p_F\mathcal{M}(\gamma qA_0, T_0). \quad (24)$$

Proof. Conditional on J , the first asset in the exchange option is multiplied by a constant. Therefore $K(J)qA_t$ remains lognormal with the same cost of carry and volatility as A_t . Margrabe's formula applies in each state, and conditioning on J gives the mixture. $\square$

The mixture again must be formed after applying the positive part. In general,

$$V_{\text{FO}} \neq \mathcal{M}([(1 - p_F) + p_F \gamma]qA_0, T_0). \quad (25)$$

Because $\gamma < 1$, flip-over dilution lowers the value of this particular settlement-share claim in the exercise branch. This is the mirror image of the flip-in per-share result, where multiplying the target share by $\delta < 1$ raises the value of $(qA - T)^+$. Neither sign by itself measures the total wealth effect on eligible rightsholders or legacy acquirer shareholders.

6.1 Haug–Haug knock-in and knock-out values

Suppose the contractual barrier is written on the undiluted takeover ratio $X_t = qA_t/T_t$ at level H . Conditional on multiplier K , the internal ratio used by the Haug–Haug formula is

$$\frac{KqA_t}{T_t} = KX_t. \quad (26)$$

Consequently, the contractual crossing $X_t = H$ occurs at the internal barrier KH .

Proposition 4 (Flip-over provision with a ratio barrier). *For any applicable Haug–Haug knock-in or knock-out claim,*

$$V_{\text{FO}}^B = (1 - p_F)\mathcal{M}^B(qA_0, T_0; H) + p_F\mathcal{M}^B(\gamma qA_0, T_0; \gamma H). \quad (27)$$

Proof. Condition on J . In the no-flip state the internal and contractual ratios coincide. In the flip-over state the internal ratio is γX_t , so a contractual barrier at $X_t = H$ must be entered into the Haug–Haug formula as γH . Conditional valuation followed by averaging over J gives the result. $\square$

If the covenant instead monitors the observed post-flip ratio $K(J)qA_t/T_t$ at the same numerical level H , no barrier transformation is required. Initial-trigger and up-barrier domain conditions continue to be applied state by state. In–out parity holds conditionally and therefore also for the mixture.

6.2 Collared takeover options and certain exercise

For the standard collar $F \leq 1 < C$, define the conditional flip-over payoff

$$G_{\mathcal{T}}^{\text{FO}}(K) = (KqA_{\mathcal{T}} - T_{\mathcal{T}})^+ - (KqA_{\mathcal{T}} - CT_{\mathcal{T}})^+. \quad (28)$$

Without a barrier,

$$G_0^{\text{FO}}(K) = \mathcal{M}(KqA_0, T_0) - \mathcal{M}(KqA_0, CT_0), \quad (29)$$

$$V_{\text{collar,FO}} = (1 - p_F)G_0^{\text{FO}}(1) + p_F G_0^{\text{FO}}(\gamma). \quad (30)$$

If a barrier at $X_t = H$ is defined on the undiluted contractual ratio, then

$$G_0^{B,\text{FO}}(K) = \mathcal{M}^B(KqA_0, T_0; KH) - \mathcal{M}^B(KqA_0, CT_0; KH/C), \quad (31)$$

$$V_{\text{collar,FO}}^B = (1 - p_F)G_0^{B,\text{FO}}(1) + p_F G_0^{B,\text{FO}}(\gamma). \quad (32)$$

The second barrier is KH/C because the capped exchange leg is written on the internal ratio KX_t/C .

For a binding lower collar $1 < F < C$, the conditional no-barrier value is

$$G_0^{\text{FO}}(K) = (F - 1)T_0 e^{(b_T - r)\tau} + \mathcal{M}(KqA_0, FT_0) - \mathcal{M}(KqA_0, CT_0). \quad (33)$$

If the contractual barrier event B is written on X_t at H , the corresponding value is

$$G_0^{B,\text{FO}}(K) = (F - 1)\Pi_0^{T,B}(X_0; H) + \mathcal{M}^B(KqA_0, FT_0; KH/F) - \mathcal{M}^B(KqA_0, CT_0; KH/C), \quad (34)$$

where $\Pi_0^{T,B}$ is the target-share barrier claim defined above. The linear floor component is not multiplied by K because it is paid in target-share units; only the two acquirer-share exchange legs are affected by flip-over dilution.

When flip-over exercise is certain, $p_F = 1$, the formulas reduce to

$$V_{\text{FO}} = \mathcal{M}(\gamma q A_0, T_0), \quad (35)$$

$$V_{\text{FO}}^B = \mathcal{M}^B(\gamma q A_0, T_0; \gamma H), \quad (36)$$

$$V_{\text{collar,FO}} = \mathcal{M}(\gamma q A_0, T_0) - \mathcal{M}(\gamma q A_0, CT_0), \quad (37)$$

with the corresponding barrier collar given by $G_0^{B,\text{FO}}(\gamma)$.

6.3 The rightsholder's additional flip-over entitlement

The preceding formulas value the merger consideration after dilution of each acquirer share. A flip-over plan may also give an eligible target rightsholder a separate entitlement to purchase additional acquirer shares. If one original target share carries the right to buy m new acquirer shares for the proportional price $\eta_A A_{\mathcal{T}}$ per share, and exercise is certain, the net value of that entitlement after issuance is

$$m(\gamma - \eta_A)A_{\mathcal{T}}. \quad (38)$$

The total post-payment consideration is then linear in the acquirer price, with effective exchange coefficient

$$q_{\text{eff}} = \gamma q + m(\gamma - \eta_A). \quad (39)$$

So, the entire rightsholder package remains a Margrabe claim, $\mathcal{M}(q_{\text{eff}}A_0, T_0)$, and a contractual barrier $X_t = H$ becomes $(q_{\text{eff}}/q)H$ in the internal ratio.

If the exercise price is a fixed cash amount, the number of acquirer shares delivered depends on the market price, exercise is optional, or the merger exchange ratio is renegotiated, the right and the merger consideration cannot generally be collapsed into one constant multiple of A_t . The diluted merger-share component remains closed form under the assumptions above, but the full rightsholder package may require additional option components or numerical valuation.

6.4 Combined flip-in and flip-over states

If a transaction contains both proportional target dilution $D \in \{1, \delta\}$ and proportional acquirer dilution $K \in \{1, \gamma\}$, the conditional payoff is

$$(KqA_{\mathcal{T}} - DT_{\mathcal{T}})^+. \quad (40)$$

For joint state probabilities $\pi_{jk} = \mathbb{Q}(D = D_j, K = K_k)$, the plain value is the four-state closed form

$$V_{\text{FI+FO}} = \sum_{j=0}^1 \sum_{k=0}^1 \pi_{jk} \mathcal{M}(K_k q A_0, D_j T_0), \quad (D_0, D_1) = (1, \delta), \quad (K_0, K_1) = (1, \gamma). \quad (41)$$

For a barrier written on $X_t = qA_t/T_t$ at level H , the conditional internal ratio is $(K_k/D_j)X_t$, so

$$V_{\text{FI+FO}}^B = \sum_{j=0}^1 \sum_{k=0}^1 \pi_{jk} \mathcal{M}^B \left(K_k q A_0, D_j T_0; \frac{K_k}{D_j} H \right). \quad (42)$$

Independence is not required for this four-state representation; only the joint state probabilities are needed. If the two events are independent, the weights factor into the corresponding Bernoulli probabilities.

7 Formula Summary

Table 3 summarize our formula results for flip-in and flip-over poison pills incorporated into exchange one asset for another options with and without barriers. For flip-in provisions, N is the number of target shares outstanding before exercise, x is the number of new target shares issued, and η is their subscription price as a fraction of the contemporaneous pre-pill target share price. For flip-over provisions, N_A is the number of acquirer shares outstanding immediately before exercise, y is the number of new acquirer shares issued, and η_A is their subscription price as a fraction of the contemporaneous pre-exercise acquirer share price. Thus η and η_A have the same economic interpretation but apply to different issuers. The barrier is assumed to be written on the undiluted contractual ratio $X_t = qA_t/T_t$ at level H . Here p is the flip-in exercise probability and p_F is the flip-over exercise probability. The first column recovers the standard Margrabe or Haug–Haug value, the middle column gives the probability mixture, and the final column gives the certain-exercise case.

Table 3: Summary of the twelve principal closed-form formulas. In the flip-in rows, x new target shares are issued at subscription-price fraction η , producing target dilution factor δ . In the flip-over rows, y new acquirer shares are issued at subscription-price fraction η_A , producing acquirer dilution factor γ .

Case	Dilution factor	Zero probability	Probability between zero and one	Certain exercise
Flip-in, plain	$\delta = \frac{N + \eta x}{N + x}$	$V = \mathcal{M}(qA_0, T_0)$	$V = (1 - p)\mathcal{M}(qA_0, T_0) + p\mathcal{M}(qA_0, \delta T_0)$	$V = \mathcal{M}(qA_0, \delta T_0)$
Flip-in, barrier	$\delta = \frac{N + \eta x}{N + x}$	$V^B = \mathcal{M}^B(qA_0, T_0; H)$	$V^B = (1 - p)\mathcal{M}^B(qA_0, T_0; H) + p\mathcal{M}^B(qA_0, \delta T_0; H/\delta)$	$V^B = \mathcal{M}^B(qA_0, \delta T_0; H/\delta)$
Flip-over, plain	$\gamma = \frac{N_A + \eta_A y}{N_A + y}$	$V = \mathcal{M}(qA_0, T_0)$	$V = (1 - p_F)\mathcal{M}(qA_0, T_0) + p_F\mathcal{M}(\gamma q A_0, T_0)$	$V = \mathcal{M}(\gamma q A_0, T_0)$
Flip-over, barrier	$\gamma = \frac{N_A + \eta_A y}{N_A + y}$	$V^B = \mathcal{M}^B(qA_0, T_0; H)$	$V^B = (1 - p_F)\mathcal{M}^B(qA_0, T_0; H) + p_F\mathcal{M}^B(\gamma q A_0, T_0; \gamma H)$	$V^B = \mathcal{M}^B(\gamma q A_0, T_0; \gamma H)$

The zero-probability column is identical for flip-in and flip-over provisions because neither provision is exercised. The difference appears in the exercise branch: flip-in dilution replaces T_0 by δT_0 and transforms the contractual barrier to H/δ , whereas flip-over dilution replaces qA_0 by $\gamma q A_0$ and transforms the barrier to γH .

8 Detailed Realistic Deal Example

Consider a target with 100 million shares outstanding and an unaffected share price of $T_0 = 62$. A bidder whose shares trade at $A_0 = 50$ offers $q = 1.30$ bidder shares for each target share, so the current stock consideration is 65 per target share. The offer is therefore 4.84% above the target's current market price. The exchange option retains additional value because the relative stock price can move before the expected closing date in nine months.

Assume that the target's rights plan would allow the other shareholders to purchase 25 million new target shares at 20% of the contemporaneous pre-pill market price. For the static control-cost calculation below, assume that exercise occurs immediately at the current prices and that eligible target shareholders subscribe fully; the option calculation continues to represent uncertainty through the separate pill-state probability. Here $N = 100$ million, $x = 25$ million, and $\eta = 0.20$, giving

$$\delta = \frac{100 + 0.20(25)}{100 + 25} = 0.84. \quad (43)$$

The plan therefore causes a 16% reduction in value per target share under the proportional-dilution convention. Suppose deal advisers assign a risk-neutral pill-exercise probability of $p = 35\%$. Retain the market inputs used in Table 2: $r = 4\%$, dividend yields of 1.5% and 0.5% for the bidder and target, volatilities of 24% and 32%, correlation of 0.40, and $\tau = 0.75$.

The relative volatility is

$$\sigma_X = \sqrt{0.24^2 + 0.32^2 - 2(0.40)(0.24)(0.32)} = 31.39\%.$$

The undiluted Margrabe value is

$$\mathcal{M}(65, 62) = 8.14,$$

whereas the conditional diluted value is

$$\mathcal{M}(65, 0.84 \times 62) = \mathcal{M}(65, 52.08) = 14.31.$$

Consequently, the poison-pill-adjusted value per target share is

$$V_{PP} = 0.65\mathcal{M}(65, 62) + 0.35\mathcal{M}(65, 52.08) \quad (44)$$

$$= 0.65(8.14) + 0.35(14.31) = 10.30. \quad (45)$$

The pill adds approximately 2.16 to the option value of this particular per-share claim.

8.1 Whole-deal cost

To quantify the cost of obtaining control, assume that the acquiring company and its shareholders act entirely on their own. They hold no target shares, do not participate in the rights offering, and do not cooperate with any existing target shareholder. All 100 million original target shares, and therefore all rights issued under the pill, are held by shareholders outside the acquirer group. Also assume that the $q = 1.30$ exchange ratio continues to apply to every target share outstanding at completion.

Without the pill, the acquirer must issue

$$qN = 1.30(100) = 130 \text{ million acquirer shares.}$$

At $A_0 = 50$, the gross stock consideration is 6.500 billion. With the pill, 25 million additional target shares are issued, so the acquirer must instead issue

$$q(N + x) = 1.30(125) = 162.5 \text{ million acquirer shares,}$$

worth 8.125 billion. The pill therefore increases the gross stock consideration by

$$qx A_0 = 1.30(25)(50) = \$1.625 \text{ billion.} \quad (46)$$

The target shareholders pay $\eta T_0 = 0.20(62) = \$12.40$ for each of the 25 million new target shares. The target consequently receives

$$\eta x T_0 = 0.20(25)(62) = \$310 \text{ million} \quad (47)$$

in rights-exercise proceeds. This cash remains inside the target and is acquired by the bidder at completion. Net of that acquired cash, the incremental economic cost to the acquirer is therefore

$$\Delta C_{\text{net}} = qx A_0 - \eta x T_0 = 1,625 - 310 = \$1,315 \text{ million.} \quad (48)$$

So, the acquirer issues 1.625 billion more stock, but it acquires a company containing 310 million more cash, leaving a net additional acquisition cost of 1.315 billion before synergies, taxes, transaction costs, or market-price responses.

For an ownership illustration, suppose the acquirer has 500 million shares outstanding before the transaction. Its pre-deal equity value is then 25 billion at $A_0 = 50$. Table 4 shows the mechanical incidence at unchanged market prices.

Table 4: Whole-deal consideration and post-deal ownership

	No pill	Pill exercised	Change
Target shares acquired (millions)	100.0	125.0	25.0
Acquirer shares issued (millions)	130.0	162.5	32.5
Gross stock consideration (\$ millions)	6,500	8,125	1,625
Cash entering target (\$ millions)	0	310	310
Net acquisition consideration (\$ millions)	6,500	7,815	1,315
Legacy acquirer ownership after closing	79.37%	75.47%	−3.90 pp
Former target-holder ownership after closing	20.63%	24.53%	+3.90 pp

Legacy acquirer shareholders. Without the pill, the 500 million legacy acquirer shares represent $500/630 = 79.37\%$ of the combined company’s shares immediately after closing. If the pill is exercised, they represent only $500/662.5 = 75.47\%$. Thus the pill causes an additional 3.90 percentage points of ownership dilution for the legacy acquirer shareholders. Equivalently, their post-deal ownership percentage is 4.91% lower than it would have been without the pill. This is the shareholder-level counterpart of the additional 32.5 million acquirer shares issued.

Legacy target shareholders. Because no target shareholder is affiliated or cooperating with the acquirer, the legacy target shareholders receive the entire benefit of the rights issue. Collectively, they receive acquirer shares worth 8.125 billion at closing, after paying 310 million to exercise the rights. Their net value is therefore 7.815 billion, compared with 6.500 billion without the pill—an increase of 1.315 billion. For each original target share, its holder buys 0.25 of a new target share for 3.10, enters the merger with 1.25 target shares, and receives $1.25(1.30) = 1.625$ acquirer shares worth 81.25. Net of the 3.10 subscription payment, the holder receives 78.15 per original target share, or 13.15 more than the no-pill consideration of 65.00.

The 1.315 billion aggregate gain to the legacy target shareholders matches the acquirer’s 1.315 billion net incremental cost under these assumptions. This equality is a transfer identity, not a value-creation result. Synergies, taxes, financing effects, changes in the acquirer share price, nonparticipation by some rightsholders, renegotiation of q , or redemption of the pill would break the simple mechanical comparison.

9 Conclusion

A known poison-pill share issuance does not by itself force numerical valuation. If a flip-in pill produces a constant target-share multiplier or a flip-over pill produces a constant acquirer-share multiplier, the plain Margrabe, Haug–Haug barrier, and Haug collared formulas survive conditionally. Their poison-pill values are probability-weighted sums across undiluted and diluted states. For barriers written on the original takeover ratio, flip-in dilution divides the effective Haug–Haug barrier by the target multiplier, whereas flip-over dilution multiplies it by the acquirer multiplier. If both mechanisms are present, the same conditioning argument produces a four-state closed form using their joint probabilities.

The main modeling risk lies in the payoff definition. A per-target-share exchange claim can rise in value when the surrendered target share is diluted, while the cost of obtaining control can rise because the bidder must overcome more shares and discounted rights held by others. Conversely, flip-over dilution lowers the value of a fixed number of merger shares but may simultaneously create a valuable purchase right for eligible target holders. In the numerical flip-in example, certain exercise of the pill raises gross stock consideration by 1.625 billion and net acquisition cost by 1.315 billion, transferring the latter amount to unaffiliated legacy target shareholders while further diluting legacy acquirer ownership. Applications should specify whether they value the merger shares, the separate rights entitlement, or the entire holder package before applying a closed form.

The models are deliberately idealized. Their role is to provide closed-form corporate-finance benchmarks for deals that satisfy the stated assumptions and transparent starting points for transactions that do not. A separate empirical study can test the predicted dilution channel, but must distinguish it from endogenous pill adoption, bargaining, waiver, completion risk, regulation, financing, and other deal-specific forces.

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