Dividend Policy and Merger Dynamics*

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Abstract

This paper explores the interaction between dividend policy and mergers and acquisitions (M&A) in a dynamic setting. It examines the decisions faced by two firms regarding their dividend payout policy in the presence of a potential merger between them, under the risk of liquidation. The payout strategy (barrier or band) will depend on the level merger costs. One key finding of the paper shows that, unlike previous literature on merger cooperative games, firms' bargaining power becomes endogenous in leading to merger agreement.

Keywords: Payout Policy; Mergers and Acquisitions; Real Options.
JEL codes:

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1 Introduction

In this paper, we investigate the interplay between dividend policy and mergers and acquisitions (M&A) within a dynamic context. In particular, two firms must decide whether to retain or distribute dividends while they consider the opportunity to merge, which enhance their combined capacity to generate future cash flows. The decisions regarding dividends and the merger are made under uncertainty. This study links two main branches of literature: one addressing optimal dynamic dividend policy and the other studying dynamic M&A decisions.

Regarding the former, Décamps and Villeneuve (2007) investigate how a firm's dividend policy influences its investment decisions, especially when facing liquidity constraints. They identify situations where postponing dividend distribution to invest in future growth opportunities becomes optimal. They also find that uncertainty and liquidity shocks can create ambiguous effects on investment choices. Décamps et al. (2011) develop a dynamic model of a firm that deals with cash holding, dividend payment, and equity issuance policies. It shows how market frictions influence cash holding decisions, subsequently shaping issuance and dividend policies, corporate cash value, and stock price dynamics. The authors shed light on the asymmetric volatility phenomenon, risk management policies, the countercyclicality of stock return volatility, and the impact of agency costs on stock return volatility. Hugonnier et al. (2015) introduce a model that jointly captures investment, financing, and cash management decisions, considering that investments are lumpy and firms face uncertainty in accessing capital markets for financing it. Optimal policies are explicitly characterized, showing that the interaction between investment lumpiness and capital supply constraints may lead to locally convex firm value and suboptimal barrier strategies.

As mentioned earlier, the other related area of literature focuses on dynamic M&A decisions, particularly those that involve cooperative decision-making between merging firms[1]. Some papers follow this approach. Alvarez and Stenbacka (2006), develop a real options model to determine the timing of takeovers and analyze the split of the resulting merger surplus. They show the link between the bargaining power of the acquiring firm and the incentives for takeovers. Thijssen (2008) develop a model concerning mergers and takeovers between two firms facing different yet correlated uncertainties. It is posited that mergers not only result in efficiency improvements but also serve as a means of diversification. Finally, Lukas et al. (2019) study the entrance in a market by means of M&A when different strategies are available to the acquirer (namely, friendly and hostile).

This paper sheds light on the interplay between dividend policy and the dynamics of mergers. It investigates the strategic decisions of two firms concerning their dividend payout policy while considering the possibility of a merger between them, facing the risk of

[1] Alternatively, as in Lambrecht (2004) and Morellec and Zhdanov (2005), the timing and terms of the merger can be defined in sequential rounds.

liquidation. The chosen payout strategy (whether barrier or band) depends on the magnitude of merger costs. A key finding from the paper is that, contrary to prior literature on merger cooperative games, the bargaining power of firms becomes endogenous in shaping a merger agreements.

The paper unfolds as follows: In Section 2, we develop the model for the firms' individual dividend policies, merging decision, and subsequent payout policy. Section 3 conducts a comparative statics analysis. Section 4 provides the conclusion.

2 Model

For setting our model, we build on Décamps and Villeneuve (2007). Consider firm $i \in \{1, 2, m\}$, where m denotes the firm resulting from the merger of 1 and 2, is able to generate a continuous stream of cash flows that is subject to an industry-wide shock, modeled by an arithmetic Brownian motion, given by the following equation:

$$dX_i(t) = k_i\,(\mu dt + \sigma dW) \tag{1}$$

where k_i is a multiple, representing for instance the capital stock, μ is the instantaneous risk-neutral drift, σ is the instantaneous constant volatility, and dW denotes the standard Wiener increment.

The merger of the two firms creates the new firm m with the following capital stock:

$$k_m = k_1 + k_2 + \omega \tag{2}$$

where ω denotes the synergies created by the merger.

2.1 The value and policies of the stand-alone firms

The managers operate the firm with the primary goal of serving the shareholders' best interests, deciding about the payout policy and potential liquidation.

Following the assumption made in Décamps and Villeneuve (2007), we consider that cash holdings generate no returns within the firm, and the liquidation value of the firm is zero. Consequently, this simplifies the model to the conventional framework of optimal dividends as proposed by Jeanblanc-Picqué and Shiryaev (1995) and Radner and Shepp (1996).

The firm's cash reserves $C_i = \{C_i(t); t > 0\}$ evolves according to:

$$dC_i(t) = dX_i(t) - dL_i(t), \qquad C_i(0) = c_i \tag{3}$$

where $L_i(t)$ corresponds to the cumulative dividend process, up to and including time t.

The company faces liquidation when its cash reserves drop to zero, due to successive negative cash-flow shocks.

Since the marginal cost of cash holdings is constant and the marginal benefit is decreasing, there exists a level c_i^* for cash reserves where the marginal cost equal the benefit of cash holdings and it starts to be optimal to pay dividends. Given that the marginal value of cash is strictly higher than one below the target, the firm only chooses liquidation if its cash holdings reach zero.

Denote by $V_i(c)$ the value of a firm. Standard arguments show that in the region $(0, c_i^*)$ in which the firm retains dividends, $V_i(c)$ satisfies the following ODE:

$$rV_i(c_i) = k_i \mu V_i'(c_i) + \frac{(k_i\sigma)^2}{2} V_i''(c_i) \tag{4}$$

Dividend policy

In line with standard dividend distribution models, dividends are expected to be distributed as soon as cash reserves reach or exceed a dividend threshold c_i^*. This implies that:

$$V_i'(c_i^*) = 1 \tag{5}$$

for all $c > c_i^*$. At the dividend threshold c_i^*, the value of one dollar inside the firm equals to its value outside. Since V_i is assumed to be twice continuously differentiable over $(0, \infty)$ (5) the following super-contact condition must hold at the dividend threshold:

$$V_i''(c_i^*) = 0 \tag{6}$$

According to Equation (5), any excess of cash reserves above the dividend threshold c_i^* is immediately distributed to shareholders, so that the marginal value of cash is equal to one. When cash reserves lie in $(0, c_i^*)$, no dividend activity takes place.

This leads us to the objective of determining the value function V_i and a threshold c_i^*, which solve the following system of equations:

$$V_i(c_i) = 0; \qquad c_i < 0, \tag{7}$$

$$V_i(0) = 0, \tag{8}$$

$$-rV_i(c_i) + k_i \mu V_i'(c_i) + \frac{(k_i\sigma)^2}{2} V_i''(c_i) = 0; \qquad 0 < c_i < c_i^*, \tag{9}$$

$$V_i(c_i) = c_i - c_i^* + \frac{k_i \mu}{r}; \qquad c_i \geqslant c_i^* \tag{10}$$

The solution to the ODE (9) is:

$$V_i(c_i) = b_{1i}\, e^{\gamma_{1i}\, c_i} + b_{2i}\, e^{\gamma_{2i}\, c_i} \tag{11}$$

where γ_{1i} and γ_{2i} are the roots to the characteristic equation:

$$\frac{(k_i\sigma)^2}{2}\gamma_i^2 + k_i\mu\gamma_i - r = 0 \tag{12}$$

i.e:

$$\gamma_{1i} = -\frac{k_i\mu}{(k_i\sigma)^2} - \sqrt{\left(\frac{k_i\mu}{(k_i\sigma)^2}\right)^2 - \frac{2r}{(k_i\sigma)^2}} < 0 \tag{13}$$

$$\gamma_{2i} = -\frac{k_i\mu}{(k_i\sigma)^2} + \sqrt{\left(\frac{k_i\mu}{(k_i\sigma)^2}\right)^2 - \frac{2r}{(k_i\sigma)^2}} > 0 \tag{14}$$

Using boundary conditions conditions (5) and (6):

$$b_{1i} = \frac{\gamma_{2i}}{\gamma_{1i}(\gamma_{2i} - \gamma_{1i})}e^{-\gamma_{1i}c_i^*} \tag{15}$$

$$b_{2i} = -\frac{\gamma_{1i}}{\gamma_{2i}(\gamma_{2i} - \gamma_{1i})}e^{-\gamma_{2i}c_i^*} \tag{16}$$

and

$$V_i(c_i) = \frac{1}{\gamma_{1i}\gamma_{2i}}\left(\frac{\gamma_{2i}^2}{\gamma_{2i} - \gamma_{1i}}e^{\gamma_{1i}(c_i - c_i^*)} - \frac{\gamma_{1i}^2}{\gamma_{2i} - \gamma_{1i}}e^{\gamma_{2i}(c_i - c_i^*)}\right) \tag{17}$$

From (10) this implies that $V_i(c_i^*) = \frac{k_i\mu}{r}$. Using the boundary condition (8):

$$c_i^* = \frac{2}{\gamma_{1i} - \gamma_{2i}}\log\left(-\frac{\gamma_{2i}}{\gamma_{1i}}\right) > 0 \tag{18}$$

2.2 The value of the firms with the option to merge

When facing the option to merge, firms need to decide the payout policy along with the merger strategy (timing and terms), facing potential liquidation.

As in Décamps and Villeneuve (2007) and Hugonnier et al. (2015), when the cost of a merger is not sufficiently high, it is optimal to follow the mentioned barrier strategy, where the firm retains earnings and proceeds with the merger if cash reserves reach some target level.

When the merger cost is sufficiently high, barrier strategies are no longer optimal, i.e. the firms optimally retain earnings and merge if cash reserves reach some target level. However, if cash reserves fall to a critical level following a series of losses, the firm abandons the option of financing the merger internally as it becomes too costly to accumulate enough cash to merge. At this point, the marginal value of cash drops to one and it is optimal to make a lump-sum payment to shareholders. After making this payment, the firm retains earnings again.

With the option to merge and payment in stock, the evolution of cash reserves is described as follows:

$$dC_i^m(t) = dC_i(t)\mathbb{1}_{\{t<\tau_m\}} + \theta_i dC_m(t)\mathbb{1}_{\{t>\tau_m\}} - Y_i\mathbb{1}_{\{t=\tau_m\}}, \qquad C_i^m(0) = c_i;\ i \in \{1,2\} \tag{19}$$

where τ_m is a stopping time representing the merger timing, θ_i is the share of firm i in the merged firm, Y_i are the fixed merger costs, and

$$C_m(\tau_m) = C_1(\tau_m) + C_2(\tau_m) - Y \tag{20}$$

where $Y = Y_1 + Y_2$.

The problem is therefore to maximize the present value of future dividends by choosing the firm's payout L and merger (τ_m) policies, that is:

$$V_i^m(c_i) = \sup_{L_i^m,\tau_m} \mathbb{E}\left[\int_0^{\tau_l} e^{-rt} dL_i^m(t)\right] \tag{21}$$

where

$$dL_i^m(t) = \begin{cases} dL_i(t) & t < \tau_m \\ \theta_i dL_m(t) & t \geqslant \tau_m \end{cases} \qquad i \in \{1,2\} \tag{22}$$

Knowing the initial cash holdings $C_1(0)$ and $C_2(0)$, it is possible to state all firm values as a function of the sum of the two firms cash holdings, for instance $c = c_1 + c_2$, using:

$$c_1(c) = C_1(0) + \frac{k_1}{k_1+k_2}\left(c - C_1(0) - C_2(0)\right) \tag{23}$$

$$c_2(c) = C_2(0) + \frac{k_2}{k_1+k_2}\left(c - C_1(0) - C_2(0)\right) \tag{24}$$

$$c_m(c) = c \tag{25}$$

When the two firms have the option to merge, it is assumed that they cooperatively determine the timing and terms of the merger. One approach to modeling the outcome is to assume that the firms define the terms and timing in sequential rounds, as shown in Lambrecht (2004) and Morellec and Zhdanov (2005). However, in this paper, the outcome is modeled as the result of a Nash bargaining game, following the approaches in Alvarez and Stenbacka (2006), Thijssen (2008), and Lukas et al. (2019).

It is assumed that after the merger, each firm holds an equity stake θ_i in the new firm m. The equityholders of each firm give up their stand-alone value $V_i(c_i)$ and receive a stake in the new venture, after paying an irreversible merger cost Y_i.

We apply the asymmetric Nash bargaining solution to solve for the firms' optimal shares in the new venture, represented by the following optimization problem:

$$\sup_{0<\theta<1}\left[\left[\theta V_m(c_m(c)-Y)-V_1(c_1(c))\right]^{\eta}\left[(1-\theta)V_m(c_m(c)-Y)-V_2(c_2(c))\right]^{1-\eta}\right] \tag{26}$$

where η and $(1-\eta)$ represent the bargaining power of firm 1 and 2, respectively. The terms $V_1(c_1(c))$ and $V_2(c_2(c))$ represent each firm's disagreement point, which corresponds to the outside option available to 1 and 2, respectively, i.e. the value of the firms without the option to merge.

The solution for the maximization problem (26) is as follows:

$$\theta(c)=\frac{V_1(c_1(c))}{V_m(c_m(c)-Y)}+\eta\left(\frac{V_m(c_m(c)-Y)-V_1(c_1(c))-V_2(c_2(c))}{V_m(c_m(c)-Y)}\right) \tag{27}$$

yielding the following share for each firm:

$$\begin{aligned}\Theta_1(c)&=\theta V_m(c_m(c)-Y)\\&=V_1(c_1(c))+\eta\left(V_m(c_m(c)-Y)-V_1(c_1(c))-V_2(c_2(c))\right) && (28)\\\Theta_2(c)&=(1-\theta)V_m(c_m(c)-Y)\\&=V_2(c_2(c))+(1-\eta)\left(V_m(c_m(c)-Y)-V_1(c_1(c))-V_2(c_2(c))\right) && (29)\end{aligned}$$

The valuation of each firm holding the option to merge within the retention and waiting-to-merge region is as follows:

$$V_i^m(c)=b_{1i}^m\, e^{\gamma_{1i}\, c_i(c)}+b_{2i}^m\, e^{\gamma_{2i}\, c_i(c)} \tag{30}$$

Two possible strategies may arise, depending on the merging costs: the barrier strategy, where the firm retains profits and moves forward with the merger once cash reserves reach a certain target level, or the band strategy, where the optimal strategy includes an intermediate dividend payout region. Let us start with the former strategy.

Barrier strategy The constants b_{1i}^m, b_{2i}^m, and the merger threshold $\hat{c}_i$ are found using the following boundary conditions:

$$V_i^m(\tilde{c})=V_i(c_i(\tilde{c})) \tag{31}$$

$$V_i^m(\hat{c}_i)=\Theta_i(\hat{c}_i) \tag{32}$$

$$V_i^{m'}(\hat{c}_i)=\Theta_i'(\hat{c}_i) \tag{33}$$

where $\tilde{c}=\max\left[\tilde{c}_1,\tilde{c}_2\right]$ and $\tilde{c}_i=C_1(0)+C_2(0)-\dfrac{k_1+k_2}{k_i}C_i(0)$ denotes the level of the total cash holdings c when firm i is liquidated ($C_i=0$).

Using boundary conditions (31) and (32):

$$V_i^m(c) = L(c, \tilde{c}, \hat{c}_i)V_i(c_i(\tilde{c})) + H(c, \tilde{c}, \hat{c}_i)\Theta_i(\hat{c}_i) \tag{34}$$

where

$$L(c, c_l, c_h) = \frac{e^{\gamma_{1i}\, c_i(c)+\gamma_{2i}\, c_i(c_h)} - e^{\gamma_{1i}\, c_i(c_h)+\gamma_{2i}\, c_i(c)}}{e^{\gamma_{1i}\, c_i(c_l)+\gamma_{2i}\, c_i(c_h)} - e^{\gamma_{1i}\, c_i(c_h)+\gamma_{2i}\, c_i(c_l)}} \tag{35}$$

$$H(c, c_l, c_h) = \frac{e^{\gamma_{1i}\, c_i(c_l)+\gamma_{2i}\, c_i(c)} - e^{\gamma_{1i}\, c_i(c)+\gamma_{2i}\, c_i(c_l)}}{e^{\gamma_{1i}\, c_i(c_l)+\gamma_{2i}\, c_i(c_h)} - e^{\gamma_{1i}\, c_i(c_h)+\gamma_{2i}\, c_i(c_l)}} \tag{36}$$

The merger threshold is obtained using the smooth-pasting condition presented in Equation (33).

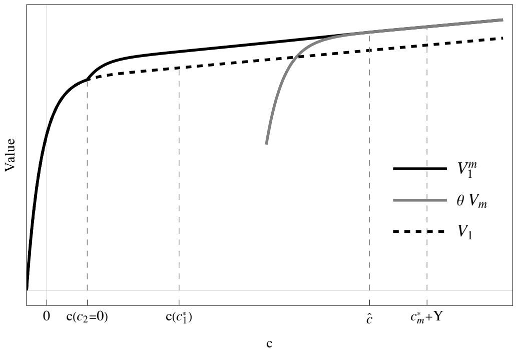
The value functions for Firm 1 and 2, depicting the barrier strategy, can be found in Figure 1. Starting with Firm 2 (1b), it is shown its stand-alone value (V_2) and the corresponding threshold for payout ($c(c_2^*)$). V_2^m represents the value of Firm 2 when incorporating the option to merge. The additional value created by the option to merge is $V_2^m - V_2$, which goes to zero as cash reserves go to zero, as the option to merge disappears due to the firm's liquidation. For $c_2 > 0$ (and smaller than $\hat{c}$), the firm accumulates cash (i.e., does not distribute any dividends) waiting for the optimal timing to merge at $\hat{c}$. After merging, the new firm sets its optimal payout policy, distributing dividends whenever cash reserves exceed $c_m^* + Y$ (when measured at the pre-merger cash level[2]).

Similar conclusions can be taken for Firm 1 (1a). However, on the left of $c(c_2 = 0)$ the option to merge disappears for Firm 1, as Firm 2 has already been liquidated. In that case, the value of Firm 1 and its dividend policy corresponds to the stand-alone case.

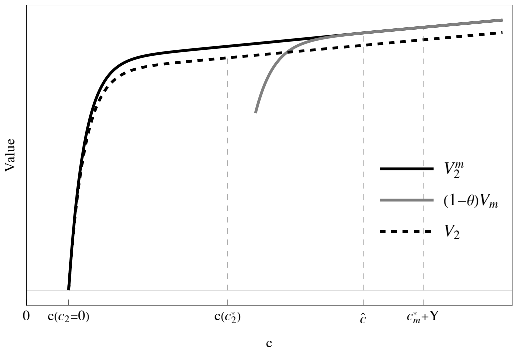
The perspective of the central planner is represented in Figure 1c. All previous regions are also depicted: for cash reserves below c $(c_2 = 0)$, Firm 1 remains in the market, whereas Firm 2 has already been liquidated (eliminating the option to merge). If cash reserves continue to drop, Firm 1 will eventually also liquidate. In the absence of an option to merge, the central planner's position is simply $V_1 + V_2$. With that option in place, combined cash is retained until the trigger of the merger is reached ($\hat{c}$). After the merger, the payout occurs for cash reserves larger than c_m^*.

An important finding of our model concerns the way the merger surplus is shared to reach an agreement about the timing of the deal. Unlike previous literature, the bargaining power is now endogenous in leading to an agreement. In other words, the central planner's trigger (i.e., the first best solution) is only achieved for a particular level of bargaining power that corresponds to the levels of η and $(1 - \eta)$ such that the triggers of both firms meet that of the central planner (see Figure 2).

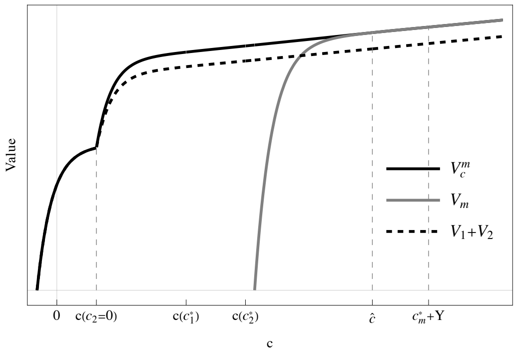
[2] At the merger, Y is spent, and after that the threshold for payout is c_m^*.



(a) Firm 1



(b) Firm 2



(c) Central Planner

Figure 1: Firms' value: barrier strategy

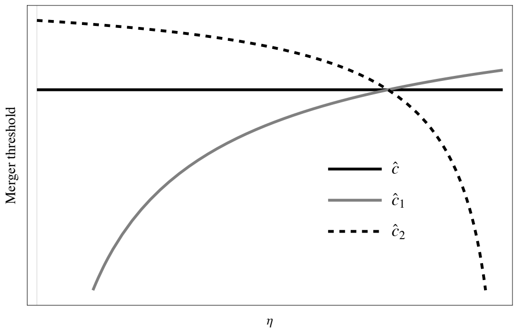


Figure 2: Merger thresholds: barrier strategy

Band strategy The constants b^m_{1i}, b^m_{2i}, and the merger threshold $\hat{c}_i$ and the low threshold $\underline{c}_i$ are found using the following boundary conditions:

$$V_i^m(\underline{c}_i) = V_i(c_i(\underline{c}_i)) \tag{37}$$

$$V_i^{m\prime}(\underline{c}_i) = V_i'(c_i(\underline{c}_i)) \tag{38}$$

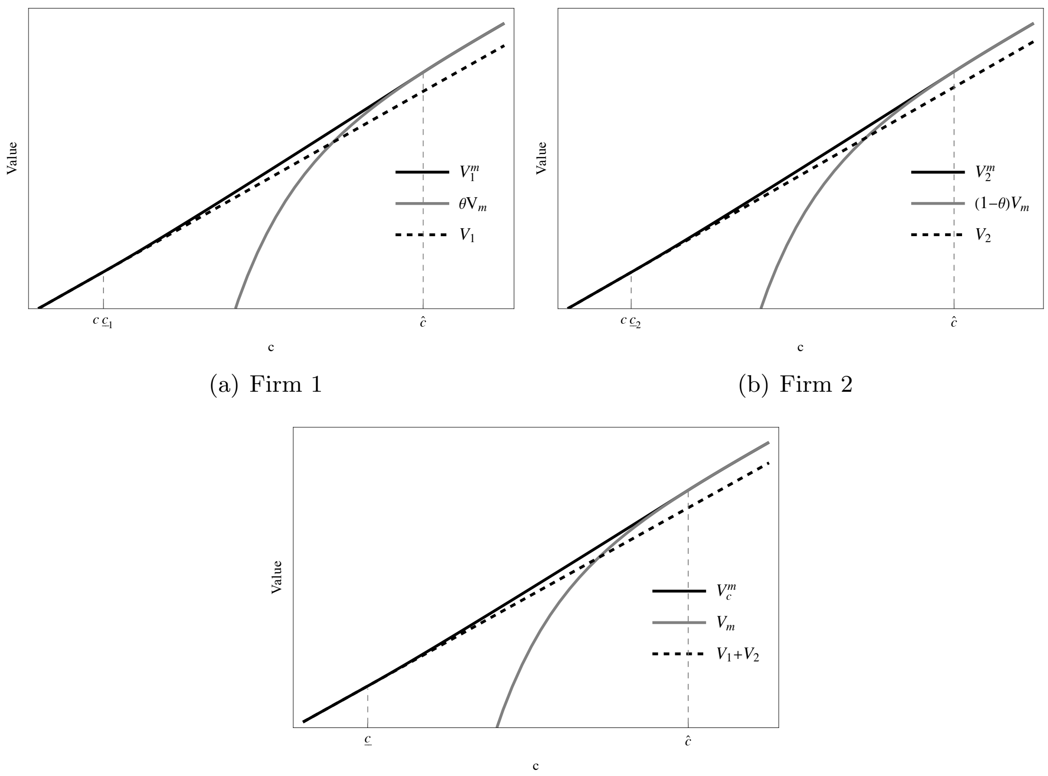
$$V_i^m(\hat{c}_i) = \Theta_i(\hat{c}_i) \tag{39}$$

$$V_i^{m\prime}(\hat{c}_i) = \Theta_i'(\hat{c}_i) \tag{40}$$

Using boundary conditions (37) and (39):

$$V_i^m(c) = L(c, \underline{c}_i, \hat{c}_i)V_i(c_i(\underline{c})) + H(c, \underline{c}_i, \hat{c}_i)\Theta_i(\hat{c}_i) \tag{41}$$

The merger threshold $\hat{c}_i$ and the low threshold $\underline{c}_i$ are then found using (38) and (40).



(a) Firm 1

(b) Firm 2

(c) Central Planner

Figure 3: Firms' value: band strategy

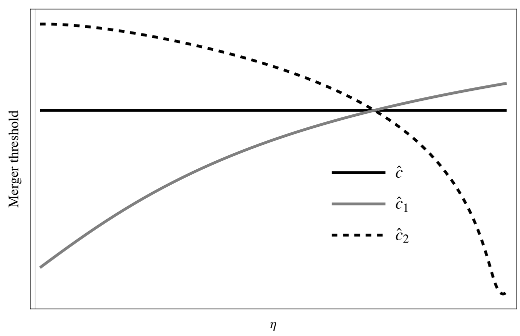


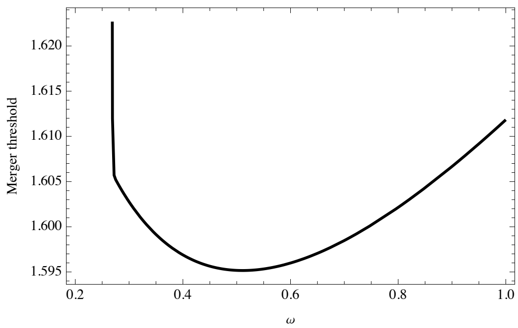
Figure 4: Merger thresholds: band strategy

3 Comparative statics

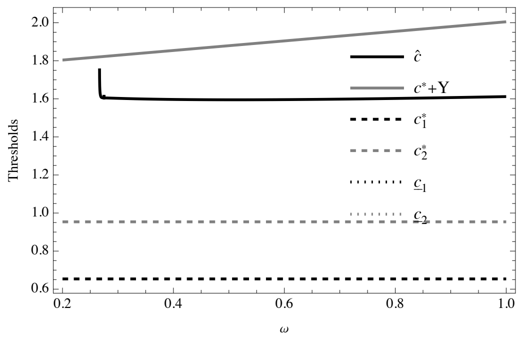
TO BE ADDED

Table 1: The base-case parameter values.

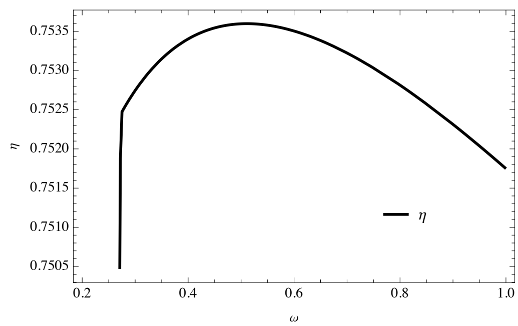
Parameter	Description	Value
c_1	Current level of C_1	0.4
c_2	Current level of C_2	0.1
k_1	Capital stock of firm 1	2
k_2	Capital stock of firm 2	1
ω	Synergy factor	0.5
Y	Merger fixed costs $(Y_1 + Y_2)$	1
r	Risk-free interest rate	0.06
μ	Risk-neutral drift rate	0.2
σ	Volatility	0.1



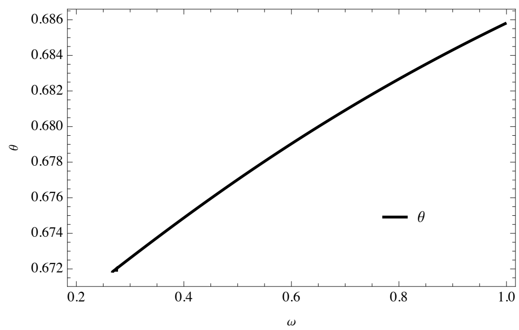
(a) Merger threshold



(b) Thresholds

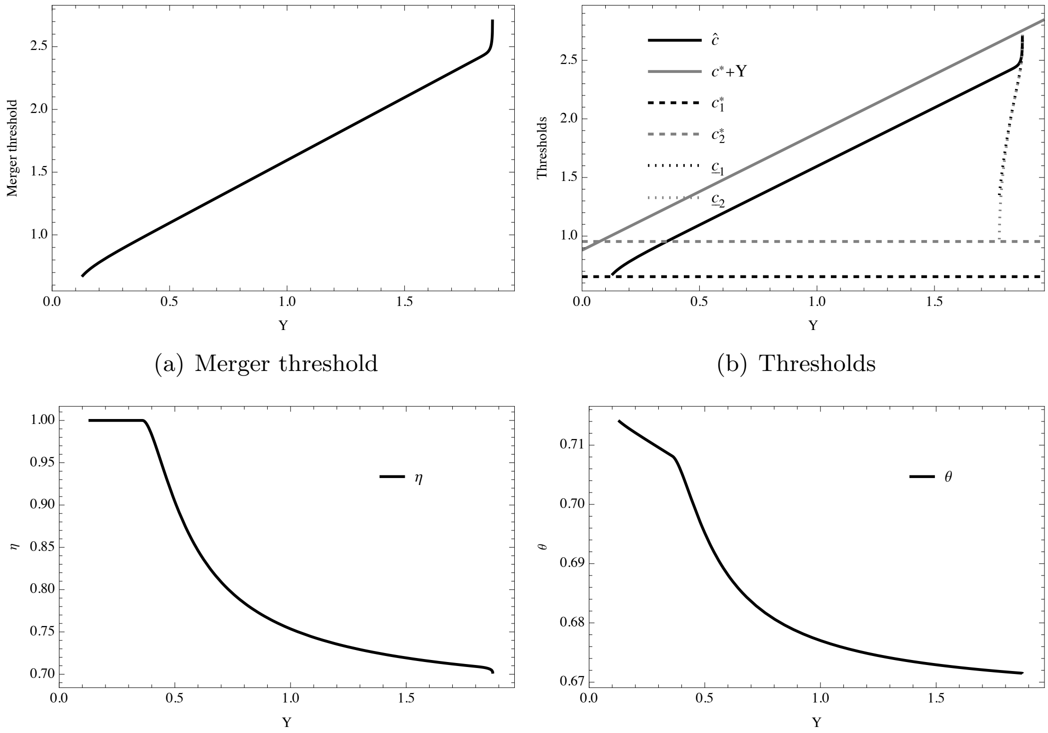


(c) Bidder's share of the surplus



(d) Share of the bidder

Figure 5: The effect of the synergy (ω)



(a) Merger threshold

(b) Thresholds

(c) Bidder's share of the surplus

(d) Share of the bidder

Figure 6: The effect of the merger cost (Y)

4 Conclusion

TO BE ADDED

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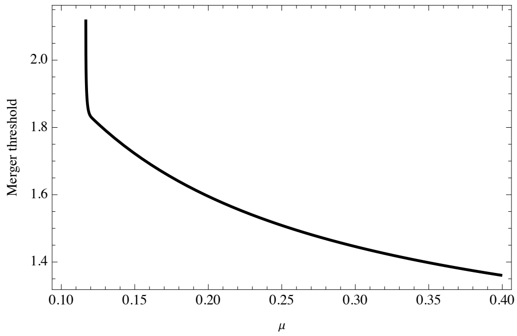
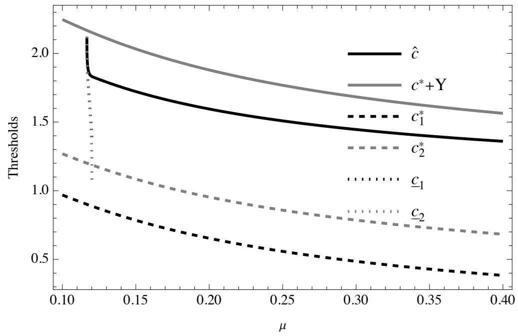
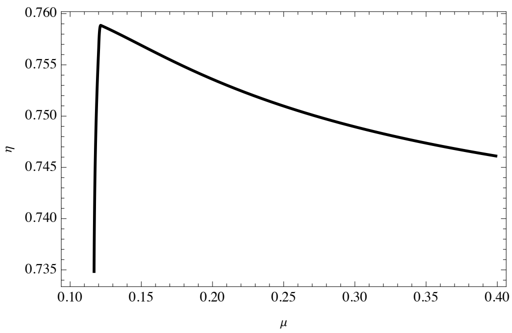


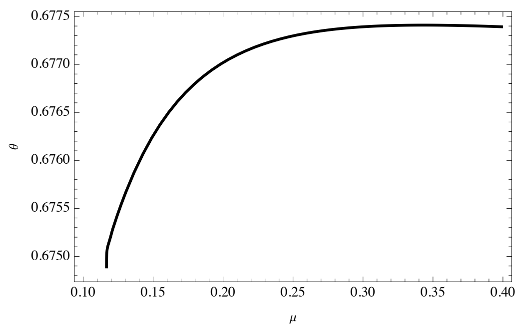
(a) Merger threshold



(b) Thresholds



(c) Bidder's share of the surplus



(d) Share of the bidder

Figure 7: The effect of the drift rate (μ)

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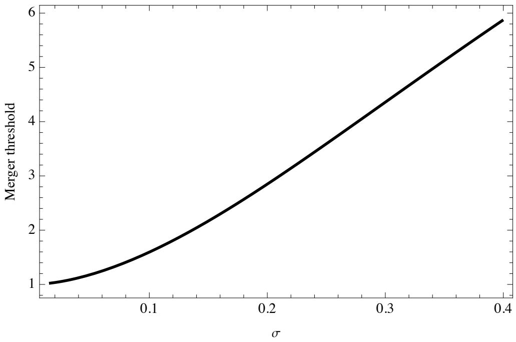
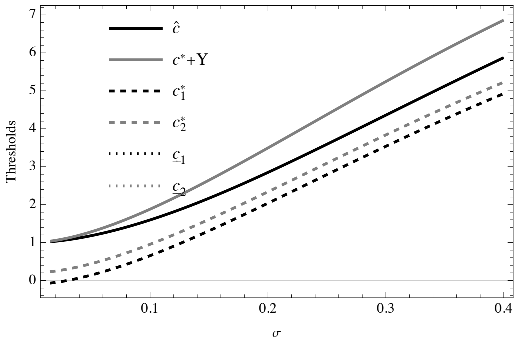
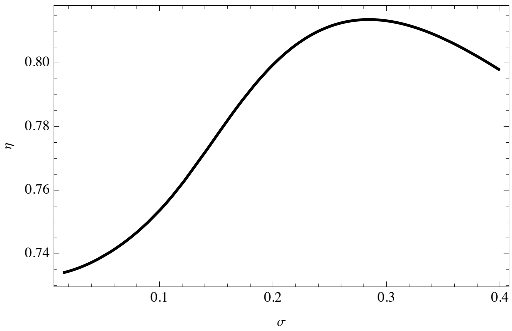


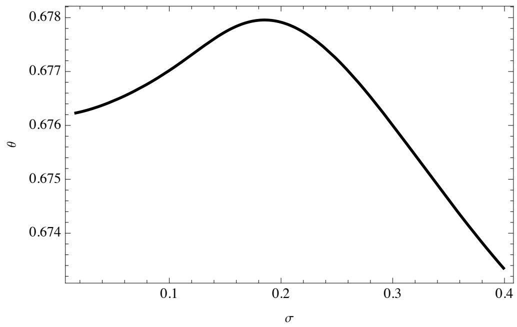
(a) Merger threshold



(b) Thresholds



(c) Bidder's share of the surplus

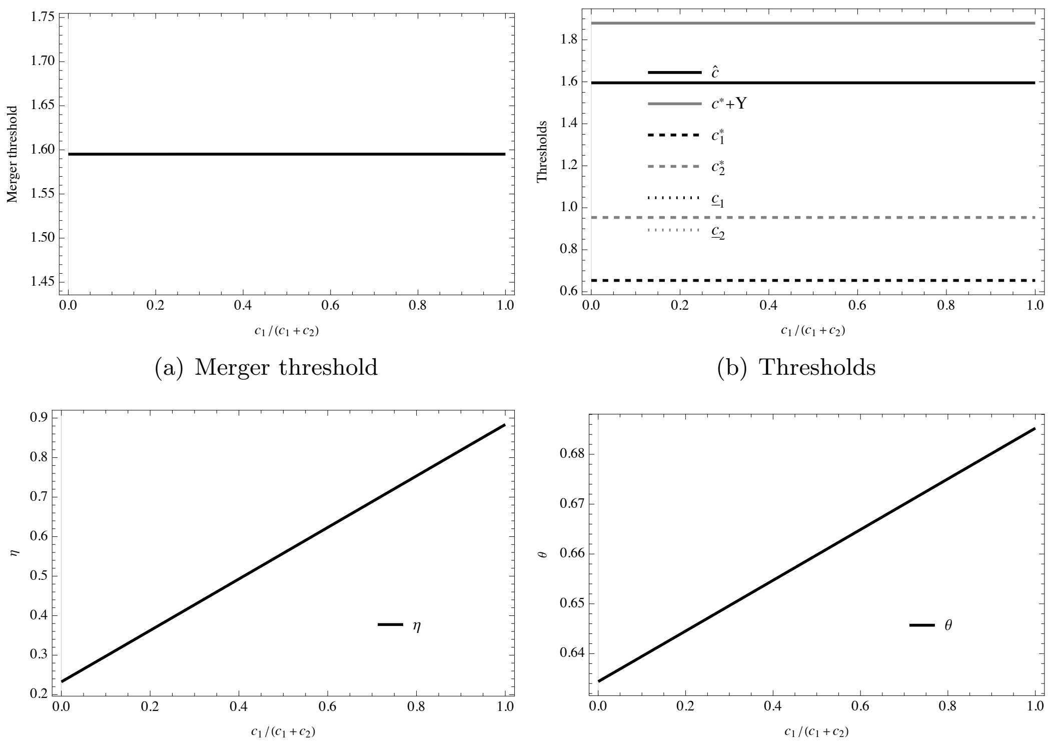


(d) Share of the bidder

Figure 8: The effect of volatility (σ)

Appendices

A Proofs



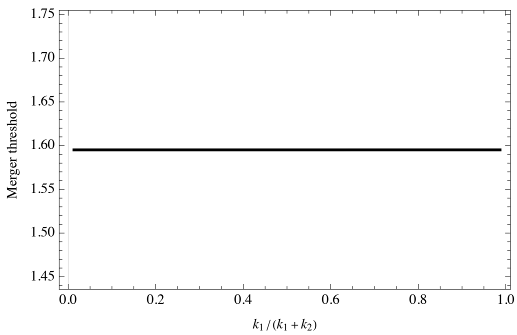
(a) Merger threshold

(b) Thresholds

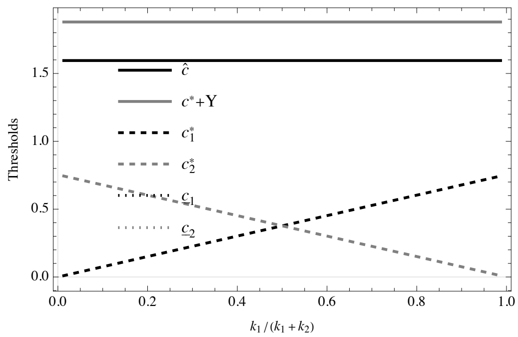
(c) Bidder's share of the surplus

(d) Share of the bidder

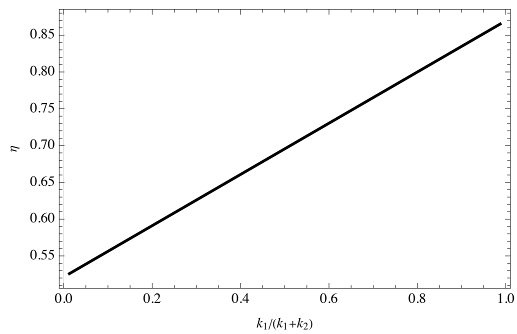
Figure 9: The effect of relative cash holdings



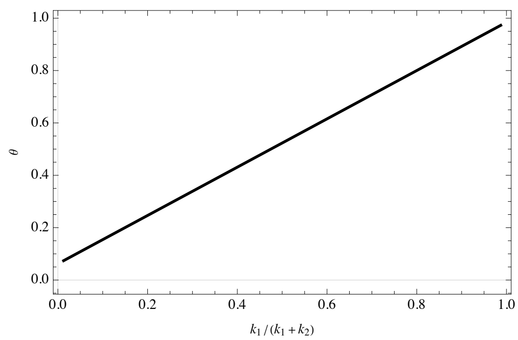
(a) Merger threshold



(b) Thresholds



(c) Bidder's share of the surplus



(d) Share of the bidder

Figure 10: The effect of relative size