# A Theory of Mergers and Acquisitions:

# Synergy, Private Benefits, or Hubris Hypothesis

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## Abstract

In this paper, we apply the perfect Bayesian equilibrium concept to analyze the equilibrium for takeover game, and then using the necessary conditions of the equilibrium to explain the reason why takeovers are motivated. Our theoretical results show that synergy, private benefits and hubris hypotheses may all explain why companies engage in mergers and acquisitions; the critical point between the motives is the management of the acquiring firm how to confirm the movement and strategies of the target firm. When the management of the acquiring firm indefinitely knows the target firm whether resists or co-operates, the hubris and synergy hypotheses both are supported. When the management of the acquiring firm will resist, then the private benefits hypothesis is supported. The findings indicate that, in certain circumstances, the more overconfident the management of the acquiring firm and the greater private benefits will be, the more likely the merger and acquisition will be motivated.

Keywords: Perfect Bayesian equilibrium, Mergers and acquisitions

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In recent years, the takeover market has become significantly more active and therefore discussions of mergers and acquisitions are ubiquitous between investors in the investment market. Despite the large number of mergers and acquisitions that have become regarded as failures after a period of time, there are still companies that enthusiastically seek merger and acquisition targets. In order to explain the reasons why companies are keen on mergers and acquisitions, many motives have been proposed by financial economists. Evidence finds that the importance of various motivations for mergers and acquisitions changes over time. The existing empirical research often is inconclusive because of the difficulty of clearly distinguishing among the different motives. Therefore, grouping the motives of mergers and acquisitions into various categories is often useful. Three broad motivations for takeovers have long been grouped in the literature: synergy, agency and hubris (Berkovitch and Narayanan, 1993).

The most common view in the past was that the essential motive of companies engaging in mergers and acquisitions was the synergy<sup>1</sup>. The synergy hypothesis suggests that the value of the combined firm is higher than the sum of the individual firm values (Bradley, Desai, and Kim, 1988; Seth, 1990; Maquiera, Megginson, and Nail, 1998; Hubbard and Palia, 1990). The synergy hypothesis also implies that management shall not only create value on behalf of the shareholders but also that it needs to have the competence to measure the value of the combined firm.

Under the managerial self-interest hypothesis, or private benefits hypothesis, merger and acquisition activity is driven by personal interests whereby the manager obtains and maximizes its welfare at the expense of acquirer shareholders (Mitchell and Lehn, 1990; Berkovitch and Narayanan, 1993). Thus, private benefits motivate the management of acquiring firms. By engaging in mergers

<sup>&</sup>lt;sup>1</sup> Synergy creates value, the existence of scale economic and scope economic is so-called operational synergy, when the value of the merged company is greater than the total value of the two individual firms this is so-called information synergy (Goergen and Renneboog, (2004)), such as the establishment of internal capital markets decreasing trading and bankruptcy costs.

and acquisitions, may be able to extract value for themselves in several ways. For example, under managerial control, if a company has an excessive cash flow, the manager is more likely to further entrench management and increase personal interests by spending the cash on low-benefit or even value-destroying mergers rather than distribute dividends to stockholders (Servaes, 1991; Lang, Stulz, and Walking, 1989, 1991). The managerial self-interest hypothesis is associated with private benefits; furthermore evidence from recent studies directly shows the support for the private benefits hypothesis (Barclay and Holderness, 1989; Hietala, Kaplan and Robinson, 2003). In this paper, we construct a theoretical model within which we use private benefits hypothesis to replace the traditional "managerial self-interest hypothesis".

Under the "hubris hypothesis" (Roll, 1986), citing a psychological effect of overconfidence, the bidder management could incorrectly assess the value of the target firms. In some cases, managers retain the positive valuation error that bids are made even when a valuation above the current market price. However, there is evidence showing the premium is overpaid by the acquiring firm. Overconfident managers overestimate the returns to their investment projects (Malmendier and Tate, 2005; Heaton, 2002). Therefore, the manager engages in takeovers only when it overestimates. Bruner (1999) indicates that the Volvo's attempt to merge with Renault in 1993 temporarily destroyed SEK 8.6 billion (US\$ 1.1 billion) in Volvo shareholder wealth in support of the hubris hypothesis. Hietala, Kaplan, and Robinson (2003) present a framework to estimate how much the bidder overpays for the target and illustrate one of these generic cases using the takeover contest for Paramount in 1994 in which Viacom overpaid by more than \$2 billion. They conclude that such a findings are consistent with managerial overconfidence and/or large private benefits, but not with the traditional agency-based incentive problem.

Since the three hypotheses (synergy, private benefits & hubris) have been published there has been great interest among empirical researchers. A review of recent literature relating to these finds that the synergy hypothesis is supported by much of the empirical literature, while some supports are found for the managerial self-interest hypothesis and hubris hypothesis. For example, Goergen and Renneboog (2004), in their analysis of the short-term wealth effects of large intra-European takeover bids, suggest that synergies are the prime motivation for bids and that target and bidders share the wealth gains. Gondhalekar, Sant, and Ferris (2004) believe that the overpayment in mergers and acquisitions is derived from managerial self-interest effects rather than synergy and hubris hypotheses. The findings of Hietala, Kaplan, and Robinson (2003) are consistency with managerial overconfidence and/or large private benefits, but not with the traditional agency-based incentive problem. Mueller and Sirower (2003) present considerable support is found for the managerial discretion and hubris hypotheses, and some support is found for the market-for-corporate-control hypothesis. Little or no support is found for the hypothesis that mergers create synergies and those shareholders of both the acquiring and acquired firms share gains from these synergies.

Pangarkar and Lie (2004) conclude that acquisitions undertaken in a low market cycle will exhibit better performance than those undertaken in high market cycle for two key reasons: lower likelihood of overpayment due to hubris and ease in implementing restructuring initiatives such as retrenchment. Gondhalekar and Bhagwat (2003) compare the motives in the acquisitions of Nasdaq targets during the after the crash of 1987 period with those in the ten-year period before the crash. They find agency is the motive for takeovers that have negative total gains (acquirer + target), but synergy and hubris are comotives for takeovers that have positive total gains. The proportion of takeovers in which the managers of acquirers act against the interest of the shareholders increases after the crash. Hodgkinson and Partington(2008) report there is evidence of bids motivated by synergy, but there is also evidence of the presence of hubris and weak evidence of bids with an agency motivation.

Mergers & acquisitions involve the game of multiple players for the corporate control and the resources of target firms. Bidders use various bidding strengths such as the bidder's toe-hold shareholding in the target and the level of bid premiums offered, and at the same time the target firms could use different strategies to resist the takeover bids; so whether the takeover is successful or not, there are a lot of key factors involved to influence the outcome of takeover bids. In order to understand the key factors determining whether takeovers succeed or fail, there have been many empirical

literature studies such as Target Management Resistance (Cotter, Shivdasani and Zenner, 1997; O'Sullivan and Wong, 1998a,b; Sudarsanam, 1996; Holls and Kyriazis, 1996, 1997), Managerial Equity Holdings (Song and Walking, 1993; Duggal and Miller, 1994; O'Sullivan and Wong, 1998a, 1999), Bidders Toe-hold (Walking, 1995; Holls and Kyriazis, 1996, 1997; Sudarsanam, 1996), and Bid Premium (Walking, 1995; Franks and Mayer, 1996; Holls and Kyriazis, 1996).

Although the empirical documents mentioned above more or less provide explanations to key factors during the mergers and acquisitions, they may not completely be incorporated with the motivations for takeover. To date, academic researchers have not yet proposed a complete theory that completely and perfectly integrates the synergy, private benefits and hubris hypotheses to explain why the three hypotheses can all be supported. Thus, this study attempts to propose an integration theory including these three hypotheses to interpret why a company at the end of the day is motivated to engage in mergers and acquisitions.

In this paper, we apply the perfect Bayesian equilibrium concept to analyze why firms engage in mergers and acquisitions. Results of our study show that when information is incomplete, it is possible that three types of equilibrium exist, separating equilibrium, pooling equilibrium and partial pooling equilibrium. The pooling equilibrium is most likely to be in support of both synergy and hubris hypotheses. The private benefits hypothesis can also possibly be supported under both types of separating equilibrium and partial pooling equilibrium. The critical point is that the attitude of the target firm is unknown to the acquiring firm, whether the target firm will resist or cooperate. This study proves that the more overconfident the management of the acquiring firm and the greater the private benefits will be, and also the more likely the merger and acquisition will be motivated.

The results of our study implies that when the management of the acquiring firm is not sure about the strategies of the target firm, if the overconfidence and hubris are significantly influential, and then the management of the acquiring firm will definitely continue the offensive; nevertheless subsequently pay a higher premium. In addition, under the same circumstances, when the management of the acquiring firm is unsure about the target firm strategy, if the synergy is significantly influential, the acquiring firms' payoff can be increased after acquiring the corporate control of the target firm, and then the management of the acquiring firm also will definitely continue the offensive. However, when the management of the acquiring firm is convinced that the target firm will resist, and a strong private benefits motive dominates, the management of the acquiring firm is likely to take the offensive even if it means paying higher premium, and causing loss to shareholders' interests. In mergers and acquisitions, a dominant overconfidence or private benefit mentality will be detrimental to the interests of other shareholders.

The article is organized as follows. Section I develops the model. Section II explores the equilibrium including separating equilibrium, pooling equilibrium and partial pooling equilibrium analysis. According to the outcome of the analysis we propose three important propositions. Section III concludes. Proofs of all propositions are in the Appendix.

## I. The model

In this section we introduce the model. There is a two-player game of incomplete information, and both players are risk neutral. One player is the management of the target firm (henceforth referred to as the target) and is denoted T. The other player is the management of the acquiring firm (henceforth referred to as the acquirer) and is denoted K. In theory, the takeover market may also involve competing bidders. Studies have found that the probability of takeover success is significantly lower in the presence of one or more competing bidders (Henry, 2004). In order to include the factor of the competing bidders, the winning probability of the competing bidders is added to the model<sup>2</sup> and is denoted P. The game structure designed by this study is shown in Fig. I.

According to Fig. I, the game tree shows the order of moves in the two-player game. It is assumed that there are two types of acquirers in mergers and acquisitions. Firstly, we define a good acquirer as one who can create synergy and increase target shareholders' wealth following a successful takeover (henceforth referred to as good acquirers); and a bad acquirer as one who will bring the contrary effect to the target firm, target shareholders' wealth either falls or remains constant (henceforth referred to as

<sup>&</sup>lt;sup>2</sup> P=1, denotes there is no competitor or the acquirer cooperates with competitors.

bad acquirers). The probability that a good acquirer will appear into the takeover market,  $\pi$ , is common knowledge.

There are two stages in the game. The movement sequence starts with the informed acquirer choosing a strategy to either attack (denoted by Y) or remain passive (denoted by N); then, the target observes the action of the acquirer and decides either to take resisting (denoted by R) or cooperating (denoted by C). It is as follows:



Acquirer actions

Fig. I. Game Tree. Please refer to Table 1 for the expected payoffs for both the acquirer and the target.

Stage 0 (the beginning of the game) :

To begin the game, the acquirer analyses potential target firms. At the beginning of the game, there have been no corporate control contests. The values of the target and acquiring firm are denoted by  $v_0$  and  $A_0^K$  respectively. Pre-bid shareholding in the target owned by the target and the acquirer are expressed as a fraction of total equity and are denoted by  $\alpha_0$  and  $\beta_0^K$ , respectively (K = G for the good acquirer, K = B for the bad acquirer).

After determining the possible target, because the acquirer fully understands the real type of mergers and acquisitions, that is, those engaging in acquisitions completely understand the reasons for mergers and acquisitions, the acquirer can choose from the two strategies: actively attack or remain passive<sup>3</sup>. It is assumed that the prior probability that a good acquirer will attack is  $\theta_{g}$ , and the prior probability that a bad acquirer will attack is  $\theta_{g}$ . According to Bayesian rules, the posterior probability that a good acquirer will take offensive action is  $\rho$ , the mathematical expression is as follows:

$$\rho = \frac{\pi \theta_G}{\pi \theta_G + (1 - \pi) \theta_B}$$

Stage 2:

After the target has observed the actions of the acquirer, it may choose one of two strategies: resisting or cooperating. The strategy chose by the target will influence whether the merger and acquisition will be a success or failure. For examples, O'Sullivan and Wong (1998a) report 26 percent of takeover bids launched in the period between 1989 and 1995 were resisted by target management. O'Sullivan and Wong (1999) report 45 percent of hostile takeover targets in the period between 1989 and 1993 were successfully resisted. Holl and Kyriazis (1997) indicate that all defenses investigated, apart from a white knight defense, promote the interests of target firm managers by significantly lowering the probability of bid success. However, resistance will generate costs for the target, these costs are denoted by  $R_J$  (J=S for the successful resisting, J=F for the fail resisting). Similarly, the acquirer facing resisting or cooperating will also bear different costs, these acquiring costs are denoted by  $C_R$  or  $C_C$ , in general  $C_R > C_C$ . It assumed that if the acquirer estimates the exogenous probability of this successful resisting is denoted by  $\delta$ .

<sup>&</sup>lt;sup>3</sup> Because the target may take a resisting strategy, the acquirer may remain passive after assessing.

After the second stage, the nature of the acquirer will be revealed and the corporate control contests ended<sup>4</sup>:

- 1. The value of the target firm will be different owing to the change of the corporate control, this is denoted by  $v^{K}$ , where K=G for the corporate control changed into a good acquirer, K=B for the corporate control changed into a bad acquirer, K=H for the corporate control changed into competing bidders. As good acquirer will have positive influence on the target firm value, so  $v^{G} > v^{B}$ .
- 2. The corporate control will be transferred because of the success of the merger and acquisition. if the target's resisting fails, the expected value of the target firm is denoted by:  $v^g = Pv^G + (1-P)v^H$ ,  $v^b = Pv^B + (1-P)v^H$ ,  $v^g > v^b$ , the value of the target firm after the successful resisting is denoted by:  $v_0^R$ .
- 3. After acquiring the corporate control of the target firm, the value of the acquiring firm is denoted by  $A_1^K$ , where K = G for the good acquirer, K = B for the bad acquirer.
- 4. Post-bid shareholding in the target firm owned by the target and the acquirer are expressed as a fraction of total equity and are denoted by  $\alpha_I$  and  $\beta_I$ , respectively, where I=S for the successful resisting, I=C for the cooperating, I=F for the fail resisting, I=H for the competing bidders acquiring the corporate control), in general  $\alpha_C > \alpha_F$ .
- 5. The private benefits are denoted by  $\phi^J$ , where J=T for the target, J=A for the acquirer<sup>5</sup>. Barclay and Holderness (1989) argue that the acquirer of the controlling block pays a premium that amounts to the value of the private benefits of control in addition to the value of the block derived from the ongoing business. The difference between the price per share paid by the acquirer and the price per share prevailing on the market after the acquisition has taken place, will reflect private benefits

<sup>&</sup>lt;sup>4</sup> In consideration of the reaction by the capital market, this paper presumes that under different circumstances, companies have different market values.

<sup>&</sup>lt;sup>5</sup> In order to simplify the model; the value of the target firm  $(v_0 \text{ and } v_0^R)$  multiplying private benefits of the target  $(\phi^T)$  is the value after the private benefits of the target deducted; the value of the target firm  $(v^K)$  multiplying private benefits of the acquirer  $(\phi^A)$  is the value prior to private benefits of the acquirer deducted.

associated with the control of that company; that is, private benefits are a certain ration of the companies value. In the past, there have been many empirical studies supporting the impact that the bid premium has on the success probability of mergers and acquisitions (Walking, 1985; Franks and Mayer, 1996; Holl and Kyriazis, 1996), in line with the private benefits hypothesis.

According to Fig. 1, the game tree structure, the end of the second stage there will be eight forms of expected payoffs for both acquirer and target, summarized as shown in Table I.

Scenario	Target	Acquirer
1	$v_0 \alpha_0 + \phi^T v_0$	$v_0\beta_0^G + A_0^G$
2	$v_0^R \gamma_S - R_S + \phi^T v_0^R$	$P(v_0^R \beta_S + A_0^G - C_R) + (1 - P)(v_0^R \beta_H + A_0^G)$
3	$(1-\phi^A)v^g\alpha_F - R_F - \phi^T v_0$	$P\left[(1-\phi^{A})v^{G}\beta_{F}+A_{1}^{G}-C_{R}+\phi^{A}v^{G}\right]+(1-P)\left[(1-\phi^{A})v^{H}\beta_{H}+A_{0}^{G}\right]$
4	$(1-\phi^A)v^g\alpha_C-\phi^T v_0$	$P\left[(1-\dot{\phi}^{A})v^{G}\beta_{C}+A_{1}^{G}-C_{C}+\phi^{A}v^{G}\right]+(1-P)\left[(1-\phi^{A})v^{H}\beta_{H}+A_{0}^{G}\right]$
5	$(1-\phi^A)v^b\alpha_C-\phi^T v_0$	$P\left[(1-\phi^{A})v^{B}\beta_{C}+A_{1}^{B}-C_{C}+\phi^{A}v^{B}\right]+(1-P)\left[(1-\phi^{A})v^{H}\beta_{H}+A_{0}^{B}\right]$
6	$(1-\phi^A)v^b\alpha_F - R_F - \phi^T v_0$	$P\left[(1-\phi^{A})v^{B}\beta_{F}+A_{1}^{B}-C_{R}+\phi^{A}v^{B}\right]+(1-P)\left[(1-\phi^{A})v^{H}\beta_{H}+A_{0}^{B}\right]$
7	$v_0^{\rm R} \gamma_s - R_s + \phi^T v_0^{\rm R}$	$P(v_0^R \beta_S + A_0^B - C_R) + (1 - P)(v_0^R \beta_H + A_0^B)$
8	$v_0 \alpha_0 + \phi^T v_0$	$v_0\beta_0^B + A_0^B$

Table I. Acquirer and target expected payoffs

To illustrate,

Scenario 1: When a good acquirer adopts a passive strategy, that is, the mergers and acquisitions don't happen: The payoff of the target at the second stage remains the same as at the beginning of the game  $(v_0\alpha_0 + \phi^T v_0)$ . This expression includes the fractional equity value of the target firm  $(v_0\alpha_0)$  and private benefit  $(\phi^T v_0)$ . The good acquirer payoff remains the same as at the beginning of the game  $(v_0\beta_0^G + A_0^G)$ . This expression includes the fractional equity value of the target firm  $(v_0\beta_0^G)$  and the value of the acquiring firm  $(A_0^G)$ .

- Scenario 2: When a good acquirer adopts an offensive strategy while the target chooses resisting and succeeds (i.e. the takeover fails): The payoff of the target at Stage 2 is  $v_0^R \alpha_s R_s + \phi^T v_0^R$ . This expression includes the fractional equity value of the target firm  $(v_0^R \alpha_s)$ , deducting the resisting costs  $(R_s)$  and the private benefits  $(\phi^T v_0^R)$ . As to a good acquirer when facing competitors, and where the probability of winning is P, the payoff of the acquirer at Stage 2 is  $P(v_0^R \beta_s + A_0^G C_R) + (1 P)(v_0^R \beta_H + A_0^G)$ . If the acquirer wins, the payoff includes the fractional equity value of the target firm  $(v_0^R \beta_0^G)$  and the value of the acquiring firm  $(A_0^G)$ , but deducting the acquiring costs of resisting  $(C_R)$ . If the acquirer looses, the payoff includes the fractional equity value of the target firm  $(v_0^R \beta_H)$  and the value of the acquiring firm  $(A_0^G)$ .
- Scenario 3: When a good acquirer adopts an offensive strategy while the target chooses resisting and fails (i.e. the takeover succeeds): The payoff of the target at Stage 2 is  $(1-\phi^A)v^s\alpha_F R_F \phi^T v_0$ , even though the corporate control may be changed to good acquirers or competitors. This expression includes the fractional equity value of the target firm  $((1-\phi^A)v^s\alpha_F)$ , deducting the resisting costs ( $R_s$ ) and private benefits ( $\phi^T v_0$ ). As for the good acquirer facing competitors, the payoff of the acquirer at Stage 2 is  $P[(1-\phi^A)v^G\beta_F + A_i^G + \phi^A v^G C_R] + (1-P)((1-\phi^A)v^B\beta_H + A_0^G)$ . If the acquirer wins, the payoff includes the value of the target firm  $((1-\phi^A)v^G\beta_F)$ , the value of the acquiring firm  $(A_i^G)$  and the private benefits  $(\phi^A v^G)$ , but deducting the acquiring costs of resisting ( $C_R$ ). If the acquirer looses, the payoff includes the value of the target company equals  $(1-\phi^A)v^H\beta_H$  and the value of the acquiring firm is  $A_0^G$ . The expected payoffs in the rest of the scenarios listed in Table 1 will follow the similar illustration above and as such will not be repeated.

According to the game model, when the target decides to choose either resisting or cooperating,

then the expected payoff of the target is  $M_T(R)$  or  $M_T(C)$ , respectively :

$$M_{T}(R) = \rho \{ \delta [v_{0}^{R} \alpha_{S} - R_{S} + \phi^{T} v_{0}^{R}] + (1 - \delta) [(1 - \phi^{A}) v^{s} \alpha_{F} - R_{F} - \phi^{T} v_{0}] \}$$
$$+ (1 - \rho) \{ \delta [v_{0}^{R} \alpha_{S} - R_{S} + \phi^{T} v_{0}^{R}] + (1 - \rho) [(1 - \phi^{A}) v^{b} \alpha_{F} - R_{F} - \phi^{T} v_{0}] \}$$
$$M_{T}(C) = \rho [(1 - \phi^{A}) v^{s} \alpha_{C} - \phi^{T} v_{0}] + (1 - \rho) [(1 - \phi^{A}) v^{b} \alpha_{C} - \phi^{T} v_{0}] \}$$

When the acquirer decides to choose either an offensive or passive strategy, then the expected payoff of the acquirer is  $M_K(Y)$  or  $M_K(N)$ , respectively, where K= G for the good acquirer, K= B for the bad acquirer).

$$\begin{split} M_{K}(Y) &= \gamma \{ \delta [P(v_{0}^{R}\beta_{S} + A_{0}^{K} - C_{R}) + (1 - P)(v_{0}^{R}\beta_{H} + A_{0}^{K})] \\ &+ (1 - \delta) [P((1 - \phi^{A})v^{K}\beta_{F} + A_{1}^{K} - C_{R} + \phi^{A}v^{K}) + (1 - P)((1 - \phi^{A})v^{H}\beta_{H} + A_{0}^{K})]\} \\ &+ (1 - \gamma) \{ P[(1 - \phi^{A})v^{K}\beta_{C} + A_{1}^{K} - C_{C} + \phi^{A}v^{K}] + (1 - P)[(1 - \phi^{A})v^{H}\beta_{H} + A_{0}^{K}]\} \\ \\ M_{K}(N) &= v_{0}\beta_{0}^{K} + A_{0}^{K} \end{split}$$

We rationally anticipate the acquirer's behavior and take this into account when choosing the offensive strategy that maximizes the payoff of the acquirer. To design the takeover contest, we must also ensure that the resultant expected payoff of offensive strategy is above the passive strategy while the target chooses cooperating (i.e., satisfying the acquirer's participation constraint).

#### II. The equilibria

In this section, we apply the concept of perfect Bayesian equilibrium to derive the necessary conditions that may exist in three equilibria: separating equilibrium, pooling equilibrium and partial pooling equilibrium. Although it is theoretically possible for both types to play either a pure strategy of choosing Y or N, or a mixed strategy, thus leading to a total of eight possible equilibria, we show that only four out of eight situations can be possible equilibria. Each equilibrium regime is characterized by a certain type of motivations for takeovers in the literature: synergy, agency and hubris.

#### A. Separating equilibrium

Under the separating equilibrium, it is assumed that a good acquirer adopts an offensive strategy, while a bad acquirer adopts a remaining passive strategy<sup>6</sup> (that is  $\theta_G = 1$  and  $\theta_B = 0$ ), and the target definitely chooses resisting<sup>7</sup> (that is  $\gamma = 1$ ), there are necessary conditions for the existence of the separating equilibrium: (see the Appendix).

$$\delta > \tilde{\delta} = \frac{(1 - \phi^{A})v^{g}(\alpha_{c} - \alpha_{F}) + R_{F}}{(v_{0}^{R}\alpha_{S} - R_{S}) - [(1 - \phi^{A})v^{g}\alpha_{F} - R_{F}] + \phi^{T}(v_{0}^{R} + v_{0})}$$
(1)

$$\delta < \overline{\delta} = \frac{\phi^{A} [P v^{G} - P v^{G} \beta_{F} - (1 - P) v^{H} \beta_{H}] + P(v^{G} \beta_{F} - C_{R}) + P(A_{1}^{G} - A_{0}^{G}) + (1 - P) v^{H} \beta_{H} - v_{0} \beta_{0}^{G}}{\phi^{A} [P v^{G} - P v^{G} \beta_{F} - (1 - P) v^{H} \beta_{H}] + P(v^{G} \beta_{F} - v_{0}^{R} \beta_{S}) + P(A_{1}^{G} - A_{0}^{G}) + (1 - P)(v^{H} \beta_{H} - v_{0}^{R} \beta_{H})}$$
(2)

$$\delta > \underline{\delta} = \frac{\phi^{A} [P v^{B} - P v^{B} \beta_{F} - (1 - P) v^{H} \beta_{H}] + P(v^{B} \beta_{F} - C_{R}) + P(A_{1}^{B} - A_{0}^{B}) + (1 - P) v^{H} \beta_{H} - v_{0} \beta_{0}^{B}}{\phi^{A} [P v^{B} - P v^{B} \beta_{F} - (1 - P) v^{H} \beta_{H}] + P(v^{B} \beta_{F} - v_{0}^{R} \beta_{S}) + P(A_{1}^{B} - A_{0}^{B}) + (1 - P)(v^{H} \beta_{H} - v_{0}^{R} \beta_{H})}$$
(3)

because  $v^G > v^B$ , then  $\overline{\delta} > \underline{\delta}$ .

The  $\phi^{A}[Pv^{G} - Pv^{G}\beta_{F} - (1-P)v^{H}\beta_{H}]$  and  $\phi^{A}[Pv^{B} - Pv^{B}\beta_{F} - (1-P)v^{H}\beta_{H}]$  represent the expected private benefits for the good acquirer and the bad acquirer, respectively. We assume the main influence on the acquirer to adopt an offensive or passive strategy is the positive or negative of private benefits. Therefore, the  $\phi^{A}$  has positive correlation with  $\overline{\delta}$  for  $[Pv^{G} - Pv^{G}\beta_{F} - (1-P)v^{H}\beta_{H}] > 0$ , but negative correlation with  $\underline{\delta}$  for  $[Pv^{B} - Pv^{B}\beta_{F} - (1-P)v^{H}\beta_{H}] < 0$ 

From the analysis above, we find if a good acquirer adopts an offensive strategy, while a bad acquirer adopts a remaining passive strategy, there are necessary conditions for the existence of the separating equilibrium :  $\max\{\tilde{\delta}, \underline{\delta}\} < \delta < \overline{\delta}$ . We summarize exogenous changes that make this type of equilibrium more likely in the following proposition :

**Proposition 1** : *Ceteris paribus*, an increase in private benefits of the acquirer ( $\phi^A$ ) increases the likelihood of separating equilibrium, a good acquirer adopts an offensive strategy,

<sup>&</sup>lt;sup>6</sup> Another separating equilibrium is: a good acquirer adopts the remaining passive strategy, while a bad acquirer adopts the dynamic offensive strategy. Under such situation, the outcome from our mathematical proofs is contradictory to  $\overline{\delta} > \underline{\delta}$ ; therefore this separating equilibrium would never exist.

<sup>&</sup>lt;sup>7</sup> Since the target chooses the cooperating strategy, the outcome from our mathematical proofs is contradictory to the acquirer's participation constraint (i.e., satisfying  $M_{K}(Y) > M_{K}(N)$ ). Therefore, this separating equilibrium would never exist while the target chooses the cooperating strategy.

while a bad acquirer adopts a remaining passive strategy.

**Proof**: Given  $[Pv^G - Pv^G\beta_F - (1-P)v^H\beta_H] > 0$  and  $[Pv^B - Pv^B\beta_F - (1-P)v^H\beta_H] < 0$ , we can derive

that increase in  $\phi^{A}$  results in  $\tilde{\delta}$  or  $\underline{\delta}$  lesser,  $\overline{\delta}$  greater from the analysis of Equations (1) to (3).

In Proposition 1 we find that, under the separating equilibrium, it is assumed that a good acquirer adopts an offensive strategy, while a bad acquirer adopts a remaining passive strategy for the sake of private benefits, increase in the private benefits of the acquirer ( $\phi^A$ ) make this type of equilibrium more likely, which is in support of the private benefits hypothesis.

### **B.** Pooling equilibrium

Under pooling equilibrium, it is assumed that, whether the acquirer is good or bad adopts an offensive strategy<sup>8</sup> (that is  $\theta_G = 1$  and  $\theta_B = 1$ ), while the target randomizes between resisting and cooperating<sup>9</sup>, there are necessary conditions for the existence of the pooling equilibrium: (see the Appendix).

Given  $0 < \rho < 1$ , thus  $M_{T}(R) = M_{T}(C)$ ,

$$\delta = \hat{\delta} = \frac{(1-\phi^{A})\nu(\rho)(\alpha_{C}-\alpha_{F}) + R_{F}}{(\nu_{0}^{R}\alpha_{S}-R_{S}) - [(1-\phi^{A})\nu(\rho)\alpha_{F}-R_{F}] + \phi^{T}\nu_{0}^{R}}$$

Given the probability of resisting  $\gamma < 1$ , thus  $M_{\kappa}(Y) > M_{\kappa}(N)$ ,

$$\gamma < \gamma_{\rm K} = \frac{P[(1-\phi^{\rm A})v^{\rm K}\beta_{\rm c}+\phi^{\rm A}v^{\rm K}] + P(A_{\rm I}^{\rm K}-A_{\rm 0}^{\rm K}) + (1-P)(1-\phi^{\rm A})v^{\rm H}\beta_{\rm H} - v_{\rm 0}\beta_{\rm 0}^{\rm K}}{P[(1-\phi^{\rm A})v^{\rm K}\beta_{\rm c}] - P[(1-\phi^{\rm A})v^{\rm K}\beta_{\rm F}] + A_{\rm 0}^{\rm K} - \hat{\delta v_{\rm 0}^{\rm R}}\beta_{\rm H} + \delta P[(1-\phi^{\rm A})v^{\rm K}\beta_{\rm F} - v_{\rm 0}^{\rm R}\beta_{\rm S} + (A_{\rm 1}^{\rm K}-A_{\rm 0}^{\rm K}) + \phi^{\rm A}v^{\rm K}] + \delta(1-P)(1-\phi^{\rm A})v^{\rm H}\beta_{\rm H}}$$
(4)

From equation (4) we can analyze the implication of each component: The  $(A_1^K - A_0^K)$  represents the hubris of the acquirer,<sup>10</sup> which the acquirer overestimates the benefits of the merger. The  $P[(A_1^K - A_{\circ}^K) + (1 - \phi^A)v^K \beta_C + \phi^A v^K] - v_0 \beta_0^K$  represents the wealth gains of the acquirer due to

synergy.

<sup>&</sup>lt;sup>8</sup> If both good and bad acquirers adopt the remaining passive strategy, there will be no mergers and acquisitions activity, therefore the pooling equilibrium is not to be found when such a passive strategy is adopted by both good and bad acquirers.

<sup>&</sup>lt;sup>9</sup> Whether the target chooses a resisting or cooperating strategy, the acquirer's participation constraint always is satisfied. Therefore, the target's choice is uncertainty.

<sup>&</sup>lt;sup>10</sup> This paper adopts the method proposed by Hietala, Kaplan, and Robinson (2003), analyzing the hubris of the acquiring firm by comparing the difference in value of the acquiring firm before and after the merger.

From this we infer, assuming a dynamic offensive strategy for mergers and acquisitions is adopted by either a good or bad acquirer, there are necessary conditions for the existence of the pooling equilibrium:  $\gamma < \gamma_{\rm K}$ . We summarize exogenous changes that make this type of equilibrium more likely in the following proposition :

Proposition 2 : Ceteris paribus, any of the following changes in the critical values defining the equilibrium increases the likelihood of pooling equilibrium, both good and bad acquirers adopt an offensive strategy, while the target randomizes between resisting and cooperating:

(a) Increase in overestimating the merge benefits due to acquirer overconfidence;

(b) Increase in the pay-off of the acquirer due to synergy.

**Proof** : Those changes in the (a) and (b) above result in  $\gamma_{\rm K}$  to become greater from the analysis of

Equation (4).

In Proposition 2 we find that, under the pooling equilibrium, it is assumed that both good and bad acquirers definitely adopt the dynamic offensive strategy for mergers and acquisitions, increase in overestimating the merge benefits due to acquirer overconfidence, or increase in the pay-off of the acquirer due to synergy make this type of equilibrium more likely, which is in support of the synergy or hubris hypotheses.

## C. Partial pooling Equilibrium

Under partial pooling equilibrium, it is assumed that a good acquirer adopts the dynamic offensive strategy for mergers and acquisitions while a bad acquirer randomizes between dynamic offensive and remaining passive<sup>11</sup>, and the target definitely chooses resisting<sup>12</sup>, there should be necessary conditions for the existence of the partial-pooling equilibrium: (see the Appendix).

<sup>&</sup>lt;sup>11</sup> There are still two partial pooling equilibriums. One is a bad acquirer adopts the dynamic offensive strategy while a good acquirer randomizes between dynamic offensive and remaining. Another is passive a bad acquirer adopts the remaining passive strategy while a bad acquirer randomizes between dynamic offensive and remaining. Under such situations, the outcomes from our mathematical proofs are contradictory to  $\overline{\delta} > \underline{\delta}$ ; therefore those partial pooling equilibriums would never exist.

<sup>&</sup>lt;sup>12</sup> Since the target adopts the cooperating strategy, the outcome from our mathematical proofs is contradictory to the acquirer's participation constraint (i.e., satisfying  $M_{\kappa}(Y) > M_{\kappa}(N)$ ). Therefore, this partial pooling equilibrium would never exist while the target chooses the cooperating strategy.

$$\theta_{B} > \hat{\theta} = \frac{\pi}{1-\pi} \left\{ \frac{(1-\phi^{A})v^{g}(\alpha_{C}-\alpha_{F}) + \delta[(1-\phi^{A})v^{g}\alpha_{F}-v_{0}^{R}\alpha_{S}-\phi^{T}v_{0}^{R}+R_{S}] - (1-\delta)R_{F}}{-(1-\phi^{A})v^{b}(\alpha_{C}-\alpha_{F}) - \delta[(1-\phi^{A})v^{b}\alpha_{F}-v_{0}^{R}\alpha_{S}-\phi^{T}v_{0}^{R}+R_{S}] + (1-\delta)R_{F}} \right\}$$
(5)

From this we infer that a good acquirer adopt the dynamic offensive strategy for mergers and acquisitions while a ba rom this we infer, assuming a good acquirer adopts the dynamic offensive strategy for mergers and acquisitions while a bad acquirer randomizes between dynamic offensive and remaining passive, there are necessary conditions for the existence of the pooling equilibrium:  $\theta_B > \hat{\theta}$ . We summarize exogenous changes that make this type of equilibrium more likely in the following proposition :

**Proposition 3** : *Ceteris paribus*, an increase in private benefits of the acquirer ( $\phi^A$ ) increases the likelihood of partial pooling equilibrium, a good acquirer adopts the dynamic offensive strategy, while a bad acquirer randomizes between dynamic offensive and remaining passive, and the target definitely chooses resisting.d acquirer randomizes between dynamic offensive and remaining passive <sup>17</sup>, increase in the private benefits of the acquirer( $\phi^A$ ) make this type of equilibrium more likely, which is in support of the private benefits hypothesis<sup>13</sup>.

**Proof**: We can derive that increase in  $\phi^{A}$  results in  $\hat{\theta}$  greater from the analysis of Equations (5).

#### **III. CONCLUSION**

Over the past 2 or 3 decades, experts and intellectuals from both financial and academic sectors have attempted to put forward reasonable arguments explaining the motives of enterprises that engage in mergers and acquisitions. Three broad motivations for takeovers have long been grouped in the literature: synergy, agency and hubris hypotheses. Support for each hypothesis can be found in the empirical literatures. Therefore, in this paper, we apply the concept of perfect Bayesian equilibrium to define the necessary conditions of possible equilibrium, and then utilize such necessary conditions to

<sup>&</sup>lt;sup>13</sup> Regardless of whether a good acquirer adopts the strategy to attack or remain passive, bad acquirers definitely adopt the passive strategy under the partial pooling equilibrium; since the inference is similar to the case above, we are not going to discuss it repeatedly.

discuss the three hypotheses. In general, under the circumstances of dynamic and incomplete information, the mergers and acquisitions market is largely linked with the predictions of the target and acquiring firms, predictions such as whether acquiring firms are good or bad, if they are going to attack, whether the target resists or not. In this study, by integrating a series of scenarios into our model, we are able to know well the key motives in mergers and acquisitions.

In this paper it is discovered that the hubris hypothesis and the synergy hypothesis can only exist under the pooling equilibrium when an acquirer is not sure if the target will choose the resisting or cooperating strategy; when an acquirer affirms the target will definitely choose the resisting strategy, then private benefits hypothesis can exist under the separating and partial pooling equilibrium.

We propose reasonable and complete explanations for the phenomenon that there are many empirical studies on the same key motive with inconsistent results. Based on the model in this study, we infer that mergers and acquisitions activity occurring in different places and at different times may exist in different type of equilibrium; hence the necessary conditions of equilibrium will be different. In theory, the motives of synergy or private benefits or overconfidence from hubris can all appear in mergers and acquisitions, the key point will be that the acquirer understands the strategy of the target choosing.

# **Appendix: Proofs of Propositions**

# 1. Proof of separating equilibrium

Given  $\theta_G = 1$  and  $\theta_B = 0$ , Belief consistency check  $\therefore \rho = \frac{\pi \theta_G}{\pi \theta_G + (1 - \pi) \theta_B} = 1$ , so that,

$$M_{\rm T}(R) = \delta[v_0^R \alpha_s - R_s + \phi^{\rm T}(v_0^R - v_0) - (1 - \phi^{\rm A})v^s \alpha_F + R_F + \phi^{\rm T}v_0] + (1 - \phi^{\rm A})v^s \gamma_F - R_F - \phi^{\rm T}v_0$$
$$M_{\rm T}(C) = (1 - \phi^{\rm A})v^s \alpha_C - \phi^{\rm T}v_0$$

If  $\gamma = 1$ , then  $M_T(R) > M_T(C)$  must be satisfied, so that,

$$\delta > \tilde{\delta} = \frac{(1 - \phi^{A})v^{g}(\gamma_{C} - \gamma_{F}) + R_{F}}{(v_{0}^{R}\gamma_{S} - R_{S}) - [(1 - \phi^{A})v^{g}\gamma_{F} - R_{F}] + \phi^{T}(v_{0} + v_{0}^{R})}$$

Given  $\gamma = 1$ , then :

$$M_{K}(Y) = \delta[P(v_{0}^{R}\beta_{S} + A_{0}^{K} - C_{R}) + (1 - P)(v_{0}^{R}\beta_{H} + A_{0}^{K})] + (1 - \delta)[P((1 - \phi^{A})v^{K}\beta_{F} + A_{1}^{K} - C_{R} + \phi^{A}v^{K}) + (1 - P)((1 - \phi^{A})v^{H}\beta_{H} + A_{0}^{K})]$$

 $M_{\kappa}(N) = v_0 \beta_0^{\kappa} + A_0^{\kappa}$ 

If  $\rho = 1$ , then  $M_G(Y) > M_G(N)$  and  $M_B(Y) < M_B(N)$  must be satisfied, so that,

$$\delta < \overline{\delta} = \frac{\phi^{A} [P v^{G} - P v^{G} \beta_{F} - (1 - P) v^{H} \beta_{H}] + P(v^{G} \beta_{F} - C_{R}) + P(A_{1}^{G} - A_{0}^{G}) + (1 - P) v^{H} \beta_{H} - v_{0} \beta_{0}^{G}}{\phi^{A} [P v^{G} - P v^{G} \beta_{F} - (1 - P) v^{H} \beta_{H}] + P(v^{G} \beta_{F} - v_{0}^{R} \beta_{S}) + P(A_{1}^{G} - A_{0}^{G}) + (1 - P)(v^{H} \beta_{H} - v_{0}^{R} \beta_{H})}$$

$$\delta > \underline{\delta} = \frac{\phi^{A} [P v^{B} - P v^{B} \beta_{F} - (1 - P) v^{H} \beta_{H}] + P(v^{B} \beta_{F} - C_{R}) + P(A_{1}^{B} - A_{0}^{B}) + (1 - P) v^{H} \beta_{H} - v_{0} \beta_{0}^{B}}{\phi^{A} [P v^{B} - P v^{B} \beta_{F} - (1 - P) v^{H} \beta_{H}] + P(v^{B} \beta_{F} - v_{0}^{R} \beta_{S}) + P(A_{1}^{B} - A_{0}^{B}) + (1 - P)(v^{H} \beta_{H} - v_{0}^{R} \beta_{H})}$$

To rewrite above as

$$\overline{\delta} = 1 - \frac{P(v_{\circ}^{R}\beta_{H} - v_{\circ}^{R}\beta_{S} + C_{R}) + v_{0}\beta_{0} - v_{0}^{R}\beta_{H}}{\phi^{A}[Pv^{G} - Pv^{G}\beta_{F} - (1 - P)v^{H}\beta_{H}] + P(v^{G}\beta_{F} - v_{0}^{R}\beta_{S}) + P(A_{1}^{G} - A_{0}^{G}) + (1 - P)(v^{H}\beta_{H} - v_{0}^{R}\beta_{H})}$$

$$\underline{\delta} = 1 - \frac{P(v_{\circ}^{R}\beta_{H} - v_{0}^{R}\beta_{S} + C_{R}) + v_{0}\beta_{0} - v_{0}^{R}\beta_{H}}{\phi^{A}[Pv^{B} - Pv^{B}\beta_{F} - (1 - P)v^{H}\beta_{H}] + P(v^{B}\beta_{F} - v_{0}^{R}\beta_{S}) + P(A_{1}^{B} - A_{0}^{B}) + (1 - P)(v^{H}\beta_{H} - v_{0}^{R}\beta_{H})}$$

Since  $v^{G} > v^{B}$ , the  $\overline{\delta} > \underline{\delta}$  will always be true. Therefore, we can also infer that

 $M_G(Y) < M_G(N)$  and  $M_B(Y) > M_B(N)$  would never exist.

Combine (1), (2) and (3) to get necessary conditions for the existence of the separating equilibrium:  $\max\{\tilde{\delta}, \underline{\delta}\} < \delta < \overline{\delta}$ .

### 2. Proof of pooling equilibrium

Given  $\theta_G = 1$  and  $\theta_B = 0$ , Belief consistency check  $\therefore \rho = \frac{\pi \theta_G}{\pi \theta_G + (1 - \pi) \theta_B} = 1$ , so that,

$$M_{T}(R) = \rho \{ \delta [v_{0}^{R} \alpha_{S} - R_{S} + \phi^{T} v_{0}^{R}] + (1 - \delta) [(1 - \phi^{A}) v^{g} \alpha_{F} - R_{F} - \phi^{T} v_{0}] \}$$
$$+ (1 - \rho) \{ \delta [v_{0}^{R} \alpha_{S} - R_{S} + \phi^{T} v_{0}^{R}] + (1 - \rho) [(1 - \phi^{A}) v^{b} \alpha_{F} - R_{F} - \phi^{T} v_{0}] \}$$
$$M_{T}(C) = \rho [(1 - \phi^{A}) v^{g} \alpha_{C} - \phi^{T} v_{0}] + (1 - \rho) [(1 - \phi^{A}) v^{b} \alpha_{C} - \phi^{T} v_{0}]$$

If  $\gamma < 1$ , then  $M_T(R) = M_T(C)$  must be satisfied, so that,

$$\delta = \hat{\delta} = \frac{(1 - \phi^{A})v^{g}(\gamma_{C} - \gamma_{F}) + R_{F}}{(v_{0}^{R}\gamma_{S} - R_{S}) - [(1 - \phi^{A})v^{g}\gamma_{F} - R_{F}] + \phi^{T}(v_{0} + v_{0}^{R})}$$

Given  $\gamma < 1$ , then,

$$\begin{split} M_{K}(Y) &= \gamma \{ \delta [P(v_{0}^{R}\beta_{S} + A_{0}^{K} - C_{R}) + (1 - P)(v_{0}^{R}\beta_{H} + A_{0}^{K})] \\ &+ (1 - \delta) [P((1 - \phi^{A})v^{K}\beta_{F} + A_{1}^{K} - C_{R} + \phi^{A}v^{K}) + (1 - P)((1 - \phi^{A})v^{H}\beta_{H} + A_{0}^{K})]\} \\ &+ (1 - \gamma) \{P[(1 - \phi^{A})v^{K}\beta_{C} + A_{1}^{K} - C_{C} + \phi^{A}v^{K}] + (1 - P)[(1 - \phi^{A})v^{H}\beta_{H} + A_{0}^{K}]\} \\ \\ M_{K}(N) &= v_{0}\beta_{0}^{K} + A_{0}^{K} \end{split}$$

If  $\rho = \pi$ , then  $M_{\kappa}(Y) > M_{\kappa}(N)$  must be satisfied, so that,

$$\gamma < \gamma_{\rm K} = \frac{P[(1-\phi^{\rm A})\nu^{\rm K}\beta_{\rm C}+\phi^{\rm A}\nu^{\rm K}] + P(A_{\rm I}^{\rm K}-A_{\rm 0}^{\rm K}) + (1-P)(1-\phi^{\rm A})\nu^{\rm H}\beta_{\rm H} - \nu_{\rm 0}\beta_{\rm 0}^{\rm K}}{P[(1-\phi^{\rm A})\nu^{\rm K}\beta_{\rm c}] - P[(1-\phi^{\rm A})\nu^{\rm K}\beta_{\rm F}] + A_{\rm 0}^{\rm K} - \delta\tilde{\nu}_{\rm 0}^{\rm R}\beta_{\rm H}} + \delta P[(1-\phi^{\rm A})\nu^{\rm K}\beta_{\rm F} - \nu_{\rm 0}^{\rm R}\beta_{\rm S} + (A_{\rm 1}^{\rm K}-A_{\rm 0}^{\rm K}) + \phi^{\rm A}\nu^{\rm K}] + \delta(1-P)(1-\phi^{\rm A})\nu^{\rm H}\beta_{\rm H}}$$

We will get necessary conditions for the existence of the pooling equilibrium:  $\gamma < \gamma_{\rm K}$ 

#### 3. Proof of partial pooling equilibrium

Given  $\theta_G = 1$  and  $\theta_B < 1$ , Belief consistency check :  $\rho = \frac{\pi \theta_G}{\pi \theta_G + (1 - \pi) \theta_B} = \frac{\pi}{\pi + (1 - \pi) \theta_B}$ , so that,

$$M_{T}(R) = \frac{\pi}{\pi + (1 - \pi)\theta_{B}} \{\delta[v_{0}^{R}\alpha_{S} - R_{S} + \phi^{T}v_{0}^{R}] + (1 - \delta)[(1 - \phi^{A})v^{B}\alpha_{F} - R_{F} - \phi^{T}v_{0}]\} + (1 - \frac{\pi}{\pi + (1 - \pi)\theta_{B}})\{\delta[v_{0}^{R}\alpha_{S} - R_{S} + \phi^{T}v_{0}^{R}] + (1 - \delta)[(1 - \phi^{A})v^{B}\alpha_{F} - R_{F} - \phi^{T}v_{0}]\}$$

$$M_{\rm T}(C) = \frac{\pi}{\pi + (1 - \pi)\theta_{\rm B}} [(1 - \phi^{\rm A})v^{\rm g}\alpha_{\rm C} - \phi^{\rm T}v_{\rm 0}] + (1 - \frac{\pi}{\pi + (1 - \pi)\theta_{\rm B}})[(1 - \phi^{\rm A})v^{\rm b}\alpha_{\rm C} - \phi^{\rm T}v_{\rm 0}]$$

If  $\gamma = 1$ , then  $M_T(R) > M_T(C)$  must be satisfied, so that,

$$\theta_{B} > \hat{\theta} = \frac{\pi}{1 - \pi} \left\{ \frac{(1 - \phi^{A}) v^{g} (\alpha_{C} - \alpha_{F}) + \delta[(1 - \phi^{A}) v^{g} \alpha_{F} - v_{0}^{R} \alpha_{S} - \phi^{T} v_{0}^{R} + R_{S}] - (1 - \delta) R_{F}}{-(1 - \phi^{A}) v^{b} (\alpha_{C} - \alpha_{F}) - \delta[(1 - \phi^{A}) v^{b} \alpha_{F} - v_{0}^{R} \alpha_{S} - \phi^{T} v_{0}^{R} + R_{S}] + (1 - \delta) R_{F}} \right\}$$

Given  $\gamma = 1$ , then,

$$M_{K}(Y) = \delta[P(v_{0}^{R}\beta_{S} + A_{0}^{K} - C_{R}) + (1 - P)(v_{0}^{R}\beta_{H} + A_{0}^{K})] + (1 - \delta)[P((1 - \phi^{A})v^{K}\beta_{F} + A_{1}^{K} - C_{R} + \phi^{A}v^{K}) + (1 - P)((1 - \phi^{A})v^{H}\beta_{H} + A_{0}^{K})]$$

$$M_{K}(N) = \nu_0 \beta_0^K + A_0^K$$

If 
$$\rho = \frac{\pi}{\pi + (1 - \pi)\theta_B}$$
, then  $M_G(Y) > M_G(N)$  and  $M_B(Y) = M_B(N)$  must be satisfied, so that,  

$$\delta < \overline{\delta} = \frac{\phi^A [P v^G - P v^G \beta_F - (1 - P) v^H \beta_H] + P(v^G \beta_F - C_R) + P(A_1^G - A_0^G) + (1 - P) v^H \beta_H - v_0 \beta_0^G}{\phi^A [P v^G - P v^G \beta_F - (1 - P) v^H \beta_H] + P(v^G \beta_F - v_0^R \beta_S) + P(A_1^G - A_0^G) + (1 - P) (v^H \beta_H - v_0^R \beta_H)}$$

$$\delta = \underline{\delta} = \frac{\phi^A [P v^B - P v^B \beta_F - (1 - P) v^H \beta_H] + P(v^B \beta_F - C_R) + P(A_1^B - A_0^B) + (1 - P) v^H \beta_H - v_0 \beta_0^B}{\phi^A [P v^B - P v^B \beta_F - (1 - P) v^H \beta_H] + P(v^B \beta_F - C_R) + P(A_1^B - A_0^B) + (1 - P) (v^H \beta_H - v_0 \beta_0^B)}$$

Given  $\overline{\delta} > \underline{\delta}$  and  $\gamma = 1$ ,  $M_G(Y) > M_G(N)$  and  $M_B(Y) = M_B(N)$  will always exist.

We will get necessary conditions for the existence of the partial pooling equilibrium:  $\theta_{B} > \hat{\theta}$ 

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