A Unified Theory of Forward- and Backward-looking M&As and Divestitures

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Abstract

In a unified theory of forward- and backward-looking M&As and divestitures, an M&A today may be a cause for a divestiture in the future; conversely a divestiture today may be a consequence of an M&A in the past. M&As and divestitures are not only two sides of the same coin, they are also causes and consequences of each other. In this paper, in a two-period model, two firms consider integrating or separating in each period. We analyze forward- and backward-looking M&As and divestitures, and compare them with static M&As and divestitures.

Keywords: unified framework, forward looking, backward looking, M&A, divestiture

JEL classification: G34

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1. Introduction

In the business world, it is common to see a firm acquiring another firm but later divesting it, or a firm divesting a division but later reacquiring it. Ravenscraft and Scherer (1987) find that 33% of acquisitions in the 1960s and 1970s were later divested. Porter (1987) finds that more than half of the acquisitions in new industries were subsequently divested and a startling 74% of the unrelated acquisitions were later divested. He observed that "even a highly respected company like General Electric divested a very high percentage of its acquisitions." Kaplan and Weisbach (1992) also find that, for a sample of large acquisitions during 1971-1982, the acquirers divested almost 44% of the acquired divisions by the end of 1989. Empirical evidence indicates that firms that merge and then divest often perform well in the interim period, indicating that divestitures are not failures of the past (Allen *et al.*, 1995).

Most of the literature on mergers and acquisitions (M&As) treats M&As and divestitures as separate strategic decisions (see survey papers by Singh (1993), Johnson (1996), Brauer (2006), Moschieri and Mair (2008), and Hitt *et al.* (2009)). The literature has discussed many possible reasons for M&As and divestitures, including market power, scale economies, risk aversion, operational synergies, and legal and tax benefits. However, many of these reasons arguably fail to explain M&As and divestitures, especially since most of the acquired divisions are later divested. Given that a divested business unit is often one that was acquired in the past, it is conceivable that when deciding whether or not to acquire a business unit, firms take into account the possibility of divesting that unit in the future. Conversely, a planned divestiture in the future is likely to be conditional on what the firm decides to do today. Hence, M&As and divestitures are naturally tied across time in firms' considerations.

There are relatively few studies focusing on the tied M&As and divestitures which are actually causes and consequences of each other. Weston (1989) lists 14 reasons for M&As and divestitures. He concludes that "the data on divestiture/acquisition rates portray a healthy dynamic interplay between the strategic planning of U.S. companies and continually shifting market forces". A popular view in the literature is that "acquirers often buy other firms only to sell them later". Porter (1987) finds that most divestitures are successful acquisitions of the past. Prior literature further points out that the option of divesting an acquired division is what makes the value of an acquisition positive (Porter, 1987; Weston, 1989; Aron, 1991; Kaplan and Weisbach, 1992; Shimizu and Hitt, 2005; Fulghieri and Hodrick, 2006) and that the reacquisition of a divested division is also efficient (Aron, 1991). Fluck and Lynch (1999) theorize that an acquisition occurs when the acquiree needs funding (e.g. a start-up or distressed firm) and this acquiree is later divested once its performance has improved sufficiently to allow it to be standalone again. However, by examining the 1960s conglomerate wave, Hubbard and Pahlia (1999) find that acquirers neither appear to have higher levels of free cash flows than non-acquirers nor are they punished by the stock market. We argue that two firms may choose to integrate today simply because they plan to be integrated or to separate in the future or because they were integrated or separated in the past. Our theory is consistent with both Fluck and Lynch's (1999) theory and Hubbard and Pahlia's (1999) empirical finding.

We develop a two-period model with two firms, a downstream firm (DF) and an upstream firm (UF). In this setting, we deal with related M&As and divestitures. Our model is built on the view that mergers and divestitures are corporate strategies based on internal characteristics and capabilities and external market conditions. When the firms decide to integrate or separate in the first period, they will have considered whether to be integrated or separated in the second period. Similarly, when the firms plan to integrate or separate in the second period, their plan is affected by what they do now. Without the influence of the decision in one period, the decision in the other period (called a <u>static solution</u>) can be very different. We emphasize the influence of past and expected future decisions. When considering integration or separation now, whether they are already integrated or separated will obviously have a major influence. When a decision takes into account another decision in the future, we call it a <u>forward-looking decision</u>. We also consider backward-looking mergers and divestitures, where a <u>backward-looking decision</u> takes into account a decision made in the past. We identify forward-looking and backward-looking behavior by comparing a two-period dynamic solution with a one-period static solution. If we compare a two-period solution with a one-period solution in the first period, we can identify the forward-looking effect in the two-period solution. If we compare a two-period solution with a one-period solution in the second period, we can identify the backward-looking effect in the two-period solution. For example, a backward-looking merger is a merger that is conditional on the fact that the two firms were merged or separated in the past. We provide a unified model in which both mergers and divestitures are decisions and both decisions can be forward or backward looking.

Our model has a number of interesting features. *First*, it is <u>safer to be part of a firm</u> than to be an independent firm in the competitive market. An upstream division in a firm has the advantage that there is always a demand for its product. An independent upstream firm faces the risk of not being able to find a buyer for its product. *Second*, asset specificity plays a role when a firm's status changes from separated to integrated or vice versa. An upstream division in an integrated firm may have to produce a specific intermediate product for the firm. But when it is an independent firm in the market, it may have to produce a general product for the market. This means that the upstream firm may incur adjustment cost when it switches from being an integrated division to being an independent firm, and vice versa. Due to asset specificity, there is an adjustment cost for an organizational change. The adjustment cost is a force working against a reversal of an earlier decision. Hence, the UF changes its status only if the benefit of doing so is large enough. For more on such adjustment cost in the literature, see theoretical analysis in Riordan and Williamson (1985) and empirical evidence in Chang and Singh (1999). The use of adjustment cost in our model is consistent with those studies in the literature that emphasize organizational inertia (Hannan and Freeman, 1984; Riordan, 1990; Amburgey *et al.* 1993; Shimizu and Hitt, 2005). *Third*, market fluctuation is a factor in organizational decisions. Our model takes into account the fact that the market may expand or contract over time. The firms may decide to change their organizational structure in response to market changes. *Fourth*, our model takes into account synergy when the two firms integrate. Synergy under integration is captured by the condition that the marginal output under integration is larger than that under separation. Synergy in our model is endogenous in the sense that, when the two firms merge, their contractual relationship changes accordingly, which affects incentives and in turn the gain from synergy. Negative synergy is also allowed. In fact, even when negative synergy and adjustment cost exist, the two firms may choose to integrate if other conditions are ripe for integration. *Fifth*, incentives are governed by contracts. A contract is a revenue-sharing arrangement offered by a firm's owners to its manager. We identify the optimal contracts for several common cases. Incentive encourages "effort", which includes work attitude, work intensity, time spent, and financial investment. The solution from our model offers an optimal linear contract—a contract that is at least as good as any nonlinear contract. In the literature, most so-called optimal linear contracts are not optimal since they are strictly inferior to many nonlinear contracts. *Sixth*, a firm's internal contractual arrangement is conditional on its organizational structure. This means that, if the two firms change their organizational structure, their internal contractual relationship will adjust accordingly. *Seventh*, managers in independent firms may have better incentives than divisional managers. A feature specific to our model is that, the UF's incentive is better under separation, since the contract under separation is based on the UF's output directly while the contract under integration is related to the UF's output indirectly through the DF's revenue. *Eighth*, the mood in the marketplace may affect firms' decisions. We use a discount factor of time preferences to take into account the market mood. The firms may decide to integrate early if they feel optimistic now, and they may decide to separate later if they feel pessimistic now. This discount factor may also be due to risk aversion to uncertainty in the marketplace. *Ninth*, our model emphasizes forward expectations and backward history dependence in firms' decisions. *Tenth*, the history is exogenous in the "dependence on history" in the literature. However, it is endogenous in our "dependence on the past". The current decision is a planned decision in the past when the past decision was made, and the past decision was made conditional on the current decision. In this sense, we say that the past is endogenous to the current decision. Dependence on endogenous history is fundamentally different from dependence on exogenous history. For example, market fluctuations have no effect on our forward-looking solutions. The explanation is that, since a planned decision has already taken into account market fluctuations in the future, it need not do so again when the time comes to carrying out that decision. *Finally*, our model is based on the view that diversification/integration is value enhancing. Some papers in the literature argue that diversification/integration is value destroying (see Fama (1980), Amihud and Lev (1981), Hart (1983), Jensen and Ruback (1983), Jensen (1986), Shleifer and Vishny (1989), Jensen and Murphy (1990), and Stulz (1990)). We do not subscribe to the view in the literature that "divestitures represent failures". We believe that firms integrate or separate only if doing so improves their overall profitability.

Our solution is consistent with many empirical findings, and it can explain some seemingly puzzling phenomena. *First*, our solution includes the case (case IS) in which a firm acquires another for the purpose of selling it later at a higher value. This is consistent with many studies in prior literature, including Kaplan and Weisbach's (1992) observation that on average targets are divested at 143% of their preacquisition market value, John and Ofek's (1995) empirical finding that a typical divested division performs as well as the industry at the time of divestiture, and Fluck and Lynch's (1999) theoretical prediction that mergers are followed by good performance and divestitures. *Second*, our solution is consistent with the evidence that diversified firms are less valuable than focused firms (Lang and Stulz, 1994; Berger and Ofek, 1995; Servaes, 1996). In our solution, two firms may choose to integrate or separate due to past and planned decisions, and not because of current value only. M&As and divestitures may be value enhancing if we take into account their forward- and backward-looking behavior, but they may be value destroying if we look at their current value only. *Third*, firms are often observed to divest poorly performing divisions (Hayward and Shimizu, 2006). In our solution, the DF may acquire the UF conditional on a plan to divest it when the latter becomes unprofitable due to prevailing market conditions. In this case, the acquirer is shown to have acquired a poorly performing firm ex post. This is due to the forward-looking behavior, and not because of entrenchment, mistakes, etc. *Fourth*, our solution is consistent with two seemingly contradictory empirical findings: (1) mergers increase the combined value of the acquirer and the target and (2) diversified firms are less valuable than more focused standalone entities. Claim (1) is based on the stock market reactions when a merger is announced, and hence on ex ante evaluations. Claim (2) is based on ex post results. We allow a situation in which a firm divests a division because of a past decision or an expected future decision, and not because of the division's current performance. Integration may be value enhancing ex ante by being forward looking, but it may be value reducing ex post by being backward looking. This can happen, for example, if integration offers security to acquirees. Also, as will be shown in Proposition 3, an M&A is likely to happen if substantial synergy exists and firms feel very optimistic now. In these two examples, the acquisition improves the overall value ex ante, but it may reduce the overall value ex post.

Our main findings are: Forward- and backward-looking organizational decisions are substantially different from static ones. The influence of the past is stronger if the market is contracting, if the adjustment cost is larger, or if the time preference for the future is weaker. On the other hand, the influence of the future is stronger if the adjustment cost is larger, if the preference for the future is stronger, or if the chance of making deals in the market is lower. Further, in the case where two firms do decide to integrate for a short term, the tendency for late (early) integration over early (late) integration is stronger if the marginal output under integration is substantially less than that under separation, if the chance of making deals in the market is higher, or if the market is expanding sufficiently quickly.

This paper proceeds as follows. Section 2 presents the model. Section 3 derives the solution. There are four cases: the two firms separate in the first period but reintegrate in the second period, the two firms integrate in the first period but separate in the second period, the two firms integrate in the first period and remain integrated in the second period, and the two firms separate in the first period and remain separated in the second period. Section 4 presents and analyzes a parametric solution. Section 5 concludes the paper. Finally, the appendix provides proofs of the results in Section 3 and justifies our choice of the parametric functions in Section 4.

2. The Model

Consider a two-period model with two firms, a downstream firm (DF) and an upstream firm (UF). If the two firms are separate, the DF buys input x from the market or the UF; if the two firms are integrated, the DF is the sole user of the UF's output x and the UF is the DF's sole supplier.

In practice, the DF is typically the parent firm. Hence, the DF is the principal and the UF is the agent in our model. This means that if the two firms are integrated, the DF designs and offers a profit-sharing contract to the UF, and the UF decides whether to take it or leave it. If the two firms are separate, with probability θ, the UF receives a purchasing contract from the DF for its output; with probability $1-\theta$, the UF receives no contract. The DF can always buy the same input from other upstream firms.

The two firms invest into their own production separately. The UF's investment is denoted by a, and the DF's investment is denoted by b. We call them efforts, which includes work attitude, work intensity, time spent, and financial investment. The costs of efforts for the UF and DF are respectively $c_U(a)$ and $c_D(b)$. As is typical in agency problems, these costs are private, meaning that each party pays for its own cost (not covered in a contract).

Let $\pi_t(x, b)$ be the DF's profit function in period t. This profit is the pre-contractual profit, which includes part of the production costs, but not the cost of x and b. The appendix offers a more detailed explanation of the pre-contractual profit. The market may expand or contract, which is an important factor in organizational decisions. The dependence of the profit on time allows us to incorporate market fluctuations. The firms may decide to change their organizational relationship in response to the changing market.

Let $x_s(a)$ be the UF's output function under status s, where the status can be either $s = I$ for "integration" or $s = S$ for "separation". The dependence of the UF's output on the status allows us to take into account synergy when the two firms integrate. Synergy exists if the UF's marginal output is increased after it is acquired by the DF. Negative synergy is also allowed. In fact, even when negative synergy and adjustment cost exist, the two firms may choose to integrate if other conditions strongly favor integration.[1]

We incorporate asset specificity in our model. If the two firms are integrated, the UF produces a relationship-specific product for the integrated firm; if not, it produces a general product for the market. Suppose there is adjustment cost $c_A(x, b)$ when the UF switches from producing a general product to a specific product or vice versa. The UF pays this cost out of its own pocket. This cost is dependent on its production capacity and the product's technological level. We use the UF's first-period output x to represent the production capacity and the DF's first-period investment b to represent the technological level. Imagine that the UF hires someone to adjust machines and production procedures when it switches from producing a specific product to a general product or vice versa. We expect the marginal cost of this activity to be diminishing. Hence, we can assume $c_A(x, b)$ to be concave. This adjustment cost discourages the UF from changing its status and hence is a force working against a reversal of an earlier decision.

We also incorporate market risk in our model. A type of market risk is the risk of failing to make a deal when the UF becomes an independent firm in a competitive market. Given contractual payment $s(x)$, if the UF receives a purchasing contract, its payoff under separation is

$$u(\tilde{x}) = \theta s(x),$$

[1] We can easily extend our model to allow profit π_t and output x_t in each period to be random. This extension is shown in the Appendix. All our results remain the same after this extension.

where θ is the probability of having a deal. When there is no deal, there is no payoff. We assume that the DF can always find a supplier of x, but the UF may not be able to find a buyer for its product. Although θ is given a specific meaning in our model, we can think of θ as representing market risks when the UF is independent in the market.[2] Hence, it is safer to be part of a firm than to be independent in the competitive market. An upstream division in an integrated firm has the advantage that there is always a demand for its product. An independent UF faces the risk of not being able to find a buyer.

There is a discount factor δ on the payoff of the second period. This δ represents the preference for the future. We may interpret it as representing the market mood. The mood in the marketplace may affect firms' decisions. The firms may decide to integrate early if they feel optimistic now, and they may decide to separate later if they feel pessimistic now. We may also interpret this discount factor as representing risk aversion to uncertainty in the market.

Investments/efforts a and b are not verifiable, but profit and output π_t and x_s are verifiable ex post. Incentives for investments are provided by contracts. A contract is a profit- or output-sharing rule. The contract $s(x_s)$ for the UF under separation is the payment to the UF based on the UF's output, while the contract $s(\pi_t)$ for the UF under integration is the payment to the UF based on the DF's profit.[3]

When the firms decide to integrate or separate in the first period, they will think/decide ahead about whether they want to be integrated or separated in the second period. Similarly, when the firms decide to integrate or separate in the second period, their decision is affected by what they do now. Such forward- and backward-looking behavior lead to four possibilities:

- Case SI: The two firms are separated in the first period, but integrated in the second period.
- Case IS: The two firms are integrated in the first period, but separated in the second period.
- Case II: The two firms are integrated in both periods.
- Case SS: The two firms are separated in both periods.

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[2] We can easily extend our model to allow θ and $x_s(a)$ to be dependent on time t (the period). Allowing θ and $x_s(a)$ to be time-dependent captures the influence of market conditions on them. However, it turns out that these extensions are unnecessary since all our results remain the same.

[3] A more general contract of the form $s(\pi_t, x)$ under integration will not change the solution at all.

There are a few underlying tradeoffs between integration and separation in our model. First, the UF's incentive is better under separation, but it faces a risk of having no business under separation. On the one hand, when the UF is independent, its income is directly related to its output; this is not so when the UF is acquired by the DF. Hence, the UF has better incentives when it is independent. On the other hand, integration guarantees demand, but there is no guarantee of demand under separation. Second, the adjustment cost deters organizational changes, but market risks and fluctuations encourage organizational changes. For example, a quickly expanding market may induce firms to emphasize incentives so that separation becomes a more preferable option.

3. The Four Cases

In this section, we set up the optimization problem for each of the four cases and find its solution.

3.1. Case SI

In this case, the two firms are separated in the first period but integrated in the second period. In the second period, the UF receives a contract $s_2(\pi)$. This contract is based on the integrated firm's profit π since the two firms are integrated at that time. The UF's ex post problem in the second period is

$$U_2(a_1, b_1) \equiv \max_{a} \; s_2\{\pi[x(a), b]\} - c_U(a) - c_A[x(a_1), b_1],$$

where the UF has to pay the adjustment cost for switching from being an independent firm to being an integrated firm. The adjustment cost c_A is dependent on the past (first-period) production capacity $x(a_1)$ and investment b_1. Here, "ex post" is after a contract is accepted, while "ex ante" is before a contract is accepted. The first-order condition (FOC) is

$$s_2'\{\pi[x(a), b]\}\pi_x'[x(a), b]x'(a) = c_U'(a).$$

The DF's ex post problem in the second period is

$$\max_{b} \; \pi[x(a), b] - s_2\{\pi[x(a), b]\} - c_D(b).$$

Its FOC is

$$\pi_b'[x(a), b] - s_2'\{\pi[x(a), b]\}\pi_b'[x(a), b] = c_D'(b).$$

Then, the DF's ex ante problem in the second period is

$$
\begin{aligned}
V_2(a_1, b_1) \equiv \max_{a,b,s_2(\cdot)} \; & \pi[x(a), b] - s_2\{\pi[x(a), b]\} - c_D(b) \\
\text{s.t. } \; & IC_1\!: \; s_2'\{\pi[x(a), b]\}\pi_x'[x(a), b]x'(a) = c_U'(a) \\
& IC_2\!: \; \pi_b'[x(a), b] - s_2'\{\pi[x(a), b]\}\pi_b'[x(a), b] = c_D'(b) \\
& IR\!: \quad s_2\{\pi[x(a), b]\} \geq c_U(a) + c_A[x(a_1), b_1].
\end{aligned} \tag{1}
$$

Here, $\pi(x, b)$ is actually $\pi_2(x_I, b_2)$ and $x(a)$ is actually $x_I(a_2)$, indicating second-period variables under integration. For convenience, we do not specify the subscripts. This applies to all cases. When necessary, the subscripts will be specified. As shown in the Appendix, problem (1) can be solved in two steps. First, we solve the following problem for optimal efforts (a^*, b^*) without referring to s_2:

$$
\begin{aligned}
V_2(a_1, b_1) = \max_{a,b} \; & \pi[x(a), b] - c_U(a) - c_D(b) - c_A[x(a_1), b_1] \\
\text{s.t. } \; & \left(1 - \frac{c_U'(a)}{\pi_x'[x(a), b]x'(a)}\right)\pi_b'[x(a), b] = c_D'(b).
\end{aligned} \tag{2}
$$

Second, given (a^*, b^*) and (a_1, b_1), we find an s_2 that satisfies

$$
\begin{aligned}
& s_2'\{\pi[x(a^*), b^*]\}\pi_x'[x(a^*), b^*]x'(a^*) = c_U'(a^*) \\
& s_2\{\pi[x(a^*), b^*]\} = c_U(a^*) + c_A[x(a_1), b_1].
\end{aligned} \tag{3}
$$

We can find a linear contract of the form $s_2(\pi) = \alpha_2\pi + \beta_2$, with two constants α_2 and β_2, to satisfy (3).

In the first period, the two firms are separated. With probability θ, the DF offers a contract $s_1(x)$ to the UF in the first period based on the UF's output x; with probability $1 - \theta$, the UF cannot find a buyer for its product in the first period. Given this contract, the UF's ex post problem in the first period is

$$
U_1 \equiv \max_a \; \theta s_1[x(a)] - c_U(a) + \delta\theta U_2(a, b),
$$

where θ is applied to the second-period payoff since the DF picks the UF with probability θ to integrate; with probability $1 - \theta$, the UF is not integrated with the DF in the second period. The FOC of the above problem is

$$
\theta s_1'[x(a)]x'(a) + \delta\theta U_{2,a}'(a, b) = c_U'(a).
$$

The DF's ex post problem in the first period is

$$
\max_b \; \pi[x(a), b] - s_1[x(a)] - c_D(b) + \delta V_2(a, b).
$$

Its FOC is

$$
\pi_b'[x(a), b] + \delta V_{2,b}'(a, b) = c_D'(b).
$$

Then, the DF's ex ante problem in the first period is

$$
\begin{aligned}
V_{SI} \equiv \max_{a,b,s_1(\cdot)} \ & \pi[x(a),b] - s_1[x(a)] - c_D(b) + \delta V_2(a,b) \\
\text{s.t.} \quad & IC_1\colon\ \theta s_1'[x(a)]x'(a) + \delta\theta U_{2,a}'(a,b) = c_U'(a), \\
& IC_2\colon\ \pi_b'[x(a),b] + \delta V_{2,b}'(a,b) = c_D'(b), \\
& IR\colon\quad \theta s_1[x(a)] + \delta\theta U_2(a,b) \geq c_U(a).
\end{aligned} \tag{4}
$$

As shown in the Appendix, problem (4) can be solved in two steps. First, we solve the following problem for optimal efforts (a^*, b^*) without referring to s_1:

$$
\begin{aligned}
V_{SI} = \max_{a,b} \ & \pi[x(a),b] - \theta^{-1}c_U(a) - c_D(b) + \delta V_2(a,b) \\
\text{s.t.} \ & \pi_b'[x(a),b] + \delta V_{2,b}'(a,b) = c_D'(b).
\end{aligned} \tag{5}
$$

Second, given (a^*, b^*), we find an s_1 that satisfies

$$
\begin{aligned}
& \theta s_1'[x(a^*)]x'(a^*) = c_U'(a^*), \\
& \theta s_1[x(a^*)] = c_U(a^*).
\end{aligned} \tag{6}
$$

We can find a linear contract of the form $s_1(x) = \alpha_1 x + \beta_1$, with two constants α_1 and β_1, to satisfy (6).

3.2. Case IS

In this case, the two firms are integrated in the first period but separated in the second period. In the second period, with probability θ, the UF receives a contract $s_2(x)$. The UF has to pay the adjustment cost for switching from being an integrated firm to being an independent firm. The UF's ex post problem is

$$
U_2(a_1, b_1) \equiv \max_a \ \theta s_2\big[x(a)\big] - c_U(a) - c_A[x(a_1), b_1].
$$

Its FOC is

$$
\theta s_2'\big[x(a)\big]x'(a) = c_U'(a).
$$

The DF's ex post problem is

$$
\max_b \ \pi[x(a),b] - s_2\big[x(a)\big] - c_D(b).
$$

Its FOC is

$$
\pi_b'[x(a),b] = c_D'(b).
$$

Then, the DF's ex ante problem is

$$
\begin{aligned}
V_2(a_1, b_1) \equiv \max_{a,b,s_2(\cdot)} \ & \pi[x(a), b] - s_2\big[x(a)\big] - c_D(b) \\
\text{s.t.} \ & IC_1\text{: } \theta s_2'\big[x(a)\big]x'(a) = c_U'(a), \\
& IC_2\text{: } \pi_b'[x(a), b] = c_D'(b), \\
& IR\text{: } \quad \theta s_2\big[x(a)\big] \geq c_U(a) + c_A[x(a_1), b_1].
\end{aligned} \tag{7}
$$

As shown in the Appendix, problem (7) can be solved in two steps. We first solve the following problem for optimal efforts (a^*, b^*) without referring to s_2:

$$
\begin{aligned}
V_2(a_1, b_1) = \max_{a,b} \ & \pi[x(a), b] - c_D(b) - \theta^{-1}c_U(a) - \theta^{-1}c_A[x(a_1), b_1] \\
\text{s.t.} \ & \pi_b'[x(a), b] = c_D'(b).
\end{aligned} \tag{8}
$$

Then, given (a^*, b^*) and (a_1, b_1), we find an s_2 that satisfies

$$
\begin{aligned}
& \theta s_2'\big[x(a^*)\big]x'(a^*) = c_U'(a^*), \\
& \theta s_2\big[x(a^*)\big] = c_U(a^*) + c_A[x(a_1), b_1].
\end{aligned} \tag{9}
$$

We can find a linear contract of the form $s_2(x) = \alpha_2 x + \beta_2$, with two constants α_2 and β_2, to satisfy (9).

In the first period, the two firms are integrated. The DF offers a contract $s_1(\pi)$ based on its profit π to the UF. Given this contract, the UF's ex post problem is

$$
U_1 \equiv \max_a \ s_1\big\{\pi[x(a), b]\big\} - c_U(a) + \delta U_2(a, b).
$$

Its FOC is

$$
s_1'\big\{\pi[x(a), b]\big\}\pi_x'[x(a), b]x'(a) + \delta U_{2,a}'(a, b) = c_U'(a).
$$

The DF's ex post problem is

$$
\max_b \ \pi[x(a), b] - s_1\big\{\pi[x(a), b]\big\} - c_D(b) + \delta V_2(a, b).
$$

Its FOC is

$$
\pi_b'[x(a), b] - s_1'\big\{\pi[x(a), b]\big\}\pi_b'[x(a), b] + \delta V_{2,b}'(a, b) = c_D'(b).
$$

Then, the DF's ex ante problem is

$$
\begin{aligned}
V_{IS} \equiv \max_{a,b,s_1(\cdot)} \ & \pi[x(a), b] - s_1\big\{\pi[x(a), b]\big\} - c_D(b) + \delta V_2(a, b) \\
\text{s.t.} \ & IC_1\text{: } s_1'\big\{\pi[x(a), b]\big\}\pi_x'[x(a), b]x'(a) + \delta U_{2,a}'(a, b) = c_U'(a), \\
& IC_2\text{: } \pi_b'[x(a), b] - s_1'\big\{\pi[x(a), b]\big\}\pi_b'[x(a), b] + \delta V_{2,b}'(a, b) = c_D'(b), \\
& IR\text{: } \quad s_1\big\{\pi[x(a), b]\big\} + \delta U_2(a, b) \geq c_U(a).
\end{aligned} \tag{10}
$$

As shown in the Appendix, problem (10) can be solved in two steps. We first solve the following problem for optimal efforts (a^*, b^*) without referring to s_1:

$$V_{IS} = \max_{a,b} \pi[x(a),b] - c_U(a) - c_D(b) + \delta V_2(a,b)$$
$$\text{s.t. } \pi'_b[x(a),b]\left(1 - \frac{c'_U(a)}{\pi'_x[x(a),b]x'(a)}\right) + \delta V'_{2,b}(a,b) = c'_D(b). \tag{11}$$

Then, given (a^*, b^*), we find an s_1 that satisfies

$$\begin{aligned} &s'_1\{\pi[x(a^*),b^*]\}\pi'_x[x(a^*),b^*]x'(a^*) = c'_U(a^*), \\ &s_1\{\pi[x(a^*),b^*]\} = c_U(a^*). \end{aligned} \tag{12}$$

We can find a linear contract of the form $s_1(\pi) = \alpha_1\pi + \beta_1$, with two constants α_1 and β_1, to satisfy (12).

3.3. Case II

In this case, the two firms are integrated in both periods. In the second period, the DF offers a contract $s_2(\pi)$ to the UF. Given this contract, the UF's ex post problem is

$$U_2 \equiv \max_a \; s_2\{\pi[x(a),b]\} - c_U(a).$$

Its FOC is

$$s'_2\{\pi[x(a),b]\}\pi'_x[x(a),b]x'(a) = c'_U(a).$$

The DF's ex post problem is

$$\max_b \; \pi[x(a),b] - s_2\{\pi[x(a),b]\} - c_D(b).$$

Its FOC is

$$\pi'_b[x(a),b] - s'_2\{\pi[x(a),b]\}\pi'_b[x(a),b] = c'_D(b).$$

Then, the DF's ex ante problem is

$$\begin{aligned} V_2 \equiv \max_{a,b,s_2(\cdot)} \; & \pi[x(a),b] - s_2\{\pi[x(a),b]\} - c_D(b) \\ \text{s.t. } \; & IC_1\!: \; s'_2\{\pi[x(a),b]\}\pi'_x[x(a),b]x'(a) = c'_U(a) \\ & IC_2\!: \; \pi'_b[x(a),b] - s'_2\{\pi[x(a),b]\}\pi'_b[x(a),b] = c'_D(b) \\ & IR\!: \quad s_2\{\pi[x(a),b]\} \geq c_U(a). \end{aligned} \tag{13}$$

As shown in the Appendix, problem (13) can be solved in two steps. We first solve the following problem for optimal efforts (a^*, b^*) without referring to s_2:

$$V_2 = \max_{a,b} \pi[x(a),b] - c_U(a) - c_D(b)$$
$$\text{s.t. } \pi'_b[x(a),b]\left(1 - \frac{c'_U(a)}{\pi'_x[x(a),b]x'(a)}\right) = c'_D(b). \tag{14}$$

Then, given (a^*, b^*), we find an s_2 that satisfies

$$s_2'\{\pi[x(a^*), b^*]\}\pi_x'[x(a^*), b^*]x'(a^*) = c_U'(a^*),$$
$$s_2\{\pi[x(a^*), b^*]\} = c_U(a^*). \tag{15}$$

We can find a linear contract of the form $s_2(\pi) = \alpha_2\pi + \beta_2$, with two constants α_2 and β_2, to satisfy (15).

In the first period, the two firms are integrated. The DF offers a contract $s_1(\pi)$ to the UF. Given this contract, the UF's ex post problem is

$$U_1 \equiv \max_a \ s_1\{\pi[x(a), b]\} - c_U(a) + \delta U_2.$$

Its FOC is

$$s_1'\{\pi[x(a), b]\}\pi_x'[x(a), b]x'(a) = c_U'(a).$$

The DF's ex post problem is

$$\max_b \ \pi[x(a), b] - s_1\{\pi[x(a), b]\} - c_D(b) + \delta V_2.$$

Its FOC is

$$\pi_b'[x(a), b] - s_1'\{\pi[x(a), b]\}\pi_b'[x(a), b] = c_D'(b).$$

Then, the DF's ex ante problem is

$$\begin{aligned} V_{II} \equiv \max_{a,b,s_1(\cdot)} \ & \pi[x(a), b] - s_1\{\pi[x(a), b]\} - c_D(b) + \delta V_2 \\ \text{s.t.} \quad & IC_1\!: \ s_1'\{\pi[x(a), b]\}\pi_x'[x(a), b]x'(a) = c_U'(a), \\ & IC_2\!: \ \pi_b'[x(a), b] - s_1'\{\pi[x(a), b]\}\pi_b'[x(a), b] = c_D'(b), \\ & IR\!: \quad s_1\{\pi[x(a), b]\} + \delta U_2 \geq c_U(a). \end{aligned} \tag{16}$$

As shown in the Appendix, problem (16) can be solved in two steps. We first solve the following problem for optimal efforts (a^*, b^*) without referring to s_1:

$$\begin{aligned} V_{II} = \max_{a,b} \ & \pi[x(a), b] - c_U(a) - c_D(b) + \delta V_2 \\ \text{s.t.} \quad & \pi_b'[x(a), b]\left(1 - \frac{c_U'(a)}{\pi_x'[x(a), b]x'(a)}\right) = c_D'(b). \end{aligned} \tag{17}$$

Then, given (a^*, b^*), we find an s_1 that satisfies

$$s_1'\{\pi[x(a^*), b^*]\}\pi_x'[x(a^*), b^*]x'(a^*) = c_U'(a^*),$$
$$s_1\{\pi[x(a^*), b^*]\} = c_U(a^*). \tag{18}$$

We can find a linear contract of the form $s_1(\pi) = \alpha_1\pi + \beta_1$, with two constants α_1 and β_1, to satisfy (18).

3.4. Case SS

In this case, the two firms are separate in both periods. In the second period, with probability θ, the UF receives contract $s_2(x)$. The UF's ex post problem is

$$U_2 \equiv \max_a \ \theta s_2[x(a)] - c_U(a).$$

Its FOC is

$$\theta s_2'[x(a)]x'(a) = c_U'(a).$$

The DF's ex post problem is

$$\max_b \ \pi[x(a), b] - s_2[x(a)] - c_D(b).$$

Its FOC is

$$\pi_b'[x(a), b] = c_D'(b).$$

Then, the DF's ex ante problem is

$$\begin{aligned} V_2 \equiv \max_{a,b,s_2(\cdot)} \ & \pi[x(a), b] - s_2[x(a)] - c_D(b) \\ \text{s.t.} \quad & IC_1\text{:} \ \theta s_2'[x(a)]x'(a) = c_U'(a), \\ & IC_2\text{:} \ \pi_b'[x(a), b] = c_D'(b), \\ & IR\text{:} \quad \theta s_2[x(a)] \geq c_U(a). \end{aligned} \tag{19}$$

As shown in the Appendix, problem (19) can be solved in two steps. We first solve the following problem for optimal efforts (a^*, b^*) without referring to s_2:

$$\begin{aligned} V_2 = \max_{a,b} \ & \pi[x(a), b] - \theta^{-1}c_U(a) - c_D(b) \\ \text{s.t.} \ & \pi_b'[x(a), b] = c_D'(b). \end{aligned} \tag{20}$$

Then, given (a^*, b^*), we find an s_2 that satisfies

$$\begin{aligned} & \theta s_2'[x(a^*)]x'(a^*) = c_U'(a^*), \\ & \theta s_2[x(a^*)] = c_U(a^*). \end{aligned} \tag{21}$$

We can find a linear contract of the form $s_2(x) = \alpha_2 x + \beta_2$, with two constants α_2 and β_2, to satisfy (21).

In the first period, the two firms are also separate. With probability θ, the UF receives contract $s_1(x)$. The UF's ex post problem is

$$U_1 \equiv \max_a \ \theta s_1[x(a)] - c_U(a) + \delta U_2.$$

Its FOC is

$$\theta s_1'[x(a)]x'(a) = c_U'(a).$$

The DF's ex post problem is

$$\max_b \ \pi[x(a), b] - s_1[x(a)] - c_D(b) + \delta V_2.$$

Its FOC is

$$\pi_b'[x(a), b] = c_D'(b).$$

Then, the DF's ex ante problem is

$$\begin{aligned} V_{SS} \equiv \max_{a,b,s_1(\cdot)} \ & \pi[x(a), b] - s_1[x(a)] - c_D(b) + \delta V_2 \\ \text{s.t.} \quad & IC_1\colon \ \theta s_1'[x(a)]x'(a) = c_U'(a), \\ & IC_2\colon \ \pi_b'[x(a), b] = c_D'(b), \\ & IR\colon \quad \theta s_1[x(a)] + \delta U_2 \geq c_U(a). \end{aligned} \tag{22}$$

As shown in the Appendix, problem (22) can be solved in two steps. We first solve the following problem for optimal effort (a^*, b^*) without referring to s_1:

$$\begin{aligned} V_{SS} = \max_{a,b} \ & \pi[x(a), b] - \theta^{-1}c_U(a) - c_D(b) + \delta V_2 \\ \text{s.t.} \ & \pi_b'[x(a), b] = c_D'(b). \end{aligned} \tag{23}$$

Then, given (a^*, b^*), we find an s_1 that satisfies

$$\begin{aligned} & \theta s_1'[x(a^*)]x'(a^*) = c_U'(a^*), \\ & \theta s_1[x(a^*)] = c_U(a^*). \end{aligned} \tag{24}$$

We can find a linear contract of the form $s_1(x) = \alpha_1 x + \beta_1$, with two constants α_1 and β_1, to satisfy (24).

4. Analysis

According to (A2) and (A3), we choose the following functional forms for π_t and x_s:

$$\pi_t(x, b) = A_t f(x, b), \qquad x_s(a) = B_s g(a),$$

where $A_t > 0$ and $B_s > 0$ are some constants and f and g are some functions. More specifically, let

$$\pi_t(x, b) = A_t\sqrt{xb}, \quad x_s(a) = B_s a, \quad c_D(b) = b^2, \quad c_U(a) = a^2, \quad c_A(x, b) = \rho A_1\sqrt{xb}\,, \tag{25}$$

where t is the period and s is the status, $t = 1{,}2$ and $s = S, I$. Here, the adjustment cost is concave. This set of parametric functions are rich enough to capture some popular factors involving mergers and divestitures. For example, synergy under integration is captured by the condition that the marginal output under integration is larger than that under separation, i.e., $B_I > B_S$.

Given this set of functions, the DF's payoffs for the four cases are

$$\begin{aligned}
V_{SI} &= \frac{(1-\rho\delta)^2\sqrt{\theta}}{8}A_1^2B_S + \frac{3\delta}{32}A_2^2B_I,\\
V_{IS} &= \frac{3}{32}\left(1-\frac{\rho\delta}{\theta}\right)^2 A_1^2B_I + \frac{\delta\sqrt{\theta}}{8}A_2^2B_S,\\
V_{II} &= \frac{3}{32}(A_1^2+\delta A_2^2)B_I,\\
V_{SS} &= \frac{\sqrt{\theta}}{8}(A_1^2+\delta A_2^2)B_S.
\end{aligned} \tag{26}$$

Since the UF has no surplus, these payoffs are also the joint payoffs (social welfare) of the two firms.

We will also consider one-period models. For the one-period model in the first period, we set $\delta = 0$ in the above solutions and obtain payoffs V_{1S} and V_{1I} for separation and integration, respectively. These are the payoffs of separation and integration in the first period when there is no second period. Similarly, for the one-period model in the second period, we obtain payoffs V_{2S} and V_{2I} for the two options from V_2 in cases SS and II. These payoffs are

$$V_{1S} = \frac{\sqrt{\theta}}{8}A_1^2B_S, \quad V_{1I} = \frac{3}{32}A_1^2B_I, \quad V_{2S} = \frac{\sqrt{\theta}}{8}A_2^2B_S, \quad V_{2I} = \frac{3}{32}A_2^2B_I. \tag{27}$$

We identify forward-looking and backward-looking behavior by comparing a two-period dynamic solution with a one-period static solution. By comparing a two-period solution with a one-period solution in the first period, we can identify the forward-looking effect in the two-period solution. By comparing a two-period solution with a one-period solution in the second period, we can identify the backward-looking effect in the two-period solution.

4.1. Influence of Past Decisions

Given the decisions in the first period, we now analyze the decisions in the second period. In the second period, the two firms consider integrating or separating conditional on the decision made in the first period. That is, the firms' organizational decisions in the second period are backward looking. We consider two pairs of comparison:

$$V_{SI} \text{ vs. } V_{SS}, \quad V_{II} \text{ vs. } V_{IS}.$$

In the first pair, the first-period status is separation; in the second pair, the first-period status is integration.

Given First-Period Separation: Cases SI vs. SS

Given that the two firms are separate in the first period, they consider integrating or staying separate in the second period. We find that $V_{SI} > V_{SS}$ if and only if

$$\frac{B_I}{B_S} > \frac{4\sqrt{\theta}}{3}\left[1 + \frac{1-(1-\rho\delta)^2}{\delta}\left(\frac{A_1}{A_2}\right)^2\right]. \tag{28}$$

We can draw five conclusions from (28). First, since (28) is more likely to hold if B_I/B_S is larger, given separation in the first period, the tendency for integration in the second period is stronger if the UF's marginal output under integration is substantially larger than that under separation. Second, since (28) is more likely to hold if θ is smaller, given separation in the first period, the tendency for integration is stronger in the second period if the chance of making deals in the market is lower. Third, since (28) is more likely to hold if ρ is smaller, the tendency for a change of status is stronger in the second period if the adjustment cost is smaller. In this case, since the two firms are separated in the first period, it is less costly to integrate in the second period if the adjustment cost is smaller. Fourth, since (28) is more likely to hold if A_2/A_1 is larger, given separation in the first period, the tendency for integration is stronger in the second period if the market is expanding. The explanation is that, with an expanding market, the agency problem in an integrated firm is lessened. Fifth, since the right-hand side of (28) is decreasing in δ, given separation in the first period, the tendency for integration is stronger in the second period if the preference for the future is stronger (i.e., the discount factor is larger). That is, when the future is viewed more importantly, the fact that the two firms are separated in the first period is less of a factor for integration in the second period.

In contrast, if the first period does not exist (or not in consideration), the payoffs are as defined in (27). We find that $V_{2I} > V_{2S}$ if and only if

$$\frac{B_I}{B_S} > \frac{4\sqrt{\theta}}{3}. \tag{29}$$

We can see that it is more difficult for condition (28) than for (29) to hold. By comparing (28) with (29), we see that the tendency for integration in the second period is weakened (less likely to be chosen) by the fact that the two firms are separated in the first period. Without the influence of the first period, the firms are more likely to integrate in the second period. This influence is represented by the extra multiplier μ_{1S} in (28), where the subscript $1S$ stands for "first-period separation" and

$$\mu_{1S} = 1 + \frac{1-(1-\rho\delta)^2}{\delta}\left(\frac{A_1}{A_2}\right)^2.$$

We make several observations regarding this multiplier. First, when the market expands (A_2/A_1 is larger), this multiplier is smaller, implying that second-period integration is less influenced by first-period separation. The explanation is that, when the market in the second period is larger than that in the first period, the choice of organizational structure in the second period depends less on the past. Second, a larger ρ implies a larger μ_{1S}, in turn implying a larger influence of the first period if adjustment cost rises. The explanation is that, since the two firms are separated in the first period, a larger adjustment cost boosts the influence of the first period since first-period separation hinders second-period integration through the adjustment cost. Third, since a rising δ reduces μ_{1S}, stronger preference for the future reduces the influence of the first period.

Proposition 1. *Given first-period separation, the two firms decide to integrate in the second period if and only if (28) holds, which implies that*

- *The tendency for integration in the second period is stronger if the marginal output under integration is substantially larger than that under separation, if the chance of making deals in the market is lower, if the adjustment cost is smaller, if the market is expanding, or if the preference for the future is stronger.*
- *The influence of the first period is stronger if the market is shrinking, if the adjustment cost is larger, or if the preference for the future is weaker.*

History matters, especially when current moves were planned in the past. Instead of looking at current conditions as most researchers do, Bergh (1997) looks at earlier conditions at the time when a division was acquired as we do. He finds that the likelihood of divestiture is dependent on motives, expectations and conditions at the time when a division was acquired. Consistent with our theory, Aron (1991) points out that the reacquisition of the spun-off division is efficient, that is, both the spin-off and the acquisition are optimal. Johnson (1996) studies the prevalent phenomenon during the 1980s when many U.S. firms divested their previous acquisitions. He finds that conditions such as changing business environment and firm governance are explanations for this.

Given First-Period Integration: Cases II vs. IS

Given that the two firms are integrated in the first period, they consider staying integrated or separating in the second period. We find that $V_{II} > V_{IS}$ if and only if

$$\frac{B_I}{B_S} > \frac{4\sqrt{\theta}}{3}\left\{1 + \frac{1}{\delta}\left[1 - \left(1 - \frac{\rho\delta}{\theta}\right)^2\right]\left(\frac{A_1}{A_2}\right)^2\right\}^{-1}, \tag{30}$$

where ρ is assumed to be small enough so that $\rho\delta \leq \theta$. We can draw five conclusions from (30). First, since (30) is more likely to hold if B_I/B_S is larger, given first-period integration, the tendency for second-period integration is stronger if the UF's marginal output under integration is substantially larger than that under separation. Second, since (30) is more likely to hold if θ is smaller, given first-period integration, the tendency for second-period integration is stronger if the chance of making deals in the market is lower. Third, since (30) is more likely to hold if ρ is larger, the tendency for maintaining the existing status is stronger in the second period if the adjustment cost is larger. In this case, since the two firms are integrated in the first period, the tendency for integration in the second period is stronger if the adjustment cost is larger. Fourth, since (30) is more likely to hold if A_2/A_1 is smaller, given first-period integration, the tendency for second-period integration is stronger if the market is contracting. With a contracting market, the adjustment cost does not justify a change of status. Fifth, since the right-hand side of (30) is decreasing in δ, given first-period integration, the tendency for second-period integration is weaker if the preference for the future is stronger (the discount factor is larger). That is , when the future is view more importantly, the fact that the two firms are integrated in the first period has less influence on the second-period decision.

In contrast, if the first period does not exist (or not in consideration), the payoffs are as defined in (27). We find that $V_{2I} > V_{2S}$ if and only if (29) holds. We can see that condition (30) holds more easily than (29). Without the influence of the first period, the two firms are less likely to integrate in the second period. By comparing (30) with (29), we see that the tendency for integration is strengthened (more likely to be chosen) by the fact that they are integrated in the first period. This factor is represented by the extra multiplier μ_{1I} in (30), where the subscript $1I$ stands for "first-period integration" and

$$\mu_{1I} = \left\{1 + \frac{1}{\delta}\left[1 - \left(1 - \frac{\rho\delta}{\theta}\right)^2\right]\left(\frac{A_1}{A_2}\right)^2\right\}^{-1}.$$

We make several observations regarding this multiplier. First, when the market expands (A_2/A_1 is larger), this multiplier is larger, implying that second-period integration is less influenced by first-period integration.[4] The explanation is that, when the market is expanding, it makes more sense to maintain the existing organizational structure in the second period. Second, a larger ρ implies a smaller μ_{1I}, in turn implying a larger influence of the first period if the adjustment cost rises. The explanation is that, since the two firms are integrated in the first period, it makes more sense to remain integrated in the second period when the adjustment cost is larger. Third, since a rising δ raises μ_{1I}, a higher preference for the future reduces the influence of the first

[4] A larger μ_{1I} means less influence. When μ_{1I} is at its largest possible value, i.e., $\mu_{1I} = 1$, the first period has no influence.

period. Fourth, since a larger θ raises μ_{1I}, a better chance of making deals in the market reduces the influence of the first period. A larger θ encourages separation, which is against the first-period decision.

We make a further interesting observation by comparing μ_{1S} with μ_{1I}. Since $\mu_{1S} > 1$ and $\mu_{1I} < 1$, we see that different first-period decisions have very different influences on second-period decisions. The fact that $\mu_{1S} > 1$ means that first-period separation has a negative effect on second-period integration comparing with that if the first period does not exist (or not in consideration), while the fact that $\mu_{1I} < 1$ means that first-period integration has a positive effect on second-period integration comparing with that if the first period does not exist. That is, first-period separation hinders second-period integration, while first-period integration encourages second-period integration. The differential effect $\mu_{1S} - \mu_{1I}$ of the first period is not trivially dependent on the adjustment cost. The adjustment cost obviously plays a role, but so do other factors. For example, if the market contracts, i.e., A_2/A_1 decreases, the difference $\mu_{1S} - \mu_{1I}$ increases, implying a larger differential effect of the first period. On the other hand, if the market expands quickly, when $A_2/A_1 \to \infty$, we have $\mu_{1S} = \mu_{1I}$, meaning that the influence of the first-period becomes marginal if the market expands quickly. Also, a larger δ implies a smaller μ_{1S} but a larger μ_{1I}, meaning that an increase in the preference for the future reduces the differential effect of the first period. This is intuitive. As the firms have a stronger preference for the future, the influence of the first period would be reduced. Further, a larger θ has no effect on μ_{1S} but implies a larger μ_{1I}, meaning that a better chance of making deals in the market reduces the differential effect of the first period. Also, a larger ρ implies a larger μ_{1S} but a smaller μ_{1I}, meaning that an increase in the adjustment cost enlarges the differential effect of the first period.

Proposition 2. *Given first-period integration, the two firms decide to integrate in the second period if and only if (30) holds, which implies that*

- *The tendency for second-period integration is stronger if the marginal output under integration is substantially larger than that under separation, if the chance of making deals in the market is lower if the adjustment cost is larger, if the market is contracting, or if the preference for the future is weaker.*
- *The influence of the first period is stronger if the market is contracting, if the adjustment cost is larger, if the preference for the future is weaker, or if the chance of making deals in the market is lower.*
- *The differential effect of differences in first-period decisions on second-period decisions is stronger if the market is contracting, if there is less preference for the future, if the chance of making deals in the market is lower, or if the adjustment cost is larger.* ∎

Prior literature supports our findings. Porter (1987) finds that companies divest more than half of their acquisitions and "the track record in unrelated acquisitions is even worse – the average divestment rate is a startling 74%." Kaplan and Weisbach (1992) find that 44% of the large acquisitions between 1971 and 1982 were divested by 1989. Weston (1989) points out that some divestitures may have been planned at the time of acquisition as a way to harvest investments. He further finds that the dependence of divestitures on past acquisitions is influenced by the external environment, which supports our theory. Montgomery *et al.* (1984) find that divestitures made as part of integrated strategic plans are positively valued by the market, while non-strategic divestitures are negatively valued. Miles and Rosenfeld (1983) argue that divestitures are likely to be planned at the time of acquisition. They observe that assets were spun off after a period of generally positive abnormal returns, implying the possibility of planned spin-offs. Ravenscraft and Scherer (1991) further find that acquired divisions are more likely to be sold off than original divisions. These studies support our theory that a divestiture is already anticipated at the time of acquisition.

4.2. Influence of Future Decisions

Given the plan in the second period, we now analyze the decisions in the first period. In the first period, the two firms consider integrating or separating conditional on a plan in the second period. That is, the firms' organizational decisions in the first period are forward looking. We consider two pairs of comparison:

$$V_{IS} \text{ vs. } V_{SS}, \quad V_{II} \text{ vs. } V_{SI}.$$

In the first pair, the second-period status is separation; in the second pair, the second-period status is integration.

Conditional on Second-Period Separation: Cases IS vs. SS

Given that the two firms are to be separated in the second period, they consider whether or not to integrate or separate in the first period. We find that $V_{IS} > V_{SS}$ if and only if

$$\frac{B_I}{B_S} > \frac{4\sqrt{\theta}}{3}\left(1 - \frac{\rho\delta}{\theta}\right)^{-2}. \tag{31}$$

We can draw four conclusions from (31). First, since (31) is more likely to hold if B_I/B_S is larger, in expectation of second-period separation, the tendency for first-period integration is stronger if the UF's marginal output under integration is substantially larger than that under separation. Second, since (31) is more likely to hold if ρ is smaller, the tendency for a change of status in the first period is stronger if the adjustment cost is smaller. In this case, since the two firms plan to be separate firms in the second period, the tendency for first-period integration is stronger if the adjustment cost is smaller. Third, since (31) is interestingly not affected by A_2/A_1, the tendency for first-period integration is not affected by market fluctuations. The explanation is that, since the second-period decision has taken into account market fluctuations, the first-period decision needs not do the same. Fourth, since (31) is more likely to hold if δ is smaller, the tendency for first-period integration is stronger if the preference for the future is weaker. The explanation is that, with a weaker preference for the future, second-period separation has less influence on first-period integration.

In contrast, if there is no second period to speak of (or not in consideration), the payoffs are as defined by V_{1I} and V_{1S} in (27). We find that $V_{1I} > V_{1S}$ if and only if

$$\frac{B_I}{B_S} > \frac{4\sqrt{\theta}}{3}. \tag{32}$$

We can see that it is more difficult for condition (31) than for (32) to hold. By comparing (31) with (32), we see that the tendency for first-period integration is weakened (less likely to be chosen) by the fact that the firms are to be separated in the second period. Without the influence of the second period, the firms are more likely to integrate in the first period. This influence is represented by the extra multiplier μ_{2S} in (31), where the subscript $2S$ stands for "second-period separation" and

$$\mu_{2S} = \left(1 - \frac{\rho\delta}{\theta}\right)^{-2}.$$

We make several observations regarding this multiplier. First, this multiplier is not affected by changes in A_2/A_1, implying that the influence of second-period separation on first-period integration is not affected by market fluctuations. The explanation is that, since the second-period decision has already taken into account market fluctuations, the first-period decision need not do the same. Second, a larger ρ implies a larger μ_{2S}, in turn implying a larger influence of the second period if adjustment cost rises. The explanation is that, since the two firms are to be separated in the second period, a larger adjustment cost hinders a change of status and boosts the influence of the second period. Third, since a rising δ raises μ_{2S}, a stronger preference for the future increases the influence of the future. Fourth, since a larger θ reduces μ_{2S}, a better chance of making deals in the market reduces the influence of the second period. The explanation is that, since separation is less costly with a larger θ, second-best separation is more likely and hence has less influence on first-period decisions.

<u>Proposition 3</u>. *In expectation of second-period separation, the two firms decide to integrate in the first period if and only if (31) holds, which implies that*

- *The <u>tendency</u> for first-period integration is stronger if the marginal output under integration is substantially larger than that under separation, if the adjustment cost is smaller, or if the preference for the future is weaker. Market fluctuations have no effect on this tendency.*
- *The <u>influence</u> of the second period is stronger if the adjustment cost is larger, if the preference for the future is stronger, or if the chance of making deals in the market is lower. This influence is not affected by market fluctuations.*

Hitt *et al.* (2009) mention that "While there has been a significant amount of research on mergers and acquisitions, there appears to be little consensus as to the reasons for outcomes achieved from them". One major puzzle is that M&As often have a negative effect on the current stock value yet the market typically reacts positively to divestitures (Allen *et al.* 1995; Betton and Morán 2003; Morán 2003). Our theory offers an explanation to this puzzle. If an acquiring firm has a long-term plan, an M&A today may be conducted in anticipation of some future action. If that is the case, then the M&A may have a negative effect on today's stock value, but it would have a positive effect on the future divestiture. If the market is not aware of the firm's plan or suspects other reasons for the M&A, especially if the acquired division does not seem to fit the firm, the market would react negatively when the acquired division is losing money and react positively when the division is divested. Tehranian *et al.* (1987) find that the market's response to sell-offs is based on managers' decision horizons. The market responds more favorably to sell-offs made by firms with long-term performance plans than to those made by firms with short-term performance plans. Fulghieri and Hodrick (2006) explain "why mergers may be valuable ex ante while leading to successful divestitures ex post." Mata and Portugal (2000) further find that firms that entered an industry through acquisitions are more likely to divest. These lines of theory and empirical evidence support our emphasis on the effect of future plans on current decisions.

Conditional on Second-Period Integration: Cases II vs. SI

Given that the two firms are to be integrated in the second period, they consider whether or not to integrate or separate in the first period. We find that $V_{II} > V_{SI}$ if and only if

$$\frac{B_I}{B_S} > \frac{4\sqrt{\theta}}{3}(1-\rho\delta)^2. \tag{33}$$

We can draw five conclusions from (33). First, since (33) is more likely to hold if B_I/B_S is larger, the tendency for first-period integration is stronger if the UF's marginal output under integration is substantially larger than that under separation. Second, since (33) is more likely to hold if θ is smaller, in expectation of second-period integration, the tendency for first-period integration is stronger if the chance of making deals in the market is lower. Third, since (33) is more likely to hold if ρ is larger, the tendency for first-period integration is stronger if the adjustment cost is larger. In this case, since the two firms plan to be integrated in the second period, the tendency for first-period integration is stronger if the adjustment cost is larger. Fourth, since (33) is interestingly not affected by A_2/A_1, the tendency for first-period integration is not affected by market fluctuations. Since the second-period decision has already taken into account market fluctuations, the first-period decisions need not do the same. Fifth, since (33) is more likely to hold if δ is larger, the tendency for first-period integration is stronger if the preference for the future is stronger. Given second-period integration and a stronger preference for the second period, first-period integration makes sense.

In contrast, if there is no second period to speak of (or not in consideration), the payoffs are as defined by V_{1I} and V_{1S} in (27). We find that $V_{1I} > V_{1S}$ if and only if (32) holds. We can see that condition (33) holds more easily than (32). By comparing (33) with (32), we see that the tendency for first-period integration is stronger (more likely to be chosen) by the fact that the firms are to be integrated in the second period. Without the influence of the second period, the firms are less likely to integrate in the first period. This influence is represented by the extra multiplier μ_{2I} in (33), where the subscript $2I$ stands for "second-period integration" and

$$\mu_{2I} = (1 - \rho\delta)^2.$$

We make several observations regarding this multiplier. First, this multiplier is not affected by changes in A_2/A_1, implying that the influence of second-period integration on first-period integration is not affected by market fluctuations. The explanation is that, since the second-period decision has already taken into account market fluctuations, the first-period decision need not do the same. Second, a larger ρ implies a smaller μ_{2I}, in turn implying a larger influence of the second period if the adjustment cost rises. The explanation is that, since the two firms are to be integrated in the second period, a larger adjustment cost hinders a change of status and hence boosts the influence of the second period.[5] Third, since a rising δ reduces μ_{2I}, a stronger preference for the future boosts the influence of the future.

We make a further interesting observation by comparing μ_{2S} with μ_{2I}. Since $\mu_{2S} > 1$ and $\mu_{2I} < 1$, different second-period decisions have very different influences on first-period decisions. The fact that $\mu_{2S} > 1$ means that second-period separation has a negative effect on first-

[5] The influence is larger if μ_{2I} is smaller. When μ_{2I} is at its largest possible value ($\mu_{2I} = 1$), the second period has no influence.

period integration, while the fact that $\mu_{2I} < 1$ means that second-period integration has a positive effect on first-period integration. That is, second-period separation hinders first-period integration, while second-period integration encourages first-period integration. We find that a larger δ implies a larger μ_{2S} but a smaller μ_{2I}, meaning that an increase in the preference for the future raises the differential effect $\mu_{2S} - \mu_{2I}$ of different second-period decisions. This is intuitive. As the firms focus more on the future, the influence of the second period would be greater. Also, a larger ρ implies a larger μ_{2S} but a smaller μ_{2I}, meaning that an increase in the adjustment cost enlarges the differences in influence from different second-period decisions. Further, a larger θ reduces μ_{2S} but has no effect on μ_{2I}, meaning that a better chance of making deals in the market reduces the differential effect of different second-period decisions.

Proposition 4. *In expectation of second-period integration, the two firms decide to integrate in the first period if and only if (33) holds, which implies that*

- *The tendency for first-period integration is stronger if the marginal output under integration is substantially larger than that under separation, if the adjustment cost is larger, if the chance of making deals in the market is lower, or if the preference for the future is stronger. But market fluctuations do not affect this tendency.*
- *The influence of the second period is stronger if the adjustment cost is larger, or if the preference for the future is stronger. But this influence is not affected by market fluctuations.*
- *The differential effect of differences in second-period decisions on first-period decisions is stronger if there is a stronger preference for the future, if the adjustment cost is larger, or if the chance of making deals in the market is lower.*

Van Beers and Sadowski (2003) find a stable and positive correlation between acquisitions and divestitures in the manufacturing and service industries. This suggests that a divestiture today is likely to be conducted in anticipation of an acquisition in the future and vice versa, which is in support of our conclusion.

4.3. Past vs. Future Influences

In the above two sections, we looked at the influences of the past and future separately. In this section, we allow the firms to consider both influences together.

Suppose the two firms are considering integration or separation today. This decision may be influenced by the past. If the two firms were integrated in the past, a condition for integration today is $V_{II} > V_{IS}$ or (30). If the two firms plan to be integrated in the future, a condition for integration today is $V_{II} > V_{SI}$ or (33). Hence, if the (past, future) status is (integration, integration), the conditions for integration today are (30) and (33). Similarly, we can analyze the other three (past, future) statuses and show that conditions (28) and (31) ensure that whatever the (past, future) status is, the two firms will choose integration today. We find that conditions (28) and (31) are more likely to hold if B_I/B_S is larger, A_2/A_1 is larger, or ρ is smaller. Also, (28) is more likely to hold if δ is larger, but (31) is more likely to hold if δ is smaller. If δ is large, the time preference is in favor of today over the past; if δ is small, the time preference is again in favor of today over the future. Hence, when the time preference is in favor of today, integration is likely to happen today.

Similarly, we find that, if conditions (30) and (33) fail, the two firms will decide to separate today irrespective of the past and future. The results are summarized in the following proposition.

Proposition 5. *Irrespective of the two firms' statuses in the past and future,*

- *If conditions (28) and (31) hold, they will choose integration today, and the tendency for integration today is stronger if the marginal output under integration is substantially larger than that under separation, if the market is expanding, if the adjustment cost is smaller, or if the time preference is in favor of today.*
- *If conditions (30) and (33) fail, they will choose separation today, and the tendency for separation today is stronger if the marginal output under integration is substantially less than that under separation, if the market is expanding, if the adjustment cost is smaller, if the chance of making deals in the market is higher, or if the time preference is in favor of today.*

Weston (1989) points out that divestiture is a way to harvest investments through M&As, and is often stimulated by favorable market conditions, which is consistent with our theory.

4.4. Short-Term Integration

If the two firms want to be integrated for a short time only (say one period), should they integrate early or late? Cases SI and IS are about short-term integration, where the former involves late integration and the latter early integration.

Early integration is better if and only if $V_{IS} > V_{SI}$, which is equivalent to

$$\frac{B_I}{B_S} < \frac{4\sqrt{\theta}}{3} \frac{\delta\left(\frac{A_2}{A_1}\right)^2 - (1-\rho\delta)^2}{\delta\left(\frac{A_2}{A_1}\right)^2 - \left(1 - \frac{\rho\delta}{\theta}\right)^2}, \tag{34}$$

if

$$\delta\left(\frac{A_2}{A_1}\right)^2 > \left(1 - \frac{\rho\delta}{\theta}\right)^2. \tag{35}$$

We can draw three conclusions from (34). First, since (34) is more likely to hold if B_I/B_S is smaller, the tendency for early integration is stronger if the UF's marginal output under integration is substantially less than that under separation. The explanation is that, with the requirement of δ being large enough by (35), it is better to capture the benefit of integration early if the preference for the future is strong. Second, since (34) is more likely to hold if θ is larger, the tendency for early integration is stronger if it is more likely to make deals in the market. Again, with the requirement of δ being large enough by (35), it is better to capture the benefit of integration early if the preference for the future is strong. Third, since (34) is more likely to hold if A_2/A_1 is larger, the tendency for early integration is stronger if the market is expanding. The explanation is that, since incentives are better under separation, it is better to postpone separation until the market condition improves.

Proposition 6. *For short-term integration, if (35) holds (fails), condition (34) ensures that early (late) integration is better, which implies that*

- *The tendency for early (late) integration over late (early) integration is stronger if the marginal output under integration is substantially less than that under separation, if the chance of making deals in the market is higher, or if the market is expanding sufficiently quickly.*

Our theory indicates that firms tend to acquire a division right away instead of waiting when macro conditions at the market level are favorable, such as when the market is expanding quickly or M&A activity is vigorous. Our theory also suggests that micro conditions at the firm level, such as differentials in marginal productivity, may play a role.

There is a large literature on the timing of M&As (Shleifer and Vishny 2003; Bruner 2004; Harford 2005; Müller-Stewens 2010; DePamphilis 2011; Meckl 2012; Eisenbarth and Meckl 2014). Interestingly, M&A activity typically occurs in waves, with six waves in the last 118 years (Müller-Stewens 2010; Meckl 2012), suggesting the importance of market conditions. Eisenbarth and Meckl (2014) find that M&A activity is procyclical and each M&A wave in the past was "accompanied by sinking interest rates, increasing stock market and increasing economic growth". This empirical evidence is consistent with our conclusion that the tendency to integrate early is stronger if the chance of making deals in the market is higher or if the market is expanding quickly. The chance of making deals in the market can be measured by the intensity of stock market activity. Indeed, Eisenbarth and Meckl (2014) find a significantly positive correlation between stock prices and M&A activity.

4.5. Contractual Analysis

From the analysis in Section 3, there is an optimal linear contract of the form $s_i(x) = \alpha_i x + \beta_i$ or $s_i(\pi) = \alpha_i \pi + \beta_i$ in each of the four cases. From conditions (3), (6), (9), (12), (15), (18), (21) and (24), we know that the constant α_i is designed to satisfy the IC condition, and the constant β_i is designed to satisfy the IR condition. β_i represents a one-time transfer between the two parties, which does not affect incentives, while α_i represents how the two parties share ex-post output or profit, which offers incentives. Hence, our interest is in the income sharing rule α_i. Given the set of functions in (25), the income sharing rules for the four cases are

$$\text{Case SI:} \qquad \alpha_1^* = \frac{1-\rho\delta}{2}\frac{A_1}{\sqrt[4]{\theta}\sqrt{B_S}}, \qquad \alpha_2^* = \frac{1}{2}.$$

$$\text{Case IS:} \qquad \alpha_1^* = \frac{1}{2}\left(1-\frac{\rho\delta}{\theta}\right), \qquad \alpha_2^* = \frac{1}{2}\frac{A_2}{\sqrt[4]{\theta}\sqrt{B_S}}.$$

$$\text{Case II:} \qquad \alpha_1^* = \frac{1}{2}, \qquad \alpha_2^* = \frac{1}{2}.$$

$$\text{Case SS:} \qquad \alpha_1^* = \frac{1}{2}\frac{A_1}{\sqrt[4]{\theta}\sqrt{B_S}}, \qquad \alpha_2^* = \frac{1}{2}\frac{A_2}{\sqrt[4]{\theta}\sqrt{B_S}}.$$

We make several observations regarding the income sharing rule α_i^*. First, the contractual terms are dependent on the organizational structure. In different organizational arrangements, contractual terms differ. Second, when the two firms are separate, the income sharing rule is dependent on market conditions, and the dependence is interestingly characterized by a common factor $A_i/\left(\sqrt[4]{\theta}\sqrt{B_S}\right)$. Only when a change of status in the future is expected, an extra term $\rho\delta$ is used to take into account the adjustment cost. Third, when the two firms are integrated, if a change of status in the future is not expected, the income sharing rule is $\alpha_i^* = 1/2$, i.e., they share profit equally. However, as shown in case IS, the income sharing rule under integration in the first period uses an extra term $\rho\delta/\theta$ when a change of status is expected, where the extra term takes into account the adjustment cost and the chance of making deals in the market when the UF becomes separated in the second period. Fourth, in expectation of a change of status in the second period, the UF's first-period income share is reduced comparing to that if there is no future organizational change.

5. Concluding Remarks

A company has two levels of strategy: division strategy and corporate strategy. Division strategy focuses on competitive advantage in each division. Corporate strategy concerns what businesses the company should be in and how divisions should be organized. The fact that corporate raiders can succeed in profit making is evidence for the important of corporate strategy (Porter 1987). We focus on corporate strategy.

An M&A may be due to an earlier divestiture or a planned future one. Similarly, a divestiture may occur following an earlier M&A or a planned future one. When a firm considers acquiring another, the option to divest the acquiree in the future is an important consideration; on the other hand, the fact that the acquirer had once divested this acquiree (but is trying to reacquire it now) is also an important factor. Given these considerations, this paper focuses on forward- and backward-looking M&As and divestitures.

Prior literature has never discussed the influence of past and future decisions on current decisions. As we have shown, forward- and backward-looking behaviors have major influences on current decisions. We have built a dynamic vertical integration model, which has never been seen in prior literature. In such a model, asset specificity and adjustment cost play important roles in mergers and divestitures.

Our main findings are: Forward- and backward-looking organizational decisions are substantially different from static ones. The influence of the first period is stronger if the market is contracting, if the adjustment cost is larger, or if the preference for the future is weaker. On the other hand, the influence of the second period is stronger if the adjustment cost is larger, if the preference for the future is stronger, or if the chance of making deals in the market is lower. Further, in the case where two firms choose to be integrated for a short time, the tendency for early (late) integration over late (early) integration is stronger if the marginal output under integration is substantially less than that under separation, if the chance of making deals in the market is higher, or if the market is expanding sufficiently quickly.

Our paper offers a unified theory covering four cases. These four cases encompass three patterns of mergers and divestitures that are often observed in practice. The first case is repeated integration and separation: two firms choose to integrate but later decide to separate (case IS); after a while, they decide to integrate again (case SI). The second case is permanent separation: two firms decide to separate (case IS) and to remain separated forever (case SS). The third case is permanent integration: two firms decide to integrate (case SI) and to remain integrated forever (case II). Prior studies have discussed either case IS or case SI, but they were always treated as two unrelated cases. We extend prior studies by analyzing these two cases in the same model.

Appendix

A1. The General Solution

This section offers proofs of the solutions for the four cases in Section 3.

The Solution for Case SI

For both problems (1) and (4), if the IR condition is not binding, the DF can always offer $s_t(\cdot) - \varepsilon$ for some $\varepsilon > 0$ instead of $s_t(\cdot)$ to satisfy the IR condition. Hence, the IR condition must be binding in equilibrium.

In the second period, by the binding IR condition, problem (1) becomes

$$\begin{aligned} V_2(a_1, b_1) = \max_{a,b,s_2(\cdot)} \; & \pi[x(a), b] - c_U(a) - c_D(b) - c_A[x(a_1), b_1] \\ \text{s.t. } \; & IC_1\!: \; s_2'\{\pi[x(a), b]\}\pi_x'[x(a), b]x'(a) = c_U'(a) \\ & IC_2\!: \left(1 - s_2'\{\pi[x(a), b]\}\right)\pi_b'[x(a), b] = c_D'(b) \\ & IR\!: \; s_2\{\pi[x(a), b]\} = c_U(a) + c_A[x(a_1), b_1]. \end{aligned}$$

Utilizing IC_1 for IC_2, this problem can be transformed into

$$\begin{aligned} V_2(a_1, b_1) = \max_{a,b,s_2(\cdot)} \; & \pi[x(a), b] - c_U(a) - c_D(b) - c_A[x(a_1), b_1] \\ \text{s.t. } \; & IC_1\!: \; s_2'\{\pi[x(a), b]\}\pi_x'[x(a), b]x'(a) = c_U'(a) \\ & IC_2\!: \left(1 - \frac{c_U'(a)}{\pi_x'[x(a), b]x'(a)}\right)\pi_b'[x(a), b] = c_D'(b) \\ & IR\!: \; s_2\{\pi[x(a), b]\} = c_U(a) + c_A[x(a_1), b_1]. \end{aligned} \tag{A1}$$

Since $s_2(\pi)$ does not appear in the objective function of problem (A1), it can be solved using (2) and (3).

In the first period, since the UF has no surplus in the second period (a binding IR condition), we have $U_2(a, b) = 0$. For problem (4), with a binding IR condition, problem (4) becomes

$$\begin{aligned} V_{SI} = \max_{a,b,s_1(\cdot)} \; & \pi[x(a), b] - \theta^{-1}c_U(a) - c_D(b) + \delta V_2(a, b) \\ \text{s.t. } \; & IC_1\!: \; \theta s_1'[x(a)]x'(a) = c_U'(a), \\ & IC_2\!: \; \pi_b'[x(a), b] + \delta V_{2,b}'(a, b) = c_D'(b), \\ & IR\!: \; \theta s_1[x(a)] = c_U(a). \end{aligned}$$

Since $s_1(x)$ does not appear in the objective function, it can be solved using (5) and (6).

The Solution for Case IS

In the second period, it is easy to see that the IR condition in (7) must be binding. Hence, problem (7) can be rewritten as

$$
\begin{aligned}
V_2(a_1, b_1) = \max_{a,b,s_2(\cdot)} \ & \pi[x(a), b] - c_D(b) - \theta^{-1} c_U(a) - \theta^{-1} c_A[x(a_1), b_1] \\
\text{s.t.} \ & IC_1\text{: } \theta s_2'[x(a)] x'(a) = c_U'(a) \\
& IC_2\text{: } \pi_b'[x(a), b] = c_D'(b) \\
& IR\text{: } \quad \theta s_2[x(a)] = c_U(a) + c_A[x(a_1), b_1].
\end{aligned}
$$

Since $s_2(x)$ does not appear in the objective function, this problem can be solved using (8) and (9).

In the first period, it is also easy to see that the IR condition in (10) must be binding. Hence, problem (10) can be rewritten as

$$
\begin{aligned}
V_{IS} = \max_{a,b,s_1(\cdot)} \ & \pi[x(a), b] - c_U(a) - c_D(b) + \delta V_2(a, b) \\
\text{s.t.} \ & IC_1\text{: } s_1'\{\pi[x(a), b]\} \pi_x'[x(a), b] x'(a) = c_U'(a), \\
& IC_2\text{: } \pi_b'[x(a), b]\left(1 - \frac{c_U'(a)}{\pi_x'[x(a), b] x'(a)}\right) + \delta V_{2,b}'(a, b) = c_D'(b), \\
& IR\text{: } \quad s_1\{\pi[x(a), b]\} = c_U(a).
\end{aligned}
$$

Since $s_1(\pi)$ does not appear in the objective function, this problem can be solved using (11) and (12).

The Solution for Case II

In the second period, it is easy to see that the IR condition in (13) must be binding. Hence, problem (13) can be rewritten as

$$
\begin{aligned}
V_2 = \max_{a,b,s_2(\cdot)} \ & \pi[x(a), b] - c_U(a) - c_D(b) \\
\text{s.t.} \ & IC_1\text{: } s_2'\{\pi[x(a), b]\} \pi_x'[x(a), b] x'(a) = c_U'(a) \\
& IC_2\text{: } \pi_b'[x(a), b]\left(1 - s_2'\{\pi[x(a), b]\}\right) = c_D'(b) \\
& IR\text{: } \quad s_2\{\pi[x(a), b]\} = c_U(a).
\end{aligned}
$$

Since $s_2(\pi)$ does not appear in the objective function, this problem can be solved using (14) and (15).

In the first period, it is also easy to see that the IR condition in (16) must be binding. Hence, problem (16) can be rewritten as

$$V_{II} = \max_{a,b,s_1(\cdot)} \pi[x(a), b] - c_U(a) - c_D(b) + \delta V_2$$
$$\text{s.t.} \quad IC_1:\ s_1'\{\pi[x(a), b]\}\pi_x'[x(a), b]x'(a) = c_U'(a),$$
$$IC_2:\ \pi_b'[x(a), b]\left(1 - \frac{c_U'(a)}{\pi_x'[x(a), b]x'(a)}\right) = c_D'(b),$$
$$IR:\quad s_1\{\pi[x(a), b]\} = c_U(a).$$

Since $s_1(\pi)$ does not appear in the objective function, this problem can be solved using (17) and (18).

The Solution for Case SS

In the second period, it is easy to see that the IR condition in (19) must be binding. Hence, problem (19) can be rewritten as

$$V_2 = \max_{a,b,s_2(\cdot)} \pi[x(a), b] - \theta^{-1}c_U(a) - c_D(b)$$
$$\text{s.t.} \quad IC_1:\ \theta s_2'\big[x(a)\big]x'(a) = c_U'(a),$$
$$IC_2:\ \pi_b'[x(a), b] = c_D'(b),$$
$$IR:\quad \theta s_2\big[x(a)\big] = c_U(a).$$

Since $s_2(x)$ does not appear in the objective function, this problem can be solved using(20) and (21).

In the first period, it is also easy to see that the IR condition in (22) must be binding. Hence, problem (22) can be rewritten as

$$V_{SS} = \max_{a,b,s_1(\cdot)} \pi[x(a), b] - \theta^{-1}c_U(a) - c_D(b) + V_2$$
$$\text{s.t.} \quad IC_1:\ \theta s_1'\big[x(a)\big]x'(a) = c_U'(a),$$
$$IC_2:\ \pi_b'[x(a), b] = c_D'(b),$$
$$IR:\quad \theta s_1[x(a)] = c_U(a).$$

Since $s_1(x)$ does not appear in the objective function, this problem can be solved using (23) and (24).

A2. Justification for the Parametric Functions

This section provides a justification for the parametric functions in (25).

Suppose there are two types of variables: verifiable and unverifiable variables. Verifiable variables, such as labor input l and capital input k, can be dealt with through the market, while unverifiable variables, such as the UF's effort a and the DF's effort b, can be dealt with through contracts. The DF's pre-contractual profit is denoted by $\pi(x, b)$, which includes part of the production costs, but not the cost of immediate input x and effort b. In the Arrow-Debreu world, organizational structure (and capital structure, etc.) is irrelevant. Hence, no matter whether the two firms are separated or integrated, we can always treat them as independent firms when referring to verifiable inputs and these inputs will be determined by market equilibrium.

For example, suppose that labor and capital inputs l and k are verifiable. Then, in perfectly competitive markets, given inputs x and b, consider the DF's problem:

$$\pi(x,b) \equiv \max_{l,k}\, pl^{\alpha}k^{\beta}f(x,b)^{1-\alpha-\beta} - wl - rk,$$

where prices p, w and r are assumed to be constant, α and β are positive constants, and an arbitrary function $f(x,b)$ covers contributions from inputs x and b. We may call α and β the <u>contribution shares</u> of labor and capital, respectively. They are the contribution shares of the verifiable variables. And, $1-\alpha-\beta$ is the contribution share of the unverifiable variables. Then, the optimal profit is

$$\pi(x,b) = (1-\alpha-\beta)p^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{w}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{r}\right)^{\frac{\beta}{1-\alpha-\beta}} f(x,b).$$

Hence, for given x and b, we can generally let the DF's profit function in period t be

$$\pi_t(x,b) = A_t f(x,b), \tag{A2}$$

where $A_t > 0$ is dependent on market conditions in period t.

We can similarly consider the UF's problem. Again, since a firm's organizational structure is irrelevant in competitive markets, no matter whether the UF is separated or integrated, we can always treat it as an independent firm when referring to verifiable inputs. Hence, in perfectly competitive markets, given input a, the UF's problem for verifiable inputs is

$$\pi(a) \equiv \max_{l,k}\, pl^{\alpha}k^{\beta}g(a)^{1-\alpha-\beta} - wl - rk,$$

where prices p, w, and r and parameters α and β may not be the same as those in the DF's problem above. We use the same notation for convenience. Let l^* and k^* be the optimal inputs. Then, the optimal output is

$$x(a) \equiv (l^*)^{\alpha}(k^*)^{\beta}g(a)^{1-\alpha-\beta} = p^{\frac{\alpha+\beta}{1-\alpha-\beta}}\left(\frac{\alpha}{w}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{r}\right)^{\frac{\beta}{1-\alpha-\beta}} g(a),$$

and the optimal profit is

$$\pi(a) = (1-\alpha-\beta)p^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{w}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{r}\right)^{\frac{\beta}{1-\alpha-\beta}} g(a) = (1-\alpha-\beta)px(a).$$

Hence, we can generally let the UF's production function under status s be

$$x_s(a) = B_s g(a), \tag{A3}$$

for some constant $B_s > 0$, where B_s is dependent on market conditions under status s.

A3. The Model under Uncertainty

This part shows that an extension to allow random profit and output will not change our results at all.

We now assume that both $\tilde{\pi}$ and $\tilde{x}$ in each period are random variables. Let $h(a)$ and $h(x,b)$ be two arbitrary functions. Given x, $\tilde{\pi}$ follows the conditional density function $f[\pi|h(x,b)]$, i.e.,

$$\tilde{\pi} \sim f[\pi|h(x,b)].$$

Output $\tilde{x}$ follows the conditional density function $f[x|h(a)]$, i.e.,

$$\tilde{x} \sim f[x|h(a)].$$

The explanation is that uncertainty comes from the markets. When a division is an independent firm and faces the markets, its output is uncertainty. Only when it is inside a firm as a division, its output is deterministic. Denote the expected profit by

$$\Pi(x,b) \equiv E(\tilde{\pi}|x) = \int \pi f\big[\pi|h(x,b)\big]d\pi,$$

and the expected output is

$$X(a) \equiv E(\tilde{x}) = \int x f[x|h(a)]dx,$$

and

$$\Pi(a,b) \equiv E(\tilde{\pi}) = \iint \pi f\big[\pi|h(x,b)\big]f[x|h(a)]d\pi dx.$$

Here, there is some abuse of notation. $h(a)$ and $h(x,b)$ are actually unrelated functions, and $f[\pi|h(x,b)]$ and $f[x|h(a)]$ are also unrelated functions.

Output x is deterministic when the division is inside a firm; output is random when the division is an independent firm. Actually, output can be random even when the division is inside the firm; all results remain exactly the same.

Case SI

In the second period, the UF is under a contract $s_2(\pi)$. This contract is based on the integrated firm's profit π since the two firms are integrated at that time. The UF's problem is

$$U_2(a_1,b_1) \equiv \max_a \int s_2(\pi) f\{\pi|h[x(a),b]\}d\pi - c_U(a) - c_A[x(a_1),b_1],$$

where $x(a_1)$ is output in the first period, which is not random in the second period since the division is inside the firm. The DF's ex post problem in the second period is

$$\max_{b} \int [\pi - s_2(\pi)] f\{\pi | h[x(a), b]\} d\pi - c_D(b).$$

Then, the DF's ex ante problem is

$$\begin{aligned} V_2(a_1, b_1) = \max_{a,b,s_2(\cdot)} & \int [\pi - s_2(\pi)] f\{\pi | h[x(a), b]\} d\pi - c_D(b) \\ \text{s.t.} \quad & IC_1\colon\ h'_x[x(a), b] x'(a) \int s_2(\pi) f'_h\{\pi | h[x(a), b]\} d\pi = c'_U(a), \\ & IC_2\colon\ h'_b[x(a), b] \int [\pi - s_2(\pi)] f'_h\{\pi | h[x(a), b]\} d\pi = c'_D(b), \\ & IR\colon\ \int s_2(\pi) f\{\pi | h[x(a), b]\} d\pi \geq c_U(a) + c_A[x(a_1), b_1]. \end{aligned}$$

In the first period, the two firms are separated. The DF offers a contract $s_1(x)$ to the UF in the first period. This contract is based on the UF's output x. This x is random since the division is an independent firm. Given this contract, the UF's first period problem is

$$U_1 = \max_{a} \theta \int s_1(x) f[x | h(a)] dx - c_U(a) + \delta\theta E[U_2(a, b)].$$

$U_2(a, b)$ is random in the first period since the second-period output is random in the first period. The DF's ex post problem is

$$\max_{b} \iint \pi f[\pi | h(x, b)] f[x | h(a)] d\pi dx - \int s_1(x) f[x | h(a)] dx - c_D(b) + \delta E[V_2(a, b)],$$

$V_2(a, b)$ is random in the first period since the second-period output is random in the first period. Then, the DF's ex ante problem is

$$\begin{aligned} V_{SI} = \max_{a,b,s_1(\cdot)} & \ \Pi(a, b) - \int s_1(x) f[x | h(a)] dx - c_D(b) + \delta E[V_2(a, b)] \\ \text{s.t.} \quad & IC_1\colon\ h'(a)\theta \int s_1(x) f'_h[x | h(a)] dx + \delta\theta E[U'_{2,a}(a, b)] = c'_U(a), \\ & IC_2\colon\ \Pi'_b(a, b) + \delta E[V'_{2,b}(a, b)] = c'_D(b), \\ & IR\colon\ \theta \int s_1(x) f[x | h(a)] dx + \delta\theta E[U_2(a, b)] \geq c_U(a). \end{aligned}$$

By the same derivation process as that in Section A1, we have the following solution.

Proposition 7. *For case SI, investments* (a_2^*, b_2^*) *are from*

$$\begin{aligned} V_2(a_1, b_1) = \max_{a,b} & \ \Pi[x(a), b] - c_U(a) - c_D(b) - c_A[x(a_1), b_1] \\ \text{s.t.} \quad & \frac{\partial \Pi[x(a), b]}{\partial a} = c'_U(a) + \frac{h'_x[x(a), b]}{h'_b[x(a), b]} x'(a) c'_D(b); \end{aligned} \tag{A4}$$

and investments (a_1^*, b_1^*) *are from*

$$V_{SI} = \max_{a,b} \ \Pi(a,b) - \theta^{-1}c_U(a) - c_D(b) + \delta E[V_2(a,b)] \\ \text{s.t.} \ \ \Pi'_b(a,b) + \delta E\left[V'_{2,b}(a,b)\right] = c'_D(b). \tag{A5}$$

There is an optimal linear contract in each period, where

$$s_1^*(x) = \frac{c'_U(a_1^*)}{\theta X'(a_1^*)}[x - X(a_1^*)] + \theta^{-1}c_U(a_1^*),$$

$$s_2^*(\pi) = \frac{c'_U(a_2^*)}{\frac{\partial \Pi[x(a_2^*), b_2^*]}{\partial a}}\left\{\pi - \Pi[x(a_2^*), b_2^*]\right\} + c_U(a_2^*) + c_A[x(a_1^*), b_1^*]. \ \blacksquare$$

Problem (5) is the same as problem (A5). The constraint in (A4) can be written as

$$\left[\int \pi f'_h\{\pi | h[x(a), b]\} d\pi - \frac{c'_U(a)}{h'_x[x(a), b]x'(a)}\right] h'_b[x(a), b] = c'_D(b).$$

If $\tilde{\pi} = h[x(a), b] + \tilde{\varepsilon}$, then $E(\tilde{\pi}) = h[x(a), b]$, implying $\int \pi f'_h\{\pi | h[x(a), b]\} d\pi = 1$. Hence, if we replace $\pi[x(a), b]$ by $h[x(a), b]$, problem (2) is the same as problem (A4). Hence, the extension to random profit and output will not change the conclusions.

We have derived the solution for Case SI. Other cases are similar.

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