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Institutional trading, information production, and the choice between spin-offs, carve-outs, and tracking stock issues

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ABSTRACT

We analyze a firm's choice between spin-offs, equity carve-outs, and tracking stock issues and the role of institutional investors in corporate restructuring. We model a firm with two divisions. Insiders have private information about firm value and face an equity market with retail and institutional investors. We show that restructuring increases information production by institutional investors (relative to that about the consolidated firm): the highest increase in information production arises from spin-offs, the next highest from carve-outs, and the lowest from tracking stock issues. Insiders with the most favorable private information implement spin-offs; those with less favorable private information implement carve-outs; those with even less favorable private information implement tracking stock issues; and those with unfavorable private information remain consolidated. We explain the positive announcement effect and increase in analyst coverage associated with all three forms of restructuring. Our model also generates a number of novel testable predictions for firms' choice between spin-offs, carve-outs, and tracking stock issues, and for institutional trading around these three forms of restructuring.

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1. Introduction

The pace of corporate restructuring, especially spin-offs and carve-outs, has accelerated recently. At least part of this acceleration seems to be driven by the views of firms' managers and institutional investors that spin-offs and carve-outs (as well as other forms of restructuring) help to “unlock hidden value” by correcting the undervaluation of various parts of a conglomerate firm.¹ Institutional investors seem to have a particular preference for “pure-play” firms (where all projects of the firm are in related industries) rather than conglomerate firms (where different divisions operate in unrelated industries), which seem to be reflected

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¹ Firms often explicitly state that their motive for restructurings is to help analysts and investors better understand their businesses. To quote a *Wall Street Journal* (September 21, 1995) report on AT&T's decision to spin off Lucent Technologies Inc. and NCR Corp.: “The market value of AT&T was being buried,” Mr. Allen said. “Investors couldn't understand the strategy of the combined company.” Under the new setup, AT&T will be the biggest pure play in telecommunications. “Investors will clearly understand it now,” the chairman said...” Another article from the *Wall Street Journal* (December 7, 1992) expresses similar views on Adolph Coors Co.'s spin-off decision: “Adolph Coors Co., in a filing with the SEC, said it was spinning off its ceramics, aluminum, and packaging businesses to make it easier for analysts and investors to evaluate the separate businesses of Coors Brewing Co. and the ‘technology,’ or nonbeer companies...”

in their lower valuation of conglomerate firms (the “diversification discount”).² While the stated argument that spin-offs, carve-outs, and other forms of restructuring help unlock hidden value is well known among practitioners and empirical researchers, the precise mechanism through which this occurs has been controversial in the literature. The objective of this paper is to develop a theoretical analysis explicitly studying the role of institutional investors in corporate spin-offs, carve-outs, and tracking stock issues and analyze a firm's choice between these three forms of restructuring.³

A number of other rationales have been advanced for corporate spin-offs (e.g., Parrino, 1997; Aron, 1991; Nanda and Narayanan, 1999; Chemmanur and Yan, 2004) in the literature. However, theoretical analyses of other forms of restructuring such as carve-outs or tracking stock issues are extremely rare, and the analyses that do exist focus on the fact that carve-outs raise external financing, treating carve-outs as essentially spin-offs where one of the spun-off firms sells equity to outsiders. In practice, however, many firms explicitly consider the alternative forms of restructuring such as spin-offs, carve-outs, or tracking stock issues, and choose among these alternatives based on the costs and benefits of these restructuring mechanisms for shareholder value. Despite this, there has been no theoretical analysis so far in the literature regarding a firm's choice between the aforementioned three mechanisms from the point of view of maximizing shareholder value, and our objective in this paper is to develop such an analysis.

Our theory is based on the insight that all three forms of restructuring, namely, spin-offs, carve-outs, and tracking stock issues, result in an increase in the extent of information production by institutional investors (and affiliated analysts) about the firm. This increase in information production arises due to two reasons. First, by dividing consolidated firms into less complex units with their own financial reports certified by outside auditors, they reduce outside investors' information production cost for various divisions of a firm; this “direct reduction in institutional investors' information production cost” effect may be different across different forms of restructuring, as we argue later.⁴ Second, since different investors may have expertise in producing information about some parts of the firm but not about others, the aforementioned forms of restructuring allow them to concentrate their investment in those parts of the conglomerate firm about which they have an advantage in producing information, thereby increasing their expected profits from information production (and therefore their incentive to produce information). This second “specialization in information production” effect is likely to be similar across the three forms of restructuring, since all of the restructuring forms allow investors to focus their equity investments on those parts of the firm regarding which they have an informational advantage. The two effects of the three forms of restructuring on outsiders' incentives to produce information about the firm, and the differences in the synergy loss incurred by the firm across spin-offs, carve-outs, and tracking stock issues are the important driving factors behind a firm's choice of restructuring mechanism in our model.

We develop a model where the firm makes a choice between three restructuring mechanisms (spin-offs, carve-outs, and tracking stock issues), or remaining consolidated. The firm has two divisions: division 1 and division 2. We consider a setting with a continuum of firm types in which a consolidated firm may realize a high or a low long-run cash flow with the probability of the high cash flow realization (“firm type”) private information to firm insiders, with outside investors knowing only the probability distribution across types. The equity market consists of institutional investors, who may produce information about the cash flow of the two divisions of the firm by incurring a certain cost, and retail investors, who have no such ability to produce information. Institutional investors are of two types: those with a comparative advantage (low cost) for producing information about division 1, and those with a comparative advantage (low cost) for producing information about division 2.

We focus on the following important difference between spin-offs, carve-outs, and tracking stock issues. A spin-off represents a clean break-up between parent and subsidiary, resulting in two independent firms after the spin-off. In contrast, only a minority interest in a carved-out firm is held by outsiders, with the parent company maintaining the majority interest in the firm subsequent to the carve-out. Further, in many cases, the parent and subsidiary firm share many top corporate officers. Tracking stocks are shares of the parent company, but their cash flows are tied to the performance of a particular subsidiary which they “track.” In particular, in the case of tracking stock issues, parent and subsidiary have the same management team and board of directors. This ongoing connection between parent and subsidiary after carve-outs and tracking stock issues has both positive and negative consequences. On the one hand, the ongoing connection makes it easier to maintain synergies existing before the restructuring. On the other hand, the fact that there is no clean break-up between parent and subsidiary makes it harder for outsiders to evaluate the two firms resulting from a restructuring (relative to the case where the two firms are cleanly separated, as in a spin-off). We capture these two differences by assuming that the reduction in institutional investors' information

² The important role played by institutional investors in corporate spin-offs is reflected in the following quote from an article in the *Financial Times* (October 28, 2005): “The new backlash against conglomerates suggests that a more lasting shift in investor preferences may be taking place, driven in part by the growing influence of hedge funds and private equity houses. In public equity markets, big rarely has appeared less beautiful. In the U.S., the most visible sign of this is the break-up of companies such as Cendant, the sprawling leisure group behind Avis rental cars; and Orbitz travel website, which this week announced a four-way merger to try to lift its flagging share price. It follows a similar decision by Barry Diller's InterActive Corporation to spin-off its Expedia travel site, and the breaking apart of Viacom, the media empire that owns CBS television network.”

³ Tracking stock, also called targeted stock, letter stock, or alphabet stock, is equity ownership in one division of a diversified firm. An equity carve-out is the sale of a portion of a wholly-owned subsidiary's common stock to the public. A corporate spin-off is a pro-rata distribution of a subsidiary's shares to the firm's shareholders. For the differences between the three types of restructuring, see, e.g., Chemmanur and Paeglis (2001).

⁴ Empirical researchers have observed and documented the improved dissemination of information about the different divisions of a firm following various forms of restructuring. For example, Schipper and Smith (1986) point out that, in the case of carve-outs, “the dissemination of information about the subsidiary's financial position and performance may be increased through subsidiary financial reports and additional private search for information” (p155). They also document that 14 of 59 firms conducting carve-outs in their sample state that their motive is to “improve investor understanding of subsidiary” (Table 8). D'Souza and Jacob (2000) notice that “Targeted stock issuances might nevertheless represent good news from an information perspective because of the comprehensive financial statements that firms must provide for each targeted stock segment” (p461).

production cost is the highest in spin-offs, lower in carve-outs, and the lowest in tracking stock issues, and the synergy loss is the highest in spin-offs, lower in carve-outs, and the lowest in tracking stock issues.⁵

The equilibrium involves the highest set of firm types choosing to implement a spin-off; the next lower set of firm types implement a carve-out; the further next lower set of firm types implement a tracking stock issue; and the lowest set of firm types choose to remain consolidated. We first demonstrate that restructuring increases information production by institutional investors about each division of the previously consolidated firm. This is because, as discussed before, restructuring increases institutional investors' incentives to produce information in two ways: directly by reducing their information production cost for each division, and indirectly by allowing each type of institutional investor to invest only in those firms (divisions) for which they have a comparative advantage in producing information (thus increasing their expected profits from producing information). Further, the increase in information production is the greatest in a spin-off because the reduction in outsiders' information production cost is the highest among the three restructuring mechanisms. The increase in information production is smaller in a carve-out and the smallest in a tracking stock issue.

Given the difference in the increase in information production by outsiders, firm insiders with the most favorable private information (the highest types) take different restructuring decisions from those with less favorable private information. On the one hand, a spin-off requires the firm to incur a great loss of synergy between divisions, as well as the direct transaction costs involved. On the other hand, the benefits of a spin-off are the greatest to the highest firm types, who are able to separate more from lower firm types in the long run due to the increased information production by outsiders and thereby obtain higher stock prices. In contrast, medium-type firms benefit less and the lowest type firms suffer from increased information production. Therefore, only the highest firm types find it optimal to implement a spin-off to separate themselves from the rest of firm types.⁶

The next set of firm types finds a spin-off too costly in terms of synergy loss. They, however, also benefit from increased information production (although to a lesser extent than the highest firm types). They will choose a carve-out to separate themselves from even lower firm types. The next (even lower) set of firm types choose a tracking stock issue to avoid the higher synergy loss associated with a spin-off or a carve-out. At the same time, they also benefit from the increased information production due to the tracking stock issue since it enables them to separate from the lowest firm types. The lowest type firms actually lose from the increased information production that would result from a restructuring (since this would distinguish them more from higher type firms, reducing their share price). In equilibrium, the lowest type firms find it optimal to remain consolidated, since this allows them to at least keep all their synergies between their two divisions intact.

In the given equilibrium, spin-offs will have unambiguously positive announcement effects, since outsiders will infer that firms implementing spin-offs are the highest firm types. Carve-outs and tracking stock issues may also have positive announcement effects, since the market infers that they are better than the worst firm types, who remain consolidated. However, the announcement to a carve-out or a tracking stock issue will be less favorable than that due to a spin-off. The stock price of a subset of the aforementioned higher type firms will increase further subsequent to the actual implementation of a restructuring, as the stock price becomes more informative about true firm type as a result of further information production by institutional investors.⁷

Our model generates three sets of empirical predictions. The first set of predictions deals with a firm's choice between the three forms of restructuring and other related phenomena. Our analysis predicts that firms that are most undervalued relative to their intrinsic values (i.e., where firm insiders have the most favorable private information) will choose to implement a spin-off, despite the significant losses in synergy involved. Firms that are less undervalued will implement a carve-out to reduce synergy losses (relative to spin-offs). Firms that are least undervalued and that wish to keep their divisions together under one corporate umbrella to minimize synergy losses (but would nevertheless receive some information production and the resulting valuation benefits from having two distinct shares representing the firm's two divisions trading) will issue tracking stock.

Our model is also able to explain several related phenomena, such as two-stage combination carve-outs and spin-offs (see, e.g., Thompson and Apilado, 2006): firms that temporarily have a high synergy loss will implement a carve-out, and subsequently spin-off the shares held by the parent firm to their shareholders as soon as these synergy losses are reduced (e.g., when both parent and subsidiary have created independent facilities that were previously shared or have terminated existing supplier–customer relationships). Our model is also able to explain the fact that tracking stock issues are popular only for firms with a wide disparity in valuations between the industries of the two divisions involved. For example, tracking stock issues were popular for old media firms with internet divisions during the internet bubble period: while management felt that the internet division could not survive

⁵ For simplicity of modeling, we abstract away from one important feature of carve-outs, namely, the fact that, in a carve-out, the parent firm raises external financing by selling a minority interest in the equity of the carved-out firm to outside investors. While incorporating the effect of raising new equity financing will add additional complexity to our analysis, all our results will go through essentially unchanged even in this case as long as the amount of external financing raised is not too large (as is the case in practice).

⁶ The broad rationale for spin-offs underlying our model seems to be at work in many recent spin-offs. For example, Chris Coughlin, CFO of Tyco International, commented about the rationale for the recently completed spin-offs of two of its divisions, namely, Tyco's health care business (now called Covidien) and Tyco Electronics from the parent company: "Early indications became apparent out of our discussions with investors. Between 2004 and 2005, their questions were all about the electronics business, because investors were looking at what could move within Tyco's diverse portfolio that would make earnings go up or down in a particular period. There were few questions about health care, our largest business. Investors seemed to view it simply as a solid generator of profits and cash flow" (McKinsey Quarterly, October 2007). Translated into the setting of our model, Coughlin seems to be indicating that one of the reasons motivating the spin-off was that the information production cost about the electronics business was higher than that about the health care business for at least some investors, so that there would be a net valuation benefit to a spin-off.

⁷ Recall that institutional investors have incentives to produce information even after the firm's type is partially revealed through its restructuring choice. This is because there is residual uncertainty about the future cash flows of the firm even after a restructuring announcement, so that it is profitable for institutional investors to produce additional information about the realization of the firm's future cash flows and trade on it.

on their own (i.e., the synergy loss from any cleaner break-up such as a spin-off or carve-out would be unacceptably large), they nevertheless felt that the valuation benefit arising from increased information production by internet analysts were large enough to justify issuing tracking stock for these internet divisions.

The second set of predictions deals with the trading behavior of institutional investors around restructuring. First, our model predicts that, of the institutional investors trading in the equity of the consolidated firm, a certain fraction will trade predominantly in the equity of the parent firm after a restructuring, while the remaining fraction will trade predominantly only in the equity of the subsidiary (given that different institutional investors and affiliated analysts may specialize in producing information about different parts of the firm). Second, our model predicts that, given that institutional investors produce additional information after a restructuring, the extent of institutional net buy (the extent of equity bought minus equity sold) in the equity of the two firms resulting from a restructuring will be positively related to the long-term operating performance and long-term stock returns of these two firms: in other words, institutional trading will have predictive power for long-term operating performance and stock returns. Finally, the predictive power of institutional trading will be greater for a spin-off rather than a carve-out or a tracking stock issue (since the increase in information production by institutional investors following a spin-off will be greater compared to that in a carve-out or a tracking stock issue). Evidence consistent with the first two predictions is provided by Chemmanur and He (2008), who test these implications of our model using data on institutional trading around spin-offs derived from the Abel-Noser database.

The third set of predictions is common to all three forms of restructuring, though the intensity of various effects may differ across restructuring mechanisms. The prediction here is that the announcement effect of all three forms of restructuring will be positive, and the extent of information production by outsiders will increase subsequent to all three.⁸ Further, our model is able to explain three widely documented empirical regularities regarding restructuring: (1) the number and quality of analysts covering the firm increase and the degree of information asymmetry decreases following restructuring⁹; (2) focus-increasing forms of restructuring are associated with higher announcement returns compared with non-focus-increasing ones¹⁰; (3) the gains around the announcement dates are positively related to the degree of information asymmetry of firms prior to restructuring.¹¹ As discussed before, restructuring leads outsiders to produce more information about the firm, and, given that a significant proportion of the information about firms is produced by financial analysts (Frankel and Li, 2004), we would expect the number and quality of analysts covering the firm to increase after a restructuring. Further, since the information produced by outsiders is partially reflected in the firm's stock price through trading, a restructuring also makes the stock price more informative and reduces the information asymmetry about the firm. Therefore, our model explains stylized fact (1).

Our analysis shows that the higher the reduction in outsiders' cost to produce information due to a restructuring, the higher the announcement return. Consequently, compared to a non-focus-increasing restructuring, a focus-increasing one will have a higher announcement return since the latter will be associated with a higher reduction in outsiders' information production cost.¹² This explains stylized fact (2). Finally, we also show that the higher the degree of information asymmetry of the firm prior to a restructuring, the higher is the announcement return. Since the higher the degree of information asymmetry, the more undervalued high intrinsic value firms are, the announcement effect of a restructuring will be greater in this case, explaining stylized fact (3).

The rest of this paper is organized as follows. Section 2 briefly summarizes the related literature. Section 3 describes the setup of our model, and Section 4 characterizes the equilibrium of our model. Section 5 summarizes testable implications and section 6 concludes. The proofs of all lemmas and propositions are confined to the Appendix.

2. Related literature

This paper is related to the theoretical as well as the empirical literature on spin-offs, carve-outs, and tracking stock issues. We will first discuss the related theoretical literature. Aron (1991) argues that a spin-off can improve the incentive scheme offered by the firm to divisional managers since the stock price of one division is a much cleaner signal of managerial productivity than when the division belongs to the parent firm. Nanda and Narayanan (1999) model a firm's choice between selling the combined firm's equity and selling stock in one division (either to a private party or to the public, which is a carve-out in the latter case) to raise external capital. In their paper, spin-offs help unearth hidden value, but through a mechanism different from that in our paper: spin-offs help reduce the commingling of cash flows from the two divisions of the firm. Chemmanur and Yan (2004) argue that spin-offs create value by increasing the probability of a takeover of either the parent firm or the subsidiary or both, and this either

⁸ Extant literature has documented positive stock price reactions to announcements of restructurings. See Daley et al. (1997) for spin-offs, Schipper and Smith (1986) for carve-outs, and D'Souza and Jacob (2000) for tracking stock issues.

⁹ See, e.g., Zuta (1999) and Chemmanur and Paeglis (2001) for evidence on tracking stock offerings, Fu (2002) for evidence on carve-outs, Krishnaswami and Subramaniam (1999) and Huson and MacKinnon (2003) for evidence on spin-offs.

¹⁰ A restructuring is focus-increasing when the two divisions of the firm belong to different industry groups, and is sometimes referred to as an unrelated restructuring. Vijh (2002) finds that focus-increasing carve-outs are associated with higher announcement returns, and Daley et al. (1997) and Desai and Jain (1999) find the same pattern for spin-offs.

¹¹ See Burch and Nanda (2003) and Krishnaswami and Subramaniam (1999) for evidence on spin-offs and Fu (2002) for evidence on carve-outs.

¹² In the case of a focus-increasing restructuring, the two divisions of the firm operate in two different industries, which makes it harder for outsiders to value the consolidated firm before a restructuring since analysts usually specialize in a given industry so that a restructuring will significantly reduce outsiders' information production cost. In contrast, outsiders' information production cost for a consolidated firm with two divisions operating in the same industry is not too high to begin with, and the reduction in outsiders' information production cost due to a restructuring can be expected to be smaller.

motivates the managers to work harder (in the absence of an actual takeover) or forces the incumbent management to relinquish control to a more competent rival (in the case of a takeover). Habib et al. (1997) argue that spin-offs improve the manager's investment decisions when investors are better informed than the management by allowing the manager to infer outsiders' information more efficiently. They, however, do not model information production by outside investors. Nanda (1991) argues that a firm with financing needs will resort to a carve-out only when the parent is undervalued by the market and offers an explanation for the positive price reactions to the announcements of carve-outs. Zuta (1999) argues that tracking stock issues are a way to mitigate the managerial agency problem. This paper is also broadly related to the literature on information production in financial markets; examples include Grossman and Stiglitz (1980) and Verrecchia (1982), among others. More specifically, it is related to Boot and Thakor (1993), who examine the effect of issuing multiple financial claims that partition a firm's total asset cash flows on investors' incentives to produce information about the value of the firm.¹³ Fulghieri and Lukin (2001) analyze a setting in which firms choose between debt and equity when outsiders can engage in information production about the firm.

A vast empirical literature exists on spin-offs, carve-outs, and tracking stock issues. The main motivations for spin-offs examined in the literature include the following: expropriation of wealth from bondholders to equity holders (Parrino, 1997; Hite and Owers, 1983; Schipper and Smith, 1983; Maxwell and Rao, 2003), relaxation of tax and regulation constraints (Schipper and Smith, 1983), facilitation of takeover of the parent and the subsidiary (Cusatis et al., 1993), re-creation of value destroyed in previous acquisitions (Allen et al., 1995), and efficiency improvement (Gertner et al., 2002; Ahn and Denis, 2004; Chemmanur and Nandy, 2006). The empirical evidence regarding Nanda's (1991) prediction that firms raise capital through a carve-out when the parent is undervalued and the subsidiary is overvalued is mixed: while some studies find support for the stated prediction (Slovin et al., 1995; Hand and Skantz, 1999; Powers, 2001), others contradict it (Vijh, 2002; Hulburt et al., 2002). Allen and McConnell (1998) argue that managers value control of assets and undertake carve-outs only when the firm is capital constrained. Motivations for and the sources of value increases arising from tracking stock offerings documented in the literature include an increased ability to reward division managers for their productivity (Logue et al., 1996), preservation of the internal capital market (Billet and Mauer, 2000), and improved monitoring and greater information on individual firm divisions (D'Souza and Jacob, 2000; Chemmanur and Paeglis, 2001). Finally, this paper is related to the literature on institutional trading around corporate spin-offs: in particular, it is related to Chemmanur and He (2008), who test the predictions of our model for information production by institutional investors around corporate spin-offs, and find supporting evidence.

3. The model

The model consists of four dates: times 0, 1, 2, and 3. At time 0, a firm with two divisions operates as a consolidated firm, and the equity market assigns a value to the firm. At time 1, firm insiders decide whether to announce a spin-off, a carve-out, a tracking stock issue, or to remain consolidated, and the market updates the market value of the firm based on the firm's announcement. At time 2, the restructuring takes place if it is announced at time 1; otherwise the firm remains consolidated. Subsequently, investors produce information about the firm's time-3 cash flow, and shares are traded among investors. At time 3, the firm's cash flows are realized and distributed to shareholders. There is also a risk-free asset in the economy, the return on which is normalized to zero. All agents are risk neutral.

3.1. Restructuring versus consolidated firms

The consolidated firm has two divisions, with a fraction α of the time-3 cash flow arising from division 1, and the remaining $1 - \alpha$ from division 2, where $\alpha \in (0, 1)$.¹⁴ If the firm remains consolidated, only the stock of the whole firm is traded, while if the firm implements a restructuring (i.e., either a spin-off, a carve-out, or a tracking stock issue), each division has its own stock. There is a continuum of firm types, denoted by p , uniformly distributed on the interval $[0, 1]$. The time-3 cash flow from division 1 of a type p firm, x_1 , is αX^H with probability p and αX^L with probability $1 - p$. Similarly, the time-3 cash flow from division 2 of a type p firm, x_2 , is $(1 - \alpha)X^H$ with probability p and $(1 - \alpha)X^L$ with probability $1 - p$. The cash flows from the two divisions of the firm are independent.¹⁵ We normalize the number of shares of the consolidated firm to one. If the firm breaks up its stock by implementing a restructuring, we assume that each division of the firm has one share of stock (i.e., we also normalize the number of shares in each division to one).

There is a loss of synergy associated with a restructuring. Further, this loss of synergy is the highest when the firm conducts a spin-off and the lowest when the firm conducts a tracking stock issue. Specifically, the synergy loss associated with a spin-off, a carve-out, and a tracking stock issue are W , \hat{W} , and \tilde{W} , respectively, where $W > \hat{W} > \tilde{W} > 0$. The synergy loss is reflected in the

¹³ In addition to Boot and Thakor (1993), several other papers compare the effects of trading baskets of securities versus individual securities on endogenous information collection by investors using a Kyle (1985) type setting: see, e.g., Subrahmanyam (1991), who compares the effect of trading an index versus individual securities on information collection, or Goldman (2005), who compares the effect on information collection of trading the various divisions of a firm bundled as a single security or as multiple securities (each representing a single division). However, none of the above papers incorporate the role of the firm manager (or his private information about the firm or its divisions), so that they are unable to adequately analyze a firm's choice between a conglomerate firm or a spin-off (or its choice across various restructuring mechanisms such as spin-offs and carve-outs); neither can they explain the positive announcement effects that have been documented upon the announcements of spin-offs, carve-outs, and tracking stock issues.

¹⁴ We assume two divisions for the purpose of tractability. All results hold qualitatively when the firm has more than two divisions.

¹⁵ Given that we allow the actual cash flow realizations to be independent across divisions, allowing for the probability of a high cash flow to be different across divisions would only complicate our results without changing the qualitative nature of these results.

time-3 cash flow of the firm, and divided between the two divisions proportionally. For example, the net cash flow of the two divisions are $x_1 - \alpha W$ and $x_2 - (1 - \alpha)W$, respectively, after accounting for the synergy loss if the firm implements a spin-off.

3.2. Firm insiders' private information and information production by outsiders

Firm insiders know the true firm type p , whereas outside investors only know the prior distribution of p , which is uniformly distributed over $[0, 1]$. There are two types of outside investors: institutional investors and retail investors (liquidity traders). Retail investors are pure liquidity traders and their demand for the firm's equity is exogenous.¹⁶ The total aggregate demand (in terms of number of shares) from these retail investors, u , is uniformly distributed on the interval $[-1, 1]$, i.e.,

$$u \sim U[-1, 1]. \quad (1)$$

If the firm conducts a restructuring, the aggregate demand from the liquidity traders for each division's stock remains u .¹⁷

Institutional investors, unlike retail investors, have the ability to produce information about the two divisions of the firm. There are two types of institutional investors: type 1 and type 2. Type 1 investors have a comparative advantage in producing information about division 1: if the firm remains consolidated, by incurring a cost of C_1 , each type 1 investor observes the time-3 cash flow of division 1 without noise. For simplicity, we assume that the information production cost of a type 1 investor about the cash flow of division 2 is infinite. Similarly, type 2 investors have a comparative advantage in producing information about division 2: if the firm remains consolidated, by incurring a cost of C_2 , each type 2 investor observes the time-3 cash flow of division 2 without noise; the information production cost of type 2 investor on division 1's cash flow is infinite. If the firm conducts a restructuring, the information production costs of type 1 and type 2 investors (about divisions 1 and 2, respectively) will decrease because each division is now a pure-play unit and easier to value. Further, this reduction in information production cost is the greatest when the firm conducts a spin-off and the smallest when the firm conducts a tracking stock issue. Specifically, the information production costs to type 1 investors associated with a spin-off, a carve-out, and a tracking stock issue are C'_1 , \hat{C}_1 , and \tilde{C}_1 , respectively, where $C_1 > \tilde{C}_1 > \hat{C}_1 > C'_1 > 0$. Similarly, the information production costs to type 2 investors associated with a spin-off, a carve-out, and a tracking stock issue are C'_2 , \hat{C}_2 , and \tilde{C}_2 , respectively, where $C_2 > \tilde{C}_2 > \hat{C}_2 > C'_2 > 0$. That is, a restructuring improves institutional investors' information production technology, by making it easier for them to access information about the individual cash flows of each division. Institutional investors are wealth-constrained, and we model this constraint by assuming each investor can buy only one share of the consolidated firm's stock when the firm remains consolidated; each institutional investor can buy either $\frac{1}{\alpha}$ share of division 1's stock or $\frac{1}{1-\alpha}$ share of division 2's stock in the case of a restructuring.¹⁸

While institutional investors have the ability to produce information, they may not necessarily choose to do so, and may instead choose to trade in the firm's equity as uninformed (discretionary) traders. In section 3, where we characterize the equilibrium of the model, we will solve for the number of each type of institutional investor choosing to produce information about the two divisions of the firm. Uninformed institutional investors (UIIs) are the marginal investors, and they submit bids to clear the market after observing the total demand from the liquidity and informed traders.¹⁹ We assume that there are enough uninformed institutional investors in the market to absorb the total order flow from the liquidity and informed traders. The equity market is perfectly competitive so that both the uninformed and informed institutional investors make an expected net return of 0. In other words, in equilibrium, each institutional investor will be indifferent between producing and not producing information. In the case where the firm remains consolidated, denote the total order flow from retail and informed institutional investors by $y = z_1 + z_2 + u$, where z_1 and z_2 are the total order flow from type 1 and type 2 informed institutional investors, respectively. In the case of a restructuring, denote the total order flows for the two divisions' stocks by $y_1 = z_1 + u$ and $y_2 = z_2 + u$, respectively.

The market-clearing value of the consolidated firm at time 2 is the expected value of its future cash flows conditional on the total order flow from liquidity traders and informed institutional investors:

$$V_2^N = E[x_1 + x_2 | y, N]. \quad (2)$$

¹⁶ We can think of the pure liquidity traders as investors who trade the stock to hedge their own investment risks. Alternatively, they could trade the stock for purely behavioral reasons.

¹⁷ This is the appropriate assumption here since after a restructuring, one share of the combined firm's stock is divided into one share of division 1's stock and one share of division 2's stock.

¹⁸ This assumption is consistent with the assumption that a fraction α of the firm's time-3 cash flow comes from division 1, and the remaining $1 - \alpha$ from division 2, and that institutional investors have only a certain amount of wealth devoted to trading in the equity of the firm. While we choose to make assumptions on institutional trading directly in terms of number of shares for tractability, it is reasonable to assume that, given that each individual division generates only a fraction of the cash flows of the combined firm, institutional investors can buy a proportionately larger number of shares in either of the two divisions resulting from a restructuring relative to the number of shares they can buy in the combined firm.

¹⁹ Thus, following the standard role played by market makers in microstructure models, we assume that market-clearing prices are set by UIIs, who observe only the total order flow for each security, but unable to distinguish between orders placed by informed institutional investors and retail (liquidity) investors. Further, for tractability, we assume that different UIIs set prices for the two divisions' stocks. Therefore, UIIs setting the price for division 1's stock do not observe the total order flow for division 2's stock.

In the case of a restructuring, the market-clearing value of division 1 is the expected value of its future cash flow conditional on the total order flow for division 1's stock minus the proportional synergy loss arising from the restructuring:

$$V_2^{R1} = E[x_1 | y_1, R] - \alpha W^R, \quad (3)$$

where R stands for a spin-off, a carve-out, or a tracking stock issue. Similarly, the market-clearing value of division 2 is the expected value of its future cash flow conditional on the total order flow for division 2's stock minus the proportional synergy loss arising from the restructuring:

$$V_2^{R2} = E[x_2 | y_2, R] - (1 - \alpha) W^R. \quad (4)$$

3.3. The objective function of firm insiders

Following a standard assumption in the literature (see, e.g., Ross, 1977), we assume that the firm cares about both current and future market values.^{20,21} Thus, when making the decision at time 1 on whether or not to conduct a restructuring, the firm maximizes the weighted average of its time 1 and time 2 market values. In other words, the firm chooses either consolidation or one of the three types of restructuring to maximize the following objective function:

$$\max \gamma V_1 + (1 - \gamma) E[V_2], \quad (5)$$

where $\gamma \in [0, 1]$ is the weight of the firm's time-1 market value in the firm's objective function, and V_t is the market value of the whole firm at time t .

4. Market equilibrium

Definition of equilibrium: The equilibrium concept we use is Perfect Bayesian Equilibrium (PBE). An equilibrium consists of (i) a choice of the firm at time 1 on whether to announce a restructuring, and if yes, which type of restructuring; (ii) a choice made by type 1 and type 2 institutional investors at time 2 regarding whether to produce information; (iii) a decision made by informed institutional investors regarding how much to trade at time 2; (iv) a price set by ULLs at time 2 after observing the total order flow from retail investors and informed institutional investors; (v) a system of beliefs formed by investors at time 1 about the type of the firm after observing the firm's restructuring decision. The aforementioned set of prices, choices, and beliefs must be such that (a) the choice of each party maximizes his or her objective, given the choices and beliefs of others; (b) the beliefs of all parties are consistent with the equilibrium choices of others; further, along the equilibrium path, these beliefs are formed using Bayes' rule; (c) any deviation from the equilibrium strategy by any party is met by beliefs of other parties which yields the deviating party a lower payoff compared to that obtained in equilibrium.

Two broad categories of equilibria may exist (depending on parameter values): (i) partial pooling equilibria, where firms take different restructuring decisions, thus revealing the range of their firm types; (ii) pooling equilibria where all types of firms make the same restructuring decisions, regardless of their type. We will start with one type of partial pooling equilibrium, in which some firms choose a spin-off, some a carve-out, some a tracking stock issue, and some consolidation. We then characterize other partial pooling equilibria in which not all four choices are observed and pooling equilibria in which all firms choose the same strategy.

4.1. Choice between spin-offs, carve-outs, tracking stock issues, and consolidated firms

We characterize the existence and properties of the following equilibrium: the highest set of firm types ($p \in [q_1, 1]$) choose a spin-off, the next lower set of firm types ($p \in [q_2, q_1]$) choose a carve-out, the next lower set of firm types ($p \in [q_3, q_2]$) choose a tracking stock issue, and the lowest firm types ($p \in [0, q_3]$) choose to remain consolidated, where $0 < q_3 < q_2 < q_1 < 1$.

4.1.1. Information production and the trading of shares

At time 2, type 1 and type 2 institutional investors first decide whether or not to become informed. After that, information production and trading take place, and informed institutional investors trade with liquidity traders and ULLs. The following lemma describes the amount of information production and the market value of the firm when the firm remains consolidated at time 2.

²⁰ We can alternatively assume that the firm cares about market values at three dates: times 1, 2, and 3. Since all information asymmetry is resolved at time 3, assuming that the firm cares about time-3 as well does not change the qualitative nature of our results, provided that the firm places some weights on time-1 and time-2 market values as well.

²¹ Firm insiders may care about intermediate market values of the firm's equity for various reasons. For example, the firm may wish to raise capital through equity financing at the prevailing market price; the compensation of the management may be tied to the current and future stock prices; the firm may be subject to hostile takeover at undervalued price if its stock price is too low. This assumption can be translated to an assumption about maximizing the long-term wealth of current shareholders, since they may wish to liquidate some of their share holdings at dates 1 and 2 for liquidity reasons.

Lemma 1. If a firm remains consolidated at time 2, the numbers of type 1 and type 2 institutional investors producing information are h_1 and h_2 , which are characterized by Eqs. (A.1) and (A.2) in the Appendix. Firm insiders' expected market value of a type p firm at time 2 when it remains consolidated is:

$$E[V_2^{p,N}] = [\alpha h_1 + (1-\alpha)h_2][pX^H + (1-p)X^L] + [1-\alpha h_1 - (1-\alpha)h_2][0.5q_3X^H + (1-0.5q_3)X^L]. \quad (6)$$

When the firm remains consolidated, type i institutional investors produce information about division i and trade the shares of the consolidated firm, where $i \in \{1, 2\}$. The expected payoff to each informed investor decreases with the number of informed investors. Since the market for information production is perfectly competitive, the number of informed institutional investors is such that the equilibrium expected profit from becoming informed equals the cost of information production.

The following lemma describes the amount of information production and the expected combined market value of the two divisions of the firm at time 2 when the firm conducts a restructuring.

Lemma 2. (i) If the firm conducts a spin-off at time 2, the numbers of type 1 and type 2 institutional investors producing information are h'_1 and h'_2 , which are characterized by Eqs. (A.4) and (A.5) in the Appendix. Firm insiders' expectation of combined market value of the two divisions of a type p firm at time 2 is:

$$E[V_2^{p,S}] = (h'_1 + h'_2)[pX^H + (1-p)X^L] + (1-h'_1-h'_2)\left(\frac{1+q_1}{2}X^H + \frac{1-q_1}{2}X^L\right) - W. \quad (7)$$

(ii) If the firm conducts a carve-out at time 2, the numbers of type 1 and type 2 institutional investors producing information are \hat{h}_1 and \hat{h}_2 , which are characterized by Eqs. (A.6) and (A.7) in the Appendix. Firm insiders' expectation of combined market value of the two divisions of a type p firm at time 2 is:

$$E[V_2^{p,C}] = (\hat{h}_1 + \hat{h}_2)[pX^H + (1-p)X^L] + (1-\hat{h}_1-\hat{h}_2)\left[\frac{q_1+q_2}{2}X^H + \frac{2-q_1-q_2}{2}X^L\right] - \hat{W}. \quad (8)$$

(iii) If the firm issues tracking stock at time 2, the numbers of type 1 and type 2 institutional investors producing information are \tilde{h}_1 and \tilde{h}_2 , which are characterized by Eqs. (A.8) and (A.9) in the Appendix. Firm insiders' expectation of combined market value of the two divisions of a type p firm at time 2 is:

$$E[V_2^{p,T}] = (\tilde{h}_1 + \tilde{h}_2)[pX^H + (1-p)X^L] + (1-\tilde{h}_1-\tilde{h}_2)\left[\frac{q_2+q_3}{2}X^H + \frac{2-q_2-q_3}{2}X^L\right] - \tilde{W}. \quad (9)$$

In the case of a restructuring, a type $i \in \{1, 2\}$ institutional investor decides whether or not to produce information about division i . If they decide to produce information, they will trade division i 's stock based on the private information they have. The expected profit to each informed type i institutional investor decreases with the number of informed type i institutional investors. Since the market for information production is perfectly competitive, the equilibrium number of informed type i institutional investors is such that the payoff from information production equals the cost of information production. We will compare the extent of informed trading about the two divisions in spin-offs, carve-outs, tracking stock issues, and consolidated firms in Proposition 2.

4.1.2. Choice between a spin-off, a carve-out, a tracking stock issue, and a consolidated firm

The following proposition characterizes firms' choice between a spin-off, a carve-out, a tracking stock issue, and a consolidated firm.

Proposition 1. Choice between a spin-off, a carve-out, a tracking stock issue, and a consolidated firm

Assume that the synergy loss associated with a spin-off, a carve-out, or a tracking stock issue is moderate, such that $\bar{W} > W > \hat{W} > \tilde{W} > \underline{W}$, where \bar{W} and \underline{W} are defined in the Appendix. Further, let conditions (A.13) to (A.16) hold. Then, in equilibrium: (i) firms with type $p \in [q_1, 1]$ choose a spin-off; (ii) firms with type $p \in [q_2, q_1]$ choose a carve-out; (iii) firms with type $p \in [q_3, q_2]$ choose a tracking stock issue; and (iv) firms with type $p \in [0, q_3]$ choose to remain consolidated, where q_1 , q_2 , and q_3 are determined by Eqs. (A.10) to (A.12).

The firms' choice between a spin-off, a carve-out, a tracking stock issue, or a consolidated firm arises from a comparison of the costs and benefits of these alternatives. A restructuring facilitates informed trading and brings the market value of the firm closer to its true value. The higher the firm type, the higher the benefit from a restructuring, since more informed trading increases the chance that the true firm quality will be revealed by price, which results in a higher market value for higher value firms at time 2. The increase in informed trading is the greatest in a spin-off, lower in a carve-out, and the lowest in a tracking stock issue.

However, there is a synergy loss in a restructuring, and this synergy loss is the greatest in a spin-off, lower in a carve-out, and the lowest in a tracking stock issue. Firms choose between a spin-off, a carve-out, a tracking stock issue, or a consolidated firm based on this trade-off. Since the highest quality firms benefit the most from more informed trading, they find it optimal to choose

a spin-off to induce the maximum amount of information production and separate them from the rest of the firm types. The second highest set of firm types find it too costly to conduct a spin-off because the synergy loss is too high and they benefit less from increased informed trading compared to the highest types of firms. Therefore, they find it optimal to conduct a carve-out. Similarly, the third highest set of firm types choose a tracking stock issue, since it can increase informed trading and distinguish them from the lowest firm types. Given that they benefit less from an increase in informed trading, the third highest set of firm types prefer a tracking stock issue to a carve-out, since a tracking stock issue enables them to reduce the synergy loss compared to a carve-out. Finally, the lowest firm types find it suboptimal to implement any form of restructuring, since they actually lose from an increase in informed trading, and therefore do not wish to incur any synergy loss. They therefore remain consolidated in equilibrium.

The following proposition compares the amount of informed trading at time 2 when the firm remains consolidated with that when the firm conducts a spin-off, a carve-out, or a tracking stock issue.

Proposition 2. *Informed trading in spin-offs, carve-outs, tracking stock issues, and consolidated firms*

In the equilibrium characterized in Proposition 1, the amount of informed trading at time 2 is the greatest when the firm implements a spin-off, the next greatest when the firm implements a carve-out, the next greatest when the firm implements a tracking stock issue, and the least when the firm remains consolidated: i.e., $\frac{h'_1}{\alpha} > \frac{\hat{h}_1}{\alpha} > \frac{\tilde{h}_1}{\alpha} > h_1$ and $\frac{h'_2}{1-\alpha} > \frac{\hat{h}_2}{1-\alpha} > \frac{\tilde{h}_2}{1-\alpha} > h_2$.

The amount of informed trading at time 2 is the greatest when the firm conducts a spin-off, the next greatest when the firm implements a carve-out, followed by firms conducting a tracking stock issue, and is the least when the firm remains consolidated. Compared to a consolidated firm, a firm conducting a restructuring offers two advantages to informed traders to collect private information. First, the information production costs decrease after a restructuring and this will give informed traders a higher incentive to produce information. Second, wealth-constrained informed traders can specialize trading only in the division about which they have private information and buy more shares of that division and earn higher profits after a restructuring. In contrast, if the firm remains consolidated, informed traders are forced to trade the shares of the whole firm and buy a smaller number of shares. While the second advantage is the same for all three types of restructuring, the first advantage is the greatest for a spin-off, followed in magnitude by a carve-out and the least for a tracking stock issue. This explains the ordering in the amount of informed trading subsequent to the three forms of corporate restructuring.

Corollary 1. *Consider the special case where there is no reduction in institutional investors' cost of producing information about either of the two divisions of the firm after a tracking stock issue; i.e., $\tilde{C}_1 = C_1$ and $\tilde{C}_2 = C_2$. Further, let conditions (A.17) and (A.18) hold. In the equilibrium characterized in Proposition 1, there will be more informed trading in the shares of firms conducting a tracking stock issue than those remaining consolidated: i.e., $\frac{\tilde{h}_1}{\alpha} > h_1$, and $\frac{\tilde{h}_2}{1-\alpha} > h_2$.*

The Corollary 1 demonstrates that the second effect discussed (specialization in information production) by itself is able to generate an increase in information production about firms conducting tracking stock issues even in the absence of the first effect discussed above: i.e., even in the absence of a decrease in institutional investors' cost of information production about the two divisions of the firm after a tracking stock issue.²² Each of the previously stated two effects individually contribute to a significant increase in information production after firms undergoing restructuring over that about firms remaining consolidated.

The following proposition characterizes the market reaction to the announcement of a firm's spin-off decision.

Proposition 3. *Announcement returns in spin-offs, carve-outs, and tracking stock issues*

Assume conditions (A.19) through (A.21) hold. In the equilibrium characterized in Proposition 1, the announcement return is positive if a firm announces a restructuring at time 1; further, the announcement return is the highest for firms announcing a spin-off, the next highest for firms announcing a carve-out, the next highest for firms announcing a tracking stock issue: i.e., $\Delta V_1^S > \Delta V_1^C > \Delta V_1^T > 0$.

At time 0 (when all firms remain consolidated), the market gives all firms the average value of firms in the economy, and higher type firms are undervalued while lower type firms are overvalued. At time 1, when firms announce the restructuring decision, the market updates firm value accordingly, partially inferring the private information of firm insiders. Since the highest type firms announce a spin-off, the next highest type firms announce a carve-out, and the next highest type firms announce a tracking stock issue in equilibrium, the increase in market value of firms announcing a spin-off will be the highest, and the next highest increase will be for firms announcing a carve-out, followed in magnitude by firms announcing a tracking stock issue.

Proposition 4. *Announcement returns and the reduction in information production costs in restructuring*

In the equilibrium characterized in Proposition 1, for firms that announce a restructuring, the time-1 market value increases with the magnitude of the reduction in institutional investors' information production costs due to the restructuring: i.e., $\frac{\partial V_1^S}{\partial(C_1 - \hat{C}_1)} > 0$, $\frac{\partial V_1^C}{\partial(C_1 - \tilde{C}_1)} > 0$, $\frac{\partial V_1^T}{\partial(C_2 - \hat{C}_2)} > 0$, $\frac{\partial V_1^S}{\partial(C_2 - \tilde{C}_2)} > 0$, and $\frac{\partial V_1^S}{\partial(C_1 - C_1)} > 0$.

²² While we focus only on tracking stock issues in this corollary since it is the closest to a consolidated firm in terms of information production by outsiders, we can derive similar results for carve-outs and spin-offs. That is, in the special case where there is no reduction in outsiders' cost of producing information about either of the two divisions of the firm after a carve-out or a spin-off, there will nevertheless be more informed trading in the shares of firms conducting a carve-out or a spin-off than those remaining consolidated.

Proposition 4 states that the market value of the firm upon the announcement of a restructuring increases with the magnitude of the reduction in institutional investors' information production costs due to the restructuring. This is because, when the reduction in institutional investors' information production costs is large, the price becomes more informative after the restructuring, and it is more likely that true firm quality is detected by the market. Therefore, the benefit of mimicking higher type firms and implementing a restructuring will be lower for lower type firms when the magnitude of the reduction in outsiders' information production cost is larger, making them less likely to pool with higher type firms and obtain a higher market value after the restructuring. Consequently, in equilibrium, only firms with a higher intrinsic value find it worthwhile to conduct a restructuring when the reduction in outsiders' information production costs is large. Correspondingly, the market gives firms implementing a restructuring a higher valuation in this case, leading to higher value increase upon the announcement of a restructuring.

Proposition 5. Predictive power of informed institutional trading in restructuring

In the equilibrium characterized in **Proposition 1**, for firms that implement a restructuring, the time-2 market value increases with the order flow from informed institutional investors: i.e., $\frac{\partial E[V_2^{S1}]}{\partial z_1} > 0$, $\frac{\partial E[V_2^{S2}]}{\partial z_2} > 0$, $\frac{\partial E[V_2^{C1}]}{\partial z_1} > 0$, $\frac{\partial E[V_2^{C2}]}{\partial z_2} > 0$, $\frac{\partial E[V_2^{T1}]}{\partial z_1} > 0$, and $\frac{\partial E[V_2^{T2}]}{\partial z_2} > 0$.

At time 2, informed institutional investors observe the cash flows of the firm that will be realized at time 3. They will place a buy order if the cash flow is high and a sell order if the cash flow is low. Since the aggregate order flow from retail investors is exogenous and independent of the time-3 cash flow, the total order flow, on average, is higher when the time-3 cash flow is higher, resulting in the market value of the stock being also higher. Therefore, there is a positive relation between the time-2 market value of a firm and the order flow from informed institutional investors.

4.2. Other possible equilibria

So far, we have considered only one type of equilibrium, namely, a partial pooling equilibrium in which the highest firm types choose a spin-off, the next lower set of firm types choose a carve-out, the next lower set of firm types choose a tracking stock issue, and the lowest set of firm types remain consolidated. For this equilibrium to exist, we need the synergy loss associated with a spin-off, a carve-out, or a tracking stock issue to be moderate, so that $\bar{W} > W > \hat{W} > \tilde{W} > \underline{W}$. In this subsection, we explore the possibility of other equilibria when the synergy loss is extremely high or extremely low.

Proposition 6. Equilibria with high synergy losses

(i) If the loss of synergy is high in all three types of restructuring so that $W > \hat{W} > \tilde{W} > \bar{W}$, then all types of firms remain consolidated in equilibrium; (ii) if the loss of synergy is high in spin-offs and carve-outs and moderate in tracking stock issues so that $W > \hat{W} > \bar{W} > \tilde{W} > \underline{W}$, then firms with type $p \in [q^T, 1]$ choose a tracking stock issue and firms with type $p \in [0, q^T)$ choose to remain consolidated; (iii) if the loss of synergy is high in spin-offs and moderate in carve-outs and tracking stock issues so that $W > \bar{W} > \hat{W} > \tilde{W} > \underline{W}$, then firms with type $p \in [\bar{q}^T, 1]$ choose a carve-out, firms with type $p \in [q^T, \bar{q}^T)$ choose a tracking stock issue, and firms with type $p \in [0, q^T)$ choose to remain consolidated.

The pooling equilibrium with all types of firms remaining consolidated exists when the synergy loss from a restructuring is large. When the synergy loss is large, higher type firms find it too costly to use a restructuring to distinguish themselves from lower type firms, since the increase in market value is not enough to cover the synergy loss associated with the restructuring. Therefore, higher type firms choose to remain consolidated and pool with lower type firms.

If the synergy loss associated with a spin-off or carve-out is high, but that associated with a tracking stock issue is moderate, then a spin-off or carve-out is too costly for even the highest firm types. However, high firm types find it optimal to use a tracking stock issue, which is associated with moderate synergy losses, to increase informed trading and separate themselves from lower firm types. Lower firm types will choose to remain consolidated, since they do not benefit from increased informed trading after a tracking stock issue and they can save the synergy loss arising from a restructuring by remaining consolidated.

If the synergy loss associated with a spin-off is high, but that associated with a carve-out or tracking stock issue is moderate, then a spin-off is too costly for even the highest firm types. However, the highest firm types find it optimal to conduct a carve-out because a carve-out increases informed trading more than a tracking stock issue. Therefore, based on the trade-off between the costs and benefits associated with a carve-out, the highest firm types find it optimal to incur the higher cost of synergy loss associated with a carve-out to separate themselves from the rest of firm types. The medium firm types also benefit from increased informed trading, but to a lesser degree compared to the highest firm types. They find the synergy loss associated with a carve-out too high and will instead choose a tracking stock issue to separate themselves from the lowest firm types. The lowest firm types will choose to remain consolidated: they do not benefit from increased informed trading after a restructuring and remaining consolidated can save the synergy loss arising from any restructuring.

Proposition 7. Equilibria with low synergy losses

(i) If the loss of synergy is low in all three types of restructuring so that $\underline{W} > W > \hat{W} > \tilde{W}$, then all types of firms choose a spin-off; (ii) if the loss of synergy is moderate in spin-offs and low in carve-outs and tracking stock issues so that $\bar{W} > W > \underline{W} > \hat{W} > \tilde{W}$, then firms with type $p \in [q^S, 1]$ choose a spin-off and firms with type $p \in [0, q^S)$ choose a carve-out; (iii) if the loss of synergy is moderate

in spin-offs and carve-outs and low in tracking stock issues so that $\bar{W} > W > \hat{W} > \underline{W} > \tilde{W}$, then firms with type $p \in [\bar{q}^C, 1]$ choose a spin-off, firms with type $p \in [\underline{q}^C, \bar{q}^C)$ choose a carve-out, and firms with type $p \in [0, \underline{q}^C)$ choose a tracking stock issue.

The pooling equilibrium with all types of firms conducting a spin-off exists when the loss of synergy associated with a restructuring (even that associated with a spin-off) is quite small. It is obvious that higher firm types have incentives to conduct a spin-off because doing so will increase informed trading at time 2 and this will lead to higher time-2 market values. Even the lowest firm types have incentive to pool with higher firm types and conduct a spin-off. The cost of mimicking is small because the synergy loss associated with a spin-off is small. Conducting a spin-off will allow the lowest firm types to fully pool with higher firm types at time 1, and partially pool with them at time 2 (recall that information production by institutional investors will separate them only partially at time 2). If they instead choose to remain consolidated, the market will infer that they are of the lowest firm types and their market value will be lower at both time 1 and time 2.

If the synergy loss associated with a spin-off is moderate, but that associated with a carve-out or tracking stock issue is low, then the lowest firm types find it too costly to mimic through a spin-off. Instead, they will choose to pool with medium firm types through a carve-out. Only the highest firm types find it optimal to bear the cost of a spin-off and separate themselves from the rest of firm types. Therefore, in equilibrium, firms whose type is above the cutoff value q^S will conduct a spin-off, whereas firms with type below the cutoff value q^S will conduct a carve-out.

If the synergy loss associated with a spin-off or carve-out is moderate, but that associated with a tracking stock issue is low, then the highest set of firm types choose a spin-off to benefit from the greatest increase in informed trading associated with the spin-off. The next highest set of firm types finds it too costly to conduct a spin-off. At the same time, they benefit from increased informed trading. Trading off the synergy cost and valuation benefit associated with a carve-out, they choose to conduct a carve-out. The rest of lower firm types choose to conduct a tracking stock issue. Note that even the lowest firm types find it optimal to pool with higher firm types through a tracking stock issue, since the synergy loss associated with a tracking stock issue is low.

5. Empirical implications

We highlight some of the empirical implications of our model below.

- (i) *Propensity to restructure and the choice between spin-offs, carve-outs, and tracking stock issues:* Our model has several predictions for firms' propensity to restructure and their choice between various forms of restructuring, in particular, between spin-offs, carve-outs, and tracking stock issues. One of the reasons that higher type firms implement a restructuring in our setting is because this reduces institutional investors' information production costs. If a firm's two divisions operate in different industries, the reduction in outsiders' information production cost due to the restructuring tends to be high, so that higher type firms are more likely to implement a restructuring. Our model therefore predicts that we will observe more focus-increasing restructuring than non-focus-increasing restructuring. Consistent with this, both Daley et al. (1997) and Desai and Jain (1999) find that the number of focus-increasing spin-offs is more than twice that of non-focus-increasing spin-offs (60 versus 25 and 103 versus 41, respectively). We also provide a novel prediction here that if the earnings patterns of the firm's two divisions are quite different, the firm is more likely to conduct a restructuring compared to firms with similar earnings patterns from the two divisions.²³ Further, if the synergy loss between the two divisions involved in a restructuring is low while the two divisions are in unrelated industries (so that the reduction in outsiders' information production cost due to the restructuring is likely to be high), the firm is more likely to choose a spin-off rather than a carve-out. In contrast, if the potential synergy loss due to a spin-off is likely to be high, the firm is likely to choose a carve-out, especially if the two divisions involved are in related industries (so that the incremental reduction in outsiders' information acquisition costs from a spin-off over a carve-out is low). We can think of tracking stock issues as a restructuring mechanism where the synergy loss is even smaller compared to carve-outs, but where there is a less substantial reduction in outsiders' information acquisition costs. Thus, in the rare instances where firm insiders feel that potential synergy loss arising from spin-offs and carve-outs are likely to be very high, but there is nevertheless the need to increase information production by outsiders, the firm will choose to issue tracking stock rather than implementing a spin-off or a carve-out.
- (ii) *Market reaction to the announcements of spin-offs, carve-outs, and tracking stock issues:* Our model predicts that the market reaction to the announcement of a spin-off will be positive, and that the stock market reaction to a spin-off will be more favorable on average than that to a carve-out or to a tracking stock issue. Evidence consistent with this prediction is provided by Hite and Owers (1983), Miles and Rosenfeld (1983), Schipper and Smith (1983), Daley et al. (1997),

²³ Anecdotal evidence seems to support this prediction. For example, Georgia-Pacific offers tracking stock on its timber operations because the earnings on its pulp, paper, and building products businesses are too volatile (the *Wall Street Journal*, Sept. 18, 1997). This prediction is different from the prediction that we will see more focus-increasing than non-focus-increasing restructurings, since, even if a firm's two divisions operate in the same industry, their earnings patterns can be very different.

Krishnaswami and Subramaniam (1999), and Desai and Jain (1999) for spin-offs, and Schipper and Smith (1986), Allen and McConnell (1998), and Vijh (2002) for carve-outs. Evidence comparing the announcement effect of spin-offs with carve-outs and tracking stock issues is provided by Chemmanur and Paeglis (2001), whose findings also broadly support our model predictions.

- (iii) *Comparison of the market reaction to announcements of focus-increasing versus non-focus-increasing spin-offs, carve-outs, and tracking stock issues:* Our model predicts that the higher the reduction in outsiders' cost of information production due to a restructuring, the higher the announcement return (see Proposition 4). Since focus-increasing forms of restructuring are associated with higher reductions in outsiders' cost of producing information about intrinsic firm value, we predict that focus-increasing restructuring leads to higher announcement returns compared to non-focus-increasing ones. This is consistent with the findings of Vijh (2002) for carve-outs, and Daley et al. (1997) and Desai and Jain (1999) for spin-offs. This prediction is also consistent with Burch and Nanda's (2003) finding that the value increase after spin-offs is positively related to the degree of divisional diversity of firms prior to spin-offs.
- (iv) *Two-stage combination carve-outs and spin-offs:* Our analysis provides a rationale for the widely observed practice of firms first implementing a carve-out, and then, after one or two years, implementing a spin-off of the equity held by the parent firm to shareholders (see, e.g., Thompson and Apilado, 2006). While this practice may at first seem puzzling (why not implement a spin-off right away and let the individual firms raise any external financing required?), our theoretical analysis indicates that this is the right strategy in terms of preserving synergies in the short-run. By doing a carve-out, the firms are minimizing short-run synergy losses. As the two firms (divisions) resulting from a carve-out build separate facilities which were previously shared (say, in about two years after the carve-out), the potential synergy losses that would result from a spin-off become smaller, while there are still incremental information production benefits to be gained from a spin-off over a carve-out. At this stage, the parent firm will implement a spin-off of the equity it holds in the carved-out firm to its shareholders, thus reaping the incremental benefits arising from the increased information production resulting from a pure spin-off. In summary, two-stage restructuring may be a mechanism through which firms can reap the valuation benefits of increased information production while minimizing the synergy losses arising from the restructuring.
- (v) *The change in information asymmetry, level of information production, and the announcement effect of spin-offs, carve-outs, and tracking stock issues:* Our model predicts that the higher the reduction in institutional investors' information production costs after a restructuring, the higher the announcement return (see proposition 4). The findings of Fu (2002) on carve-outs and Krishnaswami and Subramaniam (1999) on spin-offs support this prediction. Proposition 2 of our model predicts that the amount of information production will be higher about firms conducting a spin-off, a carve-out, or a tracking stock issue compared to that about consolidated firms. Further, increased information production will lead to more informative stock prices, reducing the level of information asymmetry facing these firms in the equity market. Consistent with this prediction, several studies find either increased analyst coverage or reduction in information asymmetry (or both) for firms after restructuring. Chemmanur and Paeglis (2001) find that analyst coverage increases for firms subsequent to spin-offs, carve-outs, and tracking stock issues. Other evidence includes Fu (2002) for carve-outs, Krishnaswami and Subramaniam (1999) and Huson and MacKinnon (2003) for spin-offs, Gilson et al. (2001) for focus-increasing tracking stock offerings, carve-outs, and spin-offs, and Zuta (1999) for tracking stock issues. Our model also predicts that the greater the reduction in outsiders' information production costs due to a restructuring, the greater the increase in the level of information production subsequent to the restructuring (see proposition 4). Fu (2002) finds that the reduction in information asymmetry is more pronounced when a carve-out is intended to refocus the parent's operations, and Huson and MacKinnon (2003) find similar results for spin-offs. These findings are consistent with the predictions of our model, since focus-increasing restructuring are likely to be associated with a larger reduction in outsiders' information production costs compared to non-focus-increasing ones.
- (vi) *Institutional trading around spin-offs, carve-outs, and tracking stock issues:* Our model has several predictions for the trading behavior of institutional investors around restructuring. First, our model predicts that, of the institutional investors trading in the equity of the consolidated firm, a certain fraction will trade predominantly in the equity of the parent after a restructuring, while the remaining fraction will trade predominantly only in the equity of the subsidiary (given that different groups of institutional investors have a comparative advantage in producing information about different parts of the firm). Second, our model predicts that, given that institutional investors produce additional information after a restructuring, the extent of institutional net buy (extent of equity bought minus equity sold) in the equity of the two firms resulting from a restructuring will be positively related to the long-term operating performance and stock returns of these two firms: in other words, institutional trading will have predictive power for subsequent returns. Finally, the predictive power of institutional trading will be greater for a spin-off rather than for a carve-out or a tracking stock issue (since institutional investors collectively produce more information subsequent to a spin-off compared to that after a carve-out or a tracking stock issue). Evidence consistent with the first two predictions stated earlier is provided by Chemmanur and He (2008), who specifically test the predictions of our model using the Abel-Noser database of institutional trading.
- (vii) *Comparison of operating performance in spin-offs versus carve-outs and tracking stock issues:* While we do not explicitly model improvements in operating performance subsequent to restructuring, our results are consistent with improvements in operating performance after all these forms of restructuring, and also have indirect predictions for the relative magnitude of

operating performance improvements after spin-offs, carve-outs, and tracking stock issues. Our model predictions are consistent with the improvements in operating performance following a restructuring being greatest for spin-offs, less for carve-outs, and the least for tracking stock issues. Further, within a given form of restructuring, our analysis implies that performance improvements will be greater for focus-increasing rather than non-focus-increasing restructuring. This is because, given that the extent of increase in information production over a consolidated firm is greatest after spin-offs, less in carve-outs, and least after tracking stock issues, the long-term (time 2 in our model) stock price will reflect the operating performance of individual divisions (firms) most closely (i.e., with the least noise) after a spin-off and will be more noisy after carve-outs and tracking stock issues. Thus, our model implies that stock-based incentive compensation for managers will be most effective in improving operating performance after a spin-off and less effective in the case of carve-outs and tracking stock issues. Similar arguments apply for the relationship between performance improvement in focus-increasing versus non-focus-increasing restructuring. Evidence consistent with operating performance improvements following spin-offs is provided by Chemmanur and Nandy (2006), Daley et al. (1997), and Desai and Jain (1999). Daley et al. (1997) and Desai and Jain (1999) document that performance improvements for non-focus-increasing spin-offs are smaller relative to focus-increasing ones; Michaely and Shaw (1995) document that performance improvements are smaller for carve-outs. Finally, Haushalter and Mikkelsen (2001) document that tracking stock issues exhibit smaller performance improvements compared to spin-offs and carve-outs.

6. Conclusion

This paper has developed a theory of the role of institutional investors and affiliated analysts in corporate restructuring, and has analyzed a firm's choice between spin-offs, carve-outs, and tracking stock issues, for the first time in the literature. We consider a setting with a continuum of firm types where insiders of a firm with two divisions have private information about their true values and face an equity market consisting of retail investors (liquidity traders) and institutional investors. Institutional investors may engage in costly information production about the divisions of the firm, with some investors having a comparative advantage in producing information about division 1, and others having a similar comparative advantage for division 2. We show that, in the described setting, restructuring increases information production by institutional investors (relative to that about a consolidated firm), with the highest increase in information production associated with spin-offs, the next highest associated with equity carve-outs, and the lowest associated with tracking stock issues. In equilibrium, insiders with the most favorable private information choose to implement spin-offs; those with less favorable private information implement carve-outs; those with even less favorable private information implement tracking stock issues; and those with unfavorable private information retain a consolidated structure. In addition to explaining the positive announcement effect and the increase in analyst coverage that has been empirically documented following all three forms of restructuring, our model generates a number of novel testable predictions for firms' choice between spin-offs, carve-outs, and tracking stock issues, and for institutional trading around these three forms of restructuring.

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Appendix A. Proofs of Lemmas and Propositions

Proof of Lemma 1. At time 2, if a firm remains consolidated, the market knows that the firm type is between 0 and q_3 , and the probability of time-3 cash flow being X^H is $\frac{\int_0^{q_3} p dp}{\int_0^{q_3} dp} = \frac{q_3}{2}$. Consider the following four cases:

- i). With probability $\frac{q_3^2}{4}$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^H$, so that the total order flow is uniformly distributed on the interval $[-1 + h_1 + h_2, 1 + h_1 + h_2]$.
- ii). With probability $\frac{q_3}{2} \left(1 - \frac{q_3}{2}\right)$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^L$, so that the total order flow is uniformly distributed on the interval $[-1 + h_1 - h_2, 1 + h_1 - h_2]$.
- iii). With probability $\frac{q_3}{2} \left(1 - \frac{q_3}{2}\right)$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^H$, so that the total order flow is uniformly distributed on the interval $[-1 - h_1 + h_2, 1 - h_1 + h_2]$.
- iv). With probability $\left(1 - \frac{q_3}{2}\right)^2$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^L$, so that the total order flow is uniformly distributed on the interval $[-1 - h_1 - h_2, 1 - h_1 - h_2]$.

Since the two divisions are symmetric ex ante, we can assume that the parameters are such that $h_1 \geq h_2$. Uninformed institutional investors (UIIs from now on) set the share price as follows:

1. When $y > 1 + h_1 - h_2$, the UIIs know that $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^H$, and the reasoning is as follows: if it is not true that $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^H$, then $z_1 + z_2 \leq h_1 - h_2$, and therefore $y \leq 1 + h_1 - h_2$, which contradicts $y > 1 + h_1 - h_2$. The UIIs will therefore set a price of X^H .
2. When $1 - h_1 + h_2 < y \leq 1 + h_1 - h_2$, the UIIs know that with probability $\frac{q_3}{2}$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^H$, and with probability $1 - \frac{q_3}{2}$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^L$. The UIIs will therefore set a price of $\alpha X^H + (1 - \alpha) \left[\frac{q_3}{2} X^H + \left(1 - \frac{q_3}{2}\right) X^L \right]$.
3. When $1 - h_1 - h_2 < y \leq 1 - h_1 + h_2$, the UIIs know that with probability $\frac{q_3}{4 - q_3}$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^H$, with probability $\frac{2 - q_3}{4 - q_3}$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^L$, and with probability $\frac{2 - q_3}{4 - q_3}$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^H$. The UIIs will therefore set a price of $\frac{2X^H + (2 - q_3)X^L}{4 - q_3}$.
4. When $-1 + h_1 + h_2 < y \leq 1 - h_1 - h_2$, the UIIs know that with probability $\left(\frac{q_3}{2}\right)^2$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^H$, with probability $\frac{q_3}{2} \left(1 - \frac{q_3}{2}\right)$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^L$, with probability $\frac{q_3}{2} \left(1 - \frac{q_3}{2}\right)$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^H$, and with probability $\left(1 - \frac{q_3}{2}\right)^2$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^L$. The UIIs will therefore set a price of $\frac{q_3}{2} X^H + \left(1 - \frac{q_3}{2}\right) X^L$.
5. When $-1 + h_1 - h_2 < y \leq -1 + h_1 + h_2$, the UIIs know that with probability $\frac{q_3}{2 + q_3}$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^H$, with probability $\frac{q_3}{2 + q_3}$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^L$, and with probability $\frac{2 - q_3}{2 + q_3}$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^L$. The UIIs will therefore set a price of $\frac{q_3 X^H + 2X^L}{2 + q_3}$.
6. When $-1 - h_1 + h_2 < y \leq -1 + h_1 - h_2$, the UIIs know that with probability $\frac{q_3}{2}$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^H$, and with probability $1 - \frac{q_3}{2}$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^L$. The UIIs will therefore set a price of $\alpha X^L + (1 - \alpha) \left[\frac{q_3}{2} X^H + \left(1 - \frac{q_3}{2}\right) X^L \right]$.
7. When $y \leq -1 - h_1 + h_2$, the UIIs know that $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^L$. The UIIs will therefore set a price of X^L .

To calculate the expected profit of each type 1 and type 2 trader, consider the following four cases:

- (i). With probability $\left(\frac{q_3}{2}\right)^2$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^H$. The order flow from informed traders are $z_1 = h_1$ and $z_2 = h_2$. Since the aggregate order flow from pure liquidity traders is uniformly distributed over $[-1, 1]$, the distribution of the total order flow observed by UIIs is as follows: $y \in (1 + h_1 - h_2, 1 + h_1 + h_2]$ with probability h_2 , $y \in (1 - h_1 + h_2, 1 + h_1 - h_2]$ with probability $h_1 - h_2$, $y \in (1 - h_1 - h_2, 1 - h_1 + h_2]$ with probability h_2 , and $y \in [-1 + h_1 + h_2, 1 - h_1 - h_2]$ with probability $1 - h_1 - h_2$. The expected conditional profits for each type 1 and type 2 trader are therefore:

$$\begin{aligned} E[\pi_1 | x_1 = \alpha X^H, x_2 = (1 - \alpha)X^H] &= E[\pi_2 | x_1 = \alpha X^H, x_2 = (1 - \alpha)X^H] \\ &= \left(1 - \frac{q_3}{2}\right) (X^H - X^L) \left[(h_1 - h_2)(1 - \alpha) + \frac{2h_2}{4 - q_3} + 1 - h_1 - h_2 \right]. \end{aligned}$$

- (ii). With probability $\frac{q_3}{2} \left(1 - \frac{q_3}{2}\right)$, $x_1 = \alpha X^H$ and $x_2 = (1 - \alpha)X^L$. The order flow from informed traders are $z_1 = h_1$ and $z_2 = -h_2$. The distribution of the total order flow observed by UIIs is as follows: $y \in (1 - h_1 + h_2, 1 + h_1 - h_2]$ with probability $h_1 - h_2$, $y \in (1 - h_1 - h_2, 1 - h_1 + h_2]$ with probability h_2 , $y \in [-1 + h_1 + h_2, 1 - h_1 - h_2]$ with probability $1 - h_1 - h_2$, and $y \in (-1 + h_1 - h_2, -1 + h_1 + h_2]$ with probability h_2 . The expected conditional profits for each type 1 and type 2 trader are therefore:

$$\begin{aligned} E[\pi_1 | x_1 = \alpha X^H, x_2 = (1 - \alpha)X^L] &= -E[\pi_2 | x_1 = \alpha X^H, x_2 = (1 - \alpha)X^L] \\ &= -(h_1 - h_2) \frac{q_3}{2} (1 - \alpha) (X^H - X^L) + h_2 \frac{(4\alpha - \alpha q_3 - 2)}{4 - q_3} (X^H - X^L) \\ &\quad + (1 - h_1 - h_2) \left(\alpha - \frac{q_3}{2} \right) (X^H - X^L) + h_2 \frac{(2\alpha + \alpha q_3 - q_3)}{2 + q_3} (X^H - X^L). \end{aligned}$$

- (iii). With probability $\frac{q_3}{2} \left(1 - \frac{q_3}{2}\right)$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^H$. The order flow from informed traders are $z_1 = -h_1$ and $z_2 = h_2$. The distribution of the total order flow observed by UIIs is as follows: $y \in (1 - h_1 - h_2, 1 - h_1 + h_2]$ with probability h_2 , $y \in [-1 + h_1 + h_2, 1 - h_1 - h_2]$ with probability $1 - h_1 - h_2$, $y \in (-1 + h_1 - h_2, -1 + h_1 + h_2]$ with probability h_2 , and $y \in (-1 - h_1 + h_2, -1 - h_1 - h_2]$ with probability $h_1 - h_2$. The expected conditional profits for each type 1 and type 2 trader are therefore:

$$\begin{aligned} E[\pi_1 | x_1 = \alpha X^L, x_2 = (1 - \alpha)X^H] &= -E[\pi_2 | x_1 = \alpha X^L, x_2 = (1 - \alpha)X^H] \\ &= -h_2 \frac{(2 - q_3 - 4\alpha + \alpha q_3)}{4 - q_3} (X^H - X^L) - (1 - h_1 - h_2) \left(1 - \alpha - \frac{q_3}{2}\right) (X^H - X^L) \\ &\quad - h_2 \frac{(2 - 2\alpha - \alpha q_3)}{2 + q_3} (X^H - X^L) - (h_1 - h_2) \left(1 - \frac{q_3}{2}\right) (1 - \alpha) (X^H - X^L). \end{aligned}$$

- (iv). With probability $\left(1 - \frac{q_3}{2}\right)^2$, $x_1 = \alpha X^L$ and $x_2 = (1 - \alpha)X^L$. The order flow from informed traders are $z_1 = -h_1$ and $z_2 = -h_2$. The distribution of the total order flow observed by ULLs is as follows: $y \in [-1 + h_1 + h_2, 1 - h_1 - h_2]$ with probability $1 - h_1 - h_2$, $y \in (-1 + h_1 - h_2, -1 + h_1 + h_2]$ with probability h_2 , $y \in (-1 - h_1 + h_2, -1 + h_1 - h_2]$ with probability $h_1 - h_2$, and $y \in (-1 - h_1 - h_2, -1 - h_1 + h_2]$ with probability h_2 . The expected conditional profits for each type 1 and type 2 trader are therefore:

$$\begin{aligned} E[\pi_1 | x_1 = \alpha X^L, x_2 = (1 - \alpha)X^L] &= E[\pi_2 | x_1 = \alpha X^L, x_2 = (1 - \alpha)X^L] \\ &= \frac{q_3}{2} (X^H - X^L) \left[(h_1 - h_2)(1 - \alpha) + \frac{2h_2}{2 + q_3} + 1 - h_1 - h_2 \right]. \end{aligned}$$

The (unconditional) expected profits of each type 1 and type 2 trader are

$$E[\pi_1] = \frac{q_3(2 - q_3)(X^H - X^L) \left[\alpha(1 - h_1 - h_2)(8 + 2q_3 - q_3^2) - 2h_2(2 + 2q_3 - q_3^2) \right]}{2(4 - q_3)(2 + q_3)}$$

and

$$E[\pi_2] = \frac{q_3(2 - q_3)(X^H - X^L) \left[(1 - \alpha)(8 + 2q_3 - q_3^2) - 2h_2(2 + 2q_3 - q_3^2) \right]}{2(4 - q_3)(2 + q_3)}.$$

In equilibrium, we have $E[\pi_1] = C_1$ and $E[\pi_2] = C_2$, which lead to

$$\begin{aligned} h_1 &= \frac{C_2 \left[(4 + 4q_3 - 2q_3^2) - \alpha(8 + 2q_3 - q_3^2) \right]}{\alpha q_3(2 - q_3)(X^H - X^L)(2 + 2q_3 - q_3^2)} - \frac{2(2 + 2q_3 - q_3^2) - \alpha(16 + 10q_3 - 5q_3^2) + \alpha^2(8 + 2q_3 - q_3^2)}{2\alpha(2 + 2q_3 - q_3^2)} \\ &\quad - \frac{2C_1}{\alpha q_3(2 - q_3)(X^H - X^L)} \end{aligned} \quad (\text{A.1})$$

and

$$h_2 = \frac{(8 + 2q_3 - q_3^2)(1 - \alpha)}{4 + 4q_3 - 2q_3^2} - \frac{C_2(8 + 2q_3 - q_3^2)}{q_3(X^H - X^L)(4 + 2q_3 - 4q_3^2 + q_3^3)}. \quad (\text{A.2})$$

The proof of Eq. (6) is similar to that of Eq. (7). Q.E.D.

Proof of Lemma 2. At time 2, if a firm conducts a spin-off, the market knows that the firm type is between q_1 and 1, and the probability of time-3 cash flow being X^H is $\frac{\int_{q_1}^1 p dp}{\int_{q_1}^1 dp} = \frac{1 + q_1}{2}$. Type 1 informed traders trade the shares of division 1's stock while type 2 informed traders do not. Type 1 informed traders know the true values of the time-3 cash flow and each can trade $\frac{1}{\alpha}$ shares, so the total order flow for division 1's stock from type 1 informed traders is $z_1 = \frac{h'_1}{\alpha}$ when $x_1 = \alpha X^H$ and $z_1 = -\frac{h'_1}{\alpha}$ when $x_1 = \alpha X^L$, where h'_1 is the number of type 1 informed traders. The ULLs observe the total order flow for division 1's stock from the liquidity and informed traders, $y_1 = u + z_1$. When $y_1 > 1 - \frac{h'_1}{\alpha}$, the ULLs know that $x_1 = \alpha X^H$, and the reasoning is as follows: if $x_1 = \alpha X^L$, then $z = -\frac{h'_1}{\alpha}$, and $y_1 = u + z_1 \leq 1 - \frac{h'_1}{\alpha}$ (since $u \leq 1$). Therefore, $y_1 > 1 - \frac{h'_1}{\alpha}$ reveals to ULLs that $x_1 = \alpha X^H$. Similarly, when $y_1 < -1 + \frac{h'_1}{\alpha}$, ULLs know that $x_1 = \alpha X^L$. When $y_1 \in \left[-1 + \frac{h'_1}{\alpha}, 1 - \frac{h'_1}{\alpha}\right]$, ULLs learn nothing from the order flow. Consider the following four cases: (1) with probability $\frac{1 + q_1}{2} \frac{h'_1}{\alpha}$, $x_1 = \alpha X^H$, and $u > 1 - 2\frac{h'_1}{\alpha}$, so that $y_1 > 1 - \frac{h'_1}{\alpha}$ and the price of the stock is $V_2^{S1} = \alpha(X^H - W)$. Each informed trader earns zero profit in this case. (2) With probability $\frac{1 + q_1}{2} \left(1 - \frac{h'_1}{\alpha}\right)$, $x_1 = \alpha X^H$, and $u < 1 - 2\frac{h'_1}{\alpha}$, so that $y_1 \in \left[-1 + \frac{h'_1}{\alpha}, 1 - \frac{h'_1}{\alpha}\right]$ and the price of the stock is $V_2^{S1} = \alpha\left(\frac{1 + q_1}{2} X^H + \frac{1 - q_1}{2} X^L - W\right)$. Each informed trader earns a profit of $\frac{1 - q_1}{2} (X^H - X^L)$ in this case. (3) With probability $\frac{1 - q_1}{2} \frac{h'_1}{\alpha}$, $x_1 = \alpha X^L$, and $u < -1 + 2\frac{h'_1}{\alpha}$, so that $y_1 < -1 + \frac{h'_1}{\alpha}$ and the price of the stock is $V_2^{S1} = \alpha(X^L - W)$. Each informed trader earns zero profit in this case. (4) With probability $\frac{1 - q_1}{2} \left(1 - \frac{h'_1}{\alpha}\right)$, $x_1 = \alpha X^L$, and $u > -1 + 2\frac{h'_1}{\alpha}$, so that $y_1 \in \left[-1 + \frac{h'_1}{\alpha}, 1 - \frac{h'_1}{\alpha}\right]$ and the price of the stock is $V_2^{S1} = \alpha\left(\frac{1 + q_1}{2} X^H + \frac{1 - q_1}{2} X^L - W\right)$. Each informed trader earns a profit of $\frac{1 + q_1}{2} (X^H - X^L)$ in this case. The expected profit for each type 1 informed trader is therefore given by

$$E[\pi_1^S] = \frac{1 - q_1}{2} (X^H - X^L) \left(1 - \frac{h'_1}{\alpha}\right), \quad (\text{A.3})$$

which decreases with h'_1 . Since the market for information production is perfectly competitive, the number of informed traders is such that the expected profit from producing information equals the cost of doing so, i.e.,

$$E[\pi_1^S] = C'_1,$$

which leads directly to

$$h'_1 = \alpha \left[1 - \frac{2C'_1}{(1-q_1^2)(X^H - X^L)} \right], \quad (\text{A.4})$$

and similarly,

$$h'_2 = (1-\alpha) \left[1 - \frac{2C'_2}{(1-q_1^2)(X^H - X^L)} \right]. \quad (\text{A.5})$$

Firm insiders' expected market value of division 1 of a type p firm at time 2 is

$$\begin{aligned} E[V_2^{p,S1}] &= p \frac{h'_1}{\alpha} \times \alpha X^H + p \left(1 - \frac{h'_1}{\alpha} \right) \times \alpha \left(\frac{1+q_1}{2} X^H + \frac{1-q_1}{2} X^L \right) \\ &\quad + (1-p) \frac{h'_1}{\alpha} \times \alpha X^L + (1-p) \left(1 - \frac{h'_1}{\alpha} \right) \times \alpha \left(\frac{1+q_1}{2} X^H + \frac{1-q_1}{2} X^L \right) - \alpha W \\ &= h'_1 [pX^H + (1-p)X^L] + (\alpha - h'_1) \left(\frac{1+q_1}{2} X^H + \frac{1-q_1}{2} X^L \right) - \alpha W. \end{aligned}$$

Similarly, firm insiders' expected market value of division 2 of a type p firm at time 2 is

$$E[V_2^{p,S2}] = h'_2 [pX^H + (1-p)X^L] + (1-\alpha-h'_2) \left(\frac{1+q_1}{2} X^H + \frac{1-q_1}{2} X^L \right) - (1-\alpha)W.$$

The expected combined market value of the type p firm at time 2 is $E[V_2^{p,S}] = E[V_2^{p,S1}] + E[V_2^{p,S2}]$, which leads to Eq. (7).

Similar to the proof of the case where the firm conducts a spin-off, we can show that, if a firm conducts a carve-out at time 2, the numbers of type 1 and type 2 traders are given by

$$\hat{h}_1 = \alpha \left[1 - \frac{2\hat{C}_1}{(q_1 + q_2)(2-q_1-q_2)(X^H - X^L)} \right], \quad (\text{A.6})$$

$$\hat{h}_2 = (1-\alpha) \left[1 - \frac{2\hat{C}_2}{(q_1 + q_2)(2-q_1-q_2)(X^H - X^L)} \right], \quad (\text{A.7})$$

and the expected combined market value of the two divisions of the type p firm at time 2 is

$$E[V_2^{p,C}] = (\hat{h}_1 + \hat{h}_2) [pX^H + (1-p)X^L] + (1-\hat{h}_1-\hat{h}_2) \left[\frac{q_2 + q_1}{2} X^H + \frac{2-q_2-q_1}{2} X^L \right] - \hat{W}.$$

If a firm conducts a tracking stock issue at time 2, the numbers of type 1 and type 2 traders are given by

$$\tilde{h}_1 = \alpha \left[1 - \frac{2\tilde{C}_1}{(q_3 + q_2)(2-q_3-q_2)(X^H - X^L)} \right], \quad (\text{A.8})$$

$$\tilde{h}_2 = (1-\alpha) \left[1 - \frac{2\tilde{C}_2}{(q_3 + q_2)(2-q_3-q_2)(X^H - X^L)} \right], \quad (\text{A.9})$$

and the expected combined market value of the two divisions of the type p firm at time 2 is

$$E[V_2^{p,C}] = (\tilde{h}_1 + \tilde{h}_2) [pX^H + (1-p)X^L] + (1-\tilde{h}_1-\tilde{h}_2) \left[\frac{q_3 + q_2}{2} X^H + \frac{2-q_3-q_2}{2} X^L \right] - \tilde{W}.$$

Q.E.D.

Proof of Proposition 1. At time 1, if a firm announces a spin-off, outsiders' equilibrium inference is that the firm type is between q_1 and 1. The market value of the firm is then $\frac{1+q_1}{2} X^H + \frac{1-q_1}{2} X^L - W$. Similarly, if a firm announces a carve-out, the market value

of the firm is $\frac{q_1 + q_2}{2} X^H + \frac{2 - q_1 - q_2}{2} X^L - \widehat{W}$. If a firm announces a tracking stock issue, the market value of the firm is $\frac{q_3 + q_2}{2} X^H + \frac{2 - q_3 - q_2}{2} X^L - \widetilde{W}$. If a firm does not announce a restructuring, outsiders infer its market value to be $\frac{q_3}{2} X^H + \frac{2 - q_3}{2} X^L$.

The utility of a type p firm from choosing a spin-off is

$$U^S(p) = \gamma \left(\frac{1 + q_1}{2} X^H + \frac{1 - q_1}{2} X^L - W \right) + (1 - \gamma) \left\{ [h'_1 + h'_2] [pX^H + (1 - p)X^L] + (1 - h'_1 - h'_2) \left[\frac{1 + q_1}{2} X^H + \frac{1 - q_1}{2} X^L \right] - W \right\}.$$

and the utility of the type p firm from choosing a carve-out is

$$U^C(p) = \gamma \left(\frac{q_1 + q_2}{2} X^H + \frac{2 - q_1 - q_2}{2} X^L - \widehat{W} \right) + (1 - \gamma) \left\{ (\widehat{h}_1 + \widehat{h}_2) [pX^H + (1 - p)X^L] + (1 - \widehat{h}_1 - \widehat{h}_2) \left[\frac{q_2 + q_1}{2} X^H + \frac{2 - q_2 - q_1}{2} X^L \right] - \widehat{W} \right\}.$$

Incentive compatibility conditions require that firms with type $p \in [q_1, 1]$ prefer a spin-off to a carve-out, and firms with type $p \in [q_2, q_1]$ prefer a carve-out to a spin-off: i.e., $U^S(p) - U^C(p) \geq 0$ for $p \in [q_1, 1]$ and $U^S(p) - U^C(p) \leq 0$ for $p \in [q_2, q_1]$. Note that

$$U^S(p) - U^C(p) = \gamma \frac{(1 - q_2)(X^H - X^L)}{2} + (1 - \gamma) \left\{ (h'_1 + h'_2 - \widehat{h}_1 - \widehat{h}_2) [pX^H + (1 - p)X^L] + (1 - h'_1 - h'_2) \left[\frac{1 + q_1}{2} X^H + \frac{1 - q_1}{2} X^L \right] - (1 - \widehat{h}_1 - \widehat{h}_2) \left[\frac{q_2 + q_1}{2} X^H + \frac{2 - q_2 - q_1}{2} X^L \right] \right\} - W + \widehat{W},$$

which increases in p since $h'_1 > \widehat{h}_1$ and $h'_2 > \widehat{h}_2$ under condition (A.13). Therefore, if $U^S(p = q_1) - U^C(p = q_1) = 0$, the incentive compatibility conditions hold for all $p \in [q_2, 1]$. $U^S(p = q_1) - U^C(p = q_1) = 0$ leads to

$$\gamma \frac{(1 - q_2)(X^H - X^L)}{2} + (1 - \gamma) \left\{ \frac{\alpha C'_1 + (1 - \alpha) C'_2}{(1 + q_1)} + \frac{(q_1 - q_2) [\alpha \widehat{C}_1 + (1 - \alpha) \widehat{C}_2]}{(2 - q_1 - q_2)(q_1 + q_2)} \right\} + \widehat{W} - W = 0. \quad (\text{A.10})$$

Similarly, incentive compatibility conditions require that firms with type $p \in [q_3, q_2]$ prefer a tracking stock issue to a carve-out, and firms with type $p \in [q_2, q_1]$ prefer a carve-out to a tracking stock issue, which holds when $U^T(p = q_2) - U^C(p = q_2) = 0$ under condition (A.14). This leads to the condition

$$\gamma \frac{(q_1 - q_3)(X^H - X^L)}{2} + (1 - \gamma) \left\{ \frac{(q_1 - q_2) [\alpha \widehat{C}_1 + (1 - \alpha) \widehat{C}_2]}{(2 - q_1 - q_2)(q_1 + q_2)} + \frac{(q_2 - q_3) [\alpha \widetilde{C}_1 + (1 - \alpha) \widetilde{C}_2]}{(2 - q_3 - q_2)(q_3 + q_2)} \right\} + \widetilde{W} - \widehat{W} = 0. \quad (\text{A.11})$$

Incentive compatibility conditions require that firms with type $p \in [q_3, q_2]$ prefer a tracking stock issue to a consolidated firm, and firms with type $p \in [0, q_3]$ prefer a consolidated firm to a tracking stock issue, which holds when $U^T(p = q_3) - U^N(p = q_3) = 0$ under conditions (A.15) and (A.16). This leads to the condition

$$\gamma \frac{q_3(X^H - X^L)}{2} + (1 - \gamma) \frac{3(1 - \alpha)(X^H - X^L)(2 - q_3)^2 q_3^2 + 4C_1(2 + 2q_3 - q_3^2) + 2C_2(4 - 2q_3 + q_3^2)}{4(4 + 2q_3 - 4q_3^2 + q_3^3)} + (1 - \gamma) \frac{(q_2 - q_3) [\alpha \widetilde{C}_1 + (1 - \alpha) \widetilde{C}_2]}{(2 - q_3 - q_2)(q_3 + q_2)} - \widetilde{W} = 0. \quad (\text{A.12})$$

The values of q_1 , q_2 , and q_3 are simultaneously determined by Eqs. (A.10) through (A.12). The conditions $\widetilde{W} > W > \widehat{W} > \widetilde{W} > \underline{W}$ ensure that $q_1 \in (0, 1)$, $q_2 \in (0, 1)$, and $q_3 \in (0, 1)$, where \widetilde{W} and \underline{W} are defined in Eqs. (A.23) and (A.27). Q.E.D.

Proof of Proposition 2. The amount of informed trading from type 1 investors in spin-offs, carve-outs, and tracking stock issues are $\frac{h'_1}{\alpha}$, $\frac{\widehat{h}_1}{\alpha}$, and $\frac{\widetilde{h}_1}{\alpha}$, respectively, because each type 1 investor is allowed to trade $\frac{1}{\alpha}$ shares of division 1's stock. In contrast, the amount of informed trading from type 1 investors in a consolidated firm is h_1 because each type 1 investor is allowed to trade one share of the consolidated firm's stock. Similarly, the amount of informed trading from type 2 investors are $\frac{h'_2}{1 - \alpha}$, $\frac{\widehat{h}_2}{1 - \alpha}$, $\frac{\widetilde{h}_2}{\alpha}$, and h_2 , respectively. From Eqs. (A.4), (A.5), (A.6), and (A.7), we know that

$$h'_1 - \widehat{h}_1 = \alpha \left[\frac{2\widehat{C}_1}{(q_1 + q_2)(2 - q_1 - q_2)(X^H - X^L)} - \frac{2C'_1}{(1 - q_1^2)(X^H - X^L)} \right],$$

and

$$h'_2 - \hat{h}_2 = (1-\alpha) \left[\frac{2\hat{C}_2}{(q_1 + q_2)(2-q_1-q_2)(X^H - X^L)} - \frac{2C'_2}{(1-q_1^2)(X^H - X^L)} \right].$$

The condition

$$1 - q_1^2 > (2 - q_1 - q_2)(q_1 + q_2) \max \left\{ \frac{C'_1}{\hat{C}_1}, \frac{C'_2}{\hat{C}_2} \right\} \quad (\text{A.13})$$

ensures that $\frac{h'_1}{\alpha} > \frac{\hat{h}_1}{\alpha}$ and $\frac{h'_2}{1-\alpha} > \frac{\hat{h}_2}{1-\alpha}$.

Similarly, the condition

$$(2 - q_1 - q_2)(q_1 + q_2) > (2 - q_3 - q_2)(q_3 + q_2) \max \left\{ \frac{\hat{C}_1}{\tilde{C}_1}, \frac{\hat{C}_2}{\tilde{C}_2} \right\} \quad (\text{A.14})$$

ensures that $\frac{\hat{h}_1}{\alpha} > \frac{\tilde{h}_1}{\alpha}$ and $\frac{\hat{h}_2}{1-\alpha} > \frac{\tilde{h}_2}{1-\alpha}$. The conditions

$$1 - \frac{2\tilde{C}_1}{(q_3 + q_2)(2 - q_3 - q_2)(X^H - X^L)} > \frac{C_2 \left[(4 + 4q_3 - 2q_3^2) - \alpha(8 + 2q_3 - q_3^2) \right]}{\alpha q_3(2 - q_3)(X^H - X^L)(2 + 2q_3 - q_3^2)} \\ - \frac{2(2 + 2q_3 - q_3^2) - \alpha(16 + 10q_3 - 5q_3^2) + \alpha^2(8 + 2q_3 - q_3^2)}{2\alpha(2 + 2q_3 - q_3^2)} - \frac{2C_1}{\alpha q_3(2 - q_3)(X^H - X^L)} \quad (\text{A.15})$$

and

$$1 - \frac{2\tilde{C}_2}{(q_3 + q_2)(2 - q_3 - q_2)(X^H - X^L)} > \frac{(8 + 2q_3 - q_3^2)(1-\alpha)}{4 + 4q_3 - 2q_3^2} - \frac{C_2(8 + 2q_3 - q_3^2)}{q_3(X^H - X^L)(4 + 2q_3 - 4q_3^2 + q_3^3)} \quad (\text{A.16})$$

ensure that $\frac{\tilde{h}_1}{\alpha} > h_1$ and $\frac{\tilde{h}_2}{1-\alpha} > h_2$. Q.E.D.

Proof of Corollary 1. When $C_1 = \tilde{C}_1$ and $C_2 = \tilde{C}_2$, condition (A.15) becomes

$$1 - \frac{2C_1}{(q_3 + q_2)(2 - q_3 - q_2)(X^H - X^L)} > \frac{C_2 \left[(4 + 4q_3 - 2q_3^2) - \alpha(8 + 2q_3 - q_3^2) \right]}{\alpha q_3(2 - q_3)(X^H - X^L)(2 + 2q_3 - q_3^2)} \\ - \frac{2(2 + 2q_3 - q_3^2) - \alpha(16 + 10q_3 - 5q_3^2) + \alpha^2(8 + 2q_3 - q_3^2)}{2\alpha(2 + 2q_3 - q_3^2)} - \frac{2C_1}{\alpha q_3(2 - q_3)(X^H - X^L)}, \quad (\text{A.17})$$

and condition (A.16) becomes

$$1 - \frac{2C_2}{(q_3 + q_2)(2 - q_3 - q_2)(X^H - X^L)} > \frac{(8 + 2q_3 - q_3^2)(1-\alpha)}{4 + 4q_3 - 2q_3^2} - \frac{C_2(8 + 2q_3 - q_3^2)}{q_3(X^H - X^L)(4 + 2q_3 - 4q_3^2 + q_3^3)}. \quad (\text{A.18})$$

Therefore, we have $\frac{\tilde{h}_1}{\alpha} > h_1$ and $\frac{\tilde{h}_2}{1-\alpha} > h_2$ when $C_1 = \tilde{C}_1$ and $C_2 = \tilde{C}_2$ under conditions (A.17) and (A.18).

Proof of Proposition 3. The firm value at time 0 is the expected value of the firm's time-1 market value: i.e.,

$$V_0 = \int_0^{q_3} \left(\frac{q_3}{2} X^H + \frac{2-q_3}{2} X^L \right) dq + \int_{q_3}^{q_2} \left(\frac{q_3 + q_2}{2} X^H + \frac{2-q_3-q_2}{2} X^L - \tilde{W} \right) dq \\ + \int_{q_2}^{q_1} \left(\frac{q_1 + q_2}{2} X^H + \frac{2-q_1-q_2}{2} X^L - \hat{W} \right) dq + \int_{q_1}^1 \left(\frac{1+q_1}{2} X^H + \frac{1-q_1}{2} X^L - W \right) dq \\ = \frac{1}{2} X^H + \frac{1}{2} X^L - (q_2 - q_3) \tilde{W} - (q_1 - q_2) \hat{W} - (1 - q_1) W.$$

The market value of a firm announcing a spin-off is

$$V_1^S = \frac{1+q_1}{2} X^H + \frac{1-q_1}{2} X^L - W,$$

which implies a market value change of

$$\Delta V_1^S = V_1^S - V_0 = \frac{q_1}{2} (X^H - X^L) + (q_2 - q_3) \tilde{W} + (q_1 - q_2) \hat{W} - q_1 W.$$

Similarly,

$$\Delta V_1^C = V_1^C - V_0 = \frac{q_1 + q_2 - 1}{2} (X^H - X^L) + (q_2 - q_3) \tilde{W} + (1 - q_1 + q_2) \hat{W} + (1 - q_1) W,$$

and

$$\Delta V_1^T = V_1^T - V_0 = \frac{q_2 + q_3 - 1}{2} (X^H - X^L) + (1 - q_2 + q_3) \tilde{W} + (q_1 - q_2) \hat{W} + (1 - q_1) W.$$

Under conditions

$$\frac{1 - q_2}{2} (X^H - X^L) + (2q_1 - 2q_2 - 1) \hat{W} - W > 0, \quad (\text{A.19})$$

$$\frac{q_1 - q_3}{2} (X^H - X^L) + (2q_2 - 2q_3 - 1) \tilde{W} + (1 - 2q_1 + 2q_2) \hat{W} > 0, \quad (\text{A.20})$$

and

$$\frac{q_2 + q_3 - 1}{2} (X^H - X^L) + (1 - q_2 + q_3) \tilde{W} + (q_1 - q_2) \hat{W} + (1 - q_1) W > 0, \quad (\text{A.21})$$

we have $\Delta V_1^S > \Delta V_1^C > \Delta V_1^T > 0$. Q.E.D.

Proof of Proposition 4. Define $\Delta C_1' = C_1 - C_1'$. It is obvious from Eq. (A.4) that $\frac{\partial h_1'}{\partial C_1'} < 0$, which implies $\frac{\partial h_1'}{\partial \Delta C_1'} > 0$. That is, the amount of informed trading in a spin-off increases in the reduction in type 1 investors' information production cost. Because high quality firms benefit more from informed trading than low quality firms, the value of q_1 will increase when there is more informed trading: i.e., $\frac{\partial q_1}{\partial \Delta C_1'} > 0$. By the chain rule, we have $\frac{\partial V_1^S}{\partial (C_1 - C_1')} = \frac{\partial V_1^S}{\partial q_1} \frac{\partial q_1}{\partial \Delta C_1'} > 0$ since $\frac{\partial V_1^S}{\partial q_1} = \frac{X^H - X^L}{2} > 0$. The proofs of $\frac{\partial V_1^S}{\partial (C_2 - C_2')} > 0$, $\frac{\partial V_1^C}{\partial (C_1 - C_1')} > 0$, $\frac{\partial V_1^C}{\partial (C_2 - C_2')} > 0$, $\frac{\partial V_1^T}{\partial (C_1 - C_1')} > 0$, and $\frac{\partial V_1^T}{\partial (C_2 - C_2')} > 0$ are similar. Q.E.D.

Proof of Proposition 5. After a firm implements a spin-off at time 2, informed type 1 institutional investors observe the time-3 cash flow of division 1, and they collectively place an order of $z_1 = \frac{h_1'}{\alpha}$ when $x_1 = \alpha X^H$ and $z_1 = -\frac{h_1'}{\alpha}$ when $x_1 = \alpha X^L$. Following cases (1) to (4) outlined in the proof of Lemma 2, the market price of division 1 is

$$E[V_2^{S1}] = h_1' X^H + (\alpha - h_1') \left(\frac{1 + q}{2} X^H + \frac{1 - q}{2} X^L \right) - \alpha W$$

when $z_1 = \frac{h_1'}{\alpha}$ and

$$E[V_2^{S1}] = h_1' X^L + (\alpha - h_1') \left(\frac{1 + q}{2} X^H + \frac{1 - q}{2} X^L \right) - \alpha W$$

when $z_1 = -\frac{h_1'}{\alpha}$: i.e., $\frac{\partial E[V_2^{S1}]}{\partial z_1} > 0$. The proofs of $\frac{\partial E[V_2^{S2}]}{\partial z_2} > 0$, $\frac{\partial E[V_2^{C1}]}{\partial z_1} > 0$, $\frac{\partial E[V_2^{C2}]}{\partial z_2} > 0$, $\frac{\partial E[V_2^{T1}]}{\partial z_1} > 0$ and $\frac{\partial E[V_2^{T2}]}{\partial z_2} > 0$ are similar. Q.E.D.

Proof of Proposition 6. In the equilibrium in which all firms remain consolidated, the market value of a type p firm that remains consolidated is $\frac{1}{2} X^H + \frac{1}{2} X^L$ at time 1, and the expected market value is $[\alpha h_1 + (1 - \alpha) h_2] [p X^H + (1 - p) X^L] + [1 - \alpha h_1 - (1 - \alpha) h_2] \left(\frac{1}{2} X^H + \frac{1}{2} X^L \right)$ at time 2. If the type p firm chooses the out-of-equilibrium strategy and conducts a spin-off, the market value is $X^H - W$ at time 1, and the expected market value is also $X^H - W$ at time 2 (no information production in this case since the expected profit is 0 for informed traders due to the fact that the time-3 cash flow of the firm will be X^H for sure). The incentive compatibility condition is therefore

$$\gamma [0.5 X^H + 0.5 X^L] + (1 - \gamma) \{ [\alpha h_1 + (1 - \alpha) h_2] [p X^H + (1 - p) X^L] + [1 - \alpha h_1 - (1 - \alpha) h_2] [0.5 X^H + 0.5 X^L] \} > (X^H - W), \quad (\text{A.22})$$

for all $p \in [0, 1]$. Since the left side of the given condition is increasing in p , as long as the incentive compatibility condition holds for $p = 0$, the condition holds for all $p \in [0, 1]$. Furthermore, the numbers of type 1 and type 2 informed traders are given by

$$h_1 = 1 - \frac{2C_1}{\alpha(X^H - X^L)},$$

$$h_2 = 1 - \frac{2C_2}{(1-\alpha)(X^H - X^L)}.$$

Plugging the value of h_1 , h_2 , and $p = 0$ in condition (A.22) yields the value of \bar{W}

$$\bar{W} = \frac{\gamma(X^H - X^L)}{2} + (1-\gamma)(X^H - X^L - C_1 - C_2). \quad (\text{A.23})$$

When $W > \hat{W} > \bar{W} > \tilde{W} > \underline{W}$, the synergy loss is too high in spin-offs or carve-outs, but not in tracking stock issues. Therefore, firms with type $p \in [q^T, 1]$ choose a tracking stock issue to increase outsider information production to separate themselves from low quality firms. Firms with type $p \in [0, q^T)$ choose to remain consolidated because they benefit less from more informed trading and remaining consolidated can avoid the synergy loss. In this equilibrium, at time 1, if a firm announces a tracking stock issue, outsiders' equilibrium inference is that the firm type is between q^T and 1. The market value of the firm is then $\frac{1+q^T}{2}X^H + \frac{1-q^T}{2}X^L - \tilde{W}$. Similarly, if a firm remains consolidated, outsiders infer its market value to be $\frac{q^T}{2}X^H + \frac{2-q^T}{2}X^L$. Similar to the arguments outlined in the proof of proposition 1, the value of q^T is determined by $U^T(p = q^T) - U^N(p = q^T) = 0$. Following the same arguments, when $W > \bar{W} > \hat{W} > \tilde{W} > \underline{W}$, the synergy loss is too high in spin-offs, but not in carve-outs or tracking stock issues. Firms with type $p \in [\bar{q}^T, 1]$ choose a carve-out, firms with type $p \in [q^T, \bar{q}^T)$ choose a tracking stock issue, and firms with type $p \in [0, \bar{q}^T)$ choose to remain consolidated. Q.E.D.

Proof of Proposition 7. In the equilibrium in which all firms conduct a spin-off, the equilibrium market value of a type p firm is $\frac{1}{2}X^H + \frac{1}{2}X^L - W$ at time 1, and the expected market value is $(h'_1 + h'_2)[pX^H + (1-p)X^L] + (1-h'_1-h'_2)(\frac{1}{2}X^H + \frac{1}{2}X^L) - W$ at time 2, where

$$h'_1 = \alpha \left[1 - \frac{2C'_1}{(X^H - X^L)} \right] \quad (\text{A.24})$$

and

$$h'_2 = (1-\alpha) \left[1 - \frac{2C'_2}{(X^H - X^L)} \right]. \quad (\text{A.25})$$

If the type p firm chooses the out-of-equilibrium strategy and remains consolidated, the market value at time 1 is X^L , and the expected market value at time 2 is also X^L (no information production in this case since the expected profit is 0 for informed traders due to the fact that the time-3 cash flow will be X^L for sure). The incentive compatibility condition is therefore

$$\gamma \left[\frac{1}{2}X^H + \frac{1}{2}X^L - W \right] + (1-\gamma) \left\{ (h'_1 + h'_2)[pX^H + (1-p)X^L] + (1-h'_1-h'_2) \left(\frac{1}{2}X^H + \frac{1}{2}X^L \right) - W \right\} > X^L \quad (\text{A.26})$$

for all $p \in [0, 1]$. Since the left side of the given condition is increasing in p , as long as the incentive compatibility condition holds for $p = 0$, the condition holds for all $p \in [0, 1]$. Plugging the values of h'_1 , h'_2 , and $p = 0$ in Eq. (A.26) yields the value of \underline{W}

$$\underline{W} = \frac{\gamma(X^H - 3X^L)}{2} + (1-\gamma)[\alpha C'_1 + (1-\alpha)C'_2]. \quad (\text{A.27})$$

When $\bar{W} > W > \underline{W} > \hat{W} > \tilde{W}$, the synergy loss is moderate in spin-offs and low in carve-outs or tracking stock issues, firms with type $p \in [q^S, 1]$ choose a spin-off to separate themselves from lower types. All other firms (type $p \in [0, q^S)$) pool together by choosing a carve-out. No firm has an incentive to choose a tracking stock issue or a consolidated firm because doing so will reveal them to be the lowest firm type. If the loss of synergy is moderate in spin-offs and carve-outs and low in tracking stock issues so that $\bar{W} > W > \hat{W} > \underline{W} > \tilde{W}$, then firms with type $p \in [\bar{q}^C, 1]$ choose a spin-off, firms with type $p \in [\underline{q}^C, \bar{q}^C)$ choose a carve-out, and firms with type $p \in [0, \underline{q}^C)$ choose a tracking stock issue. The lowest firm types find that mimicking through a carve-out is too costly and they find it optimal to conduct a tracking stock issue to pool with firms with higher intrinsic values. Q.E.D.

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