# Facilitating Mergers and Acquisitions with Earnouts and Purchase Price Adjustments

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## Abstract

This paper examines how post-closing contingent payment (PCP) mechanisms (such as earnouts and purchase price adjustments) can facilitate mergers and acquisitions transactions. The paper examines two informational environments: in the first, the seller has superior information about the value of her assets (private information setting) and in the second, the parties differ in their estimates on the value but are unable to overcome their difference (non-convergent priors setting). The paper also allows the parties to use either cash or the buyer's stock as consideration. By conditioning payment on post-closing, verifiable information, PCPs can mitigate the problems of private information or non-convergent priors. In the private information setting, PCPs function as an imperfect verification mechanism (like a product warranty) and can lead to all parties using a PCP in a pooling equilibrium. In the non-convergent priors setting, PCPs can be used to satisfy different, non-converging beliefs. The paper also addresses the problems of limitations on the size of payment and post-closing incentives to maximize (or minimize) the PCP (particularly, earnout) payments. When such issues are a concern, the paper shows that (1) neither party may use a PCP (particularly an earnout); and (2) stock-based PCPs will generally work better than cash-based PCPs. Stock works better than cash because (1) its value is partially correlated with the value of the merged firm, thereby reducing the burden of having to structure a large contingent payment; and (2) with respect to post-closing moral hazard, the parties partly internalize the deadweight loss from engaging in earnings management (signal manipulation).

**Introduction**

In mergers and acquisitions transactions with privately-held (or closely-held) target companies, transacting parties will often agree to make payments to the target shareholders contingent upon some post-closing measures. Two often used arrangements are purchase price adjustments (PPAs) and earnouts.[1] With a purchase price adjustment mechanism, payment to the target shareholders is adjusted based on an accounting metric calculated shortly after the deal is closed. For instance, if the mechanism were to use the target's net working capital, as the target's post-closing net working capital goes up or down compared to a pre-closing estimate, consideration to the target shareholders increases or decreases in accordance. Similarly, with an earnout, the transacting parties will agree upon post-closing performance targets, using measures such as earnings, net income, or gross revenue, and the amount of consideration that the target shareholders are entitled to receive will depend on whether such targets are met over the earnout period, which typically lasts from one to five years after closing.[2] For instance, an earnout can allow the target shareholders to receive additional $5 million if the target's post-closing earnings increase by $1 million over a one year period.

Practitioners' understanding of why parties utilize such post-closing contingent payment (PCP) mechanisms is that they make it easier for the transacting parties to come to an agreement, particularly when the valuation of the target company is subject to some uncertainty. More nuanced rationales over these two mechanisms differ, however. According to the practitioners, purchase price adjustments are used when transacting parties basically agree on the valuation of the target but the valuation is subject to common uncertainty. For instance, when the transacting parties agree that the target is worth either $10 or $12 million but they are uncertain over which outcome will realize, they can use a purchase price adjustment that adjusts in accordance with the realized accounting estimate. In contrast, earnouts are understood to be useful when the parties cannot agree on the valuation of the target. For instance, when the seller argues that the target is worth $12 million while the buyer thinks it is worth $10 million, rather than trying to narrow that assessment gap, by agreeing to pay $10 million at closing but making additional $2

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[1] For an overview of purchase price adjustments and/or earnouts, see Kling and Nugent (2013) at 17.12—17.26; Miller (2008) at 112—115 and 210—214; and Bruner (2004) at 609—635. Earnouts are sometimes also based on non-financial measures, such as securing regulatory approval or clearance (e.g., FDA approval of a pharmaceutical drug), introduction of a new product, obtaining a major contract from a new customer or reaching a minimum number of customers/subscribers. Private target transactions are also more likely subject to robust post-closing indemnification rights for the buyers. See Gilson (1984) at 262—267 for a discussion on how earnouts function as a "state-contingent contracting" to manage the "non-homogeneous expectations" of the transacting parties; and Coates (2010) at 24—26 for how earnouts and purchase price adjustments are much more prevalent for private than public targets (17% versus 2% in sample from 2007-2008 period). See American Bar Association (2010) volume I at 63—75 for a sample purchase price adjustment (based on changes to shareholder's equity) clause and volume II at 119—140 for a sample earnout agreement.

[2] Although the primary focus of the paper is on earnouts and purchase price adjustments (PPAs), there are other mechanisms that allow for post-closing variations in payments, such as escrows, holdbacks, contingent value rights (CVRs), and even debt financing. See Coates (2012). In particular, CVRs, which typically tie post-closing payout to target shareholders to the performance of the acquirer's stock, can be structured very much like earnouts or purchase price adjustments, and are known to be useful in bridging the valuation gap. To the extent that this is true, the main analysis also applies to CVRs. See Bruner (2004) at 653—660 for a detailed analysis of CVR used in the merger between Rhone-Poulenc and Rorer.

million to be triggered based on some post-closing performance metric as an earnout, the transacting parties are supposedly better able to come to an agreement.

At the same time, practitioners also emphasize that implementing such post-closing contingent payment (PCP) mechanisms is difficult and the use of such mechanisms can engender serious post-closing disputes. Such concerns are directed especially towards earnouts, which typically last for a longer period (one to five years) than purchase price adjustments.[3] One particular concern is the transacting parties' post-closing behavior. If the seller is paid $10 million at closing but is promised a $2 million earnout contingent on certain target accounting measure being met within the earnout period, when the operation of the business remains under the seller's effective control, to the extent that there often is much discretion in calculating accounting measures and that accounting measures can diverge from fundamentals, the seller's incentive would be to maximize the chances of collecting the earnout rather than improving the long-term health of the company. If the buyer is left in charge of the operations, the opposite may happen. Partly due to such concerns, some practitioners have even noted that earnouts "are a nightmare to draft, negotiate and…to live with," and as a result, transacting parties would often "give up on [negotiating an earnout] before too long—they simply compromise on the price."[4]

The purpose of this paper is to better understand the advantages and disadvantages of post-closing contingent payment (PCP) mechanisms in mergers and acquisitions. The paper presents a simple bargaining game between two players, a buyer and a seller, in which, the parties can utilize a PCP mechanism to tackle bargaining challenges. Importantly, the paper examines two informational environments. In a private information (PI) setting, the seller is endowed with private information (represented as the seller's "type") over the valuation of the seller's assets and attempts to use its informational advantage to extract the best possible terms from the buyer. In a non-convergent priors (NP) setting, both parties may attach different opinions ("beliefs") about the valuation and such difference is known by both, but they fail to agree on a single valuation. In particular, we are interested in a setting in which the seller may be more "optimistic" than the buyer about the underlying value of the assets and is unwilling to compromise its belief solely to close the deal. The parties can also choose between cash or the buyer's stock as the means of payment to the seller.

In the private information (PI) setting, if the seller has to make a single-price offer, not all positive-surplus transactions get consummated since the buyer becomes skeptical when the seller claims high valuation and demands high cash or stock consideration. In a signaling equilibrium, the buyer has to reject the high cash (or stock) offer with a positive probability to prevent the

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[3] Earnout arrangements are also subject to a host of other issues, including (1) reconciling the target's and the buyer's differing accounting practices; (2) delay of integrating the target's assets into the buyer's operations due to the (frequent) requirement that the target remains an independent entity; (3) engendering disputes over management, earnings (e.g., allocation of overhead expenses), and valuation; (4) dealing with unforeseen contingencies such as change of control during the earnout period; and (5) tax considerations particularly in a tax-free reorganization. See Kling and Nugent (2013) at 17.22.1—17.26; Miller (2008) at 112—115; and Bruner (2004) at 613—615.

[4] Kling and Nugent (2013) at 17.26. According to Miller, "earnouts are complicated and frequently problematic, and the parties regret that they used an earnout rather than just compromising the difference in the purchase price. Earnouts have a conceptual attraction, but they are difficult to implement. Disputes are common." Miller (2008) at 112. See also Gilson (1984) at 265—267; Bruner (2004) at 613—615; and American Bar Association (2010) volume II at 126—128.

low-type seller from mimicking the high-type. The parties similarly fail to reach a deal in the non-convergent priors (NP) environment if they have to agree on a single payment (of cash or stock), unless the difference in beliefs is sufficiently small. Simply put, if the buyer believes that the seller's assets are worth $10 million, the seller believes that they are worth $12 million, and their beliefs do not converge, there is no single price that can satisfy both beliefs. The problems are mitigated when the parties use the buyer's stock as means of payment, but they do not disappear. Because the value of the stock correlates with the value of the merged company, the same fraction (say 10%) of the merged company is worth less to the low-type seller than to the high-type seller, thereby reducing the incentive to mimic. However, as the size of the buyer's assets gets larger, the signal gets weaker thereby reducing the benefits of using the buyer's stock as consideration.

The paper shows that with a post-closing contingent payment (PCP) mechanism, the parties can alleviate or eliminate the inefficiency that stems from information asymmetry or non-convergent priors. By making the buyer's payment contingent upon post-closing, verifiable information, the parties can tailor the expected payment by the buyer to the underlying valuation. In the private information (PI) setting, for instance, suppose the high-type seller's true valuation is $12 million while the low-type seller's true valuation is $10 million. Then, even with the identical payment structure of $9 million at closing and $5 million earnout, if the high-type seller has a 60% chance of collecting the earnout while the low-type seller has only 20% chance, the buyer's expected payment will differ by $2 million ($12 million versus $10 million), thereby allowing de facto separation. In the non-convergent priors (NP) setting, using a set of prices that depend on post-closing, verifiable information allows the parties to simultaneously satisfy the divergent views on valuation and successfully close the deal. If the buyer believes that the seller's assets are worth $10m and the seller has only 20% chance of meeting an earnout target while the seller believes that the assets are worth $12m, with 60% chance of meeting the target, $9 million at closing with $5 million earnout payment will satisfy both parties' beliefs. Buyer believes that he will pay out, in expectation, $10 million, while the seller believes that she will collect $12 million in expectation.

The fact that PCP mechanisms are harnessing post-closing, verifiable information has two important implications for the current understanding of the mechanisms. First, notwithstanding the practitioners' understanding over the different uses of purchase price adjustments and earnouts, to the extent that both rely on post-closing information, both mechanisms can have a similar function of alleviating informational issues between the parties. That is, both can be used to reduce the problems of private information or non-convergent priors. Second, particularly with respect to the private information issues, because a PCP arrangement incorporates post-closing information, it functions differently from conventional signaling mechanisms: it functions more like a product warranty.[5] Empirically, therefore, it may be unclear whether the adoption of a PCP mechanism operates as a "signal" of high valuation. Using the numbers from above, in equilibrium, it is possible for both types of seller to agree to a payment structure of $9 million at closing and $5 million as an earnout. Both types of seller pool

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[5] Grossman (1981) shows that under general conditions, when producers with different product qualities offer full warranty, (risk-averse) consumers do not infer product quality based on the warranty and the separation among products with different qualities is achieved through ex post warranty payments. PCP mechanisms will have a similar characteristic.

and separation is achieved through differences in probability of earnout collection. If such a pooling equilibrium is in play, empirically observing a certain earnout structure may not tell us much about the characteristics of the deal or the target company.

The paper also presents important variations to the model by (1) imposing limitations on payments; and (2) incorporating the problems of inefficient post-closing incentive (moral hazard) created by a PCP mechanism. With respect to the first, the size of the PCP mechanism depends, in part, on the accuracy of the post-closing signal, and as the accuracy of the signal decreases, the size of the contingent payment gets larger while the non-contingent payment gets smaller. Coming back to the previous numerical example, if the high-type seller had a 50% chance of meeting the earnout target while the low-type seller's chance increases to 30% (instead of the 60% to 20% difference), now the PCP will be structured so that the buyer pays $7 million at closing while $10 million will be a post-closing contingent payment. When the signal (difference in probabilities) gets weaker, the slope will get even steeper. For various reasons, the parties may be unable to implement such a large contingent payment scheme. The seller's shareholders, for instance, may balk at receiving only $7 million at closing for assets that are worth at least $10 million. The buyer may be unable to finance the $17 million ($7 million closing plus $10 million contingent) payout.

Another problem of incorporating a contingent payment scheme is that it could engender either parties to engage in post-closing signal manipulation solely for the purpose of maximizing (or minimizing) the PCP payment at a potential detriment to the fundamental value of the merged company. The problem is perceived to be particularly acute with respect to an earnout, which can last a substantially longer period compared to a PPA, thereby giving more opportunity to the respective parties to engage in value-destroying signal manipulation. For instance, if the seller is left in charge of the operation of the assets after closing and the earnout is based on some measure of accounting-based earnings over the earnout period, the seller will be tempted to boost the earnout period earnings (for instance, by reducing research and development or more aggressively collecting accounts receivable) at the expense of the long-term health of the merged company. If the buyer were in charge, the earnout will create an opposite incentive.[6]

The paper makes two primary findings when such issues (payment limitations and post-closing moral hazard) are present. First, although fully rational parties will take such issues into account in designing a PCP schedule, when the problems are sufficiently severe, the parties will either selectively use the mechanism or forgo using the mechanism altogether. Post-closing

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[6] According to Miller, "if the Target's management is to run [the business] or have a significant hand in running it and also has an economic interest in the earnout, their incentive is to run the business to maximize the particular income statement item that is the basis of the earnout, which may not be what is best for the business. The converse is that if the Buyer runs it (as is normally the case), the business will be run based on what is best for the Buyer's overall business objectives (which may or may not coincide with the earnout measure) or it may be run largely to minimize the earnout adjustment that the Buyer will have to pay (which may or may not coincide with what is best for the business." Miller (2008) at 113. There also are some serious contracts interpretation and incompleteness issues. Earnout agreements often contain vague, open-ended obligations, such as an obligation to exercise "reasonable efforts" in post-closing operation. Agreements can even be silent on what action the buyer or the seller should take in previously unanticipated contingencies. These raise important questions for the courts in resolving disputes ex post. See Kling and Nugent (2013) at 17.23—17.26. See Choi and Triantis (2008) on how incorporating both precise measures (e.g., based on financials) and vague obligations (e.g., reasonable efforts) can improve principal-agent contracting.

moral hazard does this by reducing the surplus of the transaction. Payment limitations, on the other hand, allow the uninformed buyer to capture more rent in equilibrium, thereby making the PCP less attractive for the seller. Second, using the buyer's stock in designing a PCP mechanism is generally better than relying on a cash-based PCP. The advantage stems from two sources. Because the value of the buyer's stock is correlated with the value of the merged company, stock-based PCP partially reflects the seller's information which, in turn, allows the parties to reduce the incentive component. The lower contingent payment makes it easier for the parties to satisfy the transfer limitations and also to reduce the post-closing moral hazard. Further, with respect to moral hazard, with stock-based PCP, the party that engages in earnings manipulation partially internalizes the loss that stems from the manipulation. This, in turn, makes stock-based PCP more attractive. Even with a stock-based PCP, however, such advantages disappear as the size of the buyer's assets gets larger.

The paper is organized as follows. Part I contains a brief review of the existing academic literature. The existing literature almost exclusively focuses on empirical investigation of earnouts. So far, there doesn't seem to have been any serious attempt to theoretically examine earnouts or purchase price adjustments. Part II lays out the transactional environment. It presents the basic ingredients of both the private information (PI) and the non-convergent priors (NP) models. Parts III and IV analyze the bargaining game between an acquirer and a target in which a post-closing contingent payment (PCP) mechanism can be used in the private information and non-convergent priors settings, respectively. In both settings, the seller (target) can make a take-it-or-leave-it offer to the buyer (acquirer) and can use either cash or the buyer's stock as consideration. In its offer, the seller can adopt a PCP structure (again with either cash or stock) so that some portion of the consideration can depend on the realization of a post-closing variable. Part V analyzes the problems of post-closing moral hazard induced by earnouts. The analysis allows for potential value destruction from post-closing behavior, thereby juxtaposing the benefits of solving the adverse selection issue with the costs of engendering post-closing moral hazard. In Part VI, the results of the models are reconciled with the existing empirical findings and some additional implications are noted. The last part concludes.

## I.        Related Scholarship

The existing academic literature on post-closing contingent payment (PCP) mechanisms not only is relatively thin but also focuses almost exclusively on empirically investigating the uses and structures of earnouts. The earlier studies examined the incidence (i.e., whether an earnout is used in a particular transaction) and the valuation of earnouts. Kohers and Ang (2000), using sample data over the period 1984—1996, show that earnouts are more likely to be used when the target is a high-tech or service company that is privately held and that acquisition premiums are larger when earnouts are used. Both results suggest that earnouts are being used to deal with the problems of uncertainty and asymmetric information. They also show that there is a (statistically significant) positive correlation between the frequency of earnout payments and the likelihood of target managers staying with the merged firm beyond the earnout period, supporting the hypothesis that the earnouts function as retention bonuses. Datar, Frankel, and Wolfson (2001), using survey data from the period 1990—1997, similarly demonstrate that earnouts are more likely used when the acquirer and target are from different industries or when fewer acquisitions take place within an industry. Ragozzino and Reuer (2009) uncover similar

findings with a more extensive dataset. They show that earnouts and stock consideration function as substitutes: when the acquirer uses stock as consideration, earnout is less likely to be used.

More recent empirical studies attempt to open the black-box of earnout arrangements and examine the details of earnout contracts. Cain, Denis, and Denis (2011), for instance, examine the terms of earnout contracts using a sample of about 1,000 acquisition transactions between 1994 and 2003. They show, among others, that earnout size is associated with uncertainty of target valuation; earnout periods are longer when valuation uncertainty is likely to be resolved over a longer period of time; and the choice of performance measure is associated with the informational content and the verifiability of the measure. Quinn (2013) relies on the "fair value" accounting data over earnouts, mandated by Financial Accounting Standards Board (FASB) through Statement of Financial Accounting Standards (SFAS) 141(R) for public companies in 2007,[7] to see whether the expected value estimates of earnouts change over the earnout period. The paper shows that during the first eight quarters following the announcement of the transaction, the average fair value of earnout payments are more likely to decrease rather than increase. Based on the findings, the paper argues that earnouts are used more to alleviate symmetric, rather than asymmetric, uncertainties over valuation. Cadman, Carrizosa, and Faurel (2013) also conduct empirical investigations on earnouts using SFAS 141(R) "fair value" reporting data. They show that earnout fair values are a smaller percentage of the maximum earnout payment amounts when firms "primarily" use earnouts to resolve adverse selection or valuation gap problems and markets respond favorably to positive adjustments in post-closing earnout fair value estimates.

The paper also relates to two other strands of literature: one dealing with the means of payment in mergers and acquisitions; and the other dealing with earnings manipulation by corporate managers. With respect to the first, Hansen (1987) has shown that, in a mergers-and-acquisitions setting, when the seller is better informed, the buyer (who gets to make a take-it-or-leave-it offer and screen the seller type) is more likely to make a stock-based, rather than cash-based, offer.[8] Similarly, Fishman (1989) showed that stock-based bidding allows the target to make a more efficient decision over acceptance when the target (in addition to the bidder) has private information about the value of the acquisition. This paper incorporates and builds on the insight from this literature by analyzing both cash-based and stock-based PCP mechanisms. With respect to the latter, Stein (1989) analyzed how a corporate manager would engage in

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[7] See Quinn (2013) at 146—151 and Cadman, Carrizosa, and Faurel (2014) at 46—48 for background information on SFAS 141(R). Fair value is the price that the owner of an asset can secure in a market transaction. Under the previous rule, contingent payments, including earnouts, were not required to be disclosed at the time of the acquisition but be accounted for when realized. Under the new rule, earnouts need to be required to be reported at their "fair values" at the time of the acquisition and be reevaluated periodically post-acquisition. The new rule applied to acquisitions made after December 15, 2008.

[8] In many settings, stock consideration may be unavailable or impractical either because the target is being acquired by a buyer with no outstanding stock (e.g., a private equity firm with no publicly issued stock) or because distribution of buyer's stock to the target stockholders may trigger the registration requirement under the federal securities laws, thereby (greatly) increasing the cost. There also is a larger, related literature, since Myers and Majluf (1984), that examines the design of securities in addressing the problems of adverse selection between a borrower-firm and investors. For example, Chakraborty and Yilmaz (2011) shows how contingent securities, such as convertible bonds that are callable, can harness future information to better address the issues of adverse selection at the time of financing.

value-destroying earnings management (by "borrowing" against future earnings) when the manager cares sufficiently about the current stock price. More recently, Goldman and Slezak (2006) examined how using a pay-for-performance incentive scheme to induce the manager to exert more productive effort could be a double-edged sword when the manager can engage in value-destroying earnings manipulation. The optimal incentive system, designed by the principal, will take both of these effects into account will make a trade-off between under-provision of effort incentive with earnings manipulation. This paper extends the findings from this literature to a PCP setting and also examines the incentive effects of using either stock-based or cash-based incentive scheme.[9]

To the author's knowledge, there has not been any academic work that theoretically analyzes the purposes and functions of earnouts and purchase price adjustments. As the subsequent sections demonstrate, this paper attempts to contribute to the existing literature in at least four ways. First, this is the first study that examines both earnouts and purchase price adjustments. To the extent that both mechanisms utilize post-closing information, both can be useful in dealing with the problems of asymmetric information and valuation gap. Second, as the theoretical analysis shows, PCP mechanisms are somewhat different from conventional signaling mechanisms because they incorporate additional, verifiable information. This implies that pooling, as well as separating, equilibrium can be likely and neither may dominate the other in terms of welfare. Especially, in a non-convergent priors (NP) setting, a pooling equilibrium is quite likely. Third, while the existing academic studies have touted the virtues of using earnouts in dealing with informational problems, this paper addresses the "dark side" of earnouts by more explicitly accounting for the post-closing moral hazard problems and the possibility of executing a surplus-reducing deal that are engendered by earnouts. This will allow us to better understand why some transactions will deliberately shy away from adopting a PCP mechanism. Fourth, the paper incorporates the analyses from the means of payment literature and the earnings manipulation literature; and, in the process, contrasts the benefits of using a PCP in solving the adverse selection issue with the costs of post-closing, value-destroying moral hazard.

## II.    Transactional Environment

Two players, a buyer and a seller ($i \in \{b, s\}$), both risk-neutral, are engaged in a negotiation over the seller's assets. There are four periods in the game with no time discount: $t \in \{0,1,2,3\}$. Briefly, the state of the world (or the seller's "type") is determined at $t = 0$; the players negotiate and the assets may be transferred at $t = 1$; signals are observed at $t = 2$; and the valuations are realized at $t = 3$. At $t = 0$, Nature determines the state of the world (or the seller's "type") which can be either "high" or "low": $\theta \in \{h, l\}$. The "high" type seller is determined with probability $\alpha \in (0,1)$, and the "low" type, with probability $1 - \alpha$. Although these parameters are common knowledge, we entertain two possibilities on the parties' beliefs

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[9] While this paper is more closely related to Stein (1989) and Goldman and Slezak (2006), in terms of shifting future earnings to the present at a deadweight loss, there are also other papers that theoretically examine the "myopic" behavior of the executives. Bolton, Scheinkman, and Xiong (2006), for instance, allows for over-optimistic investors in the financial market that could lead to an emphasis on short-term stock performance in executive compensation so as to reap the benefits of speculative component in the stock price. Benmelech, Kandel, and Veronesi (2010) shows how executive compensation based only on stock induces the executive to delay revealing bad news to the market, and how the optimal compensation structure would incorporate a golden parachute or a generous severance package, in addition to stock-based compensation, to induce truth-telling from the executive.

about the state of the world and whether their beliefs can be harmonized. In the private information (PI) model, the realized state of the world is observed only by the seller and the buyer's prior belief is given by $\alpha$. If the seller credibly conveys her information to the buyer, the buyer ignores his prior and the buyer's posterior converges to the seller's. In the non-convergent priors (NP) model, neither party observes the realized state and each attaches a (possibly) different belief $(\theta_b, \theta_s)$ about the state. The different beliefs are common knowledge among the parties, in that while they acknowledge the difference, their beliefs do not converge: despite full disclosure of respective information, neither party completely drops her prior.

The realized state of the world (the seller's type) determines the respective valuation for the seller's assets: $v_i^\theta$. To keep the analysis straightforward, we assume that the valuation of the high-type seller is higher than that of the low-type seller for both players, $v_i^h \geq v_i^l$, and that the buyer's valuation is higher than the seller's at least for the high type, $v_b^h \geq v_s^h$. For the low-type, we let $v_b^l \gtreqless v_s^l$, so that the surplus from the transaction can be negative. For notational convenience, we let $E(v_b) = \alpha v_b^h + (1 - \alpha)v_b^l$ to stand for the buyer's ex ante expected valuation of the seller's assets. We also assume that valuations are not verifiable, so that the parties cannot write a valuation-contingent contract. This assumption is motivated by the fact that there often are many subjective elements in determining the present value of future earnings, for example, with respect to potential synergies and growth prospects, which would be difficult to verify and could engender dispute. On the other hand, as will be explained shortly, the parties receive a verifiable signal at $t = 2$ that is correlated with the true valuations. Finally, we assume that the buyer owns a set of assets with valuation $x > 0$, which is common knowledge. Also, let $\omega^\theta = v_b^\theta / (x + v_b^\theta)$ stand for the maximum share of the combined company that the buyer would be willing to give to the seller under symmetric information.

At $t = 1$, the parties negotiate over the acquisition. We'll focus on the signaling aspect of the negotiation by allowing the seller to make a take-it-or-leave-it offer to the buyer. The buyer can either accept or reject the seller's offer.[10] The seller's offer depends on whether a post-closing contingent payment (either an earnout or a purchase price adjustment) is possible. For instance, if the seller's stock is publicly traded or is held by dispersed owners (the case of public target), a post-closing adjustment on price will be prohibitively difficult. If, on the other hand, the seller's stock is held by a small number of owners, as in a privately held target, a post-closing price adjustment can be more easily arranged. For now, we will not distinguish between an earnout and a purchase price adjustment and denote them jointly as a post-closing contingent payment (PCP) mechanism. When the parties cannot use a PCP mechanism, the seller's offer consists of either a one-time cash payment ($p_1$) or the buyer's stock ($q_1$), where $q_1 \in [0,1]$ represents the seller's ownership share of the combined company. When the buyer accepts the

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[10] If the buyer were to make a take-it-or-leave-it offer to the seller, we'll instead have a screening equilibrium. In the private information (PI) model, without a PCP mechanism, inefficiencies (either too much or too little transactions) would result. In that case, the problem will be similar to that of market for "lemons." See Akerlof (1970). The buyer could use a PCP mechanism to successfully screen seller types. This is similar to adopting (costless) certification mechanism to screen out lemons. One important difference is that, when the buyer gets to make an offer with a PCP, a pooling equilibrium will be more likely, in which the buyer will offer the same PCP to both types of seller and de facto screening will take place through ex-post payment. When post-closing moral hazard is a concern (as we show in part IV), this can generate a larger deadweight loss.

seller's offer, the buyer pays the consideration (either cash or stock) and the assets are transferred (the deal "closes") at $t = 1$.[11]

If a post-closing contingent payment is possible, on the other hand, transfer payments can be made in two stages, once at the time of closing ($t = 1$) and the second time when the parties observe a verifiable signal post-closing ($t = 2$). In a purchase price adjustment (PPA) setting, for instance, the first payment is based on pre-closing balance sheet and the second on closing balance sheet. Equivalently, transfer payment can be made to depend on the realized, verifiable signal. We assume that the signal takes on two values, $\beta \in \{h, l\}$, and is correlated with the seller's type, $prob(\beta = h | \theta = h) = \rho \in (1/2, 1]$ and $probl(\beta = h | \theta = l) = \sigma \in [0, 1/2)$.[12] If $\rho = 1 - \sigma$, signals are symmetric. Also, the case of $(\rho, \sigma) = (1,0)$ is equivalent to the case where the valuations are verifiable. Correspondingly, the seller's offer consists of state-contingent payment: $p_2(\beta) \equiv (p_2(h), p_2(l))$ in case of cash consideration and $q_2(\beta) \equiv (q_2(h), q_2(l))$ in case the consideration is the buyer's stock. Finally, at $t = 3$, respective valuations ($v_i^\theta$) are realized and the verifiable signal ($\beta$) is observed. If the deal closed at $t = 1$, the buyer has ownership over all the assets and realizes the valuation of $x + v_b^\theta$. Further, if a PCP arrangement has been made, the buyer also pays the seller $p_2(\beta)$ or $q_2(\beta)$. If the negotiations failed and the deal did not close, the seller retains ownership over the assets with the valuation of $v_s^\theta$ and the buyer owns the assets that are worth $x$.

## III.    A Private Information Model of Earnouts and Purchase Price Adjustments

Suppose we are in a private information (PI) setting such that the seller knows the realized state of the world ($\theta$) while the buyer does not, and if the seller credibly conveys her information to the buyer, the buyer's belief converges to the seller's. Recall that at $t = 0$, the seller's type is realized and observed only by the seller; at $t = 1$, the seller makes a take-it-or-leave-it offer to the buyer and the buyer either accepts or rejects; at $t = 2$, verifiable signal ($\beta$) is observed; and non-verifiable valuations ($v_i^\theta$) are realized at $t = 3$. When the seller gets to make a take-it-or-leave-it offer to the buyer, it creates the classic signaling problem. The equilibrium concept we use is Perfect Bayesian Equilibrium (PBE). The following two Lemmas demonstrate that even when $v_b^\theta \geq v_s^\theta$ for $\theta \in \{h, l\}$, so that the parties know that there is a positive surplus from the transaction, when the parties are negotiating over a single acquisition consideration, either in cash or stock ($p_1$ or $q_1$), unless the buyer's expected valuation ($E(v_b)$) is sufficiently high, not all acquisitions get consummated.

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[11] The model assumes that the buyer is paying all the consideration to the seller in cash. To allow for a transaction where stock is used, given the assumption that the seller is making a take-it-or-leave-it offer to the buyer, we need to include the buyer's reservation value ($U_b^\theta$), i.e., the minimum value the buyer must obtain to accept the seller's offer. If the buyer's reservation value is invariant to the seller's type, for instance, in a separating equilibrium, the high-type seller will offer a lower ownership share to the buyer while the low-type seller will offer a higher share and the buyer will reject the lower ownership share with a positive probability; and the rest of the analyses will follow. One major advantage of using stock as consideration, however, is that it could mitigate the post-closing moral hazard issues.

[12] The reason why we use two different parameters, $\rho$ and $\sigma$, for the post-closing signal is that when there is a pooling equilibrium, each signal may be subject to manipulation by different type of seller.

**Lemma 1** *Suppose $v_b^\theta \geq v_s^\theta$ for $\theta \in \{h, l\}$ and a post-closing contingent payment (PCP) is not possible. Suppose the parties use cash ($p_1$) as consideration. In a welfare-maximizing separating equilibrium, the high-type seller offers $p_1^h = v_b^h$ and the low-type seller offers $p_1^l = v_b^l$. The buyer accepts $p_1^l$ with probability one but accepts $p_1^h$ with probability $\gamma^h < 1$. When $E(v_b) \geq v_s^h$, there also exists a pooling equilibrium, in which both types of seller offers $p_1 = E(v_b) \geq v_s^h$ and the buyer always accepts the offer. As $(v_b^l - v_s^l) \to 0$, $\gamma^h \to 0$ and as $(v_b^h - v_b^l) \to 0$, $\gamma^h \to 1$.*

**Proof of Lemma 1.** Suppose the parties use cash as consideration. To construct a separating equilibrium, suppose the $\theta$-type seller makes a take-it-or-leave-it offer of $p^\theta$ (where $p^h \neq p^l$) and the buyer accepts the offer with probability $\gamma^\theta \in [0,1]$. To sustain separation, we need

$$\gamma^h \cdot p_1^h + (1 - \gamma^h) \cdot v_s^h \geq \gamma^l \cdot p_1^l + (1 - \gamma^l) \cdot v_s^h$$
$$\gamma^l \cdot p_1^l + (1 - \gamma^l) \cdot v_s^l \geq \gamma^h \cdot p_1^h + (1 - \gamma^h) \cdot v_s^l$$
$$v_b^h \geq p_1^h$$
$$v_b^l \geq p_1^l$$

With the power to make a take-it-or-leave-it offer, the seller will set $v_b^\theta = p_1^\theta$, so that the last two constraints are satisfied. The first two constraints, then, become

$$\gamma^h \cdot v_b^h + (1 - \gamma^h) \cdot v_s^h \geq \gamma^l \cdot v_b^l + (1 - \gamma^l) \cdot v_s^h$$
$$\gamma^l \cdot v_b^l + (1 - \gamma^l) \cdot v_s^l \geq \gamma^h \cdot v_b^h + (1 - \gamma^h) \cdot v_s^l$$

Maximizing the social welfare implies increasing $\gamma^\theta$ as much as we can. The assumptions of $v_i^h \geq v_i^l$ and $v_b^\theta \geq v_s^\theta$ imply that for any $\gamma^h < 1$, $\gamma^l \geq \gamma^h$. Hence, in equilibrium, we get $\gamma^l = 1$. The two constraints become:

$$\gamma^h \cdot v_b^h + (1 - \gamma^h) \cdot v_s^h \geq v_b^l$$
$$v_b^l \geq \gamma^h \cdot v_b^h + (1 - \gamma^h) \cdot v_s^l$$

Note that, as $\gamma^h \to 1$, the first constraint will be satisfied with slack, but the second constraint will bind. Hence, in equilibrium, we will have $v_b^l = \gamma^h \cdot v_b^h + (1 - \gamma^h) \cdot v_s^l$, which renders

$$\gamma^h = \frac{v_b^l - v_s^l}{v_b^h - v_s^l} < 1$$

While the buyer always accepts the $p_1^l = v_b^l$ offer, she rejects the $p_1^h = v_b^h$ with probability $(1 - \gamma^h) > 0$. As seen from the expressions, as $(v_b^l - v_s^l) \to 0$, $\gamma^h \to 0$ and as $(v_b^h - v_b^l) \to 0$, $\gamma^h \to 1$. The expected welfare loss from the equilibrium is $\alpha \cdot (1 - \gamma^h) \cdot (v_b^h - v_s^h)$.

To construct a pooling equilibrium, suppose $E(v_b) \geq v_s^h$. In that case, we can let both types of seller offer $p_1 = E(v_b) \geq v_s^h$. Since this is equal to the buyer's expected valuation, the buyer accepts the offer. For the off-the-equilibrium-path beliefs, whenever the buyer observes any $p_1 > E(v_b)$, we can let the buyer believe that the offer is coming from the low type seller and

rejects the offer. With this belief, neither type of seller would want to deviate from the equilibrium. *QED*

Without the post-closing contingent payment mechanism, when the parties are using cash as consideration, the seller's ability to signal its valuation to the buyer is limited. Even when the buyer always places a higher valuation on the seller's assets than the seller, not all transactions get consummated. When the seller claims that she is of high-type and makes a high cash offer $(p_1^h > p_1^l)$, the buyer becomes skeptical and rejects the offer with some positive probability $((1 - \gamma^h) > 0)$. A positive probability of rejection is necessary to keep the low-type seller from mimicking the high-type.[13] The seller's ability to signal its valuation to the buyer is limited, because cash payment is independent of the realized valuation $(v_i^\theta)$. As the following Lemma demonstrates, when the parties use the buyer's stock as consideration $(q_1^\theta)$, because the value of stock depends on the valuation of the seller's assets, the informational issues are mitigated compared to the case of cash consideration but not completely eliminated.

**Lemma 2** *Suppose $v_b^\theta \geq v_s^\theta$ for $\theta \in \{h, l\}$ and a post-closing contingent payment (PCP) is not possible. Suppose the parties use the buyer's stock $(q_1)$ as consideration. In a welfare-maximizing separating equilibrium, the high-type seller offers $q_1^h = \omega^h = v_b^h/(x + v_b^h)$ and the low-type seller offers $q_1^l = \omega^l = v_b^l/(x + v_b^l)$. The buyer accepts $q_1^l$ with probability one but accepts $q_1^h$ with probability $\delta^h < 1$. When $E(v_b) \geq [(x + E(v_b))/(x + v_b^h)]v_s^h$, there also exists a pooling equilibrium, in which both types of seller offers $q_1 = E(v_b)/(x + E(v_b))$ and the buyer always accepts the offer.*

*Conditional on having a separating equilibrium, the buyer's acceptance probability under stock consideration is strictly higher: $\delta^h > \gamma^h$. As $x \to 0$, $\delta^h \to 1$, but as $x \to \infty$, $\delta^h \to \gamma^h$. As $(v_b^l - v_s^l) \to 0$, $\delta^h \to 0$, but as $(v_b^h - v_b^l) \to 0$, $\delta^h \to 1$. Since $[(x + E(v_b))/(x + v_b^h)] < 1$, compared to using cash consideration, there is a bigger parameter region where a pooling equilibrium is possible.*

**Proof of Lemma 2.** Now suppose the parties use the buyer's stock as consideration. Since most of the analysis is analogous to the case with cash consideration, we'll keep the proof brief. Recall that $q_1 \in [0,1]$ represents the seller's ownership share of the merged firm. To construct a separating equilibrium, suppose the respective seller types offer $q^\theta$ and the buyer accepts the offer with probability $\delta^\theta$ that satisfy the following constraints:

$$\delta^h q_1^h(x + v_b^h) + (1 - \delta^h)v_s^h \geq \delta^l q_1^l(x + v_b^h) + (1 - \delta^l)v_s^h$$
$$\delta^l q_1^l(x + v_b^l) + (1 - \delta^l)v_s^l \geq \delta^h q_1^h(x + v_b^l) + (1 - \delta^h)v_s^l$$
$$(1 - q_1^h)(x + v_b^h) \geq x$$
$$(1 - q_1^l)(x + v_b^l) \geq x$$

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[13] This problem is similar to that of successor liability, where the seller has private information about uncovered liability that will transfer to the buyer when the buyer purchases the seller's assets. See Choi (2007) for a more detailed analysis of dealing with private information in successor liability setting. In the separating equilibrium, the high-type seller is engaged in "costly signaling" since she faces a strictly positive probability of her offer being rejected by the buyer. See Bolton and Dewatripont (2004) at 99—127 on hidden information and costly signaling.

Given the seller's power to make a take-it-or-leave-it offer, in welfare maximizing separating equilibrium, we get $q_1^h = \omega^h > q_1^l = \omega^l$, $\delta^l = 1$, and

$$\delta^h = \frac{v_b^l - v_s^l}{\lambda v_b^h - v_s^l} < 1$$

where $\lambda \equiv \frac{x + v_b^l}{x + v_b^h} < 1$. When $E(v_b) \geq \frac{x + E(v_b)}{x + v_b^h} v_s^h$, there also exists a pooling equilibrium, where both types offer $q_1 = \frac{E(v_b)}{x + E(v_b)}$.

In comparing the two cases, first, recall from Lemma 1, that $\gamma^h = \frac{v_b^l - v_s^l}{v_b^h - v_s^l} < 1$. Since $\lambda v_b^h - v_s^l < v_b^h$, we have $\delta^h > \gamma^h$. As $x \to 0$, $\delta^h \to 1$ while as $x \to \infty$, $\delta^h \to \gamma^h$. Also, as $(v_b^l - v_s^l) \to 0$, $\delta^h \to 0$, and as $(v_b^h - v_b^l) \to 0$, $\delta^h \to 1$. With respect to the pooling equilibrium, recall from Lemma 1 that with cash consideration, the necessary condition is $E(v_b) \geq v_s^h$. Since $\frac{x + E(v_b)}{x + v_b^h} < 1$, the parameter region where an efficient, pooling equilibrium is possible with stock consideration is larger. *QED*

As in the case with cash consideration, the seller, in a separating equilibrium, offers ownership share of the combined company that allows her to fully extract the additional return the buyer expects to realize. Recall that the expression $\omega^\theta = v_b^\theta / (x + v_b^\theta)$ stands for the share of the combined company that the seller will demand under symmetric information. Compared to the case with cash consideration, using the buyer's stock mitigates the adverse problem ($\delta^h > \gamma^h$). The reason is that, unlike cash, the value of the stock consideration depends, in part, on the ex post valuation. By paying for the seller's assets with stock, the parties can let the consideration partly vary with the realized valuation. Put differently, for any share of the combined company that the high-type seller offers ($q_1^h$), the low-type seller places lower value on that share than the high-type seller, thereby mitigating the incentive to mimic. In contrast, when the parties are using cash as consideration, both types of seller place equal valuation on the cash consideration offered by the high-type seller ($p_1^h$). The informational issue does not completely disappear because the stock consideration contains a component (buyer's assets that are worth $x$) that does not vary with the value of the seller's assets. As the buyer gets bigger ($x$ gets larger), ex post stock valuation becomes less informative ($q_1^h(x + v_b^h)$ converges to $q_1^l(x + v_b^l)$ as $x \to \infty$) and using the buyer's stock to differentiate the seller type becomes more difficult.

**Proposition 1** *Suppose $v_b^\theta \geq v_s^\theta$ for $\theta \in \{h, l\}$ and the parties can use a post-closing contingent payment (PCP) mechanism.*

1. *There exists a pooling equilibrium in which both types of seller offer the same PCP of $p_2(\beta)$ or $q_2(\beta)$ and the buyer accepts the offer with probability one, where*

$$p_2(\beta) = (p_2(h), p_2(l)) = \left( \frac{(1 - \sigma) \cdot v_b^h - (1 - \rho) \cdot v_b^l}{\rho - \sigma}, \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma} \right)$$

$$q_2(\beta) = \big(q_2(h), q_2(l)\big) = \left( \frac{(1-\sigma) \cdot \omega^h - (1-\rho) \cdot \omega^l}{\rho - \sigma}, \frac{\rho \cdot \omega^l - \sigma \cdot \omega^h}{\rho - \sigma} \right)$$

2. *There also exists a separating equilibrium in which the high-type seller offers* $p_2(\beta) = (p_2(h), p_2(l))$ *or* $q_2(\beta) = \big(q_2(h), q_2(l)\big)$, *the low-type offers either* $p_1^l = v_b^l$ *or* $q_1^l = \omega^l$, *and the buyer accepts both offers with probability one.*

**Proof of Proposition 1.** Let's start with cash consideration. Suppose there is a pooling equilibrium, in which both types of seller offers $p_2(\beta) \equiv (p_2(h), p_2(l))$ and the buyer accepts the offer with probability one. First, given that the seller has the power to make a take-it-or-leave-it offer, the equilibrium prices will be such that

$$v_b^h = \rho \cdot p_2(h) + (1-\rho) \cdot p_2(l)$$
$$v_b^l = \sigma \cdot p_2(h) + (1-\sigma) \cdot p_2(l)$$

From the two equalities, when we solve for the prices, we get

$$p_2(h) = \frac{(1-\sigma) \cdot v_b^h - (1-\rho) \cdot v_b^l}{\rho - \sigma}$$

$$p_2(l) = \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma}$$

Note that with the assumptions of $\rho \in (1/2, 1]$ and $\sigma \in [0, 1/2)$, we have $p_2(h) > p_2(l)$ and $p_2(h) > 0$. Furthermore, when $\frac{\rho}{\sigma} \geq \frac{v_b^h}{v_b^l}$, we also get $p_2(l) \geq 0$. The pooling offer also satisfies the buyer's participation constraint:

$$\alpha \cdot \big( \rho \cdot p_2(h) + (1-\rho) \cdot p_2(l) \big) + (1-\alpha) \cdot \big( \sigma \cdot p_2(h) + (1-\sigma) \cdot p_2(l) \big) = E(v_b)$$

Finally, to sustain this pooling equilibrium, whenever the buyer receives an offer that deviates from the pooling offer, the buyer believes that the offer is coming from the low-type seller and is willing to pay only up to $v_b^l$. This off-the-equilibrium belief makes deviation (at least weakly) dominated for both types of seller.

To construct a separating equilibrium, suppose the high-type seller can offer $p_2(\beta) \equiv (p_2(h), p_2(l))$ so that $v_b^h = \rho \cdot p_2(h) + (1-\rho) \cdot p_2(l)$ and $v_b^l > \sigma \cdot p_2(h) + (1-\sigma) \cdot p_2(l)$. This can be done by setting $p_2(l) < \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma}$ and $p_2(h) = \frac{1}{\rho}\big(v_b^h - (1-\rho) \cdot p_2(l)\big)$. Now, the low-type will strictly prefer offering $p_1^l = v_b^l$ or $q_1^l = \frac{v_b^l}{x + v_b^l}$ and will not want to mimic the high-type. Buyer accepts both offers with probability one.

For stock consideration, when both types of seller are pooling, the comparable conditions are:

$$v_b^h = \rho \cdot q_2(h)(x + v_b^h) + (1-\rho) \cdot q_2(l)(x + v_b^h)$$

$$v_b^l = \sigma \cdot q_2(h)(x + v_b^l) + (1 - \sigma) \cdot q_2(l)(x + v_b^l)$$

When we solve for $q_2(\beta)$, we get

$$q_2(\beta) = \big(q_2(h), q_2(l)\big) = \left( \frac{(1 - \sigma) \cdot \omega^h - (1 - \rho) \cdot \omega^l}{\rho - \sigma}, \frac{\rho \cdot \omega^l - \sigma \cdot \omega^h}{\rho - \sigma} \right)$$

where $\omega^h = \frac{v_b^h}{x + v_b^h}$ and $\omega^l = \frac{v_b^l}{x + v_b^l}$. To ensure that that $q_2(l) \geq 0$ we need: $\frac{\rho}{\sigma} \geq \frac{v_b^h}{v_b^l}\left(\frac{x + v_b^l}{x + v_b^h}\right) = \frac{\omega^h}{\omega^l}$. Since $\left(\frac{x + v_b^l}{x + v_b^h}\right) < 1, \frac{\omega^h}{\omega^l} < \frac{v_b^h}{v_b^l}$. That is, it is easier to satisfy the liquidity constraint with stock consideration than with cash consideration. *QED*

Although the payments are expressed as being contingent on the realized signal ($\beta$), it is equivalent to the buyer paying $p_2(l)$ at closing and paying additional $\Delta p_2 = p_2(h) - p_2(l)$ when the parties observe $\beta = h$. The reason why PCPs can facilitate acquisition transactions is that it harnesses additional verifiable signal, e.g., post-closing earnings realizations, that provides more information about the valuation. While using the buyer's stock as consideration did incorporate additional signal, PCPs perform better because the mechanism isolates the signal to the valuation of the seller's assets. Armed with the additional information, the seller no longer needs to rely on possible rejection by the buyer as a method of "signaling" high valuation.[14] At the same time, however, the proposition shows that when PCPs are possible, it is uncertain whether a pooling or a separating equilibrium (both equally efficient) will result. The reason why an efficient pooling equilibrium is possible stems from the incentive feature of PCPs. When the high-type seller offers a PCP, even though the chances of receiving higher consideration ($p_2(h)$ or $q_2(h)$) is lower for the low-type seller, the low-type seller may still want to offer the same PCP arrangement to the buyer. In a pooling equilibrium, both types of seller offer the same PCP arrangement to the buyer and the buyer's (expected) payment for the seller's assets is distinguished through the post-closing earnings realizations.[15]

The main idea behind the pooling equilibrium can be more readily understood with an extreme example when the post-closing valuations are perfectly verifiable: the case when $\rho = 1$ and $\sigma = 0$. Suppose, at the time of negotiation, the high-type seller offers a PCP arrangement with one payment at closing equal to $p_2(l) = v_b^l$ and a PCP equal to $\Delta p_2 = v_b^h - v_b^l$ when the valuations are realized and verified. When the buyer knows that this offer is being made by the high-type seller, the buyer would be willing to accept the offer. At the same time, however, there is no reason why the low-type seller wouldn't make the same offer to the buyer. Although the low-type seller would not be able to realize the PCP payment of $\Delta p_2$ (due to the fact that $\sigma = $

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[14] The basic idea is similar to using additional signal to mitigate the agency problem (so long as the existing signal is not a "sufficient statistic" of the additional signal). See Holmstrom (1979) and Bolton and Dewatripont (2004) at 136—137. See also Choi and Triantis (2008) where the principal can reduce the agency cost by incorporating additional costly verifiable signal of the agent's effort. This paper is incorporating that idea to the problem of adverse selection.

[15] The pooling equilibrium is similar to that in which producers with different product qualities offer the same full warranty to consumers, consumers do not get to infer product quality based on the warranty offered, and de facto separation in product quality is achieved through ex post warranty payments. See Grossman (1981).

0), she will at least be able to receive the payment of $v_b^l$ at closing, which is the maximum she could achieve under any separation. Hence, both types of seller are likely to offer the same PCP arrangement. De facto separation between the types is achieved instead through post-closing realizations.[16]

Notwithstanding the fact that an efficient pooling equilibrium is a possible outcome with a PCP, since the low-type seller is indifferent between offering a PCP and not offering one, a separating equilibrium is also possible. For instance, when the parties are using cash consideration, the high-type seller can offer $p_2(\beta) \equiv (p_2(h), p_2(l))$ that satisfies $v_b^h = \rho \cdot p_2(h) + (1 - \rho) \cdot p_2(l)$ and the low-type can simply offer $p_1^l = v_b^l$. Better yet, the high-type seller can set the PCP so that $v_b^h = \rho \cdot p_2(h) + (1 - \rho) \cdot p_2(l)$ but $v_b^l > \sigma \cdot p_2(h) + (1 - \sigma) \cdot p_2(l)$, in which case, the low-type seller will strictly prefer offering either $p_1^l = v_b^l$ or $q_1^l = \omega^l$.[17] At the same time, it is not possible for only the low-type seller to offer a PCP. This is because, whenever the high-type were to offer either $p_1^h = v_b^h$ or $q_1^h = \omega^h$, and the buyer were to accept the offer with a sufficiently high probability, the low-type seller would want to mimic the high-type. Hence, if there was a separating equilibrium, only the high-type seller will offer a PCP.

**Corollary 1** *As the post-closing, verifiable signal becomes more accurate, the PCP payment becomes smaller:* $\frac{\partial(p_2(h) - p_2(l))}{\partial \rho} < 0,$ $\frac{\partial(q_2(h) - q_2(l))}{\partial \rho} < 0,$ $\frac{\partial(p_2(h) - p_2(l))}{\partial \sigma} > 0,$ *and* $\frac{\partial(q_2(h) - q_2(l))}{\partial \sigma} > 0.$ *As* $(\rho, \sigma) \to (1,0)$, $(p_2(h), p_2(l)) \to (v_b^h, v_b^l)$ *while* $(q_2(h), q_2(l)) \to (\omega^h, \omega^l)$. *As* $x \to 0$, $(q_2(h), q_2(l)) \to (1,1)$ *and as* $x \to \infty$, $(q_2(h), q_2(l)) \to (0,0)$.

**Proof of Corollary 1.** From the equilibrium prices, we get

$$p_2(h) - p_2(l) = \frac{(1 - \sigma) \cdot v_b^h - (1 - \rho) \cdot v_b^l}{\rho - \sigma} - \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma} = \frac{v_b^h - v_b^l}{\rho - \sigma}$$

$$q_2(h) - q_2(l) = \frac{(1 - \sigma) \cdot \omega^h - (1 - \rho) \cdot \omega^l}{\rho - \sigma} - \frac{\rho \cdot \omega^h - \sigma \cdot \omega^l}{\rho - \sigma} = \frac{\omega^h - \omega^l}{\rho - \sigma}$$

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[16] While the presence of a pooling equilibrium is a bit "knife-edge," when the seller's type space is richer, a pooling equilibrium can be more robust. For instance, suppose, in addition to the two seller types, there is another middle type, whose valuation is in between the high and low types. That is, $\theta \in \{h, m, l\}$, $v_i^h \geq v_i^m \geq v_i^l$, and $v_m^m \geq v_s^m$. We can also assume that the ex-post signal takes on three values, $\beta \in \{h, m, l\}$, and satisfies the monotone likelihood ratio property so that the higher type is more likely to generate a higher signal. See Bolton and Dewatripont (2004) at 147—148. With these assumptions, it is fairly straightforward to see that while a pooling equilibrium, in which all three types use PCPs, exists, for there to be a separation, the two high types must use a PCP while the low-type seller does not. That is because if the middle-type seller makes an unconditional offer, the buyer will have to reject that offer with some positive probability to keep the low-type seller from mimicking the middle type.

[17] Note that, compared to the pooling equilibrium, in a separating equilibrium, the slope of the PCP mechanism, $\Delta p = p_2(h) - p_2(l)$, is larger while the base pay, $p_2(l)$, is smaller, so as to make the PCP arrangement less attractive to the low-type seller. So, in theory, a separating equilibrium should exhibit a larger variation in PCPs than a pooling equilibrium. Also, in the pooling equilibrium, $p_2(l) \gtreqless v_s^l$. If the parties are constrained to set $p_2(l) \geq v_s^l$, a separating equilibrium becomes more difficult to sustain and a pooling equilibrium is more likely.

The expression implies that $\frac{\partial(p_2(h)-p_2(l))}{\partial\rho} < 0$, $\frac{\partial(q_2(h)-q_2(l))}{\partial\rho} < 0$, $\frac{\partial(p_2(h)-p_2(l))}{\partial\sigma} > 0$, and $\frac{\partial(q_2(h)-q_2(l))}{\partial\sigma} > 0$. From the expression for $p_2(\beta)$ and $q_2(\beta)$, we see that as $(\rho,\sigma) \to (1,0)$, $p_2(h) \to v_b^h$, $p_2(l) \to v_b^l$, $q_2(h) \to \omega^h$, and $q_2(l) \to \omega^l$. Finally, as $x \to 0$, $(\omega^h, \omega^l) \to (1,1)$ and $(q_2(h), q_2(l)) \to (1,1)$. As $x \to \infty$, $(\omega^h, \omega^l) \to (0,0)$ and $(q_2(h), q_2(l)) \to (0,0)$. When we differentiate $q_2(h) - q_2(l)$ with respect to $x$, we get

$$\frac{\partial(q_2(h) - q_2(l))}{\partial x} = \frac{1}{\rho - \sigma}\left(\frac{v_b^l}{(x + v_b^l)^2} - \frac{v_b^h}{(x + v_b^h)^2}\right)$$

When $x = 0$, $\frac{\partial(q_2(h)-q_2(l))}{\partial x} = \frac{1}{\rho-\sigma}\frac{v_b^h-v_b^l}{v_b^h v_b^l} > 0$, but as $x \to \infty$, $\frac{\partial(q_2(h)-q_2(l))}{\partial x} \to 0$. The difference in shares, $q_2(h) - q_2(l)$, is maximized when $\frac{v_b^l}{(x+v_b^l)^2} - \frac{v_b^h}{(x+v_b^h)^2} = 0$ or, equivalently, $v_b^l\left(\frac{x+v_b^h}{x+v_b^l}\right) = v_b^h\left(\frac{x+v_b^l}{x+v_b^h}\right)$. *QED*

The basic idea behind Corollary 1 can be explained as follows. Suppose the parties are using cash consideration and we fix the low-state payment, $p_2(l)$. In the pooling equilibrium, the prices, $p_2(\beta) = (p_2(h), p_2(l))$, are structured so as to make the expected payment equal to the buyer's respective valuation. When the verifiable signal ($\beta$) becomes less accurate, i.e., when $\rho$ increases, this will increase the expected payout to the low-type seller ($\sigma \cdot p_2(h) + (1 - \sigma) \cdot p_2(l)$) while decreasing the payout to the high-type seller ($\rho \cdot p_2(h) + (1 - \rho) \cdot p_2(l)$). Although the low-type seller would strictly prefer that outcome, the high-type seller would no longer want to pool with the low-type seller, since she can do strictly better by increasing her offer price. To restore the equilibrium, therefore, they will have to increase the PCP payment, by either increasing $p_2(h)$ or decreasing $p_2(l)$, until the expected payments again equal the buyer's valuation. Finally, unlike cash-based PCP, stock-based PCP will vary depending on the size of the buyer's assets ($x$). When the buyer's assets are very small ($x \approx 0$) or very large ($x \gg 0$), the seller's share of the combined company will respectively increase or decrease while the difference in shares ($q_2(h) - q_2(l)$) will disappear. Hence, the PCP difference will be the largest for a moderately sized buyer.

**Corollary 2** *Suppose there is a $\underline{p} \geq 0$ and $\underline{q} \geq 0$ such that the parties must satisfy $p_2(\beta) \geq \underline{p}$ and $q_2(\beta) \geq \underline{q}$ for $\beta \in \{h, l\}$. When $\underline{p}$ and $\underline{q}$ are sufficiently large or when $\rho - \sigma$ is sufficiently small, neither type of seller will use a PCP mechanism. When $\underline{p} = \underline{q} = 0$ and $\frac{\omega^h}{\omega^l} \leq \frac{\rho}{\sigma} < \frac{v_b^h}{v_b^l}$, the seller will only use stock as consideration for PCP.*

**Proof of Corollary 2.** From Proposition 1, in a pooling equilibrium, we have $p_2(l) = \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma}$ and $q_2(l) = \frac{\rho \cdot \omega^h - \sigma \cdot \omega^l}{\rho - \sigma}$; while in a separating equilibrium, $p_2(l) < \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma}$ and $q_2(l) < \frac{\rho \cdot \omega^h - \sigma \cdot \omega^l}{\rho - \sigma}$. If $\underline{p} \geq \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma}$ or $\underline{q} \geq \frac{\rho \cdot \omega^h - \sigma \cdot \omega^l}{\rho - \sigma}$, therefore, neither type of equilibrium derived in

Proposition 1 can be implemented. If $\frac{\rho}{\sigma} < \frac{v_b^h}{v_b^l}$, as an example, the inequality is violated for all

$\underline{p} \geq 0$. Similarly, if $\frac{\rho}{\sigma} < \frac{\omega^h}{\omega^l}$, the inequality is violated for all $\underline{q} \geq 0$. From Proposition 1 and Corollary 1, we also know that as $\rho - \sigma$ gets smaller, $p_2(h)$ and $q_2(h)$ increase while $p_2(l)$ and $q_2(l)$ decrease. Hence, as $\rho - \sigma$ decreases, the constraint is more likely to bind.

When $\underline{p} \geq \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma}$, the only possible equilibrium with a PCP is for both types of seller to offer $p_2(l) = \underline{p}$ and

$$p_2(h) = \frac{E(v_b) - (\alpha(1-\rho) + (1-\alpha)(1-\sigma))\underline{p}}{\alpha\rho + (1-\alpha)\sigma}$$

such that $\alpha \cdot \left(\rho \cdot p_2(h) + (1-\rho) \cdot \underline{p}\right) + (1-\alpha) \cdot \left(\sigma \cdot p_2(h) + (1-\sigma) \cdot \underline{p}\right) = E(v_b)$. This renders $\Delta p_2 = \frac{E(v_b) - \underline{p}}{\alpha\rho + (1-\alpha)\sigma}$. In this equilibrium, $\underline{p} + \rho\Delta p_2 < v_b^h$, so that the buyer pays less than his reservation value for the high-type seller's assets and earns a positive rent. If they were to implement a separating equilibrium, in which the only the high-type seller uses a PCP, they will have to set $\Delta p_2$ such that $\underline{p} + \sigma\Delta p_2 \leq v_b^l$, but this requires $\Delta p_2$ to be smaller, leaving a larger rent to the buyer who acquires the high-type seller's assets: $(v_b^h - (\underline{p} + \rho\Delta p_2))$. Hence, it is strictly dominated for the high-type seller. With stock consideration, with $\underline{q} \geq \frac{\rho \cdot \omega^h - \sigma \cdot \omega^l}{\rho - \sigma}$, we get a pooling equilibrium with $q_2(l) = \underline{q}$ and $\Delta q_2 = \frac{E(v_b) - \underline{q}(x + E(v_b))}{\alpha\rho(x + v_b^h) + (1-\alpha)\sigma(x + v_b^l)}$; and the rest of the analysis is analogous.

From Lemmas 1 and 2, if the high-type seller were to make a single cash offer ($p_1^h = v_b^h$), her expected revenue is $\gamma^h \cdot p_1^h + (1 - \gamma^h) \cdot v_s^h$ where $\gamma^h = \frac{v_b^l - v_s^l}{v_b^h - v_s^l}$; and with stock offer ($q_1^h = \omega^h = \frac{v_b^h}{x + v_b^h}$), her expected revenue is $\delta^h q_1^h (x + v_b^h) + (1 - \delta^h)v_s^h$, where $\delta^h = \frac{v_b^l - v_s^l}{q_1^h(x + v_b^h) - v_s^l}$. Since $\underline{p} + \rho\Delta p_2 = \frac{\rho(\alpha v_b^h + (1-\alpha)v_b^l)}{\alpha\rho + (1-\alpha)\sigma} - \frac{(1-\alpha)(\rho - \sigma)}{\alpha\rho + (1-\alpha)\sigma} \cdot \underline{p}$ is strictly decreasing with respect to $\underline{p}$, as $\underline{p}$ rises, the buyer makes a larger profit from acquiring the high-type seller's assets. Therefore, the high-type seller becomes more likely to use either single cash or stock offer rather than a PCP as $\underline{p}$ and $\underline{q}$ rise.

Finally, when $\frac{\omega^h}{\omega^l} \leq \frac{\rho}{\sigma} < \frac{v_b^h}{v_b^l}$ and $\underline{p} = \underline{q} = 0$, the seller will only use stock as consideration for a PCP. By doing so, the seller can still capture all the surplus from the transaction. If the seller were to use cash as consideration, since $\underline{p} + \rho\Delta p_2 < v_b^h$, the seller is strictly worse off. *QED*

Corollary 2 analyzes the effect of minimum transfer constraint, either on cash or stock, on the use of PCP mechanisms. When the size of the payments is unrestricted, it is possible for the

seller to pay the buyer or receive a very small amount at closing ($p_2(l) \approx 0$ or $q_2(l) \approx 0$). The seller may be, for various reasons, unable to implement such a contingent payment scheme. In addition to the possible wealth or limited liability constraint ($p_2(\beta) \geq 0$ and $q_2(\beta) \geq 0$), if $p_2(l)$ or $q_2(l)(x + v_s^\theta)$ is much smaller than the seller's valuation ($v_s^\theta$) and the seller does not collect on the incentive component ($\Delta p_2$ or $\Delta q_2$) because the favorable signal does not realize ex post, the seller may incur liability to its shareholders for selling its assets too cheaply.[18] Such a legal liability can operate as a positive participation constraint on the seller. The corollary explores this possibility by imposing a minimum payment requirement ($p_2(\beta) \geq \underline{p} \geq 0$ and $q_2(\beta) \geq \underline{q} \geq 0$).

The analysis reveals two insights. First, as the transfer restriction becomes more binding (as $\underline{p}$ or $\underline{q}$ rises), because the high-type seller has to leave more rent to the high-type buyer, the seller may forego using a PCP altogether. Second, the seller will prefer a PCP mechanism that relies on more accurate signal (with a larger $\rho - \sigma$). This could explain the choice of one PCP mechanism over another. For instance, because earnouts allow the transacting parties to obtain more information over time, they can produce a more accurate estimate of true valuation than purchase price adjustments. If that is the case, with minimum payment restriction in play, the parties may prefer using an earnout rather than a purchase price adjustment, subject to the post-closing moral hazard issues on earnouts, analyzed in part V. Furthermore, as shown in Lemma 1, using the buyer's stock as consideration in a PCP mechanism partially alleviates the adverse selection problem. Hence, as $\rho - \sigma$ gets smaller, the parties are more likely to use stock as consideration in structuring a PCP mechanism.

**Corollary 3** *Suppose $v_b^h \geq v_s^h$ but $v_b^l < v_s^l$.*

1. *Without a post-closing contingent payment (PCP) arrangement, the only possible equilibrium is a pooling equilibrium where both types of seller offer either $p = E(v_b)$ or $q = E(v_b)/(x + E(v_b))$, and the buyer accepts. However, pooling equilibrium is feasible only when $E(v_b) \geq v_s^h$ in case of cash consideration and only when $E(v_b) \geq [(x + E(v_b))/(x + v_b^h)]v_s^h$ in case of stock consideration.*

2. *With a PCP, there exists an equilibrium in which only the high type seller offers $p_2(\beta) = (p_2(h), p_2(l))$ or $q_2(\beta) = (q_2(h), q_2(l))$ and the buyer accepts the offer with probability one.*

**Proof of Corollary 3.** Suppose the parties cannot utilize a PCP arrangement. From Lemmas 1 and 2, when the seller can rely only on the size of the closing payment to signal her type, because the buyer should never accept any offer from the low-type seller, whenever $\gamma^h \geq 0$ or $\delta^h \geq 0$, the low-type seller will mimic the high-type seller. Therefore, a separating equilibrium does not exist.

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[18] Buyer may also be subject to some liability issues for paying too much for the target when $\Delta p_2$ or $\Delta q_2$ gets too large, which can impose an upper limit on the incentive component ($\overline{p} \geq p_2(h)$ or $\overline{q} \geq q_2(h)$). The analysis is comparable and is skipped. Also, another reason why $\Delta p_2$ or $\Delta q_2$ cannot be too large may stem from risk aversion. Although we are assuming that the transacting corporations are risk-neutral, their shareholders may not be and shareholders' risk aversion may be more relevant in the case of closely-held or privately-held companies.

A pooling equilibrium, on the other hand, is still feasible. With cash consideration, when $E(v_b) \geq v_s^h$, both types of seller can offer $p = E(v_b)$ and the buyer can accept the offer with probability one. Similarly, with stock consideration, when $E(v_b) \geq \frac{x+E(v_b)}{x+v_b^h} v_s^h$, both types can offer $q = \frac{E(v_b)}{x+E(v_b)}$ and the buyer can accept. As the off-the-equilibrium belief, if the buyer receives a different offer, the buyer believes that the offer is coming only from the low-type seller and rejects the offer.

Now, suppose that the parties can use a PCP. The high-type seller can structure the PCP payments, $p_2(\beta) = (p_2(h), p_2(l))$, to satisfy:

$$v_b^h = \rho \cdot p_2(h) + (1-\rho) \cdot p_2(l)$$
$$\frac{v_b^l + v_s^l}{2} = \sigma \cdot p_2(h) + (1-\sigma) \cdot p_2(l)$$

Compared to before, now the low-type seller would not want to offer the same PCP arrangement since, in expectation, she receives payment that is strictly lower than her valuation of the assets: $\frac{v_b^l + v_s^l}{2} < v_s^l$. Hence, the high-type seller can successfully separate herself from the low-type seller. The buyer, in turn, accepts the PCP arrangement with probability one. The analysis for stock consideration is analogous. *QED*

As Corollary 3 shows, a PCP mechanism is particularly useful when the problems of adverse selection are "severe." When the low-type seller places a higher valuation than the buyer ($v_b^l < v_s^l$) so that there is welfare loss from executing the deal, without a PCP mechanism, regardless of the offer made by the high-type seller, the low-type seller would always want to mimic the high-type. The reason is simple: the low-type seller has nothing to lose from doing so, since, in an efficient outcome, the low-type seller should not sell her assets to the buyer. Separation of types is not possible and, unless the expected valuation for the buyer is sufficiently high ($E(v_b) \geq v_s^h$ in case of cash consideration and $E(v_b) \geq \frac{x+E(v_b)}{x+v_b^h} v_s^h$ in case of stock consideration) so as to induce a pooling equilibrium,[19] there will be no transaction for both types of seller: the negotiation completely falls apart. With a PCP mechanism, on the other hand, the high-type seller can successfully execute a transaction by conditioning payment on post-closing, verifiable signal. Because the post-closing signal ($\beta$) is correlated with the true valuation, the high-type seller can set the prices so as to make the buyer be willing to purchase the assets from her while keeping the low-type seller from mimicking.

## IV.    A Non-Convergent Priors Model of Earnouts and Purchase Price Adjustments

Suppose, at $t = 0$, after Nature has determined the state, $\theta \in \{h, l\}$, buyer believes the realized state is $\theta_b \in \{h, l\}$ while the seller believes it is $\theta_s \in \{h, l\}$. Let's also assume that although the true state of the world is unknown to either party, their beliefs are common

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[19] Pooling equilibrium is inefficient since the low-type seller gets to transfer the assets to the buyer who values the assets less. The size of the expected inefficiency is given by $(1-\alpha)(v_s^l - v_b^l)$.

knowledge. That is, even though the parties may disagree about the true state of the world and they are aware of such a disagreement (when $\theta_b \neq \theta_s$), their beliefs do not necessarily converge.[20] Recall that, at $t = 1$, the seller makes a take-it-or-leave-it offer to the buyer and the buyer either accepts or rejects; and at $t = 2$, valuations and signal are realized. Unlike the private information model, because both parties' beliefs are common knowledge, the buyer no longer learns anything new from observing the seller's offer: there is no signaling aspect of the game. Rather, the issue is whether they can find a price (or a set of prices) that satisfies both parties' beliefs.

There are two easy, preliminary cases to consider. First, if their beliefs are consistent, $\theta_b = \theta_s$, they will transact only when they jointly believe that there is a positive surplus. For instance, if $\theta_b = \theta_s = l$ but $v_b^l < v_s^l$, they will forego doing the deal. Second, if $\theta_b = h$ and $\theta_s = l$, so that the buyer holds a more "optimistic" belief than the seller, they will transact with certainty. The seller will offer $p_1 = v_b^h$ and the buyer will always accept the offer. The downside is that this may lead to too many deals being done: assets get transferred even when $v_b^l < v_s^l$, leading to a loss in welfare. The rest of the analysis will focus on the more interesting case of $\theta_b = l$ and $\theta_s = h$, in which the seller believes that the assets are worth more than what the buyer thinks: the seller holds a more "optimistic" belief than the buyer. The following Lemma shows that in that setting, with a single price negotiation ($p_1$), completing the deal is feasible in fairly limited circumstances.

**Lemma 3** *Suppose $(\theta_b, \theta_s) = (l, h)$ and a post-closing contingent payment (PCP) is not possible. If $v_b^l \geq v_s^h$, the seller offers either $p_1 = v_b^l$ or $q_1 = \omega^l$, the buyer accepts, and both types of transactions close. If both types of consideration are possible, the seller strictly prefers using stock consideration. If $v_b^l < v_s^h$, there is no price or stock at which the buyer accepts the offer and neither type of transaction gets consummated.*

**Proof of Lemma 3.** When $(\theta_b, \theta_s) = (l, h)$, the maximum the buyer is willing to pay for the assets is $v_b^l$ and the minimum the seller must receive for the assets is $v_s^h$.

Suppose $v_b^l \geq v_s^h$. If the seller is using cash consideration, the seller can offer $p_1 = v_b^l$ and the buyer will accept. The buyer believes that she is earning a profit of $v_b^l - p_1 = 0$ and the seller believes that she is realizing a profit of $p_1 - v_s^h \geq 0$. Similarly, with stock, the seller can offer $q_1 = \omega^l = \frac{v_b^l}{x + v_b^l}$. Since $(1 - \omega^l)(x + v_b^l) = x$ and $\omega^l(x + v_b^h) = v_b^l\left(\frac{x + v_b^h}{x + v_b^l}\right) > v_b^l \geq v_s^h$, both parties' participation constraints are satisfied. The expected welfare is $\alpha(v_b^h - v_s^h) + (1 - \alpha)(v_b^l - v_s^l)$. Note that $v_b^l \geq v_s^h > v_s^l$, so that the transactional surplus is always positive and the maximum welfare is attained. When the seller can choose between stock and cash consideration, the seller strictly prefers using stock consideration since $\omega^l(x + v_b^h) = v_b^l\left(\frac{x + v_b^h}{x + v_b^l}\right) > v_b^l$.

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[20] Although the literature on non-convergent priors is not as extensive, it has become an important bargaining model to consider. See, e.g., Yildiz (2004) for how non-convergent priors can cause bargaining delays and Che and Kartik (2009) for how difference in opinions can produce an important incentive effect.

If, on the other hand, $v_b^l < v_s^h$, there is no cash or stock that satisfies both parties' reservation values based on their respective beliefs. Cash payment is straightforward. With respect to stock consideration, for the transaction to consummate, the seller will need to offer $q_1$ such that $(1 - q_1)(x + v_b^l) \geq x$ and $q_1(x + v_s^h) \geq v_s^h$. The first inequality can be written as $q_1 \leq \frac{v_b^l}{x + v_b^l}$ while the second can be written as $q_1 \geq \frac{v_s^h}{x + v_s^h}$. When $v_b^l < v_s^h$, $\frac{v_s^h}{x + v_s^h} > \frac{v_b^l}{x + v_b^l}$ and there is no $q_1$ that satisfies both inequalities. *QED*

When the seller is more optimistic about the asset value than the buyer and they are to negotiate on a single acquisition price ($p_1$ or $q_1$), consummating the transaction is possible only when their valuation estimates are not too far apart. With $(\theta_b, \theta_s) = (l, h)$, the seller believes that the assets are worth a lot and demand to receive at least $v_s^h$ for the assets. The buyer, on the other hand, is less sanguine about the assets' potential and is willing to pay only up to $v_b^l$.[21] With these heterogeneous and non-convergent beliefs, deal is possible only when $v_b^l \geq v_s^h$. At the same time, the seller strictly prefers using stock consideration since this allows her to capture additional surplus in case her belief is vindicated. If $v_b^l < v_s^h$, on the other hand, there is no single transfer payment (either in cash or stock) that can satisfy both parties' beliefs. Using a single transfer ($p_1$ or $q_1$) to negotiate can lead to too little (but not too much) transactions. When $v_b^l \geq v_s^h$, so that they always reach an agreement, since, by assumption $v_b^l \geq v_s^h > v_s^l$, there is a positive transactional surplus and the parties manage to realize that surplus. That is, a single price negotiation leads to a welfare-optimal result. On the other hand, when $v_b^l < v_s^h$, so that the parties fail to reach an agreement, they are unable to realize the transactional surplus of $v_b^h - v_s^h \geq 0$. Too few deals get executed.

Before we proceed to the analysis of earnouts, one important caveat is in order. With non-convergent priors, because parties attach inconsistent beliefs, unless there are any limitations, the seller can set $p_2(\beta) \equiv (p_2(h), p_2(l))$ so as to satisfy $v_b^l = \sigma \cdot p_2(h) + (1 - \sigma) \cdot p_2(l)$ while making $\rho \cdot p_2(h) + (1 - \rho) \cdot p_2(l) = p_2(l) + \rho \cdot \Delta p$ arbitrarily large. This can be done, for instance, by reducing $p_2(l)$ and increasing $\Delta p$. In such a case, while the expected payment to the buyer will stay constant, the payment seller expects to receive will strictly increase: without any limitation, the seller can make its expected payment infinitely large. This is equivalent to the parties making infinite bets against each other. In reality, various types of restrictions, such as liquidity and financing constraints, exist. Hence, we'll assume that the maximum expected consideration under the optimistic belief has to be less than $v_b^h$. That is, $\rho \cdot p_2(h) + (1 - \rho) \cdot p_2(l) \leq v_b^h$. For the stock consideration, the analogous condition is $\rho \cdot q_2(h)(x + v_b^h) + (1 - \rho) \cdot q_2(l)(x + v_b^h) \leq v_b^h$. While imposing such limitations is sensible, one important implication of the assumption is that the seller will not be able to realize more than $v_b^h$ with either type of consideration. Hence, using stock will no longer be advantageous as in Lemma 2.

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[21] Seller also believes that the buyer should be willing to pay up to $v_b^h$ ($> v_b^l$) for the assets while the buyer believes that the seller should be willing to part with the assets for $v_s^l$ ($< v_s^h$). The result of bargaining break-down when one party has more optimistic belief about the world than the other is fairly well known particularly in the settlement of litigation literature. See Landes (1971) and Priest and Klein (1984).

**Proposition 2** *Suppose* $(\theta_b, \theta_s) = (l, h)$ *and the parties can use a post-closing contingent payment (PCP) mechanism. In equilibrium, the seller offers* $p_2(\beta) = (p_2(h), p_2(l))$ *or* $q_2(\beta) = (q_2(h), q_2(l))$, *the buyer always accepts, and both types of transactions get consummated.*

**Proof of Proposition 2.** Given the respective beliefs, the buyer believes that $prob(\beta = h | \theta_b = l) = \sigma$ while the seller believes that $prob(\beta = h | \theta_s = h) = \rho$. Suppose the seller offers $p_2(\beta) \equiv (p_2(h), p_2(l))$ such that

$$v_b^h = \rho \cdot p_2(h) + (1 - \rho) \cdot p_2(l)$$
$$v_b^l = \sigma \cdot p_2(h) + (1 - \sigma) \cdot p_2(l)$$

Using the two equalities, which represent a system of linear equations, when we solve for the prices, we get

$$p_2(\beta) = \left(p_2(h), p_2(l)\right) = \left( \frac{(1 - \sigma) \cdot v_b^h - (1 - \rho) \cdot v_b^l}{\rho - \sigma}, \frac{\rho \cdot v_b^l - \sigma \cdot v_b^h}{\rho - \sigma} \right)$$

Given the buyer's belief of $\theta_b = l$, the buyer will accept the offer since the buyer expects to pay $\sigma \cdot p_2(h) + (1 - \sigma) \cdot p_2(l) = v_b^l$. Conditional on such belief, the buyer's expected profit is equal to $\sigma \cdot p_2(h) + (1 - \sigma) \cdot p_2(l) - v_b^l = 0$. For the seller, given the seller's belief that $\theta_s = h$, the seller expects to receive $\rho \cdot p_2(h) + (1 - \rho) \cdot p_2(l) = v_b^h$ for the assets. With the seller's belief of $\theta_s = h$, the seller's expected profit is $\rho \cdot p_2(h) + (1 - \rho) \cdot p_2(l) - v_s^h > 0$. Hence, both parties' expectations are satisfied and, unlike the case with a single price offer, both types of deals will be executed.

For stock consideration, the comparable conditions are:

$$v_b^h = \rho \cdot q_2(h)(x + v_b^h) + (1 - \rho) \cdot q_2(l)(x + v_b^h)$$
$$v_b^l = \sigma \cdot q_2(h)(x + v_b^l) + (1 - \sigma) \cdot q_2(l)(x + v_b^l)$$

The first equality makes sure that the seller, with her belief of $\theta_s = h$, gets $v_b^h$ and the second equality makes sure that the buyer pays, in expectation, $v_b^l$ under his belief of $\theta_b = l$. When we solve for $q_2(\beta)$, we get

$$q_2(\beta) = \left(q_2(h), q_2(l)\right) = \left( \frac{(1 - \sigma) \cdot \omega^h - (1 - \rho) \cdot \omega^l}{\rho - \sigma}, \frac{\rho \cdot \omega^h - \sigma \cdot \omega^l}{\rho - \sigma} \right)$$

where $\omega^h = \frac{v_b^h}{x + v_b^h}$ and $\omega^l = \frac{v_b^l}{x + v_b^l}$. The seller believes that she is realizing a profit of $\rho \cdot q_2(h)(x + v_b^h) + (1 - \rho) \cdot q_2(l)(x + v_b^h) - v_s^h > 0$ while the buyer believes that he is receiving seller's assets that are worth $v_b^l$ at a cost of $v_b^l$. *QED*

When $(\theta_b, \theta_s) = (l, h)$, the players' beliefs about the signal realization also differ. With $\theta_b = l$, the buyer believes that she will observe $\beta = h$ with probability $\rho \in (1/2, 1]$. The seller,

on the other hand, believes that the chances of observing $\beta = h$ is only $\sigma \in [0,1/2)$. Notwithstanding such different beliefs, the multiple price structure in a PCP can successfully bridge the gap in their divergent beliefs and allow them to close the deal. The rationale is quite similar to that in the private information (PI) model. In the private information setting, the buyer was uncertain of what the true value of the assets were and PCPs were being used to allow the buyer to attain the accurate value (in expectation) of the assets through ex post realization: the PCP realizations correlated with the true value of the assets. In a non-convergent priors (NP) setting, differences in valuation are brought forward to the negotiating stage ($t = 1$), but having the multiple-price structure allows the parties to be able to satisfy both parties' expectations about the transaction.

Unlike in the private information model, in the non-convergent priors setting, using PCPs could lead to too many transactions and a potential loss of welfare. When $v_b^\theta \geq v_s^\theta$ for $\theta \in \{h, l\}$, there is a positive surplus in both states of the world and using PCPs to close the deal is welfare maximizing. This is the case where both parties believe that there is a positive surplus from the transaction but they disagree on valuations. On the other hand, when $v_b^h \geq v_s^h$ but $v_b^l < v_s^l$, although the transaction should proceed only when $\theta = h$, the parties will agree to close the deal in both states of the world. This represents a case where the parties disagree on both valuations and on whether there is a surplus from the transaction. The buyer believes that there is no surplus from the deal while the seller believes that there is. The buyer is still willing to acquire the assets at $v_b^l$ (and the seller willing to part with the assets at $v_s^h$), and even though the buyer believes that the seller is entering into a money-losing deal (since the buyer believes that $v_b^l < v_s^l$), the buyer is unable (or unwilling) to convince the seller to do otherwise.[22] Hence, unlike in the private information setting, whether PCPs can improve welfare depends on the likelihood of incurring such a welfare loss.

**Corollary 4** *Suppose $(\theta_b, \theta_s) = (l, h)$. When $v_b^l \geq v_s^l$, using a PCP ($p_2(\beta)$ or $q_2(\beta)$) produces (weakly) higher social welfare than using a single payment scheme ($p_1$ or $q_2$). When $v_b^l < v_s^l$, PCP mechanism is more likely to produce higher social welfare as $v_b^h - v_s^h$ increases, as $v_s^l - v_b^l$ decreases, or as $\alpha \to 0$.*

**Proof of Corollary 4.** First, when $v_b^l \geq v_s^h$, expected welfare from both types of bargaining are $\alpha(v_b^h - v_s^h) + (1 - \alpha)(v_b^l - v_s^l)$.

Second, when $v_s^l \leq v_b^l < v_s^h$, with a PCP, the parties obtain an expected surplus of $\alpha(v_b^h - v_s^h) + (1 - \alpha)(v_b^l - v_s^l)$. But with a single-price, their expected surplus is zero.

Third, when $v_b^l < v_s^l$, the expected welfare with a PCP is $\alpha(v_b^h - v_s^h) + (1 - \alpha)(v_b^l - v_s^l)$, where the second term is negative. The comparable expected welfare with a single-price is zero. The PCP mechanism produces a higher expected welfare if

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[22] Potential welfare loss (or negative profit) provides another reason why practitioners, particularly the lawyers whose compensation is not tied to either successful completion or the size of the deal, often become cautious in recommending earnouts to their clients. If the parties fail to reach an agreement on valuation, it could be an indication that one party is having too optimistic a belief. In such a setting, it may be better for the parties to try to come to an agreement on valuation rather than take the easier way out through an earnout.

$$\alpha(v_b^h - v_s^h) \geq (1 - \alpha)(v_s^l - v_b^l)$$

The inequality is more likely to be satisfied as $v_b^h - v_s^h$ increases, $v_s^l - v_b^l$ decreases, or $\alpha \to 0$. *QED*

We can compare the relative efficiency of PCPs in three separate parameter regions. We can make the comparison from the ex ante perspective, before the state of the world (seller's type) has been chosen by Nature at $t = 0$. First, when $v_b^l \geq v_s^h$, both types of bargaining work equally well and maximize welfare. Second, when $v_s^l \leq v_b^l < v_s^h$, PCP bargaining clearly dominates a single-price bargaining. Although the surplus from the transaction is always positive, given the divergent set of beliefs, the parties are unable to realize the surplus with a single-price. A PCP, on the other hand, allows the parties to realize all potential surplus. Third, when $v_b^l < v_s^l$, neither negotiation mechanism dominates the other. In a single-price negotiation, too little transactions get completed, engendering an expected welfare loss of $\alpha(v_b^h - v_s^h)$. With a PCP, on the other hand, we have the opposite problem of too many completed transactions. Even though the transactional surplus is negative for the low-type, the parties, using a PCP, consummate the transaction, thereby engendering an expected welfare loss of $(1 - \alpha)(v_s^l - v_b^l)$. PCPs are more likely to perform worse as $v_s^l - v_b^l$ gets larger, as $v_b^h - v_s^h$ gets smaller, or as $\alpha$ gets smaller. The following table presents the expected welfare loss comparison.[23]

| | Expected Welfare Loss | |
|---|---|---|
| | Single Payment Offer ($p_1$ or $q_1$) | PCP Offer ($p_2(\beta)$ or $q_2(\beta)$) |
| $v_b^l \geq v_s^h$ | 0 | 0 |
| $v_s^l \leq v_b^l < v_s^h$ | $\alpha(v_b^h - v_s^h) + (1 - \alpha)(v_b^l - v_s^l)$ | 0 |
| $v_b^l < v_s^l$ | $\alpha(v_b^h - v_s^h)$ | $(1 - \alpha)(v_s^l - v_b^l)$ |

Table 1: Welfare Comparison between Two Types of Bargaining with Non-Convergent Priors

## V.     Post-Closing Incentive Problems Engendered by Earnouts

We have thus far not distinguished between an earnout and a purchase price adjustment. While both of the mechanisms rely on new, post-closing (or at-closing) information that informs true valuation of the seller's assets, they operate quite differently in reality. One particular difference that we want to focus on is the fact that with an earnout, there is much longer time

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[23] When the agents have heterogeneous and non-convergent beliefs, making welfare comparisons becomes a challenge. The table presents the results from the ex ante perspective, before the state of the world has been chosen by Nature and when none of the parties are assumed to have formed any beliefs. We can also apply the belief-neutral criterion developed by Brunnermeir, Simsek, and Xiong (2014). Briefly, the criterion examines whether certain allocation is more efficient than the other under all possible convex combinations of the agents' beliefs. Under that criterion, the PCP is belief-neutral efficient when $v_s^l \leq v_b^l < v_s^h$ since, under either party's belief, there is a positive surplus from the transaction and the PCP allows the parties to realize that surplus whereas a single payment mechanism does not. However, when $v_b^l < v_s^l$, neither mechanism dominates the other because the transactional surplus is positive under the seller's belief ($v_b^h \geq v_s^h$) but negative under the buyer's belief ($v_b^l < v_s^l$).

delay in payment (generally ranging from 1 to 5 years after closing) and, in the meantime, either the seller or the buyer usually stays in charge of (or at least get significantly involved with) the management of the company. With a purchase price adjustment, in contrast, the adjustments are done at, or shortly after, closing, and the buyer takes over the seller's assets.[24] The fact that one of the parties stays in charge of the assets can create a strong incentive for that party to either boost or lower the earnings to maximize or minimize the earnout payment. If the seller were in charge, for instance, she can become more aggressive in maximizing the earnings figures that the earnout is based on, e.g., through deferring expenses, more aggressively pricing the product, etc., that would increase the earnout payment without any concurrent benefit for the fundamental valuation of the company. The opposite will be true if the buyer were in charge of the operation. This type of moral hazard behavior will, in turn, affect the optimal earnout arrangement.[25]

To more succinctly reflect this moral hazard concern and to examine how that interacts with the value of deal facilitation, let's assume that, with an earnout arrangement, the seller can undertake unobservable actions ("effort") that increases the probability of receiving high earnout payment. This may be because either the seller is in charge of the assets and operation or, even though the buyer is in control of the assets, the seller remains as a key employee after closing, giving her substantial control over the assets.[26] More specifically, suppose $(\rho(e), \sigma(e))$ depends on the seller's unobservable effort $e \in [0, \infty)$ such that $\rho(0) \in (1/2, 1]$, $\rho'(e) > 0$, $\rho'(0) \gg 0$, $\rho''(e) < 0$, and $\lim_{e \to \infty} \rho(e) = 1$. Similarly, suppose that $\sigma(0) \in [0, 1/2)$, $\sigma'(e) > 0$, $\sigma'(0) \gg 0$, $\sigma''(e) < 0$, and $\lim_{e \to \infty} \sigma(e) = 1/2$. For tractability, we'll assume that $\rho'(e) = \sigma'(e) \,\forall e$, implying that the effort has the same return on skewing the signal regardless of the state of the world. Finally, the choice of $e \in [0, \infty)$ imposes cost of $e$ on the seller and also reduces the value of the assets by $\eta e$ where $\eta \geq 0$. In other words, when the seller chooses $e$, the respective party's valuation over the seller's assets becomes $v_i^\theta - \eta e$, while imposing a personal cost on the seller of $e$. We can motivate the assumption on $\eta e$ by thinking of possible earnings management by the seller, where the seller would "borrow" against the future earnings to increase the present earnings. Also, the personal cost of $e$ can include not just the cost of earnings management but

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[24] Earnouts also deal more with post-closing operation and management of the target's assets while purchase price adjustments concern pre-closing (but post-signing) operation and management.

[25] The differing incentives between the buyer and the seller stem, in large part, from the fact that the seller will have a (much) shorter time horizon than the buyer once the deal closes. This is what Gilson calls "the failure of the common-time-horizon assumption." See Gilson (1984) at 265—267. See also Kling and Nugent (2013) at 17.25.

[26] We are focusing on seller moral hazard problem for the sake of simplicity. The latter scenario where the seller remains an employee of the buyer raises a classic principal-agent problem. If the buyer takes complete control over the assets (or the buyer has substantial discretion over determining the accounting measures that trigger earnout payments), this will create an opposite incentive problem: the buyer may want to undertake actions so as to lower (or minimize) the earnout payment to the seller. The inefficiencies generated by the buyer moral hazard are comparable and the rest of the analysis. If the size of the inefficiency from buyer or seller moral hazard issues is different, presumably, holding everything else constant, the parties will leave the assets in charge of the entity with whom the deadweight loss is smaller. The issue of who gets to control the operations post-closing, particularly in light of the fact that an earnout agreement would be incomplete, is similar to the question of asset ownership in the presence of contractual incompleteness. See Grossman and Hart (1986). Finally, the problem we are analyzing here is opposite of the more "conventional" moral hazard problem, in which a principal uses an incentive scheme to encourage an agent to exert costly, but beneficial, effort. We can impose such an incentive issue on top of our model. One way to do that would be to adopt a multi-task model, in which the party in charge of the operation can either take actions to affect the earnout payment or to improve the fundamental value of the assets. See Holmstrom and Milgrom (1991). See also Bolton and Dewatripont (2004) at 216—228.

also the potential liability that the seller may face in case her earnings manipulation gets discovered. We assume that while the seller's post-closing behavior ($e$) is unobservable, all the parameters are common knowledge.

**Lemma 4** *With cash-based PCP of $p_2(\beta) = (p_2(h), p_2(l))$, the seller will choose $e > 0$ whenever $\Delta p = p_2(h) - p_2(l) > \frac{1}{\rho'(0)}$ or $\Delta p > \frac{1}{\sigma'(0)}$, respectively. With stock-based PCP of $q_2(\beta) = (q_2(h), q_2(l))$, the seller will choose $e > 0$ whenever $\Delta q = q_2(h) - q_2(l) > \frac{\eta q_2(l)+1}{\rho'(0)(x+v_b^h)-\eta\rho(0)}$ or $\Delta q > \frac{\eta q_2(l)+1}{\sigma'(0)(x+v_b^l)-\eta\sigma(0)}$, respectively. With cash-based PCP, the size of signal manipulation ( $e$ ) is independent of $\eta$, but with stock-based PCP, $e$ decreases as $\eta$ increases. As $\Delta p$ or $\Delta q$ gets larger, both $e$ and the seller's profit increase.*

**Proof of Lemma 4.** Suppose the parties use cash as consideration in PCP. With $p_2(\beta) = (p_2(h), p_2(l))$, the respective seller type will choose $e$ to maximize:

$$\rho(e)p_2(h) + \left(1 - \rho(e)\right)p_2(l) - e$$
$$\sigma(e)p_2(h) + \left(1 - \sigma(e)\right)p_2(l) - e$$

When we differentiate the expressions, we get $\Delta p \rho'(e) - 1$ and $\Delta p \sigma'(e) - 1$. Hence, when $\Delta p > \frac{1}{\rho'(0)}$ and $\Delta p > \frac{1}{\sigma'(0)}$, the seller will choose $e > 0$. Assuming that these conditions are satisfied, the first order conditions are:

$$\Delta p \rho'(e) = 1$$
$$\Delta p \sigma'(e) = 1$$

Note that the first order conditions are independent of $\eta$. Note also that when $\Delta p = 0$, increasing $e$ will only reduce the seller's expected profit and, hence, $e = 0$. With the assumptions on $\rho(e)$ and $\sigma(e)$, the first order condition produces an implicit function of $e^\theta(\Delta p) = \rho'^{-1}(\frac{1}{\Delta p})$ and $e^\theta(\Delta p) = \sigma'^{-1}(\frac{1}{\Delta p})$ where $\frac{\partial e^\theta(\Delta p)}{\partial \Delta p} > 0$. With the assumption of $\rho'(e) = \sigma'(e)$ $\forall e$, we also get $e^h(\Delta p) = e^l(\Delta p) \equiv e(\Delta p)$. In equilibrium, the respective types earn

$$p_2(l) + \rho(e(\Delta p))\Delta p - e(\Delta p)$$
$$p_2(l) + \sigma(e(\Delta p))\Delta p - e(\Delta p)$$

When we differentiate with respect to $\Delta p$, with the envelope theorem, we get $\rho(e(\Delta p)) > 0$ and $\sigma(e(\Delta p)) > 0$ respectively.

When the parties use stock as consideration in designing the PCP, the respective seller type will choose $e$ to maximize:

$$\rho(e)q_2(h)(x + v_b^h - \eta e) + \left(1 - \rho(e)\right)q_2(l)(x + v_b^h - \eta e) - e$$
$$\sigma(e)q_2(h)(x + v_b^l - \eta e) + \left(1 - \sigma(e)\right)q_2(l)(x + v_b^l - \eta e) - e$$

When we differentiate both with respect to $e$, we get:

$$\rho'(e)\big(x + v_b^h - \eta e\big)\Delta q - \eta(q_2(l) + \rho(e)\Delta q) - 1$$
$$\sigma'(e)\big(x + v_b^l - \eta e\big)\Delta q - \eta(q_2(l) + \sigma(e)\Delta q) - 1$$

When $\Delta q \geq \frac{\eta q_2(l)+1}{\rho'(0)(x+v_b^h)-\eta\rho(0)}$ and $\Delta q \geq \frac{\eta q_2(l)+1}{\sigma'(0)(x+v_b^l)-\eta\sigma(0)}$, respectively, therefore, the seller will choose $e > 0$. Assuming that this is satisfied, the respective first order conditions are:

$$\rho'(e^h)(x + v_b^h - \eta e^h)\Delta q = \eta(q_2(l) + \rho(e^h)\Delta q) + 1$$
$$\sigma'(e^l)(x + v_b^l - \eta e^l)\Delta q = \eta(q_2(l) + \sigma(e^l)\Delta q) + 1$$

Note that, unlike using cash as consideration, the first order conditions contain $\eta$ terms. This is because when the seller receives the buyer's stock, she partially internalizes the reduction in the value of the assets. Also, because of the value of the stock consideration depends on the value of the assets, the amount of earnings manipulation also depends on the seller type: $e^\theta$. When $\eta = 0$, for instance, since $x + v_b^h > x + v_b^l$, the high-type seller will engage in more aggressive earnings management than the low-type seller: $e^h > e^l$. When $\eta \gg 0$, on the other hand, since $\eta(q_2(l) + \rho(e)\Delta q) > \eta(q_2(l) + \sigma(e)\Delta q)$, the low-type seller can engage in more aggressive earnings management: $e^l > e^h$. Finally, with respect to both types, as $\eta$ increases, the right hand side increases but the left hand side falls, requiring the seller to decrease $e$ (and correspondingly increase $\rho'(e^h)$ or $\sigma'(e^l)$) to restore equality. The rest of the proof is analogous. *QED*

When earnouts create incentives for the seller to boost the chances of receiving a high post-closing payment through earnings management, they become less attractive for the parties in solving the problems of asymmetric information or bridging the differences in beliefs. Earnouts become less useful because they entail a deadweight loss due to the effort cost ($e$) and reduction in valuation due to earnings diversion ($\eta e$), both of which lead to a decrease in transactional surplus. The transacting parties, therefore, will try to use earnouts more selectively. In the private information setting, in particular, the seller will attempt to keep the incentive part of the earnout ($\Delta p$ or $\Delta q$) as small as possible or not use it if possible. As the following proposition demonstrates, the welfare maximizing equilibrium is a separating equilibrium in which only the high-type seller uses an earnout.[27] Similarly, in the non-convergent priors setting, the seller will choose the minimum $\Delta p$ or $\Delta q$ necessary to induce the more pessimistic buyer to agree to a deal. Before we proceed to the results, although Lemma 4 shows that when the slope of the PCP structure is sufficiently small, e.g., $p_2(h) - p_2(l) < \frac{1}{\rho'(0)}$ with cash-based PCP for the high-type seller, the seller will not engage in earnings manipulation, for the sake of interest, we'll assume that $\Delta p$ and $\Delta q$ are large enough so that this is not the case.

**Proposition 3** *Suppose, with a PCP, the seller can exert effort (engage in earnings manipulation) to increase the probability of receiving the high post-closing payment ($p_2(h)$ or $q_2(h)$).*

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[27] With the deadweight loss from post-closing moral hazard, earnouts function more like the conventional costly signal, as in Spence's job-market signal with costly education. Because signal is costly, separating equilibrium becomes more likely. See Spence (1973).

1. *Suppose we are in the private information (PI) setting. With cash-based PCP, in a welfare-maximizing separating equilibrium, the high-type seller offers $p_2^{PI}(\beta) = (p_2^{PI}(h), p_2^{PI}(l))$ while the low-type seller offers $p_1^l = v_b^l$. Similarly, with stock-based PCP, the high-type seller offers $q_2^{PI}(\beta) = (q_2^{PI}(h), q_2^{PI}(l))$ while the low-type seller offers $q_1^l = \omega^l$.*

2. *Suppose we are in the non-convergent priors (NP) setting with $(\theta_b, \theta_s) = (l, h)$. The seller offers $p_2^{NP}(\beta) = (p_2^{NP}(h), p_2^{NP}(l))$ or $q_2^{NP}(\beta) = (q_2^{NP}(h), q_2^{NP}(l))$ in equilibrium.*

*In both information settings, the seller prefers using stock-based PCP to cash-based PCP.*

**Proof of Proposition 3.** Suppose we are in the private information model. From Lemma 4, when the seller is using cash-based PCP, whenever $\Delta p = p_2(h) - p_2(l) > \frac{1}{\rho'(0)}$ or $\Delta p > \frac{1}{\rho'(0)}$, the respective seller-type will choose $e > 0$. Suppose, as in Proposition 2, we start with

$$v_b^h - \eta e = p_2(l) + \rho(e(\Delta p)) \cdot \Delta p$$
$$v_b^l - \eta e = p_2(l) + \sigma(e(\Delta p)) \cdot \Delta p$$

The high-type seller earns $v_b^h - e(\Delta p)$ and the low-type seller earns $v_b^l - e(\Delta p)$. We know that such a solution exists because when we subtract the second equation from the first, we need

$$v_b^h - v_b^l = \{\rho(e(\Delta p)) - \sigma(e(\Delta p))\} \cdot \Delta p$$

Since the right hand side is equal to zero when $\Delta p = 0$ and is strictly increasing with respect to $\Delta p$, we can find $\Delta p$ to satisfy the equality and then $p_2(l)$ can be adjusted accordingly. This is not an equilibrium since the low-type seller will be strictly better off by offering $p_1^l = v_b^l$. In response, the high-type seller can decrease $\Delta p$ and increase $p_2(l)$ so as to maintain $v_b^h = p_2(l) + \rho(e(\Delta p)) \cdot \Delta p$. With the equality, respective seller-type's profit, if both types were to offer $p_2(\beta) = (p_2(h), p_2(l))$, becomes

$$v_b^h - \eta e - e(\Delta p)$$
$$v_b^h - \eta e - \{\rho(e(\Delta p)) - \sigma(e(\Delta p))\} \cdot \Delta p - e(\Delta p)$$

When we differentiate with respect to $\Delta p$, we get

$$-\eta - e'(\Delta p) < 0$$
$$-\eta - \rho'(e(\Delta p)) \cdot e'(\Delta p) \cdot \Delta p - \{\rho(e(\Delta p)) - \sigma(e(\Delta p))\} < 0$$

Hence, the optimal strategy for the high-type seller is to reduce $\Delta p$ as much as it can until we get

$$v_b^h - \eta e(\Delta p) = p_2(l) + \rho(e(\Delta p)) \cdot \Delta p$$
$$v_b^l - \varepsilon = p_2(l) + \sigma(e(\Delta p)) \cdot \Delta p - e(\Delta p)$$

where $\varepsilon$ is arbitrarily small and positive. Finally, we need $v_b^h - v_s^h \geq e(\Delta p)$ to make sure that the high-type seller's participation constraint is satisfied. In equilibrium, therefore, the low-type seller will offer $p_1^l = v_b^l$ while the high-type seller will offer $p_2^{PI}(\beta) = (p_2^{PI}(h), p_2^{PI}(l))$ that satisfies both equalities (or the first equality and the second equality with an arbitrarily small slack). When we solve for $p_2^{PI}(\beta) = (p_2^{PI}(h), p_2^{PI}(l))$, we get

$$p_2^{PI}(h) = \frac{(1 - \hat{\sigma})v_b^h - (1 - \hat{\rho})v_b^l}{\hat{\rho} - \hat{\sigma}} - \frac{(1 - \hat{\rho}) + \eta(1 - \hat{\sigma})}{\hat{\rho} - \hat{\sigma}}e(\Delta p)$$

$$p_2^{PI}(l) = \frac{\hat{\rho}v_b^l - \hat{\sigma}v_b^h}{\hat{\rho} - \hat{\sigma}} + \frac{\hat{\rho} + \hat{\sigma}\eta}{\hat{\rho} - \hat{\sigma}}e(\Delta p)$$

where $\hat{\sigma} \equiv \sigma(e(\Delta p))$ and $\hat{\rho} \equiv \rho(e(\Delta p))$ to simplify the notation. Note that when $e(\Delta p) = 0$, the PCP schedule is the same as that from Proposition 1. When the seller is using stock-based PCP, the respective conditions are

$$v_b^h - \eta e^h(\Delta q) = q_2(l)(x + v_b^h - \eta e^h(\Delta q)) + \rho(e^h(\Delta q))\Delta q(x + v_b^h - \eta e^h(\Delta q))$$
$$v_b^l - \varepsilon = q_2(l)(x + v_b^l - \eta e^l(\Delta q)) + \sigma(e^l(\Delta q))\Delta q(x + v_b^l - \eta e^l(\Delta q)) - e^l(\Delta q)$$

where $e^h(\Delta q)$ and $e^l(\Delta q)$ are implicitly defined from:

$$\rho'(e^h(\Delta q))(x + v_b^h - \eta e^h(\Delta q))\Delta q = \eta(q_2(l) + \rho(e^h(\Delta q))\Delta q) + 1$$
$$\sigma'(e^l(\Delta q))(x + v_b^l - \eta e^l(\Delta q))\Delta q = \eta(q_2(l) + \sigma(e^l(\Delta q))\Delta q) + 1$$

When we solve for $q_2^{PI}(\beta) = (q_2^{PI}(h), q_2^{PI}(l))$, we get

$$q_2^{PI}(h) = \frac{(1 - \sigma^l)\hat{\omega}^h - (1 - \rho^h)\hat{\omega}^l}{\rho^h - \sigma^l} - \frac{1 - \rho^h}{\rho^h - \sigma^l} \cdot \frac{(1 + \eta)}{x + v_b^l - \eta e^l(\Delta q)}e^l(\Delta q)$$

$$q_2^{PI}(l) = \frac{\rho^h\hat{\omega}^l - \sigma^l\hat{\omega}^h}{\rho^h - \sigma^l} + \frac{\rho^h}{\rho^h - \sigma^l} \cdot \frac{(1 + \eta)}{x + v_b^l - \eta e^l(\Delta q)}e^l(\Delta q)$$

where $\sigma^l \equiv \sigma(e^l(\Delta q))$, $\rho^h \equiv \rho(e^h(\Delta q))$, $\hat{\omega}^h \equiv \frac{v_b^h - \eta e^h(\Delta q)}{x + v_b^h - \eta e^h(\Delta q)}$ and $\hat{\omega}^l \equiv \frac{v_b^l - \eta e^l(\Delta q)}{x + v_b^l - \eta e^l(\Delta q)}$ to simplify the notation. As in the case with cash-based PCP, as $(e^h(\Delta q), e^l(\Delta q)) \to (0,0)$, the second expressions disappear and the first expressions converge to those from Proposition 1.

Note that with either type of consideration, the low-type seller receives $v_b^l$. The high-type seller receives (in expectation) $v_b^h - (1 + \eta)e(\Delta p)$ with cash-based PCP or $v_b^h - (1 + \eta)e^h(\Delta q)$ with stock-based PCP. To show that the high-type seller prefers using stock-based PCP, therefore, we need to show that $e^h(\Delta q) < e(\Delta p)$. The respective first order conditions are:

$$\rho'(e(\Delta p)) = \frac{1}{\Delta p}$$

$$\rho'(e^h(\Delta q)) = \frac{\eta(q_2(l) + \rho(e^h(\Delta q))\Delta q) + 1}{(x + v_b^h - \eta e^h(\Delta q))\Delta q}$$

From the equilibrium conditions, we get:

$$\Delta p = \frac{v_b^h - v_b^l - (1+\eta)e(\Delta p)}{\rho\big(e(\Delta p)\big) - \sigma\big(e(\Delta p)\big)}$$

$$\left(x + v_b^h - \eta e^h(\Delta q)\right)\Delta q = \frac{v_b^h - v_b^l\mu - (\mu+\eta)e^h(\Delta q)}{\rho(e^h(\Delta q)) - \sigma(e^l(\Delta q))}$$

where $\mu \equiv \frac{x+v_b^h-\eta e^h(\Delta q)}{x+v_b^l-\eta e^l(\Delta q)}$. Suppose $e^h(\Delta q) \approx e^l(\Delta q)$ and we have $e(\Delta p) = e^h(\Delta q) = \hat{e}$ and $\rho'(\hat{e}) = \frac{1}{\Delta p}$. Since $\eta(q_2(l) + \rho(\hat{e})\Delta q) > 0$ and $v_b^h - v_b^l\mu - (\mu+\eta)\hat{e} < v_b^h - v_b^l - (1+\eta)\hat{e}$, we get $\frac{\eta(q_2(l)+\rho(\hat{e})\Delta q)+1}{(x+v_b^h-\eta\hat{e})\Delta q} > \frac{1}{\Delta p}$. Hence, to restore the equality, we must have $e^h(\Delta q) < e(\Delta p)$, and the high-type seller earns a higher return with stock-based PCP than with cash-based PCP.

Now suppose we're in the non-convergent priors model with $(\theta_b, \theta_s) = (l, h)$. The main difference is that rather than satisfying $v_b^l \geq p_2(l) + \sigma(e(\Delta p)) \cdot \Delta p - e(\Delta p)$ or $v_b^l \geq q_2(l)\left(x + v_b^l - \eta e^l(\Delta q)\right) + \sigma\big(e^l(\Delta q)\big)\Delta q\left(x + v_b^l - \eta e^l(\Delta q)\right) - e^l(\Delta q)$, we now need to satisfy $v_b^l - \eta e(\Delta p) \geq p_2(l) + \sigma(e(\Delta p)) \cdot \Delta p$ or $v_b^l - \eta e^l(\Delta q) \geq q_2(l)\left(x + v_b^l - \eta e^l(\Delta q)\right) + \sigma\big(e^l(\Delta q)\big)\Delta q\left(x + v_b^l - \eta e^l(\Delta q)\right)$, respectively, so that the buyer, with belief $\theta_b = l$, is willing to purchase the assets. With cash PCP, the respective conditions are:

$$v_b^h - \eta e(\Delta p) = p_2(l) + \rho(e(\Delta p)) \cdot \Delta p$$
$$v_b^l - \eta e(\Delta p) = p_2(l) + \sigma(e(\Delta p)) \cdot \Delta p$$

For stock PCP, the conditions are:

$$v_b^h - \eta e^h(\Delta q) = q_2(l)(x + v_b^h - \eta e^h(\Delta q)) + \rho(e^h(\Delta q))\Delta q(x + v_b^h - \eta e^h(\Delta q))$$
$$v_b^l - \eta e^l(\Delta q) = q_2(l)(x + v_b^l - \eta e^l(\Delta q)) + \sigma(e^l(\Delta q))\Delta q(x + v_b^l - \eta e^l(\Delta q))$$

When we solve for equilibrium $\Delta p$ and $\Delta q(x + v_b^h - \eta e^h(\Delta q))$, we get

$$\Delta p = \frac{v_b^h - v_b^l}{\rho(e(\Delta p)) - \sigma(e(\Delta p))}$$

$$\Delta q(x + v_b^h - \eta e^h(\Delta q)) = \frac{v_b^h - \eta e^h(\Delta q) - \mu(v_b^l - \eta e^l(\Delta q))}{\rho\big(e^h(\Delta q)\big) - \sigma\big(e^l(\Delta q)\big)}$$

As in the case with private information, we get $v_b^h - (1+\eta)e^h(\Delta q) > v_b^h - (1+\eta)e(\Delta p)$. Hence, the seller prefers to use stock-based PCP. *QED*

Proposition 3 demonstrates that, when post-closing signal (earnings) manipulation is a serious concern, the parties become more selective in using earnouts. In the private information

setting, for instance, a separating equilibrium, in which only the high-valuation transactions use earnouts, will result rather than a pooling equilibrium, in which all types use earnouts. Furthermore, due to the concern over post-closing signal manipulation, the slope of the incentive pay ($\Delta p$ or $\Delta q$) will be smaller than before. From the Proposition, with cash-based PCP, for instance, we get $\Delta p^{PI} = \frac{v_b^h - v_b^l - (1+\eta)e(\Delta p)}{\rho(e(\Delta p)) - \sigma(e(\Delta p))} < \frac{v_b^h - v_b^l}{\rho - \sigma}$. At the same time, given a choice, the seller will prefer using stock-based PCP to cash-based PCP. The reason stems from two factors. First, because the seller's compensation is a fraction of the combined company, the seller partially internalizes the deadweight loss from reducing the future value of the combined company ($\eta e$). Second, even when earnings manipulation does not reduce firm value ($\eta = 0$), because stock-based consideration partially correlates with firm value, lower reliance on PCP (flatter slope) also reduces the incentive to manipulate the signal. Both of these effects reduce the deadweight loss and generate a larger return for the seller.

**Corollary 5** *When the deadweight loss from using a PCP ($(1 + \eta)e(\Delta p)$ and $(1 + \eta)e^h(\Delta q)$) is sufficiently large, the high-type seller in the private information (PI) setting and the seller in non-convergent priors (NP) setting with $(\theta_b, \theta_s) = (l, h)$ and $v_b^l \geq v_s^h$ become less likely to use a PCP. In the private information setting, when using the buyer's stock as consideration is possible, the high-type seller is less likely to use a PCP as $x \to 0$. In the non-convergent priors setting with $(\theta_b, \theta_s) = (l, h)$ and $v_b^l < v_s^h$, the seller will still use a PCP.*

**Proof of Corollary 5.** From Proposition 3, the high-type seller earns, in equilibrium, $v_b^h - (1 + \eta)e(\Delta p)$ with cash-based PCP and $v_b^h - (1 + \eta)e^h(\Delta q)$ with stock-based PCP. If the high-type seller were to rely only on a single-payment mechanism (with either cash or stock), from Lemmas 1 and 2, the high-type seller's equilibrium revenue, with respect to each consideration, is

$$\gamma^h \cdot v_b^h + (1 - \gamma^h) \cdot v_s^h = \left(\frac{v_b^l - v_s^l}{v_b^h - v_s^l}\right) \cdot v_b^h + \left(\frac{v_b^h - v_b^l}{v_b^h - v_s^l}\right) \cdot v_s^h$$

$$\delta^h \cdot \omega^h(x + v_b^h) + (1 - \delta^h) \cdot v_s^h = \left(\frac{v_b^l - v_s^l}{\lambda v_b^h - v_s^l}\right) \cdot v_b^h + \left(\frac{\lambda v_b^h - v_b^l}{\lambda v_b^h - v_s^l}\right) \cdot v_s^h$$

where $\lambda \equiv \frac{x + v_b^l}{x + v_b^h}$. For instance, if $v_b^h - v_s^h < (1 + \eta)e(\Delta p)$, the high-type seller strictly prefers using a single-payment mechanism. Recall from Lemma 2 that as $x \to 0$, $\delta^h \to 1$, thereby making a PCP mechanism less attractive when the buyer's stock could be used as consideration.

Now, suppose we are in a non-convergent priors setting with $(\theta_b, \theta_s) = (l, h)$. When $v_b^l \geq v_s^h$, the seller could, instead, have offered and earned $v_b^l$. When $(1 + \eta)e(\Delta p) > v_b^h - v_b^l$ for cash consideration or $(1 + \eta)e^h(\Delta q) > v_b^h - v_b^l$ for stock consideration, the seller will not use a PCP and, instead, make a single payment offer. On the other hand, when $v_b^l < v_s^h$, the seller still will rely on a PCP. *QED*

Corollary 5 shows that when the deadweight loss from using an earnout is sufficiently large, neither types of seller will use an earnout. In the private information setting, the seller

earns $v_b^h - (1 + \eta)e(\Delta p)$ with cash-based PCP and $v_b^h - (1 + \eta)e^h(\Delta q)$ with stock-based PCP. Compared to the case where an earnout is not subject to post-closing manipulation, the seller's revenue is lower by the size of the deadweight loss, $(1 + \eta)e(\Delta p)$ and $(1 + \eta)e^h(\Delta q)$. In the private information (PI) setting, if the high-type seller decides to signal its valuation only through a single payment, the high-type seller's expected return is $\gamma^h \cdot v_b^h + (1 - \gamma^h) \cdot v_s^h$ with cash and $\delta^h \cdot \omega^h(x + v_b^h) + (1 - \delta^h) \cdot v_s^h$ with stock. When $(1 + \eta)e(\Delta p)$ or $(1 + \eta)e^h(\Delta q)$ are sufficiently large, the high-type seller is better off with not using a PCP. Especially with stock consideration, as we saw in Lemma 2, as $x \to 0$, $\delta^h \to 1$, making PCP less attractive. In the non-convergent priors (NP) setting, on the other hand, when $(\theta_b, \theta_s) = (l, h)$ and $v_b^l < v_s^h$, since single-payment mechanism is not feasible, the seller still has to resort to using a PCP. This implies that the PCP mechanism will be more prevalent when the difficulty is more over reconciling the divergent opinions of the transacting parties and when the buyer has sufficiently large assets.

## VI.    Reconciling with Empirical Findings and Implications

The two models presented in the previous sections are fairly straightforward, but they render several implications that are relevant, in particular, for empirical studies. The implications can be organized into four groups. First group consists of the implications associated with equilibrium selection; the second from distinguishing between informational issues between the parties from reliability and accuracy of earnings measurements; the third stems from the express account of post-closing moral hazard and the risk of agreeing "too easily" to execute the deal; and the fourth relates to the choice between cash and stock in designing a PCP. Briefly, with respect to the first, even when transacting parties are certain that there is a positive surplus from the deal, it is uncertain whether adoption of a PCP necessarily signals higher valuation or a larger surplus. The presence and likelihood of pooling equilibria in asymmetric information setting and non-convergent priors can support why the fair value estimates of earnouts can decrease post-closing.[28] Second, the size and incidence of PCPs should depend not only on the presence of asymmetric information (e.g., in case of cross-industry acquisitions) but also on the reliability of post-closing earnings estimates (which depend on the characteristics of the target). Third, taking more express account of post-closing moral hazard and the risk of entering into surplus-reducing deals can allow us to better explain the relatively low incidence of PCPs. Fourth, existing empirical studies have not paid much attention to using either the buyer's stock or cash in designing a PCP and this choice could tell us much about the challenges that the transacting parties face.

First, the fact that there are different possible equilibria is consistent with two strands of literature that are pointing in somewhat different directions. One group of studies show that use of earnouts is correlated with higher acquisition premium (Kohers and Ang (2000)) and higher uncertainty over valuation (Datar, Frankel, and Wolfson (2001), Ragozzino and Reuer (2009), and Cain, Denis, and Denis (2011)). To the extent that there is a separating equilibrium, in which the deals with higher valuations (high types) use earnouts while those with lower

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[28] When there are more than two types, in addition to complete pooling, there will be a partial pooling equilibrium in which the higher types use PCPs while the low type does not. A separating equilibrium in which only the highest type uses a PCP will not be feasible since that provides an incentive to the low type seller to mimic the medium type. This will also be true when the transactional surplus is negative for lower types.

valuations (low types) do not, adoption of an earnout can be associated with a larger acquisition premium. Similarly, as shown in Corollary 3, when the parties are uncertain as to whether a surplus exists (which also correlates with higher uncertainty over valuation), adoption of a PCP is much more revealing about underlying valuation. Both results are consistent with the first group of empirical findings.

At the same time, another line of empirical studies shows that post-closing fair valuations of earnouts can (and often do) decrease (Quinn (2013) and Cadman, Carrizosa, and Faurel (2014)).[29] This finding is a little troubling since in the private information (PI) setting, for instance, if earnouts lead to a complete separation of types and complete revelation of private information, the post-closing drift of earnout valuation should be (close to) zero on average. The finding can be explained through the presence of a pooling equilibrium and also the possibility of non-convergent beliefs (NP). The models show that, in the presence of asymmetric information, if both high-type and low-type sellers use an earnout in a pooling equilibrium, depending on the type, the post-closing (estimated) valuation of earnouts can either increase or decrease. Similarly, to the extent that earnouts bridge non-convergent priors, the post-closing valuation convergence can also be either upward or downward. In fact, under both information settings, the post-closing change in mean fair valuation of earnouts can actually be negative when the frequency of low-type seller (or the likelihood that the buyer is more accurate about valuation) is sufficiently high (for instance, when $\alpha < 1/2$ with the two types). Although the post-closing, negative mean drift is possible in both information settings, one possible way to distinguish between the two settings is by looking at whether the joint surplus increases or decreases post-closing. Unlike the asymmetric information setting, in the non-convergent priors setting, it is possible for the increase in surplus to be negative. Hence, if the value of the combined firm decreases post-closing in tandem with the decrease in the fair value of the earnouts, this is more indicative of being in the non-convergent priors environment than in the asymmetric information environment.

Second, the existing literature does not seem to distinguish between uncertainty over valuation versus the accuracy of earnings or other accounting measurements. When transacting parties do not agree on fundamental valuation, the lack of accuracy in accounting measurements can impose another layer of challenge in successfully completing a deal. Thus, the presence and the size of a PCP can stem from two different sources: the presence of informational challenges and the reliability or accuracy of accounting measurements. The models show (Corollaries 1 and 2) that the incidence and the sensitivity of earnouts (the size of $\Delta p$) will be positively correlated with the variance over valuation but negatively correlated with the accuracy of the accounting (or other financial) measures. The results imply that both types of uncertainty can be important and that it may be useful to distinguish between the two. For instance, after controlling for valuation uncertainty, if a certain target is subject to a larger accounting uncertainty (due, for instance, to more intangible or discretionary items), PCPs should have a larger incentive component. For instance, as shown in Datar, Frankel, and Wolfson (2001) and Cadman, Carrizosa, and Faurel (2014), an acquisition across different industries can indicate informational challenges and lead to higher frequency and larger earnouts. At the same time, the size of earnouts will also depend on the characteristics of the target industry, i.e., whether more reliable earnings estimate can be

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[29] Quinn (2013), for instance, documents that the mean fair value of earnouts is about 70.1% of the nominal earnout available at the time of closing, but the mean value decreases to about 67.8% by the end of the first year and to about 53% by the end of the second year.

derived from accounting statements. As shown in Corollary 2, particularly when the size of the payments is subject to upper or lower bounds, the accuracy of measuring earnings becomes an important driver not only over whether to use a PCP.

Third, the existing academic studies have largely touted the virtues of using earnouts in managing the problems of adverse selection. On the other hand, practitioners, particularly the transactional lawyers, have sounded much more cautionary note in using earnouts, citing difficulties of implementation, potential disputes, and creation of perverse incentives. After all, if earnouts (or other PCPs) are so effective at dealing with the informational problems, why do we not observe a (much) higher incidence of them in mergers and acquisitions transactions? To better reflect this reality, this paper has attempted to address the downside of using PCPs in two ways: first by expressly incorporating the post-closing moral hazard problem created by earnouts and second by allowing for the possibility of executing a surplus-reducing deal (as seen from the ex ante perspective) in non-convergent priors setting.

As Proposition 2 and Corollary 4 show, when transacting parties' priors do not converge, using a PCP to complete a deal can lead to a deadweight loss. To the extent that the parties are aware of such possibility (from the ex ante perspective), they will be much more cautious in adopting a PCP. Also, as shown in Proposition 3, when the potential deadweight loss from post-closing moral hazard is taken into account, not all transactions will use an earnout. Transactions with relatively small surplus, in particular, will shy away from using an earnout, opting for a more straight consideration, instead. As shown in Corollary 5, with post-closing moral hazard, neither type will use an earnout when buyer's valuations show less variance or as the valuation gap between the buyer and the seller narrows. This is roughly consistent with the empirical findings that show positive correlation between proxies for higher variation in valuations with the incidence of earnouts (Datar, Frankel, and Wolfson (2001), Ragozzino and Reuer (2009), and Cain, Denis, and Denis (2011)).

Fourth, the existing empirical studies have not paid much attention to the choice between using stock versus cash in designing a PCP mechanism, in particular, earnouts. Use of stock consideration is quite prevalent. Cain, Denis, and Denis (2011), for instance, shows that about 50% of the earnouts in their sample use the buyer's stock as consideration but does not distinguish between stock-based and cash-based earnouts when testing the incidence and magnitude of earnouts. The benefits of using a stock-based earnout is two-fold. First, because the value of the stock is correlated with the seller's type, as shown in Proposition 1, stock-based earnout can be smaller, in terms of fair value estimates, for instance, compared to cash-based earnouts. Second, because stock makes the parties to partially internalize the deadweight loss that stems from post-closing earnings management (signal manipulation), as shown in Proposition 3, stock-based earnout can be more successful in mitigating the post-closing moral hazard concerns. Conditional on deal characteristics, therefore, we should observe smaller size and less post-closing variation (both in terms of valuation) associated with stock-based earnouts. At the same time, as shown in Lemma 2 and Corollary 5, these benefits are relatively small as the size of the buyer gets larger compared to the seller. Hence, stock-based earnouts will be more prevalent when the size of the buyer is smaller.

**Concluding Remarks**

While previous empirical studies have addressed the role of post-closing contingent payment (PCP) mechanisms in addressing issues of adverse selection and moral hazard in mergers and acquisitions context, the precise nature of how PCP mechanisms are successful in dealing with such issues has not been theoretically examined. This paper presents an attempt to fill that gap. The paper has shown that PCP mechanisms can be successful in dealing with problems of asymmetric information or non-convergent beliefs because they harness the post-closing, verifiable information on target company's valuation. At the same time, because incorporation of post-closing information is unlike conventional "costly signaling" story, when the parties are certain that a transactional surplus exists, both a pooling and a separating equilibrium may be possible. This could pose a challenge on empirically distinguishing the use and structure of earnouts based on transactional characteristics. The paper has also emphasized the "dark side" of earnouts by examining the negative incentive issues that are triggered through the use of earnouts and has shown when the deadweight loss from using earnouts could outstrip the potential benefits.

Several theoretical and empirical issues remain. First, in certain acquisition transactions, we observe both purchase price adjustments and earnouts. To the extent that both function to reduce the problems of uncertainty and private information, it remains to be seen how they work with (or possibly against) each other in a given transaction. Given that the existing academic studies focus almost exclusively on earnouts, incorporating purchase price adjustments as a part of the deal facilitation mechanism will be important. Purchase price adjustments and earnouts can function as complementary mechanisms. While purchase price adjustments could induce the seller to engage in more shorter term behavior, simultaneous use of an earnout can offset such a concern. For instance, while purchase price adjustment can induce the seller to artificially maximize the firm's net working capital, earnout can partially offset such a behavior by inducing the seller to spend more net working capital for longer term investments. Second, more careful attention to the other dimensions of the PCP arrangements could be useful. For instance, the issues over who gets to control the operation post-closing and how much power the other party gets to exercise (e.g., through open-ended contractual covenants) can be a serious negotiating concern. More theoretical and empirical studies on the allocation of control can shed better light on the problems of incomplete contracts and institutional design.

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