Differences of Opinion and Stock Prices: Evidence Based on Revealed Preferences*

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Abstract

I construct a novel measure of differences of opinion based on investor holdings data which isolates the type of disagreement that is theoretically predicted to affect prices when assets are bundled or unbundled. Empirically, using the setting of corporate spin-offs, I show that differences of opinion about the two entities being separated are, as predicted, related to a significantly more positive event return. Because I focus on ex date returns, these findings cannot be explained by risk, uncertainty or the expected business impacts of the transactions. Placebo tests provide further support that other factors are not driving the results. Additional tests using mergers and closed-end funds provide consistent results, and altogether these findings provide new insight into the attribution of value created when bundling or unbundling assets.

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When investors have differences of opinion and constraints on short sales prevent the views of relatively pessimistic investors from being incorporated in prices, stock prices, Miller (1977) posits, are determined by relative optimists. This theory implies that when bundles of assets are separated, their joint market value may increase as a result of investors being able to sort into the specific holdings about which they are most optimistic. In this paper, I use investor holdings data to construct a novel measure of the type of disagreement that is predicted to be most directly linked to price effects when a combination of assets is traded as a bundle or when such bundles are separated.

Empirically examining the relation between differences of opinion and stock prices involves two main challenges. First, differences of opinion are not readily observable. Second, stock prices are affected by many factors, such as risk and uncertainty, which may be correlated with differences of opinion or proxies for such differences. These confounding factors make it difficult to disentangle the price effects that can be attributed specifically to differences of opinion. This paper presents a new approach to confronting both of these challenges.

First, I construct a revealed preferences measure of the form of disagreement that is predicted to be directly related to price effects. For example, the shareholders of a conglomerate may disagree about the relative prospects of its component parts. A spin-off provides a shock to the investment choice set by separating a company into two independently-traded entities. The shareholders—who initially own the same proportion of each entity—can then sort into their preferred holdings by selling the component they are less optimistic about. This reshuffling of investors is the mechanism through which differences of opinion can result in a higher joint price after a spin-off. Thus, I exploit this observable rebalancing to construct a measure of the disagreement that is relevant for prices, using a theoretical analysis to motivate the details of its construction. This measure directly captures the revealed preferences of investors, rather than proxying for investor beliefs with more indirect variables. It also provides greater coverage than measures that rely on analyst forecasts or options markets. Moreover, as discussed further below, this approach and its theoretical underpinning provide insight into the specific factors required for differences of opinion to affect prices.

Second, the logistics of a spin-off process allow me, by focusing on ex date returns, to cleanly identify the stock price effect of disagreement. When considering longer-term returns or the cross-sectional variation in prices, tests of the effects of differences of opinion may also reflect omitted risk factors or fundamental uncertainty.[1] While spin-offs may have various business impacts, the value of any such anticipated effects should be incorporated in prices at some point from the announcement through the date at which the transaction becomes certain. There is no new information released on the ex date and it occurs after any uncertainty of transaction completion has been resolved. At the same time, the ex date is the first date on which the two components are traded as separate securities. As investors begin to rebalance into their preferred holdings, the first direct evidence of actual disagreement may be observed and, to the extent that the actual level of disagreement has not been fully anticipated, may impact prices. Thus, the timing of the ex date allows me to isolate a price impact of disagreement (in particular, the unexpected component of disagreement) that is unrelated to various potential confounding factors, providing important validation for the broader results of this paper.

I begin by motivating the exact measure used to measure the differences of opinion by formalizing Miller (1977)'s hypothesis in the context of spin-offs. This analysis and the resulting disagreement measure highlight the specific factors required for differences of opinion to affect bundle prices. For example, given second-order effects on the prices of other assets in the market, unbundling two assets in the presence of generalized differences of opinion does not uniformly lead to an increase in their joint market price. However, the model provides guidance on how a measure can be constructed to focus on the differences of opinion that have unambiguous impact. In addition, short sales constraints need not apply to all investors; the price impact relies only on at least one investor facing a binding constraint on at least one of the assets in the bundle, whether because they are unable or

[1] See, e.g., Johnson (2004) and Jones, Kaul and Lipson (1994) for related discussions.

unwilling to sell short. This result is critical to understanding why differences of opinion may have broad effects on prices even though studies have found that very few stocks appear to be subject to market-level short sales constraints (see, e.g., Asquith, Pathak and Ritter, 2005). Importantly, the theoretical exercise also demonstrates that only disagreement that leads investors to choose not to hold one of the securities is predicted to have a price impact; investors who simply change the proportion of their holdings would not impact prices.

The intuition behind the latter result is that if an investor continues to hold even a small stake in his less preferred component, his views are still incorporated in the price of that entity. Consider, on the other hand, an investor in the joint entity who sells all of her holdings of one component after the spin-off, and, based on her views, might actually choose to sell that component short. If she is unwilling or unable to short-sell, her views would not be incorporated in the market price of that entity. Because her relatively pessimistic views regarding her less preferred component were reflected in the price of the joint entity, but would no longer be incorporated in the price of that component after the separation, the observed total market price of the two components would be expected to increase.

In order to measure the type of disagreement predicted to be related to the stock price impact of a spin-off, I therefore construct a variable equal to the ratio of continuing investors who choose to hold only one component after the transaction. For example, after the spin-off, if all of the original shareholders continue to hold some stake in both companies, I treat this as a case of no disagreement. If all of the shareholders end up with a stake in either the parent or the spun-off entity, but never both, I treat this as a case of complete disagreement.[2] In constructing this measure, I consider a holding period from before the transaction announcement to well after the ex date, to avoid capturing short-term arbitrage trading. I find that this disagreement measure is a statistically significant predictor of the

[2]Consider, for example, the much-studied spin-off of Palm from 3Com, in which the relative market valuations of the two entities appeared to violate the law of one price. Only 13% of the original institutional shareholders of 3Com ended up holding any Palm stock once it was fully spun off. This high separation of the shareholder bases, together with constraints on short-selling that restricted arbitrage trading, may help to explain the extreme divergence between the initial independent pricing of Palm and the pricing of 3Com.

excess return on spin-off ex dates. A one standard deviation increase in this ratio is related to 65 basis points of additional return. Since this return is a percentage of the value of the joint entity, and spin-offs generally represent the divestiture of only a small subsidiary, this is economically a very large effect. If I restrict the sample to cases where the larger component is no more than ten times the size of the other (about 75% of the sample), the effect almost doubles to 125 basis points of additional return for a one standard deviation increase in disagreement.

In robustness tests, I consider other measures of the reshuffling of the investor base that the model predicts would not be as directly related to the price impact as my primary disagreement measure. For example, I construct an alternative measure that reflects investors who simply change the proportion of their holdings as well as those who sell all of their holdings of one component. Also, I consider measures that reflect the holders that liquidate their holdings of either only the spun-off company or only the parent company. Consistent with the theoretical analysis, I find that my primary measure has greater explanatory power than these alternative measures.

I also consider the possibility that ex date price pressure could result from structural investor clienteles, such as funds specializing in certain style sectors or replicating certain indices. Such clienteles could reflect underlying differences of opinion, expressed via investor demand for certain kinds of funds. On the other hand, if such clienteles only represent intermediary specialization, they may result in short term price pressure even though we would not expect them to have permanent stock price impacts. I examine the returns to spin-offs after ex dates and find no evidence of reversal, providing comfort that I am not capturing the effect of price pressure.

To further account for structural clienteles, I include a control for trading that could be predicted based on transactions involving S&P 500 index constituents where one or both of the post-transaction entities would no longer be a part of the index, and find that it does not affect my results. I also run a placebo test by constructing that component of the disagreement measure that could be predicted in advance based on differences in characteristics between the parent and spun-off entity. Reshuffling of investor bases related to these predictable characteristics could be related to predicted differences of opinion but may also result from structural clienteles. However, in either case such trading should not be related to permanent returns on the ex date because it could be predicted well before the ex date. As hypothesized, I find that it is the unpredicted component of the disagreement measure that drives my results. Consistent with my results, other researchers find that style clienteles can explain trading decisions in spin-offs but do not explain spin-off returns.[3]

I next consider stock mergers, a natural extension to spin-offs in that they represent the combination rather than the separation of two stocks.[4] I find that my measure is a significant predictor of merger returns on the "information-free" ex date, in the opposite direction as for spin-offs, which represent the reverse transaction. However, in the case of a merger, the two securities are already tradable in any combination at the announcement date. While the ex date results should not be related to business information, they only capture the effect of any investors that wait to reshuffle their holdings, perhaps because some target shareholders do not pay attention until they actually receive acquirer shares. Consistent with the ability to trade in advance of the ex date, I also find that there is a negative relation between my disagreement measure and returns in the period between the announcement date and ex date of the merger. As in the case of spin-offs, an economically significant portion of the price effects of mergers could thus be attributed to shareholder disagreement about the relative prospects of the involved entities, rather than business considerations.

Finally, I examine the role of differences of opinion in the pricing of a bundle of many assets, by extending the revealed preferences approach to a study of closed-end fund dis-

[3] See, Abarbanell, Bushee, and Raedy (2003), who use factor and cluster analysis on past investment behavior to classify institutions into large-value, large-growth, small-value, and small-growth styles. They find that these classifications are predictive of trading decisions upon receiving a spin distribution, but that the trading that results does not predict price movements.

[4] In fact, Allen, Lummer, McConnell and Reed (1995) consider spin-offs that follow an earlier acquisition of the business that is spun and find that losses in the original acquisitions can predict the gains in the eventual spin-offs.

counts. I find that the disagreement measure, this time based on the popularity of a basket of stocks rather than the overlap in holders across two stocks, explains a statistically and economically significant portion of the cross-sectional as well as the time-series variation in closed-end fund discounts. These results demonstrate that the approach in this paper can be extended to the case of many assets and to situations where trading around the creation or separation of a bundle is not observed.

This paper adds to a growing empirical literature on the price effects of differences of opinion. Previous studies—such as Diether, Malloy and Scherbina (2002), Nagel (2005), Boehme, Danielsen and Sorescu (2006), and Chen, Hong and Stein (2002)—proxy for differences of opinion using variables such as the dispersion in analyst earnings forecasts, idiosyncratic volatility, trading volume, and the narrowness of the investor base. Closest to this paper is a contemporaneous study by Hwang, Lou, and Yin (2016), which uses a measure based on analyst forecast data to explore price effects in mergers, closed-end funds, and exchange-traded funds. Also, a recent paper by Reed, Saffi and Van Wesep (2016) derives additional theoretical results complementary to those presented in this paper and uses existing measures of differences of opinion to explain a portion of the diversification discount. I contribute to the literature by providing a new, theoretically-motivated measure of disagreement based on investors' revealed preferences, and relating it to a price impact that is plausibly free of confounding factors. This paper also contributes to the literature on spin-offs, mergers, and closed-end funds by providing empirical evidence of an alternative explanation for a significant portion of the market price dynamics in these situations.

1 Theoretical Motivation

Miller (1977) theorizes that in the presence of short-sales constraints, stocks tend to be held by those who are more optimistic about them, leading to higher prices and lower returns. Jarrow (1980) examines this proposition more formally and finds that disagreement about expected payoffs together with short-sales constraints would result in higher asset prices when asset payoffs are uncorrelated or when investors agree upon the variance-covariance matrix of the these payoffs. Building on Jarrow's results, I find that unbundling assets when there is disagreement about asset payoffs (but agreement about the variance-covariance matrix)[5] and when investors face short-sales constraints often results in higher asset prices.

1.1 Model Set-Up

Following Jarrow (1980), I begin with a single period mean variance model in the style of Lintner (1969) and extend it to incorporate short sales restrictions and the bundling of assets. Prices are determined and all trading occurs at time zero, such that investors maximize their expected utility over terminal wealth at time one. Further,

A1. There are no transactions costs or taxes, assets are infinitely divisible, and all investors act as price takers.

A2. Asset payoffs follow a multivariate normal distribution as seen by each investor.

A3. The risk-free rate is exogenously determined, and borrowing and lending is unlimited.

A4. Investors are risk averse and exhibit non-satiation.

A5. Short sales restrictions (or minimum holding constraints, which can be positive or negative) may apply to some or all assets for some or all investors.[6]

A6. Investors may have heterogeneous beliefs regarding the expected payoff of any risky asset but agree on the variance-covariance matrix of these payoffs. The variance-covariance matrix is of full rank.

[5] To the extent that disagreement is rational, and related either to differing priors or asymmetric access to information, Williams (1977) argues that disagreement in means is more likely to persist than disagreement in variances and covariances. That is, given the ability to learn from observed returns, and assuming continuous trading and information processing, he demonstrates that variances and covariances can be estimated to any desired degree of accuracy while means cannot be estimated without error from observed returns.

[6] While the minimum required holding can be positive or negative, the sum across investors of the minimum units required to be held of a given risky asset must be less than or equal to the supply of that asset.

A7. Investors exhibit constant absolute risk aversion.

A8. For each investor, the original units endowed of (risky) assets 1 and 2 is equal.

A9. In the bundle equilibrium, a unit of asset 1 may be traded only as a non-separable bundle with a unit of asset 2.

Assumptions A1-A7 are consistent with Jarrow (1980), though A5 has been generalized. Assumption A8 is necessary in order to compare equilibria with and without requiring these two assets to be traded only as a bundle, as per A9.

The market has K investors, indexed by $k = 1, ..., K$, and N risky assets, indexed by i or $j = 1, ..., N$. The Pratt-Arrow coefficient of absolute risk aversion for investor k is α^k. The number of units of asset i endowed to investor k is denoted as z_i^k, with $z^{k\prime} = [z_1^k, ..., z_N^k]$ representing the vector of risky assets endowments. Total population endowments are assumed to be $\overline{z}' = \sum_k z^{k\prime} = \mathbf{e}^{1\prime} = [1, ..., 1]$, a scaling assumption that is made without loss of generality. After trading has concluded at time 0, investor k holds x_0^k units of the risk-free asset, with the vector x^k giving their holdings of the risky assets. The minimum permitted holding by investor k of asset i is $c_i^k \leqslant 0$ (e.g., $c_i^k = 0$ in case of no permitted short sales by this investor in this asset). As in the case of assumption A8 for endowments, the short sales constraint on risky asset 1 and risky asset 2 is held the same, i.e., $c_1^k = c_2^k$ for any given investor, so that the bundled and unbundled markets are comparable. The price of a unit of asset i at time 0 is denoted p_i, where p_0, the price of the risk-free asset, is assumed to be 1, another scaling made without loss of generality, and the vector of risky asset prices is $p' = [p_1, ..., p_N]$.

The payoff per unit of asset i at time 1 is multivariate normally distributed and denoted as f_i. Investor k's expectation of the payoff for asset i is $\mu_i^k = E^k[f_i]$, with the vector of expected payoffs of the risky assets denoted as $\mu^{k\prime} = [\mu_1^k, ..., \mu_N^k]$. Investor k believes the variance-covariance matrix of these payoffs to be Ω^k with elements σ_{ij}^k. The payoff per unit of the risk-free asset, $\mu_0 = f_0$, is agreed upon by all investors.

1.2 Comparison of Unbundled and Bundled Equilibria

In the unbundled equilibrium (using the subscript u to denote the unbundled economy), it can be shown (as derived in the Appendix) that:

$$p_u^* = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \left\{\frac{1}{\alpha^k}(\mu^k + \lambda_u^k)\right\} - \Omega \mathbf{e}^1\right] \tag{1}$$

or for an individual risky asset

$$p_{ju}^* = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \left\{\frac{1}{\alpha^k}(\mu_j^k + \lambda_{ju}^k)\right\} - \sum_i \sigma_{ij}\right] \tag{2}$$

Note that in the absence of short sales restrictions or other minimum holding constraints, the expression for the equilibrium price of asset j would be the same as in (2) except that the λ_j^k term would not appear. Thus, these results are consistent with the finding by Jarrow (1980) that, with disagreement about risky asset payoffs but agreement on the variance-covariance matrix, the equilibrium price of an asset in the presence of short sales constraints is greater than or equal to the equilibrium price of that asset in the absence of such constraints, and is strictly greater when short sales are restricted as long as at least one investor faces a binding short sale constraint (that is, λ_j^k is positive for at least one investor).

These equilibrium prices can now be compared to the equilibrium in a market where risky assets 1 and 2 are joined in an inseparable bundle. As discussed above, the endowments and short sales constraints of these two assets were always held in proportion, $z_1^k = z_2^k$ and $c_1^k = c_2^k$, in order to ensure that this market is otherwise comparable to that in the unbundled case. The subscript b is used to denote variables in the bundled economy, and also to denote the asset bundle comprised of one unit of asset 1 and one unit of asset 2 (so, e.g., $x_{bb}^k \equiv x_{1b}^k \equiv x_{2b}^k$).

As shown in the Appendix, in the absence of short-sales constraints and when there is agreement on the variance-covariance matrix, there is no difference between the price of the bundle in the bundled equilibrium and the sum of the prices of the individual bundle components in the unbundled equilibrium.

With short sales constraints, it can be shown that the prices of the bundle and the other assets in the economy in the bundled equilibrium are:

$$p_{bb}^{*} = \left[\sum_{k} \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_{k} \left\{\frac{1}{\alpha^k}(\mu_1^k + \mu_2^k + \lambda_{bb}^k)\right\} - \sum_{i}(\sigma_{i1} + \sigma_{i2})\right] \tag{3}$$

$$p_{jb}^{*} = \left[\sum_{k} \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_{k} \left\{\frac{1}{\alpha^k}(\mu_j^k + \lambda_{jb}^k)\right\} - \sum_{i}\sigma_{ij}\right] j = 3, ..., N \tag{4}$$

Comparing the price of the bundle to the sum of the prices of its components in the unbundled economy, we have

$$p_{bb}^{*} - (p_{1u}^{*} + p_{2u}^{*}) = \left[\sum_{k} \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_{k} \left\{\frac{\lambda_{bb}^k - (\lambda_{1u}^k + \lambda_{2u}^k)}{\alpha^k}\right\}\right] \tag{5}$$

Since μ_0 and all α^k are positive, the direction of the change in price depends on the weighted average of the $\lambda_{bb}^k - (\lambda_{1u}^k + \lambda_{2u}^k)$ terms. When short sales constraints bind on only one of the two unbundled assets for some individuals, this term is often less than zero, meaning that the price impact of bundling is negative. It is possible for bundling to have a positive price impact through the second-order effects of changes in prices on assets outside of the bundle (since, as a result of the change, holdings of these assets may also be rebalanced and are also assumed to be subject to short sales constraints). Additional details on some conditions that would guarantee a negative price effect of bundling and an example of the type of situation which would give rise to a positive price effect are provided in the Appendix.

In addition to determining the overall price effect from bundling in the presence of (binding) short-sales constraints, we can also identify the individuals, by their observed holdings, that will contribute to this difference one way or the other. Investors who do not face short sales constraints do not contribute to the price change. The possible groups of investors who face short sales constraints are as follows:

1. *Hold bundle in bundled equilibrium, and hold both component assets in the unbundled*

equilibrium - For these individuals, $\lambda^k_{bb} = \lambda^k_{1u} = \lambda^k_{2u} = 0$, as their short sales constraints in these assets are never binding, so they do not contribute to any price differential.

2. *Hold bundle in bundled equilibrium, but only one component asset in the unbundled equilibrium* - For these individuals, $\lambda^k_{bb} = 0$ but $\lambda^k_{1u} + \lambda^k_{2u} \geqslant 0$, so they generally have a first order, negative contribution to the price differential from bundling (as long as their short sales constraint in their undesired component is binding).

3. *Hold bundle in bundled equilibrium, but hold neither component asset in the unbundled equilibrium* - For these individuals, the new unbundled prices are too rich to attract their investment anymore. For them, $\lambda^k_{bb} = 0$ but $\lambda^k_{1u} + \lambda^k_{2u} \geqslant 0$ and they generally contribute negatively to the price differential from bundling (again, as long as one of the constraints is binding). However, this is a second order effect because the actions of this group are dependent on the price of the bundle assets changing upon unbundling based on other investors' beliefs.

4. *Do not hold bundle in bundled equilibrium, and hold neither component asset in the unbundled equilibrium* - For these individuals, $\lambda^k_{bb} \geqslant 0$ and $\lambda^k_{1u} + \lambda^k_{2u} \geqslant 0$. In this case, the contribution is a third order effect and its sign is indeterminate. In particular, the effect on the prices of the bundle assets is indirect, through the investors' participation in the pricing of other assets in the economy, and is dependent on how the portfolio rebalancing of other individuals impacts prices of the bundle assets as well as other assets in the economy that are correlated with them. For example, if unbundling results in a higher total price for the two bundle assets, because of the contributions of the previous investor groups, these individuals may have a higher total shadow cost of not being able to sell the (now more expensive) assets.

5. *Do not hold bundle in bundled equilibrium, but hold one component asset in the unbundled equilibrium* - For these individuals, the second asset in the bundle is too undesirable to attract investment in the bundle even though they like one component. For these

individuals, $\lambda_{bb}^k \geqslant 0$ and $\lambda_{1u}^k + \lambda_{2u}^k \geqslant 0$, and the sign of their contribution is indeterminate. They contribute negatively to the price differential from bundling as long as the increased desire to sell the undesired asset once it is separated from their favored asset dominates any second order effects through market changes in other asset prices that are correlated with them.

1.3 Key Implications of Theory for Empirics

The theoretical analysis provides useful intuition and permits the construction of a measure of differences of opinion that is directly linked to the mechanism by which such disagreement can affect prices. The model demonstrates that the effect of differences of opinion on the returns to unbundling or bundling assets hinges on whether separating or combining assets changes which assets some investors are willing to hold.

In the case of a spin-off, differences of opinion that lead investors to divest one or the other of the separated components, to be replaced by investors that are more optimistic about that component, contribute to an increase in the joint market price of the two components. Any such price effects require short sales constraints, but not on all investors or on all assets; the price impact would result as long as short-sales constraints bind for at least one investor on at least one of the two assets in the bundle.

Importantly, only disagreement that leads investors to choose not to hold at least one of the securities is related to the price effect, while investors who simply change the proportion of their holdings do not impact prices. The views of the investors who change only the proportion of their holdings are still incorporated in the prices of the two assets after unbundling. The shadow cost term for such investors is zero. The views of investors who initially held the joint security but fully divest one or the other of the components after unbundling were once included in the joint price. However, for any such investors that are unwilling or unable to short sell the component they divest, their views would then now excluded from the price of one or the other component, contributing to an increase in the price via the shadow cost term in the model.

I therefore measure the price-relevant portion of disagreement as the degree of non-overlap in shareholder bases across the components. The measure considers overlapping shareholders to be any investors who hold at least some quantity of both securities, however disproportionate, rather than only crediting the quantities which are held in the original proportions. That is, the measure relies on the prediction of the model that disagreement as a function of investors who completely sell out of one or the other of the components should be the most directly related to the price impact. Theoretically, this measure also has an unambigious relation with the price impact, while disagreement generally could in some cases actually result in a decrease in price upon unbundling, as demonstrated in the Appendix. I also consider alternative measures in robustness tests.

Among the investor groups described at the end of Section 1.2, the first two groups are the investors that I will focus on in my empirical analyses. If most of the investors fall in group 1, and hold both components of the company both before and after the spin-off (or merger), the implication is that there is little disagreement among investors and that there should be little price effect (since, as shown above, group 1 investors do not contribute to the price differential from unbundling). On the other hand, if most of the investors fall in group 2, the implication is that investors disagree strongly about the prospects of the two businesses and, as shown above, that there should be a large price impact (positive in the case of a spin-off, and negative in the case of a merger) if many of these investors face short sales constraints. Thus, I will use the fraction of the investors in these two groups who fall in the second group as my primary measure of disagreement.

The third group (who hold the bundle in the bundled equilibrium but "drop out" altogether when the bundle is separated) is considered empirically as an additional disagreement measure, but is not used as a primary measure because these investors have only second order effects. It could also be argued that these groups may have other reasons (e.g., overall dissatisfaction with the transaction) for their empirical change in participation. Finally, the fourth group and fifth groups are not used because they have theoretically indeterminate impacts.

By basing my primary disagreement measure on the first two groups of investors, I am therefore focusing on the first order effects of disagreement, am quantifying those groups that can be identified empirically, and am not subject to the uncertain directional predictions related to the second order effects of the portfolio rebalancing of investors.

2 Data and Sample Characteristics

Spin-off and merger transaction details are sourced from SDC and confirmed against CRSP data for fields available in CRSP. Transaction ex dates and returns over the relevant periods are determined from CRSP. I restrict my analysis to successfully completed 100% spin-offs or mergers of public companies that are not accompanied by other significant transactions.[7] Stock mergers in the sample are required to be stock-for-stock deals with no other forms of consideration. (Similarly, the cash acquisitions analyzed herein must involve no form of consideration other than cash.) For spin-offs I also require that there was no "when-issued" trading prior to the ex date and that both entities continue trading for at least 90 days after the ex-date, and I exclude cases of multiple units being spun off at the same time and other special situations. The spin-offs and mergers that remain in my sample should generally not trigger any tax liabilities to the initial shareholders unless they respond by selling their holdings.

The shareholder disagreement measure is based on institutional holdings data in 13F filings from Thomson Financial.[8] Some noise is introduced by using data only on institutional

[7]Cases are excluded from the sample if other significant transactions (such as one of the companies acquiring or being acquired by another party) close less than 150 days before the spin-off or merger in question is announced or are announced less than 150 days after the spin-off or merger in question is closed. These windows are chosen to limit the interference of other events with investor holdings, which are given 30 days to respond to an event and are collected over a 120 day window. If an announcement date is not available for a potentially conflicting M&A transaction, it is assumed to occur at most 240 days before the closing date. Among other situations, these restrictions allow me to avoid so called "Morris-Trust" transactions, in which a spin-off is used to facilitate a merger.

[8]Insititutions who have investment discretion over \$100 million or more in 13F securities (including all equities

holdings in order to estimate disagreement, but this data limitation is expected to dampen my results rather than introducing any bias. For spin-offs, my measure of disagreement is the ratio, weighted by their holdings, of continuing investors, i.e., initial investors who continue to hold at least one of the the securities after the transaction, who hold only one of the securities after the transaction. For mergers, the corresponding measure is the ratio of continuing investors, weighted by their holdings, who, before the transaction, held only one of the two securities. For the reasons discussed in Section 1.4, these measures of non-overlap consider investors to be overlapping as long as they hold at least some amount of each security, even if they are held out of proportion.

Initial investors are those who report holding the joint firm (in the case of spin-offs) or one of either the target or acquiring firms (in the case of mergers) in a 120 day window before the announcement date of the transaction. Considering pre-announcement holders allows me to focus on long-term shareholders, rather than short term speculators who buy and sell the securities after the announcement. Continuing investments are checked in the 120 day period starting 30 days after the ex date, again to avoid capturing short-term speculative trading. The 120 day windows are required given the quarterly frequency with which institutions are required to report their holdings. The uncertain timing of the reshuffling of holdings within and between these windows increases noise when considering the information about differences of opinion that may be incorporated in prices on individual event dates. However, this noise should only make it more difficult for me to find a result.

I also calculate and control for investor "drop-in" and "drop-out" variables—that is, holders of the joint firm who do not (or did not) hold either of the individual components. These variables are theoretically linked to only second order effects on prices and are open to alternative interpretations (e.g., the dropping out of institutions could reflect overall dissatisfaction with the transaction or could reduce active monitoring), so I consider them to be control variables rather than main variables of interest.

traded on US exchanges as well as certain other securities) are required to file form 13F reporting their holdings of such securities every calendar quarter, within 45 days of quarter-end.

The resulting sample of spin-offs consists of 172 full spin-offs of wholly-owned subsidiaries of publicly-traded US firms closed between 1988 and 2012. Summary statistics are presented in Table 1. Consistent with the literature, I find a 3.28% mean excess return (over the value-weighted market index) to the joint firm on the announcement date and a 2.38% mean excess return on the ex date. The excess volume of trade, calculated relative to the daily trading volume from a 60 day reference period ending on the 31st day before the announcement date or beginning on the 31st day after the ex date, is between 1-2% on both the announcement date (for the joint company) and the ex date (for the spinner).

The mean level of my disagreement variable, the ratio of continuing investors who hold only one of the two securities after the transaction, is 24%. Of these investors, who held the joint company before the transaction but hold only the parent or only the newly spun company afterwards, the mean fraction who hold the parent is 80% (and, on average, the remaining 20% hold only the spun company). This is not surprising because, on average, the ratio of the larger to smaller component of the joint company (generally, the ratio of the parent to spun company) is 14 times. The small relative size of the spun-off companies makes the event returns even more impressive, as a 5% return to the joint company would equal about 75% of the value of the subsidiary at the average size ratio.

Some of the spin-offs are very small; the maximum parent-to-spin-off ratio is over 400. Given that spinning off a relatively very small subsidiary can be expected to have only limited impact on the joint value of both components, I consider two subsamples of relatively more significant transactions: (i) a subsample, which is about 15% smaller than the full sample, where the relative size ratio is no more than 25 (i.e., the spun entity is at least 4% of the parent) and (ii) a subsample, which is about 25% smaller than the full sample, where the relative size ratio is no more than 10.

The sample of stock mergers consists of 1,126 successfully completed stock-for-stock mergers of publicly-traded US firms between 1980 and 2012. Summary statistics are presented in Table 2. The mean level of my disagreement variable, the ratio of continuing investors who had held only one of the two securities before the transaction, is 70%.[9] Of these investors, who held only one security before the merger but hold the joint company afterwards, the mean fraction who originally held only the larger component is 87% (and, on average, the remaining 13% held only the smaller company). On average, the acquirer is 22 times the size of the target, with a maximium such ratio of well over 1,000. As in the case of spin-offs, I will therefore consider subsamples of less extreme size deviations: (i) a subsample where the ratio of acquirer to target size is no more than 25, resulting in a sample that is about 15% smaller than the overall sample and (ii) a subsample where this ratio is above the median such ratio of around 5, cutting the sample in about half.

The sample of closed-end funds consists of a total of 136 domestic equity closed-end funds that were traded from August 2005 to January 2010. Fund information—including monthly prices and NAVs, distributions, expenses, trading volumes and fund holdings—was collected from Morningstar.com, CEFConnect.com, SEC filings on EDGAR, CRSP, and the Thomson Reuters Mutual Fund Holdings database. Table 3 provides some sample statistics. Funds are in the sample for an average of about 40 months. On average, they trade at a discount of about 6%, where about 20% of the sample are cases of premia to NAV. The trading volumes of the funds are, on average, 30-40% of the weighted average trading volumes of their holdings, though about 5% of the funds are more heavily traded than their holdings. The mean distribution ratio is 11% of NAV per annum, while the mean total expenses are 1.4% of NAV per annum. The overlap measures summarized in Table 3 are explained in Section 5 below.

[9] It is possible that the high level of this non-overlap ratio, relative to the low level in the case of spin-offs, may reflect some inertia. That is, the 70% in the case of mergers may include some investors who do not like and will thus sell the joint firm some additional months after the ex date, while the 22% in the case of spin-offs might not include some investors who do not like and thus will sell one of either the parent or the spun-off company some additional months after the ex date.

3 Spin-Off Results

A corporate spin-off represents a shock to the investment opportunity set, newly allowing investors to separately hold the parent or spun-off companies. These transactions thereby provide a revealed preferences measure of disagreement about the original bundled company as investors reshuffle into their preferred holdings. As demonstrated theoretically above, the degree of separation of the original shareholder base into groups of shareholders that hold only one or the other entity is predicted to have a price impact.

The main regression specification for the empirical tests of this relation is

$$r_i = \alpha + \beta Disagreement_i + \gamma X_i + \varepsilon_i$$

where r_i is the event return, $Disagreement_i$ is the primary disagreement measure, and X_i is the vector of control variables. The primary disagreement measure, as discussed above, is equal to the ratio of continuing investors (weighted by their original holdings) that hold only the parent or only the spun-off firm after the transaction. That is, this variable measures the degree of separation of the original shareholder base after the spin-off. Because this measure is based on the behavior of institutional investors who held the joint entity well before the announcement date of the transaction, it should be unrelated to the activity of speculators, such as spin-off arbitrageurs. The investor "drop-out" variable discussed above, or the ratio of investors in the joint company that hold neither component after the spin-off, could be considered a secondary measure of disagreement and is included in the controls.

3.1 Main Results for Spin-Offs

The particular event return used in these tests has important consequences for the interpretation of the results. In general, associating returns or prices with differences of opinion in any setting involves the challenge of dealing with a wide range of potential confounding factors. Similarly, spin-offs have been associated with many different potential business effects that may impact the value impact of such transactions. For example, spin-offs may undo the effects of inefficient internal capital markets (e.g., Gertner, Powers and Scharfstein, 2002), may reduce information asymmetry by increasing subsidiary-level reporting (e.g., Krishnaswami and Subramaniam, 1999), may allow for better incentivization of subsidiary managers (e.g., Aron, 1991), may increase the effectiveness of parent company managers through an increase in operational focus (e.g., Fulghieri and Sevilir, 2011), may transfer wealth from bondholders to shareholders (e.g., Maxwell and Rao, 2003), and may remove conflicts of interest that prevent or complicate relationships with particular counterparties.

Fortunately, the setting of spin-offs provides an event return that should be unrelated to these confounding factors but would plausibly be related to differences in opinion. Figure 1 provides an illustrative timeline of the significant event dates in a spin-off transaction. I focus on the ex-date return because the ex date is pre-announced and occurs after information has been disseminated and the transaction becomes certain, and so the ex-date return should not reflect business information. As shown in the illustrative timeline, there is no new information revealed about the business aspects of the transaction on the ex date. SEC rules[10] require at least 20 days to pass between the mailing and distribution of the information statement provided to shareholders—which includes a discussion of the management's rationale for the transaction, details of the structure of the spin-off, and pro forma financial information for the company to be spun off—and the completion of the transaction. Further, a spin-off ex date is pre-announced on a declaration date, so there is no remaining uncertainty of transaction completion on this date. Thus, before the ex date, investors would have already incorporated into prices any of the anticipated business impacts discussed above.

On the other hand, there is empirically a significant return on the ex date of spin-offs and mergers (see Vijh, 1994, and Mitchell, Pulvino and Stafford, 2004), indicating that these dates are important. In the case of a spin-off, since the ex date is the first day that the securities trade separately,[11] it is also the first date at which investors can trade in and

[10]See SEC Rule 14c-2.

[11]In some transactions, spin-offs commence when-issued trading before the ex date, but these cases are excluded

out of their preferred securities. To the extent that the exact amount of reshuffling and the valuations of the reshuffling parties are not fully predicted, the ex-date return should reflect the unpredicted part of the value impact of the differences of opinion that lead to reshuffling across the two entities.

To the extent that some disagreement may be anticipated before the ex date, estimates on the ex date will only provide a portion of the full impact of disagreement. Thus, in robustness tests, I will also consider returns at announcement and over the period from announcement until the ex date. However, these other returns will also reflect information about the transaction and any accompanying business impact, so to the extent that the separation of the shareholder base may be correlated with any of these other effects, results for those other event horizons might capture some of these business impacts together with the direct price effects of disagreement.

In Table 4, spin-off ex date returns are regressed against the primary disagreement measure and control variables. The first three specifications use the full sample of clean spin-offs. As demonstrated in these columns, the main shareholder disagreement variable is a significant predictor of the ex-date excess return, whereby the joint firms earn about 65 to 70 basis points of additional return for a one-standard deviation increase in the ratio of continuing investors who choose to hold only one component after the spin-off. Because most spun-off entities represent only a small subsidiary of the parent company, these estimates are economically very significant. For the average ratio of spun-off entity to the rest of the parent company of 14 times, a 65 basis point return on the joint entity represents approximately 10% of the value of the spun-off entity.

The tests in Table 4 also include several control variables. In unreported tests, the results are similar when excluding these controls. Also, it is worth noting that these controls could absorb some of the effect of differences of opinion. For example, as discussed above, the institutional holders drop-out variable may capture second order effects of disagreement but

because business information about the spin-off, including about the probability of completion, may continue to be released at the commencement of or during the when-issued trading period.

is also open to alternative interpretations. This variable has a significant positive relation with ex date returns when based on the number of institutions that drop out, but not when weighted by ex ante shareholdings. The excess volume of trade variable may measure the reshuffling of holdings related to differences of opinion, or it could measure price pressure from short-term speculative trading. By focusing on the excess volume of trade in the spinner, I hope to limit the extent to which this control variable absorbs the effect of trading based on differences of opinion, as most long-term reshufflers hold the spinner and trade the spun company. A higher volume of trade in the spinner is associated with a lower ex date return, consistent with short term price pressure from arbitrage trading.

Finally, I include a control for trading that could be predicted based on transactions involving S&P 500 index constituents where one or both of the post-transaction entities would no longer be a part of the index. That is, the index sellers dummy indicates cases in which trackers of the S&P 500 would be expected to trade to rebalance their portfolios. Reshuffling of investor bases associated with index constituency could be related to predicted differences in opinion or to structural clienteles in the absence of differences of opinion, and could generate temporary price pressure on the ex date. However, they are not expected to be related to permanent returns on the ex date because such reshuffling could be predicted well before the ex date. In the tests in Table 4, the index sellers dummy is not significantly related to the ex date return.

Because of the extreme potential disparities in size—with the potential relative size of the parent extending to over 480 times the size of the spun-off entity—I consider samples of more significant transactions in the last two columns of Table 4. A larger relative size of the spun-off company increases the significance of the spun-off entity in the decision to hold the joint entity and on the joint valuation, and thereby increases the potential economic impact of differences of opinion regarding the two components among the holders of the joint entity. As expected, the relation is stronger in the subsamples of less disparate relative sizes and is monotonically increasing with the relative size of the spun company (or the parent if it is the smaller company). When the ratio of the size of the larger component to that of the smaller component is limited to no more than 25, there are 80 basis points of additional return for a one-standard deviation increase in the disagreement variable; when this ratio is limited to no more than 10, this effect grows further to 125 basis points, or almost double the effect for the full sample.

As discussed above, these estimates should be unrelated to the market's expectation regarding the business effects of the transaction. However, it is possible that some holders of the joint entity have private information about the value of the transaction and choose not to reveal this information until they trade on the ex date. Consider a situation in which the original holders know that the spin-off will reduce the value of the spun-off entity, but the market is unaware of this information. When the market observes these holders selling the spun-off entity on the ex date, it may update to reflect the information revealed by such trading. In this case, though, selling by the original holders should be associated with a price decrease. The results are therefore unlikely to be driven by private information because I find that selling by the original shareholders is associated with an increase in total prices, which would not be consistent with the private information story.

3.2 Robustness of Spin-Offs Results

In the first set of robustness tests, presented in Table 5, I consider other measures of the rebalancing of the investor base. If the model outlined in Section 1 is correct, these alternative measures would not be as directly related to the price impact as my primary disagreement measure. For example, a key result of the model is that those investors whose differences of opinion lead them to change only the proportion of their holdings, while continuing to hold at least some shares in both components, will not impact prices.

Thus, I first construct an alternative measure that reflects those investors who simply change the proportion of their holdings as well as those who sell all of their holdings of one component. Specifically, this variable measures the percentage of shares of either component held by the original shareholders in the joint entity that are no longer matched by a proportional holding of the other component. Consistent with the model, I find in the second column of Table 5 that this alternative measure has an economically lower relation with the ex date excess return than my primary variable. In unreported results, I find that this relation is statistically significant only when the sample is constrained to the largest spin-off transactions in terms of relative size.

The model also predicts that investors who sell all of their holdings of either component would impact prices. Given that 80% of the holders that end up selling off their holdings of one of the two entities choose to hold only the parent, one may be concerned that the results are driven by the selling off of the spun-off company. Columns 3 and 4 of Table 5 reflect measures that are limited to the divestiture of only the spinner or only the spin-off. However, as predicted by the model, I find that my primary measure, which reflects holders that liquidate of holdings of either component, has more explanatory power than measures that reflect the holders that liquidate either their holdings of only the spun-off company or of only the parent company. The measure considering holders that liquidate the parent company has a larger coefficient than my primary measure, though it has lower statistical significance. This is likely due to the fact that liquidating the parent company is more likely in the case of relatively larger-sized spin-offs, in which we expect a larger price impact. When I consider only the relatively larger transactions, I find (in unreported results) that this disparity disappears and my primary measure has a larger impact in terms of both economic and statistical significance.

My second set of robustness tests explores the fact that if my tests are valid, it should be only the unexpected part of disagreement that drives permanent price effects on the ex date. As discussed above, some differences of opinion could be predicted and would thus be expected to be priced in prior to the ex date, so only the unexpected component should have additional permanent price effects. I thus run a placebo test in Tables 9 and 10 by constructing that component of the disagreement measure that could be predicted in advance based on differences in characteristics between the parent and spun-off entity. In Table 9, I run a first stage regression to predict the primary disagreement measure based on differences in the size, industry, or growth prospects of the parent and spin-off. The reported results use relatively granular, 3-digit SIC industry categorizations, but are robust to using higher level industry categorizations such as the Fama-French 49 industries. Differences in size are the most significant predictor of the disagreement measure. However, as hypothesized, I find in Table 10 that it is the unpredicted component of the disagreement measure that drives my results.

Consistent with these results, Abarbanell, Bushee, and Raedy (2003) were not able to associate spin-off ex date returns with the predictable trading of style (i.e., small or large, value or growth) investors. They find that style classifications are predictive of trading decisions upon receiving a spin distribution, but that the trading that results does not seem to drive price movements. Thus, the disagreement that I am measuring is likely a more general form of disagreement about the future prospects of the two entities. The fact that my results are unrelated to the component of disagreement that can be predicted based on ex ante predictable differences in characteristics also provides further support that business effects are not contaminating the results.

Finally, I consider alternative event dates, with results summarized in Table 6. To address the concern that the ex date returns may be driven by short-term price pressure effects that could be reversed in the days that follow, I examine returns over a 10 trading day period after the ex date. The results in Table 6 demonstrate no such reversal, and therefore do not seem to be the result of temporary price pressure. I also consider returns upon the announcement of the spin-off, and from the announcement until just before the ex date. At these times, information about the business impact and likelihood of the transaction actually closing may be revealed and incorporated into prices. Thus, these returns may include the possible business effects of a spin-off—for example, the impact of deconstructing the internal capital market, a reduction in asymmetric information, creation of a new currency with which to incentivize spin-off management, or shareholder expropriation of bondholder wealth.

Of course, at the same time, expectations about the future changes in the shareholder base due to differences in opinion could impact returns before the ex date as well. For example, in Table 9, it is shown that some of the variation in shareholder overlap can be explained by the relative sizes of the two components, so this part of the reshuffling of shareholders could be anticipated. However, as shown in Table 6, I find no significant relation between the disagreement measure and returns prior to the ex date.

4 Merger Results

While the results for spin-offs provide an important proof of concept in a clean setting where the effects of disagreement can be separated from confounding factors, the same approach has broader applicability to other situations where discrete components are bundled. The most direct extension is to the opposite of a spinoff: a merger. As the combination rather than the separation of two entities, a merger's event returns would generally be decreased by disagreement. This can be shown by simply reversing the model presented above.

For example, if some target shareholders were not willing to hold acquirer shares prior to the merger, these investors' views about the acquirer would not have been reflected in its market price unless they were actively selling the acquirer short. Upon the merger, if some of these shareholders continue to hold the merged company, their more pessimistic views about the acquirer would be newly reflected in the value of the joint entity. Importantly, as in the case of spin-offs, disagreement should only affect prices if it is sufficient to cause some investors not to participate at all in the market for one of the securities. Thus, disagreement in the case of mergers will be measured as the fraction of shareholders of the joint entity who only chose to hold either the acquirer or the target prior to the announcement of the merger.

Focusing on the form of disagreement that is theoretically expected to have price impacts—

and that the tests for spin-offs empirically demonstrate to be related to non-business price effects—allows a targeted test of the effects of disagreement on merger returns. Considering mergers also provides important external validity to the results for spin-offs. Specifically, mergers are much more common than spin-offs, and they are also less likely to represent situations with extreme levels of disagreement.

In Panel A of Table 7, ex date returns for stock-for-stock mergers are regressed against the primary disagreement measure and control variables. On the ex date in a stock-for-stock merger, the holdings of target or acquirer shareholders are effectively replaced by stock in the joint entity. Trading on that date may thereby reflect differences of opinion about the two components. For shareholders that previously held only one component, remaining invested means that their more pessimistic views of the other piece would be newly reflected in the joint valuation.

As discussed in Vijh (1980), there should be no new business information about the merger revealed on the ex date, which is the day after the delisting date and after any floating exchange ratio window. Still, this date does not provide as ideal of an event as in the case of a spin-off because the two securities are already tradeable in any combination prior to the ex date.[12] However, to the extent that some investors wait until the ex date to trade based on their differences of opinion, perhaps in the case of target investors who do not pay attention until they actually receive the acquirer stock, it may be possible to use this date to identify a price effect of disagreement that should be unrelated to confounding factors.

As demonstrated in Panel A of Table 7, the shareholder disagreement variable is a significant predictor of the ex-date joint return for stock mergers, with about 20 to 25 basis points of lower return for a one standard deviation increase in the fraction of continuing investors who held only one component before the merger. As in the case of spin-offs, the

[12] Another difference in the case of mergers that may increase noise relative to the spin-off setting is that there is an imposed exchange ratio, which could create a value transfer from acquirer to target shareholders (or vice versa) and impact investor decisions.

impact is stronger in the subsamples of less disparate relative sizes, growing to a 30 to 40 basis point lower return for a one standard deviation increase in the disagreement measure. The control variables are similar to those used in the spin-off analysis. The index buyers dummies indicate cases in which trackers of the S&P 500 would be expected to buy to rebalance their portfolios. As mentioned above, this is also a clientele effect, but of a very specific variety which could be predictable and which might be related to price pressure rather than permanent price effects. The control for abnormal trading volume may in this case represent short-term speculative trade volume or alternatively reflect long-term rebalancing volume. Thus, both of these control variables may absorb some of the effect of disagreement-related trading and make it more difficult to find an effect of disagreement.

Panel B of Table 7 presents the ex date results for cash acquisitions as a placebo test. In the case of a cash deal, there is no particular reason to expect disagreement-related trading on the ex date, since there are no shares delivered as consideration on that date. While disagreement-related trading may occur before the ex date, it is not clear why shareholders would be particularly moved to act on the ex date. As demonstrated in Panel B of Table 7, the disagreement measure has no explanatory power for returns on the ex date of cash transactions, providing comfort that the ex date return results in Panel A are not likely to reflect some other merger-related factor.

Table 8 presents a summary of the results for merger returns over other event windows, reporting only the coefficient on the primary disagreement measure and its significance. For the periods before the ex date, disagreement may generally be predicted to have similar effects in the case of cash acquisitions as in stock mergers. In contrast with the results for spin-offs, which were concentrated on the ex date, for both stock and cash acquisitions there is a large negative relation of returns with disagreement before the ex date, though not on the announcement date itself.[13] These results are consistent with the fact that in

[13]The lack of any relation between my non-overlap variable and announcement date returns is consistent with Harford, Li and Jenter (2007), who consider the impact of acquirer-target crossholdings on bidder announcement returns.

both stock and cash deals, both stocks are separately tradable at any time until the ex date, so shareholders can trade based on their differences of opinion any time after the deal is announced. However, in contrast to the ex date results, because news about the likelihood and business impact of the transaction may also be released over this period, it is possible that these results could be affected by confounding factors.

Table 8 also presents the relation between the disagreement measure and returns in the period after the ex date. There is no evidence of reversal of the ex date effect in the ten days after the ex date for the larger relative size samples, the more inclusive of which represents about 85% of the full sample. For the full sample, there is some evidence of reversal of the ex date effect, which must be driven by the remaining 15% of the sample. This reversal is consistent with at least part of the effect for the transactions with the most extreme size disparities being driven by short term selling pressure related to differences of opinion that were already predicted and priced in advance. Decomposing disagreement into its predictable and unpredicted components should allow us to determine if this may be the case.

As in the case of spinoffs, Tables 9 and 10 construct that component of the disagreement measure that could be predicted in advance based on the differences in characteristics between the merging entities and test the separate effects of the predicted and unpredicted components of disagreement. The prediction model in Table 9 is similar for mergers and spinoffs, with size disparities having the strongest association with the disagreement measure. Table 10 supports the supposition that the ex date price effects for those mergers with the most extreme size disparities appear to be linked to differences of opinion that could be predicted in advance and thus are associated with short term price pressure rather than permanent price effects on the ex date. As shown in the third column of Table 10, the ex date price effects for the full sample is associated with the predicted component of disagreement. In contrast, when considering the effects for the larger relative size samples, the results are driven by the unpredicted component of disagreement. This is consistent with a more permanent price effect being associated with the majority of the sample.

5 Closed-End Fund Results

The spin-off and merger settings, because of the nature of the ex date, are best suited for plausibly separating the price effect of disagreement from potential confounding factors. However, the same general approach can be more broadly applied to estimate the potential effect of disagreement in many other situations in which discrete components are bundled.

Applications of this approach are not limited to the ex-post measurement of disagreement, to the bundle creation or separation events, or to cases where holders in the bundle can be directly identified. That is, similar tests can be constructed by using reasonable proxies for the securities or investors in question. This can be demonstrated in the setting of closed-end funds, which represent a many-asset extension of the merger setting. This section explores whether cross-sectional and time series variation in closed-end fund discounts or premia can be partially explained by differences of opinion about the individual fund holdings.

In theory, if a collection of stocks is bundled together and sold as a closed-end fund, it may trade at NAV if it is held only by those investors who are jointly optimistic about all of the fund holdings. If it is a group of stocks about which investors do not tend to be jointly optimistic (though they may each have, say, one favorite security in the bunch), then one or more of the investors in the fund may have some component stocks that they would not otherwise care to hold and yet would also not be able or willing to short sell. In such cases, more pessimistic views are likely to be incorporated in the price of the closed-end fund than in the prices of the individually traded components.[14]

In this setting, it may not be possible to observe whether investors in the fund would have chosen to hold all of its components in the absence of the fund. However, the popularity amongst investors at large of holding the component stocks in combination should provide a strong indication as to the likely degree of joint optimism about the components by the fund holders. The disagreement measure used in this setting is therefore based on the popularity

[14]This conclusion relies on an assumption that the likelihood of fund liquidation if low enough, or the timing of such termination is uncertain enough, to limit other investors who do not face short sales constraints from forcing the prices to converge through arbitrage trading.

of the basket of stocks represented by the fund. As in the case of spin-offs and mergers, what should matter is not what proportion these stocks are held in, but whether investors are willing to hold any amounts of the different stocks in combination.

Two sets of investors with observable holdings will be considered: open-end funds and 13F institutions. Since investors can always cash out of open-end funds at the NAV, supply and demand for these funds (and thus for their baskets of holdings) is equalized through their outstanding volumes rather than prices. The popularity of certain combinations of holdings among open-end funds thus reflects the general demand for particular baskets of stocks. I also separately consider the holdings of 13F institutions, as this holdings data was found to be subject to fewer reporting gaps and irregularities than the available data for mutual funds.

To construct the disagreement measures (which are labeled *Sum%Overlap*), for each entity that holds at least two of the stocks held by a given closed-end fund, I calculate the percent of the closed-end fund's holdings represented by the stocks that overlap (in any proportion) with this entity's holdings. These overlap fractions are then summed across all entities in the sample to capture the overall popularity of the particular combination of stocks in the fund. A higher *Sum%Overlap* therefore reflects lesser disagreement about the basket of holdings.

Of course, some of a fund's holdings may be small and less significant. While computing the overlap as a percentage of the fund's overall holdings addresses this to some extent, I also consider the total overlap only among the larger holdings of the fund: either the top ten holdings or those holdings in the top 50 percent by value of the fund's holdings.

Table 11 presents the results for the cross-section of closed-end fund discounts or premia. The regressions include control variables for other factors that have been shown to be related to the pricing of domestic equity closed-end funds, such as the relative liquidity of the fund versus its holdings (e.g., Cherkes, Sagi and Stanton, 2009) and the fund expenses as a fraction of total outflows (e.g., Ross 2002). Month fixed effects are intended absorb any common time variation of the discounts, as in the case of a sentiment effect. Discounts and premia are considered separately through the use of interactions with discount/premium indicator variables because premia may reflect the initial marketing of funds to uninformed investors, price stabilization activities, and other such factors that could confound the results (see, e.g., Hanley, Lee and Seguin, 1996).

The cross-sectional results in Table 11 are similar when considering either popularity among institutional holdings or popularity among open-end fund holdings. In both cases, the basket popularity measures are significant predictors of the cross-sectional variation in closed-end fund discounts, in the expected direction. Economically, a one standard deviation increase in basket popularity is related to a 30 to 85 basis point reduction in the discount to NAV. The economic and statistical significance is greatest when the overlap measure is restricted to more important holdings. Interestingly, the basket desirability is related to higher premia to NAV as well as lower discounts. This result suggests that the popularity of bundles matters even when factors such as marketing and price-stabilization play a role.

Time series tests are presented in Table 12. Note that fund expense ratios are not included in these regressions because they have very limited time series variation. However, the market return and NAV return relative to the market are added as potential additional sources of time series variation in pricing. In these tests, the results using both sources of holdings information are consistent, but the results for open-end fund holdings are somewhat weaker. This is likely due to the inconsistent availability of these fund holdings over time, as discussed above, which adds significant noise to the changes in popularity over time. Overall, though, the time series tests are consistent with the results in the cross-section: if basket popularity decreases over time, fund discounts to NAV widen.

6 Concluding Remarks

This paper documents the price impact of disagreement among investors when bundling or bundling assets, as in the case of spin-offs, mergers, and closed-end funds. By exploiting the revealed preferences in institutional holdings data, I am able to measure the degree of only those differences of opinion that are theoretically predicted to affect prices: disagreement that is sufficient to cause some investors to be unwilling to hold any amount of some asset. Because it does not rely on the availability of analyst estimates, this measure also has broader coverage than measures based on forecast dispersion.

In my main results regarding the ex date returns of spin-offs, I am able to differentiate the impact of differences of opinion from risk factors or any business impacts that we may expect to be related to a measure of disagreement. Since no new business information is revealed on these dates, and yet disagreement may be demonstrated as investors reshuffle their holdings in reaction to their new ability to trade the two securities separately, I am able to cleanly identify a price impact of disagreement. Robustness tests and a placebo test provide further support for the theoretical model and the interpretation of my results.

In extensions, revealed preferences measures of differences of opinion are also shown to explain a significant portion of merger event returns, including the "information-free" ex date returns, as well as the cross-sectional and time series variation in closed-end fund discounts. These additional results provide external validity and demonstrate the versatility of the approach in this paper.

Overall, this paper provides robust evidence of the price effects of disagreement and new insight into the market prices of bundled or unbundled assets. The results in the context of spin-offs, mergers, and closed-end funds highlight the importance of recognizing that a significant portion of the market price and price dynamics for any bundle of assets could be explained by differences of opinion rather than business considerations.

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Figure 1: Spin-Off Illustrative Timeline

This is an example timeline for a corporate spin-off transaction. Some transactions require additional steps, such as a proxy distribution and shareholder vote. In some deals, the payment date is after the transaction ex date, in which case the spin-off trades as a when-issued security from the ex date until the payment date. In addition, some spin-offs commence when-issued trading before the ex date, but these situations are excluded from the analyses in this study.

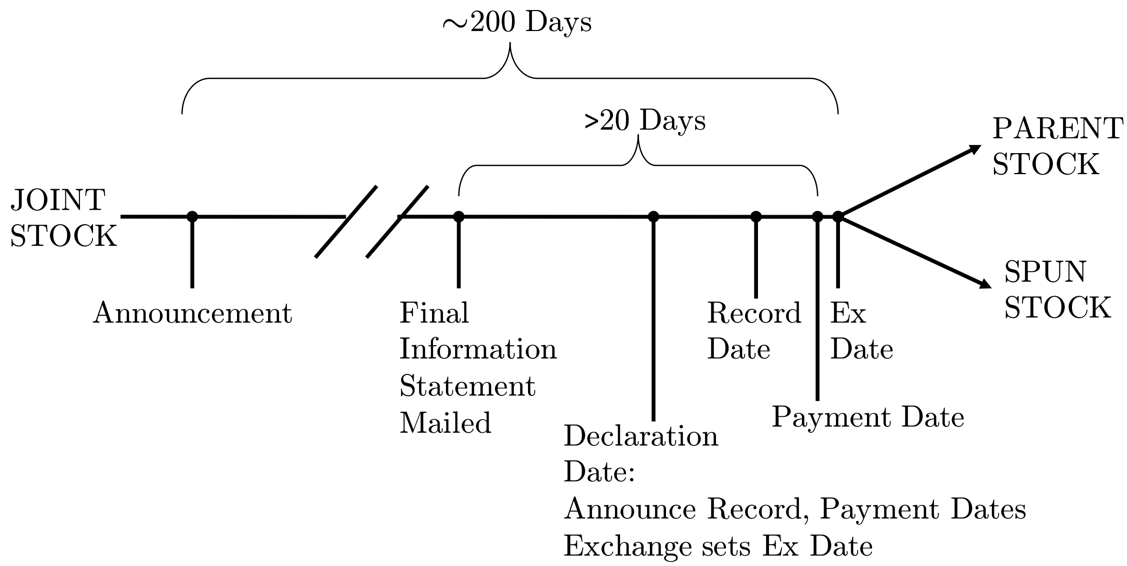

Table 1: Spin-Off Summary Statistics

The sample consists of 172 spin-offs of 100% of the wholly-owned subsidiaries of publicly-traded US firms, closed between 1988 and 2012. See Section 2.1 for details on these variables and their construction.

	N	Mean	Median	St. Dev.	Min	Max
PANEL A: Explained and Explanatory Variables						
Event Period Joint Returns - Excess over VW Index						
Announcement (2 days)	172	3.28%	2.86%	6.54%	-28.40%	21.05%
Announcement to Day Before Ex Date	172	4.14%	3.48%	25.06%	-86.05%	103.97%
Ex Date	172	2.38%	1.90%	4.33%	-10.52%	19.79%
Post Ex Date (10 days)	172	-2.71%	-1.48%	9.24%	-38.47%	25.98%
Continuing Investors Holding One Side Only[1]	172	0.24	0.19	0.18	0.00	1.00
Institutional Holders Drop-out Ratio[1]	172	0.17	0.14	0.11	0.01	0.63
Institutional Holders Drop-out Ratio[2]	172	0.31	0.31	0.10	0.07	0.61
Excess Volume of Trade - Announcement Date	172	1.74%	0.93%	2.79%	-3.26%	16.53%
Excess Volume of Trade - Ex Date, Spinner	172	1.25%	0.32%	2.71%	-2.28%	23.21%
S&P500 Index Sellers Dummy	172	0.40	0.00	0.49	0.00	1.00
PANEL B: Background Characteristics						
Combined Firm Size (pre-announcement; $M)	172	8,090	2,373	18,201	55	127,838
Larger Size/Smaller Size[3]	172	14.3	4.4	41.7	1.0	481.3
Num Institutional Holders pre-Announcement	172	248.4	194.0	231.2	7	1393
Num Institutional Holders post-Ex - Spinner	172	229.7	170.0	220.4	4	1280
Num Institutional Holders post-Ex - Spun	172	132.4	94.5	131.1	0	825
Deal Horizon - Ann. to Ex Date (days)[4]	172	203.9	195.0	127.3	6.0	1014.0

[1] Holdings-weighted

[2] Un-weighted (ratio of the number of institutions)

[3] In 26 (15%) cases, spun is larger than spinner.

[4] The four cases of deal horizon of <20 days have been hand-checked and have erroneous announcement dates reported by SDC (all actual horizons are at least 20 days).

Table 2: Merger Summary Statistics

The sample consists of 1,126 stock deals and 828 cash deals between publicly-traded US firms, closed between 1980 and 2012. See Section 2.1 for details on these variables and their construction.

	N	Mean	Median	St. Dev.	Min	Max
PANEL A: Stock Deals - Explained and Explanatory Variables						
Event Period Joint Returns - Excess over VW Index						
Announcement (2 days)	1117	-0.60%	-0.35%	6.86%	-50.95%	52.69%
Announcement to Day Before Ex Date	1117	-3.13%	-1.18%	26.06%	-147.40%	141.33%
Ex Date	1126	0.76%	0.39%	4.50%	-26.31%	84.27%
Post Ex Date (10 days)	1128	-1.67%	-0.97%	10.87%	-75.31%	77.48%
Continuing Investors Holding One Side Only[1]	1126	0.70	0.74	0.24	0.00	1.00
Institutional Holders Drop-out Ratio[1]	1126	0.20	0.16	0.16	0.00	0.98
Institutional Holders Drop-out Ratio[2]	1126	0.34	0.33	0.14	0.00	0.87
Excess Volume of Trade - Ann. Date, Joint	1117	3.26%	1.40%	5.33%	-11.82%	48.51%
Excess Volume of Trade - Ex Date, Joint	1126	0.34%	0.03%	1.52%	-6.94%	18.99%
Ex-Date S&P500 Index Buyers Dummy	1126	0.20	0.00	0.40	0.00	1.00
PANEL B: Stock Deals - Background Characteristics						
Combined Firm Size (eve of ex date; $M)	1126	7,223	1,145	28,076	13	576,541
Larger Size/Smaller Size (eve of ex date)	1126	21.9	4.7	78.4	1.0	1286.6
Num Institutional Holders pre-Ann. - Acquirer	1126	150.5	91.5	181.8	0.0	1473.0
Num Institutional Holders pre-Ann. - Target	1126	51.2	21.0	87.0	0.0	860.0
Num Institutional Holders post-Ex - Joint	1126	175.8	119.0	196.0	1.0	1591.0
Deal Horizon - Ann. to Ex Date (days)	1126	150.0	132.0	86.4	42.0	1155.0
PANEL C: Cash Deals - Explained and Explanatory Variables						
Event Period Joint Returns - Excess over VW Index						
Announcement (2 days)	822	2.62%	1.67%	5.28%	-25.54%	29.58%
Announcement to Day Before Ex Date	822	1.80%	-2.13%	16.74%	-116.07%	61.29%
Ex Date	828	0.11%	0.08%	2.11%	-13.22%	16.47%
Post Ex Date (10 days)	828	-0.41%	-0.46%	6.95%	-46.48%	27.94%
Continuing Investors Holding One Side Only[1]	828	0.73	0.78	0.23	0.00	1.00
Institutional Holders Drop-out Ratio[1]	828	0.15	0.11	0.13	0.00	0.74
Institutional Holders Drop-out Ratio[2]	828	0.28	0.25	0.13	0.00	0.83
Excess Volume of Trade - Ann. Date, Joint	822	2.81%	1.13%	4.80%	-2.51%	40.42%
Excess Volume of Trade - Ex Date, Joint	828	0.04%	-0.04%	0.87%	-2.68%	14.00%
PANEL D: Cash Deals - Background Characteristics						
Combined Firm Size (eve of ex date; $M)	828	10,584	1,560	29,863	19	291,496
Larger Size/Smaller Size (eve of ex date)	828	76.0	8.8	752.2	1.0	20711.6
Num Institutional Holders pre-Ann. - Acquirer	828	225.7	132.0	269.4	1.0	1655.0
Num Institutional Holders pre-Ann. - Target	828	46.5	21.0	57.9	0.0	345.0
Num Institutional Holders post-Ex - Joint	828	235.0	140.0	279.4	2.0	1685.0
Deal Horizon - Ann. to Ex Date (days)	828	112.2	83.0	87.9	28.0	644.0

[1]Holdings-weighted

[2]Un-weighted (ratio of the number of institutions)

Table 3: Closed-End Fund Summary Statistics

The sample consists of 136 domestic equity closed-end funds. Data are analyzed from August 2005 to January 2010. Sum%Overlap is the sum across all parties (either 13F institutions or open-end funds) of the percent overlap that each such party has with the holdings of the closed-end fund (or some subset of these holdings, as indicated), subject to a minimum overlap of at least two underlying stocks. Portfolio Stocks Avg. Institutional Ownership is a weighted average of the overall 13F institutional ownership of the underlying stocks held by the closed-end fund. Relative ADTV is the ratio of the average daily trading volume (ADTV) of the closed-end fund to the weighted average ADTV of its stockholdings for the 3 months prior to a given sample month.

	Distribution over Fund/Months or Fund/Quarters				
	Mean	Median	St. Dev.	Min	Max
Premium to NAV	-5.84%	-8.64%	13.90%	-56.86%	104.90%
Q-to-Q Change in Premium to NAV	-0.19%	0.11%	7.63%	-92.32%	45.21%
13F Institutional Holdings Overlap (minimum 2 securities overlap)					
Sum%Overlap - All Holdings	497.7	491.9	291.7	0.0	1237.5
Sum%Overlap - Top 10 Holdings	595.7	552.7	409.9	0.0	1504.7
Sum%Overlap - Top 50% Holdings	571.0	555.9	378.4	0.0	1351.3
Q-to-Q Change in Sum%Overlap - All Holdings	6.8	3.2	40.7	-638.3	437.7
Open-End Mutual Fund Holdings Overlap (minimum 2 securities overlap)					
Sum%Overlap - All Holdings	904.3	900.7	607.2	0.0	2594.6
Sum%Overlap - Top 10 Holdings	1062.0	909.0	856.7	0.0	3820.5
Sum%Overlap - Top 50% Holdings	1026.8	925.0	789.3	0.0	3026.8
Q-to-Q Change in Sum%Overlap - All Holdings	4.1	2.5	111.0	-1851.5	1861.5
Portfolio Stocks Avg. Institutional Ownership	64.0%	66.2%	14.8%	0.0%	95.3%
Relative ADTV (Fund/Portfolio)	39.8%	29.5%	38.1%	0.6%	712.4%
Expenses/(Expenses+Distributions) Ratio	15.7%	11.9%	13.9%	1.5%	100.0%
Annual Total Expenses to NAV	1.41%	1.19%	0.86%	0.44%	10.21%
Annual Distribution to NAV (if <100%)	9.10%	8.80%	4.06%	0.00%	73.77%

Distributions are over fund/quarter observations for Q-to-Q change variables, fund/month observations otherwise.

Table 4: Spin-Off Ex Date Returns vs. Disagreement

The ex date excess return is the excess of return, in percentage points, on the original parent stock on the ex date minus the value-weighted market index. "Cont. investors hold one side only" is, among institutional holders that held the joint firm before the announcement and continue to hold at least one piece afterwards, the ratio (weighted by ex-ante shares) of those who hold only one piece. "Institutional holders drop-out ratio" is the ratio of original institutional holders of the joint firm who do not hold either piece after the spin-off, either weighted by ex-ante shares or unweighted (simply the number of institutions that drop out relative to the number of original institutions) as indicated. The excess volume of trade on the ex date is calculated relative to the reference period from +31 to +90 days after the ex date. The sample in (4) is restricted to transactions where the ratio of the parent to the spun-off company size (or spun-off company to parent size, if the spun company is larger than the parent), measured on the ex date, is no more than 25; the sample in (5) is restricted to transactions where this relative size ratio is no more than 10.

	Ex Date Excess Return (over value-weighted market index, in percentage points)				
	No Relative Size Restrictions			RelSize≤25	RelSize≤10
	(1)	(2)	(3)	(4)	(5)
Cont. Investors Hold One Side Only	3.652 **	3.649 **	3.904 **	4.522 **	7.006 ***
	(2.09)	*(2.09)*	*(2.22)*	*(2.37)*	*(2.90)*
Institutional Holders Drop-out Ratio		-0.239			
(holdings-weighted)		*(-0.07)*			
Institutional Holders Drop-out Ratio			9.887 ***	9.806 **	11.539 **
(unweighted)			*(2.73)*	*(2.54)*	*(2.54)*
Excess Volume of Trade - Spinner	-25.195 **	-25.108 **	-33.008 ***	-35.066 ***	-43.881 ***
	(-2.30)	*(-2.26)*	*(-2.97)*	*(-3.16)*	*(-3.59)*
S&P500 Index Sellers Dummy	-0.829	-0.839	-0.502	-0.384	-0.524
	(-1.23)	*(-1.25)*	*(-0.78)*	*(-0.55)*	*(-0.62)*
Constant	2.140 ***	2.184 ***	-1.065	-1.088	-1.872
	(3.50)	*(2.83)*	*(-0.93)*	*(-0.90)*	*(-1.23)*
N	172	172	172	156	126
Adjusted R^2	0.03	0.02	0.08	0.08	0.11

Heteroskedasticity-robust t-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% (all two-tailed)

Table 5: Spin-Off Ex Date Returns vs. Disagreement – Alternative Disagreement Measures

The ex date excess return is the excess of return, in percentage points, on the original parent stock on the ex date minus the value-weighted market index. The disagreement measures used are, among institutional holders that held the joint firm before the announcement and continue to hold at least one piece afterwards, (1) the ratio (weighted by ex-ante shares) of those who hold only one piece after the spin-off, as in the previous table; (2) the percentage of the ex-ante shares that after the spin-off are held out of proportion in one piece compared to the other; (3) the ratio (weighted by ex-ante shares) of those who hold only the spinner after the spin-off; and (4) the ratio (weighted by ex-ante shares) of those who hold only the spun entity after the spin-off. "Inst. holders drop-out ratio" is the ratio of original institutional holders of the joint firm who do not hold either piece after the spin-off, either weighted by ex-ante shares or unweighted (simply the number of institutions that drop out relative to the number of original institutions) as indicated. The excess volume of trade on the ex date is calculated relative to the reference period from +31 to +90 days after the ex date.

	Ex Date Excess Return (over value-weighted market index, in percentage points)			
	No Relative Size Restrictions			
Disagreement Measure:	*Primary*	*Change Proportion*	*Sell Off Spun*	*Sell Off Spinner*
	(1)	(2)	(3)	(4)
Disagreement Measure	3.904 **	2.295	2.523	6.122 **
	(2.22)	*(1.21)*	*(1.48)*	*(2.06)*
Inst. Holders Drop-out Ratio	9.887 ***	9.739 ***	9.740 ***	9.679 ***
(unweighted)	*(2.73)*	*(2.61)*	*(2.64)*	*(2.61)*
Excess Vol. of Trade - Spinner	-33.008 ***	-32.413 ***	-28.407 **	-40.438 ***
	(-2.97)	*(-2.94)*	*(-2.48)*	*(-3.50)*
S&P500 Index Sellers Dummy	-0.502	-0.527	-0.454	-0.046
	(-0.78)	*(-0.76)*	*(-0.68)*	*(-0.07)*
Constant	-1.065	-1.000	-0.661	-0.398
	(-0.93)	*(-0.76)*	*(-0.58)*	*(-0.35)*
N	172	172	172	172
Adjusted R^2	0.08	0.06	0.06	0.07

Heteroskedasticity-robust t-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% (all two-tailed)

Table 6: Spin-Off Alternative Event Date Returns vs. Disagreement

This table reports the coefficients on the primary disagreement measure of the regressions reported in Table 4 for alternative event dates. In each case, the left hand side variable is the excess combined return over the indicated period and the control variables from Column 3 of Table 4 are included but suppressed. The disagreement measure is "Cont. investors hold one side only," or, among institutional holders that held the joint firm before the announcement and continue to hold at least one piece afterwards, the ratio (weighted by ex-ante shares) of those who hold only one piece. The sample in (2) is restricted to transactions where the ratio of the parent to the spun-off company size (or spun-off company to parent size, if the spun company is larger than the parent), measured on the ex date, is no more than 25; the sample in (3) is restricted to transactions where this relative size ratio is no more than 10.

	Coefficient of Excess Return on Disagreement (Cont. Investors Held One Side Only)		
	All	RelSize≤25	RelSize≤10
	(1)	(2)	(3)
Ex Date Regression	3.904 **	4.522 **	7.006 ***
	(2.22)	*(2.37)*	*(2.90)*
2-Day Announcement Regression	-3.019	-2.145	0.056
	(-1.13)	*(-0.73)*	*(0.02)*
Announcement to Pre-Ex Date Regression	-5.836	-5.174	-15.746
	(-0.71)	*(-0.60)*	*(-1.47)*
10-Days Post Ex Date Regression	0.794	1.516	2.635
	(0.22)	*(0.39)*	*(0.51)*

Heteroskedasticity-robust t-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% (all two-tailed)

Table 7: Merger Ex Date Returns vs. Disagreement

The ex date excess return is the excess combined return (weighted by size) of the merging companies on the ex date over the value-weighted market index. "Cont. investors held one side only" is, among institutional holders that held at least one piece before the announcement and continue to hold the joint firm afterwards, the ratio (weighted by ex-post shares) of those who held only one piece. "Institutional holders drop-in ratio" is the ratio of institutional holders of the joint firm who did not hold either piece before the merger, either weighted by ex-post shares or unweighted (simply the number of institutions that drop in relative to the total number of institutions that hold the joint firm) as indicated. The excess volume of trade on the ex date is calculated relative to the reference period from +31 to +90 days after the ex date. The sample in (4) is restricted to transactions where the ratio of the acquirer to target company size (or the reverse, if the target is larger than the acquirer), measured on the ex date, is no more than 25; the sample in (5) is restricted to transactions where this relative size ratio is no more than 5 in the case of stock deals and 10 in the case of cash deals.

	Ex Date Excess Return (over value-weighted market index, in percentage points)				
	No Relative Size Restrictions			RelSize≤25	RelSize≤5/10
	(1)	(2)	(3)	(4)	(5)
PANEL A: Stock-for-Stock Mergers					
Cont. Investors Held One Side Only	-0.857 *	-1.061 **	-0.885 *	-1.230 **	-1.680 **
	(-1.84)	*(-2.27)*	*(-1.92)*	*(-2.29)*	*(-1.98)*
Institutional Holders Drop-in Ratio (holdings-weighted)		1.770 **		1.757 *	1.545
		(2.05)		*(1.90)*	*(1.26)*
Institutional Holders Drop-in Ratio (unweighted)			0.359		
			(0.36)		
Excess Volume of Trade - Joint	47.589 ***	46.003 ***	47.232 ***	42.029 ***	46.256 ***
	(3.94)	*(3.80)*	*(3.93)*	*(3.41)*	*(3.36)*
S&P500 Index Buyers Dummy	-0.591 ***	-0.426 *	-0.554 **	-0.627 **	-1.611 ***
	(-2.81)	*(-1.80)*	*(-2.17)*	*(-2.30)*	*(-3.99)*
Constant	1.318 ***	1.086 ***	1.208 **	1.266 ***	1.807 ***
	(3.62)	*(2.71)*	*(2.27)*	*(2.94)*	*(3.48)*
N	1126	1126	1126	968	578
Adjusted R^2	0.03	0.03	0.03	0.03	0.02
PANEL B: Cash Acquisitions					
Cont. Investors Held One Side Only	0.089	0.116	0.094	0.232	0.124
	(0.29)	*(0.38)*	*(0.31)*	*(0.63)*	*(0.29)*
Institutional Holders Drop-in Ratio (holdings-weighted)		-0.250			
		(-0.41)			
Institutional Holders Drop-in Ratio (unweighted)			-0.061		
			(-0.10)		
Excess Volume of Trade - Joint	32.829 *	32.986 *	32.864 *	34.761 *	19.566
	(1.93)	*(1.95)*	*(1.94)*	*(1.78)*	*(1.00)*
Constant	0.031	0.048	0.044	-0.024	0.068
	(0.15)	*(0.22)*	*(0.17)*	*(-0.10)*	*(0.24)*
N	828	828	828	616	450
Adjusted R^2	0.02	0.02	0.01	0.02	0.00

Heteroskedasticity-robust t-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% (all two-tailed)

Table 8: Mergers Alternative Event Date Returns vs. Disagreement

This table reports the coefficients on the primary disagreement measure of the regressions reported in Table 7 for alternative event dates. In each case, the left hand side variable is the excess combined return over the indicated period and the control variables from Column 2 of Table 6 are included but suppressed. The disagreement measure is "Cont. investors held one side only," or, among institutional holders that held at least one piece before the announcement and continue to hold the joint firm afterwards, the ratio (weighted by ex-post shares) of those who held only one piece. The sample in (2) is restricted to transactions where the ratio of the acquirer to target company size (or the reverse, if the target is larger than the acquirer), measured on the ex date, is no more than 25; the sample in (3) is restricted to transactions where this relative size ratio is no more than 5 in the case of stock deals and 10 in the case of cash deals.

	Coefficient of Excess Return on Disagreement (Cont. Investors Held One Side Only)		
	All	RelSize≤25	RelSize≤10
PANEL A: Stock-for-Stock Mergers	(1)	(2)	(3)
Ex Date Regression	-1.061 **	-1.230 **	-1.680 **
	(-2.27)	*(-2.29)*	*(-1.98)*
2-Day Announcement Regression	*-0.221*	*-0.344*	*-1.659*
	(-0.18)	*(-0.25)*	*(-0.83)*
Announcement to Pre-Ex Date Regression	-2.128	-5.781 *	-13.951 ***
	(-0.69)	*(-1.73)*	*(-3.15)*
10-Days Post Ex Date Regression	2.825 *	1.309	-0.870
	(1.79)	*(0.96)*	*(-0.48)*
PANEL B: Cash Acquisitions	All	RelSize≤25	RelSize≤10
Ex Date Regression	0.116	0.232	0.124
	(0.38)	*(0.63)*	*(0.29)*
2-Day Announcement Regression	-0.391	0.080	-0.610
	(-0.36)	*(0.06)*	*(-0.37)*
Announcement to Pre-Ex Date Regression	-5.033 **	-6.929 **	-8.947 **
	(-1.97)	*(-2.32)*	*(-2.41)*
10-Days Post Ex Date Regression	0.677	0.042	0.501
	(0.68)	*(0.04)*	*(0.40)*

Heteroskedasticity-robust t-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% (all two-tailed)

Table 9: Predicting Disagreement

The disagreement measures are the left-hand size variable. Explanatory variables are measures of the differences in size, industry, and growth prospects between the two components of the transaction. "Cont. investors hold one side only" is, among institutional holders that held the joint firm before the announcement of the spin-off and continue to hold at least one piece afterwards, the ratio (weighted by ex-ante shares) of those who hold only one piece. "Cont. investors held one side only" is, among institutional holders that held at least one piece before the announcement of the merger and continue to hold the joint firm afterwards, the ratio (weighted by ex-post shares) of those who held only one piece. Relative size is measured on the ex date in the case of spin-offs and on the eve of announcement in the case of stock mergers.

	Spin-Offs		Stock Mergers	
	Cont. Investors Hold One Side Only		Cont. Investors Held One Side Only	
	(1)	(2)	(3)	(4)
Relative Size (Smaller/Larger)	-0.233 ***	-0.253 ***	-0.361 ***	-0.354 ***
	(-5.13)	*(-5.07)*	*(-13.36)*	*(-12.63)*
Primary 3-digit SIC Code is Same		-0.011		-0.024 *
		(-0.39)		*(-1.67)*
Absolute Difference in Q-Ratios		0.002		-0.002
		(0.31)		*(-1.11)*
Constant	0.313 ***	0.324 ***	0.792 ***	0.787 ***
	(16.17)	*(13.12)*	*(90.00)*	*(66.53)*
N	172	152	1129	957
Adjusted R^2	0.12	0.15	0.14	0.14

Heteroskedasticity-robust t-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% (all two-tailed)

Table 10: Predicted vs. Unpredicted Disagreement and Returns

All event returns used are the excess joint return over the value-weighted market index. "Cont. investors hold one side only" is, among institutional holders that held the joint firm before the announcement of the spin-off and continue to hold at least one piece afterwards, the ratio (weighted by ex-ante shares) of those who hold only one piece. "Cont. investors held one side only" is, among institutional holders that held at least one piece before the announcement of the merger and continue to hold the joint firm afterwards, the ratio (weighted by ex-post shares) of those who held only one piece. The sample in (5) and (6) is restricted to transactions where the ratio of the acquirer to target company size (or the reverse, if the target is larger than the acquirer), measured at the ex date, is no more than 5.

	Spin-Offs		Stock Mergers			
	Ex-Date - Full Sample		Ex-Date - Full Sample		Ann to Ex Date - RelSize≤5	
Prediction Variables by Column:	(1) Size	(2) Size, Q, SIC3	(3) Size	(4) Size, Q, SIC3	(5) Size	(6) Size, Q, SIC3
Cont. Investors Hold/Held One Side Only:						
Unpredicted Component	3.784 **	4.891 **	-0.462	-0.455	-8.159 *	-9.729 **
	(2.07)	*(2.58)*	*(-0.77)*	*(-0.69)*	*(-1.82)*	*(-1.97)*
Predicted Component	2.623	4.936	-3.129 *	-3.020	-4.423	-7.147
	(0.45)	*(0.88)*	*(-1.79)*	*(-1.58)*	*(-0.31)*	*(-0.46)*
Excess Volume of Trade	-25.621 **	-21.677 *	46.057 ***	47.030 ***	15.695 ***	15.752 ***
	(-2.27)	*(-1.69)*	*(3.70)*	*(3.50)*	*(4.05)*	*(3.43)*
S&P500 Index Buyers/Sellers Dummy	-0.797	-1.247 *	-0.399 *	-0.420 *	1.485	1.839
	(-1.17)	*(-1.74)*	*(-1.96)*	*(-1.94)*	*(0.62)*	*(0.72)*
Constant	2.380	1.855	2.865 **	2.773 **	-3.212	-1.930
	(1.54)	*(1.22)*	*(2.21)*	*(1.98)*	*(-0.35)*	*(-0.20)*
N	172	152	1126	957	574	487
Adjusted R^2	0.02	0.04	0.03	0.03	0.13	0.12

Heteroskedasticity-robust t-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% (all two-tailed)

Table 11: Cross Section of Closed-End Fund Discounts vs. Disagreement

The dependent variable is the closed-end fund price to NAV premium (discount) by month. Sum%Overlap is the sum across all parties (either 13F institutions or open-end funds) of the percent overlap that each such party has with the holdings of the closed-end fund (or some subset of these holdings, as indicated), subject to a minimum overlap of at least two underlying stocks. Portfolio Stocks Avg. Inst. Ownership is a weighted average of the overall 13F institutional ownership of the underlying stocks held by the closed-end fund. Log Relative ADTV is the log of the ratio of the average daily trading volume (ADTV) of the closed-end fund to the weighted average ADTV of its stockholdings for the 3 months prior to a given sample month. The first three columns measure disagreement based on the overlap of the closed-end fund holdings with the holdings of open-end funds, while the last three columns reflect holdings that overlap with the holdings of 13F institutions. All columns include month fixed effects.

	Premium/(Discount) to NAV (in percentage points)					
	Overlap with Open-End Fund Holdings			Overlap with 13F Institutional Holdings		
Overlap based on:	Full	Top 50%	Top 10	Full	Top 50%	Top 10
	(1)	(2)	(3)	(4)	(5)	(6)
Sum%Overlap x $I_{discount}$	0.001	0.001 **	0.001 **	0.001	0.002 **	0.001 **
	(1.40)	*(2.02)*	*(2.13)*	*(1.51)*	*(2.10)*	*(2.22)*
Sum%Overlap x $I_{premium}$	0.009 *	0.007 *	0.007 *	0.016 *	0.013 *	0.013 *
	(1.78)	*(1.80)*	*(1.77)*	*(1.72)*	*(1.74)*	*(1.72)*
Portfolio Stocks Avg. Inst. Ownership x $I_{discount}$	-2.963	-3.156	-3.121	-2.937	-3.122	-3.103
	(-1.24)	*(-1.31)*	*(-1.30)*	*(-1.23)*	*(-1.30)*	*(-1.29)*
Portfolio Stocks Avg. Inst. Ownership x $I_{premium}$	-23.299 **	-23.905 **	-24.145 **	-21.550 *	-22.133 **	-22.324 **
	(-2.13)	*(-2.19)*	*(-2.25)*	*(-1.94)*	*(-2.01)*	*(-2.05)*
Log Relative ADTV (fund/portfolio) x $I_{discount}$	0.955 *	0.962 *	0.953 *	0.954 *	0.955 *	0.947 *
	(1.71)	*(1.73)*	*(1.71)*	*(1.70)*	*(1.71)*	*(1.70)*
Log Relative ADTV (fund/portfolio) x $I_{premium}$	0.339	0.359	0.260	0.129	0.116	0.141
	(0.11)	*(0.12)*	*(0.09)*	*(0.04)*	*(0.04)*	*(0.05)*
Expenses/(Expenses+Distributions) x $I_{discount}$	-7.009 **	-6.684 **	-6.703 **	-7.020 **	-6.723 **	-6.693 **
	(-2.53)	*(-2.39)*	*(-2.42)*	*(-2.55)*	*(-2.42)*	*(-2.42)*
Expenses/(Expenses+Distributions) x $I_{premium}$	4.246	4.546	3.571	3.624	3.551	3.287
	(0.35)	*(0.36)*	*(0.29)*	*(0.29)*	*(0.27)*	*(0.25)*
Month Fixed Effects and Prem/Disc Dummy	Yes	Yes	Yes	Yes	Yes	Yes
N (fund-months)	3847	3847	3847	3847	3847	3847
Adjusted R^2	0.64	0.65	0.65	0.64	0.65	0.65

Heteroskedasticity-robust t-statistics clustered by fund in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 12: Time Series of Closed-End Fund Discounts vs. Disagreement

The dependent variable is the quarter-to-quarter change in the closed-end fund price to NAV premium (discount). Sum%Overlap is the sum across all parties (either 13F institutions or open-end funds) of the percent overlap that each such party has with the holdings of the closed-end fund (or some subset of these holdings, as indicated), subject to a minimum overlap of at least two underlying stocks. Portfolio Stocks Avg. Inst. Ownership is a weighted average of the overall 13F institutional ownership of the underlying stocks held by the closed-end fund. Log Relative ADTV is the log of the ratio of the average daily trading volume (ADTV) of the closed-end fund to the weighted average ADTV of its stockholdings for the 3 months prior to a given sample month. The first three columns measure disagreement based on the overlap of the closed-end fund holdings with the holdings of open-end funds, while the last three columns reflect holdings that overlap with the holdings of 13F institutions.

	Change in Premium / (Discount) to NAV (in percentage points)					
	Overlap with Open-End Fund Holdings			Overlap with 13F Institutional Holdings		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Sum%Overlap x $I_{discount}$	0.001	0.002	0.002	0.009 ***	0.010 ***	0.009 ***
	(0.88)	*(0.99)*	*(1.00)*	*(2.71)*	*(2.87)*	*(2.74)*
Δ Sum%Overlap x $I_{premium}$	0.011 **	0.010 **	0.007	0.029 **	0.025 **	0.019
	(2.11)	*(1.97)*	*(1.36)*	*(2.37)*	*(2.15)*	*(1.36)*
Δ Portfolio Stocks Avg. Inst. Ownership x $I_{discount}$	6.663		5.734	5.269		4.361
	(1.25)		*(1.07)*	*(1.01)*		*(0.85)*
Δ Portfolio Stocks Avg. Inst. Ownership x $I_{premium}$	-9.216		18.829	-11.146		15.789
	(-0.52)		*(1.30)*	*(-0.69)*		*(1.01)*
Δ Log Relative ADTV (fund/portfolio) x $I_{discount}$	0.966 **	1.234 **	1.271 **	0.875 *	1.143 **	1.177 **
	(2.00)	*(2.38)*	*(2.53)*	*(1.83)*	*(2.24)*	*(2.35)*
Δ Log Relative ADTV (fund/portfolio) x $I_{premium}$	-2.789 *	-2.637	-2.473	-2.598	-2.403	-2.326
	(-1.72)	*(-1.18)*	*(-1.09)*	*(-1.57)*	*(-1.05)*	*(-1.01)*
Δ Market Return (Value-Weighted)	23.590 ***	30.060 ***	29.955 ***	23.169 ***	29.528 ***	29.511 ***
	(9.73)	*(8.50)*	*(8.46)*	*(9.43)*	*(8.27)*	*(8.26)*
Δ NAV Return over Market Return (Value-Weighted)		16.756 ***	16.759 ***		16.492 ***	16.528 ***
		(2.83)	*(2.85)*		*(2.77)*	*(2.80)*
Beginning Premium Dummy	-2.549 ***	-2.449 ***	-2.447 ***	-2.682 ***	-2.562 ***	-2.523 ***
	(-5.67)	*(-5.60)*	*(-5.66)*	*(-5.92)*	*(-5.75)*	*(-5.62)*
Constant	0.397 ***	-34.454 ***	-34.473 ***	0.337 ***	-33.970 ***	-34.052 ***
	(3.08)	*(-2.80)*	*(-2.82)*	*(2.60)*	*(-2.75)*	*(-2.78)*
N	1632	1615	1615	1632	1615	1615
Adjusted R^2	0.13	0.15	0.15	0.13	0.15	0.15

Heteroskedasticity-robust t-statistics clustered by fund in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

A Appendix

In this appendix, I provide derivation details for equilibrium results referenced in Section 1 above. I also further examine the equilibrium prices in the bundled and unbundled economies, providing sets of sufficient (but not necessary) conditions for the price of the bundle in the bundled economy to be less than or equal to the sum of the prices of the two assets that are separately tradeable in the corresponding unbundled economy, and strictly less than the sum of these prices when short sales constraints are binding for at least one investor on only one of the two unbundled assets. In the absence of these conditions, there are situations that would give rise to the bundle price exceeding the price of the two standalone assets, and I will provide a numerical example to illustrate this possibility.

Throughout the appendix, assumptions A1-A9 from Section 1.1 and the notation of that section are maintained.

A.1 Equilibrium Prices without Bundling

In the unbundled equilibrium, investor k solves:

$$\max_{x_0^k, x^k} \left\{ x_0^k \mu_0 + \sum_i x_i^k \mu_i^k - \frac{\alpha^k}{2} \sum_i \sum_j x_i^k x_j^k \sigma_{ij}^k \right\} \tag{6}$$

subject to

$$x_0^k + \sum_i x_i^k p_i^k = z_0^k + \sum_i z_i^k p_i^k \tag{7}$$

and

$$x_i^k \geqslant c_i^k, i = 1, ..., N \tag{8}$$

Note that I have loosened the assumption of agreement on the variance-covariance matrix for now, but will re-introduce this assumption shortly. The objective function follows from constant absolute risk aversion and the multivariate normal distribution of asset payoffs.

The budget constraint in (7) is stated with equality given non-satiation. The short-sales constraints in (8) may vary by investor, with $c_i^k = -\infty$ in case of no limitations on short sales for this investor in this asset. Denoting the non-negative Lagrangean multipliers as θ^k, the shadow cost of the budget constraint, and λ_i^k, the shadow cost of each short-sales constraint, the first order conditions for the optimization problem are:

$$\frac{\delta L}{\delta x_i} = \mu_i^k - \alpha^k \sum_j x_j^k \sigma_{ij}^k - \theta^k p_i + \lambda_i^k = 0, i = 1, ..., N \tag{9}$$

$$\frac{\delta L}{\delta x_0} = \mu_0 - \theta^k = 0 \tag{10}$$

$$\frac{\delta L}{\delta \theta^k} = z_0^k + \sum_i z_i^k p_i^k - x_0^k - \sum_i x_i^k p_i^k = 0 \tag{11}$$

and the Kuhn-Tucker conditions

$$\lambda_i^k (x_i^k - c_i^k) = 0, \lambda_i^k \geqslant 0, x_i^k - c_i^k \geqslant 0 \tag{12}$$

Taking into account (10), (9) can be rewritten in matrix notation as

$$\alpha^k \Omega^k x^k = \mu^k - \mu_0 p + \lambda^k \tag{13}$$

Note that (11), the budget constraint, will be satisfied through the choice of x_0, since there are no restrictions on borrowing and lending. Thus, we can solve for equilibrium by setting the sum across individuals of the demand for risky assets equal to the aggregate supply of risky assets. The aggregate demand for the risky assets (based on the optimal individual quantities derived from (13)) is[15]

[15] The expression in (14) is not an explicit demand function because each λ^k is a function of the price vector, but it does usefully characterize demand for the exposition that follows.

$$\sum_k x^{k*} = \sum_k \left\{ \frac{1}{\alpha^k} \left[\Omega^k\right]^{-1} (\mu^k - \mu_0^k p + \lambda^k) \right\} \tag{14}$$

Since the aggregate supply of each risky asset was normalized to 1, setting the above equal to a vector of 1's and solving for prices gives us

$$p^* = \left[\sum_k \left\{ \frac{\mu_0}{\alpha^k} \left[\Omega^k\right]^{-1} \right\} \right]^{-1} \left[\sum_k \left\{ \frac{1}{\alpha^k} \left[\Omega^k\right]^{-1} (\mu^k + \lambda^k) \right\} - \mathbf{e}^1 \right] \tag{15}$$

For the special case of agreement on the payoff variance-covariance matrix, or $\Omega^k = \Omega$ for all k, (15) simplifies to

$$p^* = \left[\sum_k \frac{\mu_0}{\alpha^k} \right]^{-1} \left[\sum_k \left\{ \frac{1}{\alpha^k} (\mu^k + \lambda^k) \right\} - \Omega \mathbf{e}^1 \right] \tag{16}$$

or for an individual risky asset

$$p_j^* = \left[\sum_k \frac{\mu_0}{\alpha^k} \right]^{-1} \left[\sum_k \left\{ \frac{1}{\alpha^k} (\mu_j^k + \lambda_j^k) \right\} - \sum_i \sigma_{ij} \right] \tag{17}$$

As discussed in Section 1, these results are consistent with the finding by Jarrow (1980) that, with disagreement about risky asset payoffs but agreement on the variance-covariance matrix, the equilibrium price of an asset in the presence of short sales constraints is greater than or equal to the equilibrium price of that asset in the absence of such constraints, and is strictly greater when short sales are restricted as long as at least one investor faces a binding short sale constraint (that is, λ_j^k is positive for at least one investor). This conclusion does not follow in the case of generalized disagreement about the variance-covariance matrix because, in (15), the impact of the shadow costs in the expression for the price is ambiguous once they are multiplied by coefficients from the inverse variance-covariance matrices.[16]

[16] Jarrow (1980) shows that the conclusion is, however, robust to a special case in which there is disagreement about variances but the assets payoffs are uncorrelated with each other. This is not the case for our conclusions about the price effects of bundling and unbundling assets.

A.2 Equilibrium Prices with Bundling and Comparisons

The equilibrium from the unbundled case above can now be compared to the equilibrium in a market where risky assets 1 and 2 are joined in an inseparable bundle. As discussed above, the endowments and short sales constraints of these two assets were always held in proportion, $z_1^k = z_2^k$ and $c_1^k = c_2^k$, in order to ensure that this market is otherwise comparable to that in the unbundled case. The subscript b is used to denote variables in the bundled economy and the subscript u to denote variables in the unbundled economy (where any common parameters are not given a subscript). The subscript b is also used for the asset bundle comprised of one unit of asset 1 and one unit of asset 2 (so, e.g., $x_{bb}^k \equiv x_{1b}^k \equiv x_{2b}^k$).

First consider the case where investors agree on the variance-covariance matrix and there are no short-selling constraints, that is, $\Omega^k = \Omega$ and $c_i^k = -\infty$ for all k and all i. In this case, the unbundled market equilibrium prices are (as per (17) above, but without short-selling constraints):

$$p_{ju}^* = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \frac{\mu_j^k}{\alpha^k} - \sum_i \sigma_{ij}\right], j = 1, ..., N \tag{18}$$

while the prices in the bundled equilibrium can similarly be shown to be:

$$p_{bb}^* = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \frac{\mu_1^k + \mu_2^k}{\alpha^k} - \sum_i (\sigma_{i1} + \sigma_{i2})\right] \tag{19}$$

and

$$p_{jb}^* = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \frac{\mu_j^k}{\alpha^k} - \sum_i \sigma_{ij}\right], j = 3, ..., N \tag{20}$$

Comparing (18) and (19) we see that, in this case,

$$p_{bb}^* = p_{1u}^* + p_{2u}^*$$

so in the absence of short-sales constraints and when there is agreement on the variance-covariance matrix, there is no difference between the price of the bundle in the bundled equilibrium and the sum of the prices of the individual bundle components in the unbundled equilibrium. There are also no changes to the prices of any other assets.

Now we can introduce short sales constraints. Consider the case where $\Omega^k = \Omega$ and $c_i^k = 0$ for all k and i=1,...,N.[17] Then our bundled and unbundled prices are derived from (17) above to be

$$p_{ju}^* = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \left\{\frac{1}{\alpha^k}(\mu_j^k + \lambda_{ju}^k)\right\} - \sum_i \sigma_{ij}\right], j = 1, ..., N \tag{21}$$

$$p_{bb}^* = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \left\{\frac{1}{\alpha^k}(\mu_1^k + \mu_2^k + \lambda_{bb}^k)\right\} - \sum_i (\sigma_{i1} + \sigma_{i2})\right] \tag{22}$$

$$p_{jb}^* = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \left\{\frac{1}{\alpha^k}(\mu_j^k + \lambda_{jb}^k)\right\} - \sum_i \sigma_{ij}\right] j = 3, ..., N \tag{23}$$

This time, from (21) and (22) we have

$$p_{bb}^* - (p_{1u}^* + p_{2u}^*) = \left[\sum_k \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_k \left\{\frac{\lambda_{bb}^k - (\lambda_{1u}^k + \lambda_{2u}^k)}{\alpha^k}\right\}\right] \tag{24}$$

A.3 Sufficient Conditions for Non-Negative Price Impact of Unbundling

Conditions that limit the second order effect of rebalancing portfolios due to bundling or unbundling (namely, the changes in prices of assets that are outside of the bundle, due to rebalancing related to changing holdings of the bundle assets but in the face of short sales constraints on these non-bundle assets, which cause secondary impacts on the prices of the bundle assets) can guarantee a non-negative price impact of unbundling. I will provide two sets of such sufficient conditions. While they are somewhat restrictive, it is important to note

[17] The assumption that all investors face short sales restrictions on all risky assets ($c_i^k = 0$ for all k and i=1,...,N) can be relaxed as long as at least one of the investors has a short sale constraint (which may be a limit on the amount of short-selling rather than a restriction from short-selling) that binds on one of the two unbundled assets but not the other such asset.

that these are sufficient but not necessary conditions, and they are intended to illustrate the channel that must be limited in order to result in a non-negative price impact of unbundling.

The following notation will identify the investor groups presented in Section 1.2: (i) θ_b encapsulates groups 1, 2, and 3 as defined in Section 1.2, and is the set of investors who hold the bundle in the bundled economy (and who may hold some or none of assets 1 and 2 in the unbundled economy); (ii) $\theta_{0,0}$ represents group 4 as defined previously, and is the set of investors who do not hold the bundle or its component assets; and (iii) $\theta_{0,1}$ and $\theta_{0,2}$ are two subgroups of group 5 as defined previously, specifically the sets of investors who do not hold the bundle but hold either asset 1 or asset 2 (respectively) in the unbundled economy. The group θ_0 is the union of the groups in (ii) and (iii).

Also, define the incremental hedge portfolio, consisting of assets in set Φ where assets outside of this set are assumed to be held constant (hence it is an "incremental" hedge), for assets $i = 1, 2$ as $h^i_{[\Phi]}$. For Φ consisting of assets 3 to N (assets outside of the bundle), these incremental hedge portfolios are thus denoted $h^1_{[3-N]}$. and $h^2_{[3-N]}$. Given the optimality condition from equation 2.8, the elements of these hedge portfolios must satisfy

$$\sum_j \sigma_{jm} \Delta x_j = 0, m > 2 \tag{25}$$

Solving the N-2 equations in (25) for Δx_j, $j > 2$, (that is, the elements of the hedge portfolio) gives

$$\Delta x_{[3-N]} = h^i_{[3-N]} \Delta x_i = -\Omega^{-1}_{[3-N]} \sigma_{[i,3-N]} \Delta x_i, i = 1, 2 \tag{26}$$

where $\Omega_{[3-N]}$ is the submatrix of Ω excluding the first two rows and columns, and $\sigma_{[i,3-N]}$ is the subvector of covariances of asset i (with assets 3 through N). Note that a hedge portfolio is the same for all investors since there is agreement on the variance-covariance matrix. The element of the portfolio corresponding to asset j will be denoted as $h^i_{[\Phi]}(j)$, and an asset j will be said to be part of a hedge portfolio if $h^i_{[\Phi]}(j) \neq 0$.

Assume that an investor starts with an optimal portfolio (satisfying the first order conditions from equation (13)) and then changes his holdings of assets 1 and 2 by Δx_1 and Δx_2 (e.g., in response to a change in constraints). Importantly, the incremental hedge portfolios $h^i_{[3-N]}$ are defined such that changing his holdings of assets 3 to N as suggested by the two incremental hedge portfolios will then result in a new portfolio that again satisfies the first order conditions from (13) as long as the prices and shadow costs associated with assets 3 to N do not change. I will apply this property when considering the propositions that follow.

Proposition 1. If (i) there are no investors in sets $\theta_{0,1}$ and $\theta_{0,2}$ and (ii) the short-sale constraint is never (in the bundled or unbundled equilibrium) binding for $k \in \theta_b$with respect to assets that are part of either or both of $h^1_{[3-N]}$ and $h^2_{[3-N]}$, then $p^*_{bb} \leq (p^*_{1u} + p^*_{2u})$. Further, if short sales constraints bind on one of the assets 1 or 2 in the unbundled economy for at least one individual in θ_b, then $p^*_{bb} < (p^*_{1u} + p^*_{2u})$.

Proof: Let each investor hold their optimal quantity of the bundle in the bundled equilibrium,

$$x^k_{bb} = x^{k*}_{bb}, k = 1, ...K \tag{27}$$

It can be shown that the prices and shadow costs of assets 3 to N are the same in the bundled and unbundled economies given assumptions (i) and (ii) of the proposition. By definition of the incremental hedge portfolios, the optimal quantities of each other asset i held by each investor in the bundled economy are then

$$x^{k*}_{ib} = x^{k*}_{iu} + h^1_{[3-N]}(i) \left[x^{k*}_{bb} - x^{k*}_{1u}\right] + h^2_{[3-N]}(i) \left[x^{k*}_{bb} - x^{k*}_{2u}\right], i > 2, k = 1, ...K \tag{28}$$

Given these optimal quantities, and assumptions (i) and (ii), it can be shown that the equilibrium prices in the bundled economy (relative to the prices in the unbundled economy) are then

$$p^*_{ib} = p^*_{iu}, i > 2 \tag{29}$$

and

$$p^*_{bb} = [p^*_{1u} + p^*_{2u}] + \left[\sum_{k\in\theta_b} \frac{\mu_0}{\alpha^k}\right]^{-1} \left[\sum_{k\in\theta_b} \left\{\frac{\lambda^k_{bb} - (\lambda^k_{1u} + \lambda^k_{2u})}{\alpha^k}\right\}\right] \tag{30}$$

where the shadow costs are given by

$$\lambda^k_{ib} = \lambda^k_{iu}, i > 2, k = 1, ...K \tag{31}$$

$$\lambda^k_{bb} = 0, k \in \theta_b \tag{32}$$

$$\lambda^k_{bb} = \lambda^k_{1u} + \lambda^k_{2u} + \mu_0 \left[p^*_{bb} - (p^*_{1u} + p^*_{2u})\right], k \in \theta_{0,0} \tag{33}$$

Note that (31) and (32) are used to evaluate the expression in (30), which is then used to evaluate (33).[18]

Finally, given (32) and the non-negativity of shadow costs, (30) implies that $p^*_{bb} \leq (p^*_{1u} + p^*_{2u})$. Further, if short sales constraints bind on one of the assets 1 or 2 in the unbundled economy for at least one individual in θ_b, then there would be some positive λ^k_{1u} and/or λ^k_{2u} for at least one individual in θ_b, and therefore (30) would imply $p^*_{bb} < (p^*_{1u} + p^*_{2u})$.

Proposition 2. If (i) asset 2 is not part of the hedge portfolio for asset 1 and vice versa, that is $h^1_{[2-N]}(2) = 0$ and $h^2_{[1,3-N]}(1) = 0$ and (ii) the short-sale constraint is never (in the bundled or unbundled equilibrium) binding for $k \in [\theta_b, \theta_{0,1}, \theta_{0,2}]$ with respect to assets that are part of either or both of $h^1_{[3-N]}$ and $h^2_{[3-N]}$, then $p^*_{bb} \leq (p^*_{1u} + p^*_{2u})$. Further, if (i) at least one of $\theta_{0,1}$ or $\theta_{0,2}$ is non-empty or if short sales constraints bind on one of the assets 1 or 2 in the unbundled economy for

[18] Also note that combining (30) and (33) gives us equation (24) from earlier.

at least one individual in θ_b, then $p^*_{bb} < (p^*_{1u} + p^*_{2u})$.

Proof: First consider an additional, modified unbundled economy, identified by a subscript m. In this economy, additional constraints restricting holdings of assets 1 and 2 to zero are imposed on individuals who do not hold the bundle in the bundled economy. Thus, the additional constraints are:

$$x^k_i \leq 0, i \in (1,2), k \in \theta_0 \tag{34}$$

Applying Proposition 1,[19] we have

$$p^*_{bb} \leq (p^*_{1m} + p^*_{2m}) \tag{35}$$

It remains to compare the prices in the unbundled economy to those in the modified unbundled economy. Let each investor hold their optimal quantity of assets 1 and 2 in the unbundled equilibrium:

$$x^k_{iu} = x^{k*}_{iu}, i \in (1,2), k = 1, ...K \tag{36}$$

It can be shown that the prices and shadow costs of assets 3 to N are the same in the unbundled and modified unbundled economies given assumption (ii) of the proposition. Thus, by definition of the incremental hedge portfolios, the optimal quantities of each other asset i held by each investor in the unbundled economy, relative to their optimal holdings in the modified unbundled economy, are then

$$x^{k*}_{iu} = x^{k*}_{im} + h^1_{[3-N]}(i)\left[x^{k*}_{1u} - x^{k*}_{1m}\right] + h^2_{[3-N]}(i)\left[x^{k*}_{2u} - x^{k*}_{2m}\right], i > 2, k = 1, ...K \tag{37}$$

where the hedge portfolios applying to assets 3 to N can be used because assumption (i) of

[19]The proof of Proposition 1 can be adapted to this situation by reflecting the shadow costs of the new constraints. That is, for those individuals $k \in \theta_0$ for whom one of the new constraints from (34) is binding, the corresponding λ^k_{iu} in (33) is replaced by $-\delta^k_{iu}$. The conclusions are unchanged.

the proposition precludes assets 1 or 2 from appearing in the hedge portfolios of each other.

Given these optimal quantities, and assumptions (i) and (ii), it can be shown that the equilibrium prices in the bundled economy (relative to the prices in the unbundled economy) are then

$$p^*_{iu} = p^*_{im}, i > 2 \tag{38}$$

and

$$p^*_{iu} = p^*_{im} + \left[\sum_{k \in (\theta_b, \theta_{0,i})} \frac{\mu_0}{\alpha^k} \right]^{-1} \left[\sum_{k \in \theta_b} \left\{ \frac{\lambda^k_{iu} - \lambda^k_{im}}{\alpha^k} \right\} + \sum_{k \in \theta_{0,i}} \left\{ \frac{\delta^k_{im}}{\alpha^k} \right\} \right], i \in (1,2) \tag{39}$$

where the shadow costs are given by

$$\lambda^k_{iu} = \lambda^k_{im}, i > 2, k = 1, ...K \tag{40}$$

$$\lambda^k_{iu} \geq \lambda^k_{im}, i \in (1,2), k \in \theta_b \tag{41}$$

$$\lambda^k_{iu} = 0, i \in (1,2), k \in \theta_{0,i} \tag{42}$$

$$\lambda^k_{iu} = \lambda^k_{im} + \mu_0 \left[p^*_{iu} - p^*_{im} \right], \begin{cases} i = 1, k \in [\theta_{0,0}, \theta_{0,2}] \\ i = 2, k \in [\theta_{0,0}, \theta_{0,1}] \end{cases} \tag{43}$$

Given (41) and the non-negativity of shadow costs, (39) implies that $p^*_{iu} \geq p^*_{im}$ for each of $i \in (1,2)$ which combined with (30) means that $p^*_{bb} \leq (p^*_{1u} + p^*_{2u})$. Further, if (i) at least one of $\theta_{0,1}$ or $\theta_{0,2}$ is non-empty or if short sales constraints bind on one of the assets 1 or 2 in the unbundled economy for at least one individual in θ_b, then there would be some positive λ^k_{1u} or λ^k_{2u} for some individual in θ_b or some positive δ^k_{im} for some individual in $\theta_{0,1}$ or $\theta_{0,2}$, and therefore (30) and (39) would imply $p^*_{bb} < (p^*_{1u} + p^*_{2u})$.

A.4 Numerical Example of Negative Price Impact of Unbundling

I provide a numerical example to demonstrate that, in the absence of the conditions set forth in Proposition 1 or Proposition 2 (or other sets of sufficient conditions), there exist situations that would give rise to the bundle price exceeding the price of the two standalone assets because of the second order price effects discussed above.

The parameters in the unbundled economy are as follows.

$$\mu_0 = 1$$

$$\alpha^k = 1, k = 1, ...3$$

$$\mu^{1'} = \begin{bmatrix} 0 & 0 & 20 \end{bmatrix}$$

$$\mu^{2'} = \begin{bmatrix} 20 & 19.5 & 0 \end{bmatrix}$$

$$\mu^{3'} = \begin{bmatrix} 19.5 & 20 & 20 \end{bmatrix}$$

$$\Omega = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$$

$$\overline{z}' = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$$

Also, all three investors are restricted from short selling any of the risky assets, that is:

$$c^{k'} = \begin{bmatrix} 0 & 0 & 0 \end{bmatrix}, k = 1, ...3$$

For the bundled economy, the bundle parameters are therefore:

$$\mu^1_b = 0$$

$$\mu_b^2 = 39.5$$

$$\mu_b^3 = 39.5$$

$$\sigma_{bb} = 6$$

$$\sigma_{b3} = 1$$

$$\overline{z}_b = 1$$

$$c_b^k = 0, k = 1, ...3$$

Given these parameters, the equilibrium prices and quantities can be calculated numerically. The unbundled equilibrium is given by:

$$p_u^{*'} = \begin{bmatrix} 18.011363 & 18.25 & 18.954546 \end{bmatrix}$$

$$x_u^{1*'} = \begin{bmatrix} 0 & 0 & 0.522727 \end{bmatrix}$$

$$x_u^{2*'} = \begin{bmatrix} 0.909091 & 0.170455 & 0 \end{bmatrix}$$

$$x_u^{3*'} = \begin{bmatrix} 0.090909 & 0.829545 & 0.477272 \end{bmatrix}$$

$$\lambda_u^{1'} = \begin{bmatrix} 18.534090 & 18.249999 & 0 \end{bmatrix}$$

$$\lambda_u^{2'} = \begin{bmatrix} 0 & 0 & 19.863637 \end{bmatrix}$$

$$\lambda_u^{3'} = \begin{bmatrix} 0 & 0 & 0 \end{bmatrix}$$

The bundled equilibrium is given by:

$$p_{bb}^* = 36.308511, p_{3b}^* = 18.765958$$

$$x_{bb}^{1*} = 0, x_{3b}^{1*} = 0.617021$$

$$x_{bb}^{2*} = 0.531915, x_{3b}^{2*} = 0$$

$$x_{bb}^{3*} = 0.468085, x_{3b}^{3*} = 0.382979$$

$$\lambda_{bb}^{1} = 36.925532, \lambda_{3b}^{1} = 0$$

$$\lambda_{bb}^{2} = 0, \lambda_{3b}^{2} = 19.297873$$

$$\lambda_{bb}^{3} = 0, \lambda_{3b}^{3} = 0$$

The optimality of the solutions can be confirmed by applying the equilibrium price and quantity equations for the bundled and unbundled economies from Section 1. Notice that the short sale constraint on asset 3, which is part of the hedge portfolio for assets 1 and 2, is always binding for investor 2, who holds the bundle in the bundle equilibrium (and is thus in θ_b). This causes condition (ii) of Proposition 1 to be violated, so that proposition does not guarantee that the bundle price will be no larger than the sum of the prices of assets 1 and 2 above. In fact,

$$36.308511 = p_{bb}^{*} > p_{1u}^{*} + p_{2u}^{*} = 18.011363 + 18.25 = 36.261363$$

so the given parameters lead to a negative price impact of unbundling. Notice that investors 2 and 3, who hold the bundle in the bundle equilibrium, each continue to hold positive quantities of both assets 1 and 2 in the unbundled equilibrium. The fact that the short sales constraints on these individual assets are not binding for those investors who are constrained by the requirement to hold the bundle assets in proportion in the bundle equilibrium means that the primary price impact of disagreement and the related reshuffling of holdings is zero. This allows the secondary price impact, which results from the movement of the price of asset 3 and happens to be negative in this case, to dominate in this situation.