Financing Through Asset Sales *

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Abstract

Most research on firm financing studies debt versus equity issuance. We model an alternative source, non-core asset sales, and identify three new factors that contrast it with equity. First, unlike asset purchasers, equity investors own a claim to the firm's balance sheet (the "balance sheet effect"). This includes the cash raised, mitigating information asymmetry. Contrary to the intuition of Myers and Majluf (1984), even if non-core assets exhibit less information asymmetry, the firm issues equity if the financing need is high. Second, firms can disguise the sale of low-quality assets – but not equity – as motivated by dissynergies (the "camouflage effect"). Third, selling equity implies a "lemons" discount for not only the equity issued but also the rest of the firm, since both are perfectly correlated (the "correlation effect"). A discount on assets need not reduce the stock price, since non-core assets are not a carbon copy of the firm.

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One of a firm's most important decisions is how to raise capital. Most research focuses on the choice between debt and equity. For example, the pecking-order theory of Myers and Majluf (1984, "MM") posits that managers issue securities with least information asymmetry, while the market timing theory of Baker and Wurgler (2002) suggests that managers sell securities that are most overvalued. However, another major source of financing is relatively unexplored: selling non-core assets, such as divisions or physical capital. Asset sales are substantial in practice: Securities Data Corporation ("SDC") records \$131bn of asset sales by non-financial firms in the U.S. in 2012, versus \$81bn in seasoned equity issuance. Eckbo and Kisser (2014) find that illiquid asset sales are as large as the combined proceeds of equity and debt issuance; they argue that "the prominence of illiquid asset sales challenges the traditional financing pecking order."

While some asset sales may be motivated by operational reasons, financing is a key driver of many others. Asset sales are used to fund investment and R&D (shown by Hovakimian and Titman (2006) and Borisova and Brown (2013) respectively), to recapitalize in response to regulatory or investor concerns (as with many banks after the financial crisis), and to address one-time cash needs (BP targeted \$45bn in asset sales to cover the costs of Deepwater Horizon). More generally, Borisova, John, and Salotti (2013) find that over half of asset sellers state financing motives. Campello, Graham, and Harvey (2010) report that 70% of financially constrained firms increased asset sales in the financial crisis, versus 37% of unconstrained firms. In all of these cases, the firm could have presumably met its financing needs by issuing securities, but instead chose to sell assets. Indeed, Hite, Owers, and Rogers (1987) examine the stated motives for asset sales and note that "in several cases ... selling assets was viewed as an alternative to the sale of new securities."

This paper's goal is to analyze the factors that determine whether firms raise capital through selling assets rather than issuing securities. It may seem that asset sales can already be analyzed by extending the MM intuition from security issuance to asset sales, removing the need for a new theory. Such an extension would suggest that selling non-core assets is preferred if and only if they exhibit less information asymmetry than the firm's total assets, which underlie firm-level securities such as debt and equity. While information asymmetry about assets-in-place remains important, there are two critical differences between assets and securities which mean that asset sales cannot be studied within the MM framework. First, a purchaser of non-core assets obtains a claim to the assets alone, whereas a purchaser of securities owns a claim to the firm's entire balance sheet. Second, the sale of non-core assets – but not securities – may be motivated by dissynergies rather than private information. These two differences in turn lead to three new forces that drive the choice between asset sales and security issuance, that may outweigh information asymmetry concerns and are the core contribution of the paper. In turn, the strength of these forces depends on various factors, such as the amount of financing required, the use of proceeds, the range of potential synergies, the correlation structure of the firm's assets, and the manager's stock price concerns, thus giving rise to a rich set of empirical predictions.

We analyze a firm that comprises a core asset and a non-core asset, and has a financing need that it can meet by either selling part of the non-core asset, or issuing a security against its balance sheet. For simplicity this security is equity, but Appendix B shows that the same insights apply to debt. The firm's type is privately known to its manager and comprises two dimensions. The first is quality, which determines the assets' standalone (common) values. Firms with high-quality core assets may have either high- or low-quality non-core assets. We analyze both possibilities, labeling them the positive- and negative-correlation cases, respectively. The second dimension is synergy, which captures the additional (private) value lost when the non-core asset is separated from its current owner. Thus, our model allows firms to sell assets not only for financing reasons, but also for operational reasons (dissynergies). The model is tractable even allowing for two dimensions of private information (quality and synergy), which typically makes a signaling model difficult to solve.

The first of our three new forces is the *balance sheet effect*, which represents an advantage to selling equity, and its strength depends on the amount of financing required and the use of proceeds. It stems solely from the first difference between assets and equity. New shareholders obtain a stake in the firm's entire balance sheet, which includes not only the core and non-core assets in place (whose values are unknown), but also the funds raised. Since the value of the funds raised is known, this mitigates the information asymmetry of assets in place. In contrast, asset purchasers obtain a claim to the asset alone, and not the entire balance sheet and thus the funds raised. As a result, even if the non-core asset exhibits less information asymmetry than the firm's total assets – and so the MM intuition would suggest that firms sell non-core assets – equity may exhibit less information asymmetry, and thus be preferred, if enough funds are raised that the balance sheet effect dominates.

Thus, the source of financing depends on the amount required: larger (smaller) amounts encourage the sale of equity (assets). This contrasts standard financing models, in which the choice of financing depends only on the characteristics of each claim (such as its information asymmetry (MM) or misvaluation (Baker and Wurgler 2002) and not the amount required – unless one assumes exogenous limits such as debt capacity. The balance sheet effect does not appear in MM, since all claims (debt and equity) are on the balance sheet.

The initial analysis considers any use of funds whose expected value is uncorrelated with firm quality, e.g. replenishing capital, repaying debt, or paying suppliers. We also allow the funds to finance an investment whose expected return is correlated with firm quality, and thus exhibits information asymmetry. One might expect the balance sheet effect to weaken, since risky investment makes the balance sheet (and thus equity) riskier. However, there is a second effect: since investment is positive-NPV, the certain (i.e. quality-independent) component of the value of the injected funds rises. If the minimum investment return (earned by the low-quality firm) is large compared to the additional return earned by the high-quality firm, this second effect dominates and the balance sheet effect strengthens. Thus, equity is more common when growth opportunities are good for firms of all quality (e.g. in booms): the source of financing depends on the use of proceeds. If the additional return earned by the high-quality firm is large, the first effect dominates and the balance sheet effect weakens. However, it almost always remains positive: asset (equity) sales continue to be used for low (high) financing needs.

The second new force is the *correlation effect*, which represents an advantage to selling assets, and its strength depends on the correlation structure of the firm's balance sheet and the manager's stock price concerns (which are absent in MM). It also stems solely from the first difference between assets and securities – the purchaser of assets acquires a claim to assets alone, and not the firm, and so the value of this claim need not be positively correlated with the firm. An equity issuer suffers an Akerlof (1970) "lemons" discount on not only the equity issued, but also the rest of the firm because the two are perfectly correlated – equity is a claim on the firm, and is in fact a carbon copy of it. Thus, its stock price falls. An asset seller similarly receives a low price on the assets sold, but not necessarily the firm, since it is not a carbon copy. For example, companies often shed their original lines of business after they have become non-core.[1] Non-core business lines are not necessarily safer than the rest of the firm, but may have low correlation – while their sale is a negative signal about the divested assets, it may be a positive signal about the retained ones. The magnitude of this advantage is increasing in the manager's stock price concerns. Note that the correlation effect does not require the core and non-core asset to be negatively correlated; it can exist even if the correlation is strictly positive. The crux is that equity has a correlation of 1 with the firm, so a low price for equity issued automatically implies a low price for the rest of the firm. However, a non-core asset may have a correlation of less than 1, even if the correlation is still positive, since it is not a claim on the firm's balance sheet.

An implication of the correlation effect is that conglomerates issue equity less often, and sell assets more often, than firms with closely related divisions, since they are more likely to have lowly-correlated assets. It also gives rise to a novel benefit of diversification: a non-core asset is a form of financial slack. While the literature on investment reversibility (e.g., Abel and Eberly 1996) models reversibility as a feature of the asset's technology, here an investment that is not a carbon copy of the firm is "reversible" in that it can be sold without negative inferences on the stock price.

The third new force is the *camouflage effect*, which also represents an advantage to selling assets, and its strength depends on the firm's actual level of synergy and the range of potential synergies in the economy. It stems solely from the second difference between assets

[1] Examples include the sale of Interlake's steel business in favor of its aerospace business, GE's appliance and finance businesses in favor of its industrials business, and Pearson's Financial Times and its stake in The Economist in favor of its education business. See Feldman (2014) for a systematic study.

and securities – that the sale of the former may be motivated by dissynergies. Conglomerates often shed non-core assets stating a desire to refocus on the core business, but outsiders do not know if the true motivation is that the non-core assets were low-quality. (The balance sheet and correlation effects do not require synergies, but they are robust to the inclusion of synergies). The effect arises if firms have the option not to raise financing and instead to forgo a growth opportunity. If the growth opportunity is weak, it is outweighed by the losses that high-quality firms would suffer from issuing equity, and so they will not issue equity. However, high-quality firms will sell assets if they are sufficiently dissynergistic, not so much to finance growth but to get rid of dissynergies. Asset sales by high-quality firms allow low-quality firms to pool: they can camouflage an asset sale driven by overvaluation (the asset is low-quality and has a low common value) as instead being driven by operational reasons (it is dissynergistic and only has a low private value).

Note that *any* non-informational motive allows a seller to "camouflage" an overvalued claim. For example, in MM, firms can issue overvalued equity and claim that it is to finance investment. However, this motive can be used to disguise both asset sales and equity issuance, and so does not affect the choice between them. We use the term "camouflage effect" to refer not to general non-informational motives (which arise in other models and apply to both assets and equity), but specifically to the camouflage provided by dissynergy motives, which apply only to asset sales and is unique to this paper. When growth opportunities are strong, high-quality firms sell both assets and equity to finance growth; since both financing channels offer "camouflage," low-quality firms have no clear preference for either. When growth opportunities are weak, the only non-informational motive to issue claims is dissynergies. This motive exists only for assets and not equity, and so only assets provide camouflage. Thus, low-quality firms strictly prefer asset sales: indeed, they will sell assets even if they are synergistic.

While our model explicitly studies selling equity versus assets, it can be interpreted more broadly as studying at what *level* to issue claims: the firm level (equity issuance) or the asset level (asset sales). Our effects also apply to other *types* of claim that the firm can issue at each level.[2] All three effects apply to parent-company risky debt (or general securities issued against the firm's balance sheet, as analyzed by DeMarzo and Duffie 1999) in the same way as parent-company equity: since parent-company debt is also a claim to the entire firm, it benefits from the balance sheet effect but not the correlation effect (debt is positively correlated with firm value) nor the camouflage effect (issuing debt cannot be camouflaged by the desire to remove dissynergies). We analyze debt explicitly in Appendix B. Since our focus is on the level of claim rather than the type of claim, we study the

[2] The securitization literature (e.g. DeMarzo and Duffie 1999, DeMarzo 2005) studies the *type* of claim that a firm should issue, in contrast to our focus on the *level* of claim. In DeMarzo and Duffie (1999), all claims are against the firm's balance sheet. In DeMarzo (2005), all claims are at the asset level. Even if a claim is securitized against multiple assets, it is backed only by those assets and not by the funds injected, so there is no balance sheet effect.

firm's choice between standard claims (assets, equity, and, in an extension, debt) rather than taking general security design approach. This allows us first to focus on the core contribution of the paper, and second to simplify the model, in turn enabling us to solve a two-dimensional adverse selection problem in a tractable manner.

Existing theories of asset sales generally consider asset sales as the only source of financing and do not compare them to equity, e.g., Shleifer and Vishny (1992), Eisfeldt (2004), DeMarzo (2005), He (2009), and Kurlat (2013). In Milbradt (2012) and Bond and Leitner (2015), the firm only owns one type of asset and so there is no distinction between selling assets and equity. A partial asset sale affects the mark-to-market price of the seller's remaining portfolio, similar to our correlation effect. Here, the firm has other (core) assets in addition to the ones under consideration for sale. Thus, we show that the correlation effect is stronger for equity: while a partial asset sale implies a negative valuation of the remaining unsold non-core assets, it need not imply a negative valuation of the core assets and thus the firm. Nanda and Narayanan (1999) also consider both asset sales and equity issuance under information asymmetry, but do not feature the balance sheet, correlation, or camouflage effects. In their model, information asymmetry only exists under negative correlation, and there is no correlation effect because the manager has no stock price concerns. Arnold, Hackbarth, and Puhan (2017) study the choice between asset sales and equity issuance to overcome debt overhang, rather than information asymmetry and the pecking order.[3]

While we show that the MM pecking order intuition cannot be naturally extended to the choice between asset sales and equity, Nachman and Noe (1994) show that the original pecking order (between debt and equity) only holds under special conditions. Fulghieri, Garcia, and Hackbarth (2016) demonstrate that these conditions are particularly likely to be violated for younger firms with larger investment needs and riskier growth opportunities, where equity is indeed preferred to debt empirically.

In addition to the applied implications for asset sales, our paper makes a theoretical contribution by solving a multi-dimensional information asymmetry problem in a tractable manner. We avoid the considerable technical difficulties that typically arise in models of multi-dimensional information asymmetry, as discussed in Kreps and Sobel (1994), Armstrong and Rochet (1999), and Rochet and Stole (2003), because the expected value of the asset to the uninformed party depends only on quality and not synergy, even though both dimensions affect the value of the asset sale to the informed party. Guerrieri and Shimer (2015), Williams (2016), and Chang (2017) similarly study multi-dimensional signaling models in which one dimension of private information only affects the seller's private value. This dimension is the seller's impatience, which always leads him to wish to sell the

[3]Empirically, Jain (1985), Klein (1986), Hite, Owers, and Rogers (1987), Slovin, Sushka, and Ferraro (1995), and Feldman (2014) find positive market reactions to asset sales. Lang, Poulsen, and Stulz (1995) show that this positive reaction stems from financing rather than operational reasons. Brown, James, and Mooradian (1994) and Bates (2006) examine the use of proceeds. Maksimovic and Phillips (2001) and Eisfeldt and Rampini (2006) analyze operational rather than financing motives.

asset, whereas synergy in our model can be positive or negative. The applications of the models are quite different: the above papers consider a single asset and a search framework, where trade happens probabilistically and the probability of trading is a key dimension on which different types can separate. Our model studies multiple assets and the choice is on the type of claim rather than probability of sale. To our knowledge, ours is the first model to solve a signaling problem with multi-dimensional information asymmetry where trade happens with certainty. Such a framework is applicable to settings in which the seller must satisfy a liquidity need, although it can also apply to the case of voluntary capital raising.

1 Baseline Model

The model consists of two types of risk-neutral agent: firms, which raise financing, and investors, who provide financing and set prices. The firm is run by a manager, who has private information about the firm's quality $q \in \{H, L\}$, which measures the standalone (common) value of its assets. The prior probability that $q = H$ is $\pi \in (0, 1)$. In Section 2 we will introduce a second dimension to firm type, synergy, which measures the (positive or negative) additional private value of the asset.

The firm comprises two assets or lines of business. The core business has value C_q, where $C_H > C_L$, and the non-core business has value A_q. Where there is no ambiguity, we use the term "assets" to refer to the non-core business. We consider two specifications of the model. If $A_H > (<) A_L$, the two assets are positively (negatively) correlated. (If $A_H = A_L$, the non-core asset exhibits no information asymmetry and so it is automatic that firms will raise financing by selling it.) In both cases, we assume:

$$C_H + A_H > C_L + A_L, \tag{1}$$

so H has a higher total value even if $A_H < A_L$. The distinction between $A_H > A_L$ and $A_H < A_L$ reflects that it is not only the information asymmetry of the non-core asset that matters ($|A_H - A_L|$), as in MM, but also its correlation with the core asset ($sign\,(A_H - A_L)$).[4]

We consider an individual firm that raises financing of F. In Section 1, the firm is forced to raise financing (e.g. to meet an exogenous liquidity need), and the funds raised increase expected firm value by F. This treatment incorporates many capital raising motives, such as retaining cash to replenish capital or for precautionary reasons; repaying debtholders or suppliers; or meeting one-time cash needs such as litigation expenses.[5] Section 2 gives firms

[4] He (2009) considers a different multiple-asset setting where the value of each asset comprises a component known to the seller, and an unknown component. The (known) correlation refers to the correlation between the unknown components; here it refers to the correlation between the total values of the assets (which are known to the seller). His model considers asset sales but not equity issuance.

[5] Consistent with the first motive, Kim and Weisbach (2008) and McLean (2011) find that stockpiling cash for precautionary motives is the largest use of seasoned equity issues. Consistent with the second and third motives, DeAngelo, DeAngelo, and Stulz (2010) find that a near-term cash need is the primary motive

the choice of whether to raise financing, and also allows the cash to be used to finance an investment whose return is correlated with q and thus exhibits information asymmetry.

The firm can raise F by selling either non-core assets or equity; partial asset sales are possible. Formally, it issues a claim $X \in \{E, A\}$, where E represents equity and A assets. Investors are perfectly competitive and price both the claim being sold and the firm's stock at their expected values conditional upon X. The firm cannot sell the core asset as it is essential to the firm; Appendix D relaxes this assumption.

Appendix B allows the firm to issue risky debt and shows that the same balance sheet, correlation, and camouflage effects apply to risky debt as well as equity. Since the analysis of risky debt requires us to complicate the model by introducing risk, we do not include it in the core model (as in MM). Instead, when the core model delivers each of the three effects for equity, we discuss the intuition for why they also apply to debt.

Firms cannot raise financing in excess of F; this assumption can be justified by forces outside the model such as agency costs of free cash flow. Firms use a single source of financing; Appendix E shows that the equilibria continue to hold when firms are allowed to use a combination of both sources. We specify $F \leq \min(A_L, A_H)$, so that asset sales are feasible for any F; this ensures that there is no mechanical link between the amount of financing required and the source of financing. We abstract from differences between asset sales and equity issuance due to frictions such as taxes, transactions costs, liquidity, and bargaining power, because they will have obvious effects: the firm will lean towards the financing source that exhibits the weakest frictions.

The financing choice affects the firm's fundamental value, because it will enjoy a capital gain (loss) if the claim is overvalued (undervalued). It will also affect the firm's stock price as the market will infer firm quality from the choice of claim issued. The manager places weight ω on the firm's stock price and $1 - \omega$ on its fundamental value.[6] These concerns are common in the signaling literature and can stem from a number of sources. Examples include takeover threat (Stein 1988), reputational concerns (Narayanan 1985, Scharfstein and Stein 1990), the manager maximizing value on behalf of shareholders who may sell before fundamental value is realized (Miller and Rock 1985), or the manager expecting to sell his own shares before fundamental value is realized (Stein 1989).[7]

We solve for pure strategy equilibria.[8] We use the Perfect Bayesian Equilibrium solution

for seasoned equity issues, and that the majority of issuers would have run out of cash without the issue; the introduction cites several papers showing that cash needs motivate asset sales.

[6]The stock price is the firm's expected value based on public information, while fundamental value is based on the manager's private information. Both are calculated from the perspective of existing shareholders and are thus net of financing costs (e.g. claims given to new shareholders).

[7]Gopalan, Milbourn, Song, and Thakor (2014), Edmans, Fang, and Lewellen (2017), and Edmans, Goncalves-Pinto, Groen-Xu, and Wang (2017) show that managers typically have significant equity vesting in the short-term.

[8]Mixed strategy equilibria only exist for the type that is exactly indifferent between the two claims. Since synergies are continuous, this type is atomistic and so it does not matter for posterior beliefs whether

concept, where: (i) Investors have a belief about which firm types issue which claim X; (ii) The price of the claim being issued equals its expected value, conditional on investors' beliefs in (i); (iii) Each manager issues the claim X that maximizes his objective function, given investors' beliefs; (iv) Investors' beliefs satisfy Bayes' rule; (v) Beliefs on off-equilibrium actions are consistent with the D1 refinement of Banks and Sobel (1987) and Cho and Kreps (1987). For an off-equilibrium action, D1 precludes putting any weight on a type for which the set of beliefs that would induce deviation to that action are a strict subset of that for a different type. Specifically, if the set of prices for claim X that would induce L to deviate to X are a strict subset of that which would induce H to deviate – loosely speaking, if L is "less willing" to deviate than H – then the off-equilibrium belief that a deviator to claim X is of type L is ruled out. We use the D1 refinement as it is typically used in other security issuance models, such as Boot and Thakor (1993), Nachman and Noe (1994), and DeMarzo and Duffie (1999), and thus maximizes comparability with prior literature. An earlier version of the paper used the weaker Intuitive Criterion equilibrium refinement; all results were similar, although the expressions were somewhat more complex.[9]

We first analyze the positive correlation version of the model ($A_H > A_L$) and then move to negative correlation ($A_L > A_H$).

1.1 Positive Correlation

This section demonstrates the *balance sheet effect*, an advantage of issuing equity. It stems from the first difference between assets and securities – assets are not a claim to the firm's entire balance sheet, and thus do not share in the new funds raised whose value is certain.

For ease of exposition, we set $\omega = 0$ in the positive correlation model, so that the manager maximizes fundamental value. There is a nontrivial role for $\omega > 0$ only under negative correlation, in which case there is a trade-off in being inferred as L: market valuation falls, but the firm receives a high price if it sells assets. With positive correlation, there is no such trade-off: being inferred as L worsens both market and fundamental values. Allowing for $\omega > 0$ adds additional terms to the equilibrium conditions, without affecting the set of sustainable equilibria or their properties.

The equilibria are given in Proposition 1 below. We define $E_q \equiv C_q + A_q + F$ as the equity value of a firm of type q, and $F^* \equiv \frac{C_H A_L - C_L A_H}{A_H - A_L}$. (All proofs are in Appendix A.)

Proposition 1. *(Positive correlation, pooling equilibria):*

we specify this cutoff type as mixing or playing a pure strategy.

[9] For example, a pooling equilibrium requires three conditions: one to ensure that H does not deviate, one to ensure that L does not deviate, and one to ensure that the off-equilibrium belief is reasonable. The second is typically trivial. Under D1, the third condition is so strong that it automatically implies the first, and so the equilibrium only requires one condition. Under the Intuitive Criterion, the third condition neither implies nor is implied by the first, so we need to characterize the equilibria with two separate conditions. However, the results remain the same – intuitively, since D1 is a strong refinement, all equilibria will continue to hold under weaker refinements such as the Intuitive Criterion.

(i) An asset-pooling equilibrium is sustainable if and only if $F \leq F^*$. In this equilibrium, all firms sell assets for $\mathbb{E}[A] = \pi A_H + (1-\pi)A_L$. If equity is sold (off-equilibrium), it is inferred as type L and valued at E_L.

(ii) An equity-pooling equilibrium is sustainable if and only if $F \geq F^*$. In this equilibrium, all firms sell equity for $\mathbb{E}[E] = \pi E_H + (1-\pi)E_L$. If assets are sold (off-equilibrium), they are inferred as type L and valued at A_L.

We first discuss the asset-pooling equilibrium. This equilibrium requires three conditions: L does not wish to deviate; H does not wish to deviate; and the off-equilibrium belief that a deviator is of type L satisfies D1.

We start by analyzing the first requirement. L enjoys a capital gain of $F\frac{\pi(A_H - A_L)}{\mathbb{E}[A]}$ by selling low-quality assets (worth A_L) at a pooled price (of $\mathbb{E}[A]$). If L deviates to equity, its capital gain is zero since low-quality equity (worth E_L) is sold for E_L. Thus, L automatically does not want to deviate.

The second and third requirements are satisfied by the condition $F \leq F^*$. This condition can be rewritten

$$\frac{A_H}{A_L} \leq \frac{C_H + A_H + F}{C_L + A_L + F}. \tag{2}$$

The left-hand-side ("LHS") is the ratio of high- to low-quality asset values, and the right-hand-side ("RHS") is the ratio of high- to low-quality equity values. Thus, $F \leq F^*$ implies that the information asymmetry of assets is less than that of equity. Crucially, F appears only in the equity term on the RHS, but not the assets term on the LHS. An equity investor has a claim to the firm's entire balance sheet, which contains the funds raised F. Since F is known, this *balance sheet effect* mitigates the information asymmetry of equity. In contrast, an asset purchaser owns a claim to the asset alone, and so bears the full information asymmetry associated with its value. As F rises, the RHS of (2) becomes dominated by the term F (which is the same in the numerator and the denominator as it is known) and less dominated by the unknown assets-in-place terms C_q and A_q (which differ between the numerator and denominator). Thus, the information asymmetry of equity on the RHS falls towards 1, and the inequality is harder to satisfy. Note that, even if non-core assets exhibit less information asymmetry than total assets in place ($\frac{A_H}{A_L} < \frac{C_H + A_H}{C_L + A_L}$), they may still exhibit more information asymmetry than equity if F is large enough. Contrary to the MM intuition, equity is not always the riskiest claim.

In short, assets have less information than equity if and only if the balance sheet is weak, i.e. $F \leq F^*$. In turn, $F \leq F^*$ plays two roles. First, it ensures that H does not wish to deviate (the second requirement of the equilibrium). In equilibrium, H suffers a capital loss on asset sales, and would suffer a capital loss by deviating to equity. If $F \leq F^*$, the information equity of assets, and the thus the capital loss from asset sales, is lower. Second, $F \leq F^*$ ensures that the off-equilibrium belief, that a deviator to equity is of type L, satisfies D1 (the third requirement of the equilibrium). Loosely speaking, D1 requires L

to be "more willing" to deviate to equity than H. H prefers claims with low information asymmetry as it suffers a smaller capital loss, and L prefers high information asymmetry. If $F \leq F^*$, the balance sheet effect is sufficiently small that equity exhibits higher information asymmetry than assets, and so L is indeed "more willing" to sell it than H. Thus, the two non-trivial requirements normally needed for a pooling equilibrium reduce to only one.

The intuition for the equity-pooling equilibrium is the same. Condition $F \geq F^*$ implies that assets have more information asymmetry than equity. Thus, H will not deviate to assets, as the capital loss would be higher; it also means that the off-equilibrium belief, that a deviator to asset sales is of type L, satisfies D1.

Overall, Proposition 1 shows that a pooling equilibrium always exists and is unique. There can be no separating equilibrium since one claim would be associated with L, and so the firm selling it would have an incentive to pool with H. The claim sold in the pooling equilibrium depends on the amount of financing required. When it increases, the balance sheet effect strengthens, and firms switch from selling assets to equity. Thus, the type of claim issued depends not only on its inherent characteristics (information asymmetry) but also the amount of financing required. In standard theories, the type of security issued only depends on its characteristics (e.g., information asymmetry or overvaluation), unless one assumes exogenous restrictions on financing such as limited debt capacity. Here, F can be fully raised from either source.

To put numbers on this result, if $C_H = \$100m$, $C_L = \$85m$, $A_H = \$80m$, and $A_L = \$70m$, then $F^* = \$20m$: equity exhibits less information asymmetry than asset sales whenever the financing need is greater than \$20m. Note that F refers to the amount of financing required relative to the size of the existing assets in place. If the values C_H, C_L, A_H, and A_L all doubled, then the threshold $F^* \equiv \frac{C_H A_L - C_L A_H}{A_H - A_L}$ would also double.

It may seem that, since financing is a motive for asset sales, greater financing needs should lead to more asset sales. This result is delivered by investment models where financial constraints induce disinvestment. Here, if F rises sufficiently, the firm may sell *fewer* assets, since it substitutes into an alternative source of financing: equity. The amount of capital required therefore affects firm boundaries. If we introduce synergies and allow for the average synergy to be positive, then asset sales reduce total surplus compared to equity issuance. Surprisingly, greater financial constraints may improve real efficiency as firms retain their synergistic assets and issue equity instead.

We close this section by discussing additional extensions and applications.

Risky Debt. As shown in Appendix B, the balance sheet effect applies equally to risky debt, since debt – like equity but unlike assets – is also a claim on the firm's balance sheet and thus shares in the new funds raised. Thus, risky debt will also exhibit less information asymmetry – and is preferred to assets – if and only if F is large. (Naturally, if F is so low that debt becomes risk-free, it is also preferred.)

Single-Segment Firm. A single-segment firm corresponds to $C_q = A_q$: core and non-core assets are one and the same. Then, $F^* = 0$ and so asset-pooling is never sustainable for any F. Intuitively, since the information asymmetry of the firm equals that of the non-core asset, the balance sheet effect reduces the information asymmetry of equity lower.

Selling the Core Asset. Appendix D shows that the balance sheet effect is robust to allowing firms to also sell the core asset. The intuition is as follows. One of the assets (core or non-core) will exhibit greater information asymmetry; since equity is a mix of both assets, its information asymmetry will lie in between and so it is never the safest claim. Indeed, DeMarzo's (2005) "information destruction effect" might suggest that equity would never be issued: pooling assets together destroys the seller's option to sell one asset in particular. However, it may still be issued due to the balance sheet effect: equity-pooling can be sustained.

1.2 Negative Correlation

We now turn to the case of negative correlation, i.e., $A_L > A_H$. This section demonstrates the *correlation effect*, an advantage of selling assets. This effect stems from the first difference between assets and securities – assets are not a claim to the firm's entire balance sheet and so are not a carbon copy. Thus, even if the market infers that an asset being sold is low-quality, this need not imply that the firm as a whole is low-quality.

Since $A_L > A_H$, we now use the term "high (low)-quality non-core assets" to refer to the non-core assets of L (H). Note that negative correlation only means that high-quality firms are not universally high-quality, as they may have low-quality non-core assets. It does not require the values of the divisions to covary negatively with each other over time (e.g., that a market upswing helps one division and hurts the other). The market may know the correlation of the asset with the core business (even if it does not observe quality) by observing the type of asset traded. For example, the value of Interlake's steel business is likely negatively correlated with its aerospace business as a high steel price is good (bad) news for the former (latter).[10] As we will see, the correlation effect does not require that the correlation between the core and non-core assets be perfectly negative, only that it is not perfectly positive.

We return to the case of general stock price concerns $\omega > 0$ because, with negative correlation, there is now a trade-off involved in selling assets: being inferred as L reduces the firm's stock price but increases proceeds and thus fundamental value. Without stock

[10] Note that the correlation effect requires (the possibility of) negative correlation not between core and non-core assets' total cash flows, but between the component of their cash flows that is private information. Using the earlier example of Interlake, if private information is on the outlook for the steel price (which increases cash flows for its steel business but reduces them for its aerospace business), the correlation effect applies. However, if private information is on the quality of Interlake's corporate culture, which is likely positively correlated with the value of both businesses, it does not.

price concerns, firms would trivially sell their worst-quality claim (H sells its low-quality assets, and L sells a claim on its low-quality core assets by issuing equity), and so no pooling equilibrium is sustainable (see Appendix C.1). In MM, the firm only has a single class of assets, which are therefore perfectly positively correlated with each other. Thus, a low price for the claim issued automatically implies a low valuation for the rest of the firm, and so there is no loss of generality in setting $\omega = 0$ (just as in Section 1.1). This section generalizes MM by allowing for negative correlation, which can lead to the market's inference of the claim sold differing from that of the rest of the firm. This in turn has non-trivial implications if the manager is concerned with both stock price and fundamental value.

Proposition 2 below states that an equity-pooling equilibrium is never sustainable under negative correlation, but an asset-pooling equilibrium is sustainable if stock price concerns ω are sufficiently high.

Proposition 2. *(Negative correlation, pooling equilibria.) An equity-pooling equilibrium is never sustainable. An asset-pooling equilibrium is sustainable if and only if*

$$\omega \geq \omega^{APE} \equiv \frac{F\left(\frac{A_L}{\mathbb{E}[A]} - 1\right)}{\pi((C_H - C_L) - (A_L - A_H)) + F\left(\frac{A_L}{\mathbb{E}[A]} - 1\right)}. \tag{3}$$

In this equilibrium, all firms sell assets for $\mathbb{E}[A] = \pi A_H + (1-\pi)A_L$. If equity is sold (off-equilibrium), it is inferred as type L and valued at E_L. The stock prices of asset sellers and equity issuers are $\mathbb{E}[C + A]$ and $C_L + A_L$, respectively.

We start by discussing the asset-pooling equilibrium. Unlike in the positive correlation section, it is now L (H) that makes a capital loss (gain). Since L also has lower-quality equity, L is "more willing" to deviate to equity than H, and so the only admissible off-equilibrium belief is that a deviator to equity is of type L. Under this belief, it is automatic that H will not deviate. We now consider L's incentive to deviate. Under asset-pooling, L suffers a capital loss, but enjoys a pooled stock price. If it deviates to equity, L breaks even as its low-quality equity (worth E_L) is sold for a low price (of E_L). However, the low price applies not only to the equity sold, but also the rest of the firm, as it is a carbon copy. The manager will thus not deviate if stock price concerns are sufficiently high ($\omega \geq \omega^{APE}$), even though deviation would avoid a capital loss.

We now turn to the equity-pooling equilibrium. As in the positive correlation section, H (L) makes a capital loss (gain). Since H also has lower-quality assets than L, H is "more willing" to deviate, and so the only admissible off-equilibrium belief is that a deviator to asset sales is of type H. We now consider H's incentive to deviate under this belief. If H deviates to assets, it would receive a (fair) low price of A_H and break even compared to its current capital loss. However, this low price applies only to the asset being sold and not the rest of the firm, as it is not a carbon copy. Instead, deviation leads to a high stock price which, coupled with the avoidance of a capital loss, induces H to deviate and so equity-pooling is unsustainable for any ω. Under deviation, H's assets are correctly assessed as "lemons" and lowly-priced. Thus, the market-timing motive for financing (e.g., Baker and Wurgler 2002) does not exist – yet deviation is still profitable as it yields a high stock price.

In sum, a pooling equilibrium where all firms sell assets is sustainable, but one where all firms issue equity is not. This preference for asset sales stems from the *correlation effect*, which arises from two sources. First, equity is perfectly correlated with the rest of the firm, but the asset need not be. A low price is attached to any claim sold, but only if this claim is equity is the low price also attached to the rest of the firm. Second, the manager places sufficient weight on how financing decisions affect the market's inference over firm value, reflected in the stock price ($\omega \geq \omega^{APE}$), The correlation effect shows that it is not only an asset's information asymmetry that matters (as in MM) but also its correlation with the firm. Even if an asset exhibits high information asymmetry and thus suffers a high "lemons" discount, its sale could still be attractive, if it does not imply that the firm is low-quality.

The preference for asset sales points to a novel benefit of diversification. Stein (1997) notes that an advantage of holding assets that are not perfectly correlated is "winner-picking": a conglomerate can increase investment in the division with the best investment opportunities at the time. Our model suggests that another advantage is "loser-picking": a firm can raise capital by selling a low-quality asset, without implying a low value for the rest of the firm. Thus, diversification into unrelated sectors provides greater financial slack than expanding in one's core business. Relatedly, the analysis points to a new notion of investment reversibility. Standard theories (e.g., Abel and Eberly 1996) model reversibility as the real value that can be salvaged by undoing an investment, which in turn depends on the asset's technology. Here, reversibility depends on the market's inference of firm type if an investment is sold, and thus the correlation between the asset and the rest of the firm.

In addition to the asset-pooling equilibrium, a separating equilibrium may also be sustainable, where H sells its low-quality non-core assets and L sells its low-quality equity. Since this equilibrium yields the unsurprising result that each firms sells its low-quality claim, we defer it to Appendix C.1.

We close this section by discussing additional extensions and applications.

Risky Debt. Appendix B shows that the correlation effect also applies to risky debt since, like equity, it is positively correlated with firm value. The issuance of debt may imply that debt is low-quality, and so the firm is also low-quality.

Selling the Core Asset. Appendix D considers the case when the firm can sell the core asset. Since the core (non-core) asset is positively (negatively) correlated with firm value, this extension allows the firm to choose the correlation of the asset it sells, whereas the analysis thus far has considered either positive or negative correlation. A pooling equilibrium in which all firms sell the non-core asset can be sustained, but neither one in which all firms sell equity, nor one in which all firms sell the core asset, is feasible. This is because the non-core asset is negatively correlated with firm value, whereas equity and the core asset are both positively correlated. Thus, the correlation effect continues to apply when firms can choose the correlation of the assets they sell.

General Correlations. A two-type model, while tractable, implies that correlations are either perfectly positive (if $A_H > A_L$) or perfectly negative (if $A_H < A_L$). Appendix F studies a more general model that allows for any degree of correlation between the core and non-core assets (which nests Sections 1.1 and 1.2 as special cases). The correlation effect continues to hold as long as the correlation is sufficiently low (indeed, it can even be strictly positive): asset-pooling is sustainable if ω is sufficiently high, but equity-pooling cannot be sustained for any ω.

The intuition is the same as above. Regardless of the correlation between core and non-core assets, the correlation between the equity being sold and the rest of the firm will always be 1. Thus, deviation to equity issuance from asset-pooling always leads to a low price for both the equity being issued and the rest of the firm. In contrast, even with a positive correlation, non-core assets are not a carbon copy of the rest of the firm, and so a negative signal on the former can be a positive signal on the latter.

2 General Model

This section gives firms the choice of whether to raise capital, allows the capital raised to finance a positive-NPV investment, and introduces synergies. These extensions naturally go together since, if given the choice not to raise capital, H would never sell assets unless they are dissynergistic, nor issue equity unless the capital raised could be used productively.

Now, in addition to quality q, each firm has a second type dimension: synergy k, which is uncorrelated with q. The cumulative distribution function is given by $G(k)$, which is differentiable and bounded below and above by $\underline{k}$ and $\overline{k}$, where $-1 < \underline{k} \leq 0$, $\overline{k} > 0$. Synergy k measures the additional (private) value lost if the current owner sells the asset.[11] If a firm sells a non-core asset with a true value of \$1, its fundamental value falls by $\$1 + k$.[12] Thus, $k > (<)\, 0$ represents synergies (dissynergies), where the asset is worth more (less) to the current owner than a potential purchaser, even absent information asymmetry. That

[11] The results continue to hold when using a discrete synergy distribution (to match our discrete quality distribution). However, the analysis becomes significantly more cumbersome. While quality naturally has two outcomes (high and low), synergy would have to have at least three outcomes (negative, zero, and positive), with zero synergies necessary to nest the MM case and also match reality. Thus, we would have six firm types, making the equilibria much more complex to characterize.

[12] Synergies k thus do not appear under the current balance sheet, but instead affect the fundamental value lost if assets are sold. We have also solved the model where synergies explicitly appear on the firm's balance sheet before financing is raised, i.e. the firm's current equity value is $C_q + A_q(1 + k)$. The economic forces remain robust but the exposition is more cumbersome because the privately-known synergy k now appears in the equity claim and thus requires additional inference by investors.

$\underline{k} \leq 0$ allows for asset sales to be motivated by operational reasons (dissynergies) rather than only financing reasons.[13] In addition to synergies, $k > 0$ can also arise if investment in assets is costly to reverse (e.g. Abel and Eberly 1996). The expected value of the claim to investors depends only on how they infer quality q from X, and not synergy k, which allows us to incorporate two dimensions of private information while retaining tractability. We sometimes use the term "H" or "H-firm" to refer to a high-quality firm regardless of its synergy parameter, and similarly "L" or "L-firm".

The action space is now richer. All firms can either do nothing, or instead raise capital of F to finance an investment with expected value $R_q = F(1 + r_q)$, where $r_H \geq 0$ and $r_L \geq 0$: since the firm can always hold cash, it will only undertake positive-NPV investments. We thus now have $E_q = C_q + A_q + F(1 + r_q)$. We allow for both $r_H \geq r_L$ and $r_H < r_L$ (while continuing to assume $E_H > E_L$). Note that r_q captures the expected return on the investment; the model does not require investment to lead to a return of r_q with certainty. Thus, it accommodates general distributions for the investment return; given risk-neutrality, only the expected return matters.

In the following sections, we analyze the case of positive correlation and demonstrate two main results. First, Section 2.1 analyzes the conditions under which the pooling equilibria of Section 1.1 continue to be sustainable. It shows that the balance sheet effect continues to hold, and can even strengthen, when there is information asymmetry over the use of the cash raised. Second, Section 2.2 shows that new semi-separating equilibria may now be sustainable which demonstrate the *camouflage effect*, an advantage of selling assets. This effect stems from the second difference between assets and securities – the sale of assets, but not equity, may be motivated by dissynergies. Thus, low-quality firms can disguise asset sales that are truly motivated by negative private information as being instead due to dissynergies. Appendix C.2 shows that, in the case of negative correlation, this general model continues to generate the correlation effect of Section 1.2. Since this analysis only demonstrates robustness but does not generate any new implications, we defer it to the Appendix.

2.1 Pooling Equilibria

Proposition 3 gives conditions under which pooling equilibria are sustainable:

Proposition 3. *(Positive correlation, pooling equilibria, voluntary capital raising.)*
(i) An asset-pooling equilibrium is sustainable if and only if (ia) $\frac{E_H}{E_L} \geq \frac{A_H}{A_L}$, *(ib)* $1+\overline{k} \leq \frac{\mathbb{E}[A]}{A_L}$,

[13] A firm may own dissynergistic assets because it initially acquired them when they were synergistic, but they became dissynergistic over time. The firm may not have yet disposed of the dissynergistic asset for two reasons. First, the firm may retain it due to the transactions costs of asset sales: only if it is forced to raise financing and so would have to bear the transactions costs of equity issuance otherwise, would it consider selling assets. Second, the market for assets is not perfectly frictionless, and so not all assets are owned by the best owner at all times. Our model allows for $\underline{k} = 0$ in which case there are no dissynergies.

and (ic) $1 + r_H \geq \frac{A_H(1+\bar{k})}{\mathbb{E}[A]}$ *hold. The prices of assets and equity are* $\pi A_H + (1-\pi)A_L$ *and* $C_L + A_L + F(1 + r_L)$ *respectively.*
(ii) An equity-pooling equilibrium is sustainable if and only if (iia) $\frac{E_H}{E_L} \leq \frac{A_H}{A_L}$*, (iib)* $1 + \underline{k} \geq \frac{E_L}{\mathbb{E}[E]}$*, and (iic)* $1 + r_H \geq \frac{E_H}{\mathbb{E}[E]}$ *hold. The prices of assets and equity are* A_L *and* $\mathbb{E}[C + A] + F(\mathbb{E}[1 + r])$*, respectively.*

As in Proposition 1, condition (ia) ensures that H-firms do not deviate to equity issuance from an asset-pooling equilibrium, and (iia) ensures that H-firms do not deviate to asset sales from an equity-pooling equilibrium. When investment opportunities are zero ($r_H = r_L = 0$), (ia) reduces to the condition $F \leq F^*$ from Proposition 1. With positive investment opportunities, it becomes

$$F\left[A_H(1 + r_L) - A_L(1 + r_H)\right] \leq C_H A_L - C_L A_H. \tag{4}$$

The sign of the RHS depends on whether $\frac{C_H}{C_L} \lesseqgtr \frac{A_H}{A_L}$. We first consider $\frac{C_H}{C_L} > \frac{A_H}{A_L}$, as this is the more realistic case for two main reasons. First, Appendix D shows that if firms have the option to sell both the core and non-core asset, in a pooling equilibrium firms only sell the asset with lower information asymmetry, and so we can label this asset as the "non-core" one. Second, the core business bears the risk of the firm's future prospects, such as its ability to launch new products and retain employees, whereas a separable non-core asset (such as a factory or oilfield) does not.

If $\frac{C_H}{C_L} > \frac{A_H}{A_L}$, the RHS is positive. If the LHS is also positive ($\frac{A_H}{A_L} > \frac{1+r_H}{1+r_L}$), (4) yields

$$F \leq F^{*I} \equiv \frac{C_H A_L - C_L A_H}{A_H(1 + r_L) - A_L(1 + r_H)}. \tag{5}$$

In Section 1.1, the upper bound was $F^* \equiv \frac{C_H A_L - C_L A_H}{A_H - A_L}$. If $F^{*I} < F^*$, the balance sheet strengthens compared to Section 1.1. This is clearly true if $r_L > r_H$, as L's superior growth options reduce the information asymmetry of equity. More surprisingly, $F^{*I} < F^*$ holds even if $r_H \geq r_L$, as long as $\frac{r_H}{r_L} < \frac{A_H}{A_L}$. To see why, note that $R_H = F(1 + r_L) + F(r_H - r_L)$. When $r_H > r_L$, the second term increases the information asymmetry of equity and indeed raises F^{*I} compared to F^*, but the first term, which is common to both R_H and R_L, has the opposite effect. Intuitively, $F(1 + r_L)$ is a minimum expected investment return regardless of firm type: since the investment is positive-NPV, the certain component of the firm's balance sheet is now higher ($F(1 + r_L)$ rather than F). Only when $\frac{r_H}{r_L} > \frac{A_H}{A_L}$ do we have $F^{*I} > F^*$, weakening the balance sheet effect compared to Section 1.1.[14] Note that the only difference between F^* and F^{*I} are the r_L and r_H terms; the synergy terms do not enter into F^{*I} as they do not affect the value of assets to outside investors.

[14]Note that equity issuance does not become more likely simply because the firm is worth more due to its growth opportunities, which attracts investors. The growth opportunities are fully priced into the equity issue and are not a "freebie."

If the LHS of (4) is negative ($\frac{A_H}{A_L} \leq \frac{1+r_H}{1+r_L}$), then (4) is satisfied for any F: the upper bound on F is infinite. Intuitively, equityholders obtain a portfolio of assets in place $(C+A)$ and the new investment (R); F determines the weighting of the new investment in this portfolio. H cooperates with asset sales if his capital loss, $\frac{A_H}{A_L}$, is less than the weighted average loss on this overall equity portfolio. If both the assets in place and the new investment exhibit more information asymmetry than non-core assets, i.e., $\frac{A_H}{A_L} \leq \frac{C_H}{C_L}$ and $\frac{A_H}{A_L} \leq \frac{1+r_H}{1+r_L}$, then the loss on the equity portfolio is greater regardless of the weights.

The alternative inequality, $\frac{C_H}{C_L} < \frac{A_H}{A_L}$, is an extreme case since it means that assets have such high information asymmetry that asset sales can never be sustained for any F in the core model: it yields $F^* < 0$. In the model with investment, we similarly have $F^{*I} < 0$ if the LHS of (4) is positive, i.e. $\frac{A_H}{A_L} > \frac{1+r_H}{1+r_L}$. Intuitively, when non-core assets exhibit more information asymmetry than both core assets and the new investment, then they exhibit more information asymmetry than equity for any weight F. On the other hand, if $\frac{C_H}{C_L} < \frac{A_H}{A_L}$ and also $\frac{A_H}{A_L} < \frac{1+r_H}{1+r_L}$, then the inequality in (5) becomes a *lower* bound on F, i.e. $F \geq F^{*I}$. Now, asset-pooling is only sustainable for *high* F, as we need a high weight on investment for the balance sheet to exhibit more information asymmetry than non-core assets.

In addition to demonstrating robustness, the extension to voluntary capital raising also generates a new prediction. As r_H falls and r_L rises (the information asymmetry of investment falls), the upper bound on the asset-pooling equilibrium tightens and the lower bound on the equity-pooling equilibrium loosens. Thus, the source of financing also depends on the use of financing. If growth opportunities are good regardless of firm quality (r_L is high, for example in good macroeconomic conditions or a growing industry), then they are more likely to be financed using equity. The use of financing also matters in models of moral hazard (uses subject to agency problems will be financed by debt rather than equity) or bankruptcy costs (purchases of tangible assets are more likely to be financed by debt rather than equity); here it matters in a model of pure adverse selection. Moreover, our predictions differ from a moral hazard model. Under moral hazard, if cash is to remain on the balance sheet, equity is undesirable due to the agency costs of free cash flow (Jensen 1986). Here, equity is preferred due to the balance sheet effect.

We now turn to the new conditions for asset-pooling not in Proposition 1; the new conditions for equity-pooling are analogous. Condition (ib) ensures that L does not deviate to equity issuance. While L is making a capital gain from asset sales, it also loses (positive or negative) synergies and so its incentive constraint is no longer trivial. $1+\overline{k} \leq \frac{\mathbb{E}[A]}{A_L}$ ensures that, even for the L-firm with the greatest synergies (type $(L, \overline{k})$), the capital gain from asset sales exceeds the synergy loss, and so no L-firm wishes to deviate to equity. Condition (ic) ensures that H does not deviate to inaction (just as (ia) rules out deviation to equity issuance). It states that H's investment return is sufficiently high that he is willing to bear the capital loss from raising financing.

2.2 Semi-Separating Equilibria

The pooling equilibria require (dis)synergies to be sufficiently weak that all firms are willing to sell the same claim. If they are strong, we have a semi-separating equilibrium where firms of the same quality sell either assets or equity depending on their level of synergy. This equilibrium is characterized in Proposition 4 below.

Proposition 4. *(Positive correlation, semi-separating equilibria, voluntary capital raising.)*

(i) If $1+r_H \geq \frac{E_H}{E_L}$, a semi-separating equilibrium in which type (q,k) sells assets (equity) if $k \leq (>)\, k_q^*$ is sustainable if neither pair of conditions ($1+\overline{k} \leq \frac{\mathbb{E}[A]}{A_L}$, $\frac{E_H}{E_L} \geq \frac{A_H}{A_L}$) nor ($1+\underline{k} \geq \frac{E_L}{\mathbb{E}[E]}$, $\frac{E_H}{E_L} \leq \frac{A_H}{A_L}$) is satisfied.

(ia) If $\frac{E_H}{E_L} > \frac{A_H}{A_L}$, then $k_H^* > k_L^*$. Assets are sold at a premium to their unconditional expected value $\mathbb{E}[A]$, while equity is issued at a discount.

(ib) If $\frac{E_H}{E_L} < \frac{A_H}{A_L}$, then $k_H^* < k_L^*$. Equity is issued at a premium to its unconditional expected value $\mathbb{E}[E]$, while assets are sold at a discount.

(ic) If $\frac{E_H}{E_L} = \frac{A_H}{A_L}$, then $k_L^* = k_H^* = 0$.

(ii) If $1+r_H \leq \frac{E_H}{E_L}$, a semi-separating equilibrium is sustainable in which H sells assets if $k \leq k_H^*$ and does nothing if $k > k_H^*$, and L sells assets if $k \leq k_L^*$ and issues equity if $k > k_L^*$, where $k_L^* \geq 0$. A rise in r_H increases both k_H^* and k_L^*.

(iia) If $\frac{E_H}{E_L} \geq 1 + r_H > \frac{A_H}{A_L}(1+\underline{k})$, then $k_H^* > \underline{k}$ and $k_L^* > 0$. The price of assets exceeds A_L and the price of equity is $C_L + A_L + F(1+r_L)$. If $1 + r_H > (<)\, \frac{A_H}{A_L}$, then $k_H^* > (<)\, k_L^*$ and assets are sold at a premium (discount) to their expected value $\mathbb{E}[A]$.

(iib) If $1 + r_H \leq \min\left(\frac{E_H}{E_L}, \frac{A_H}{A_L}(1+\underline{k})\right)$, then $k_H^* = \underline{k}$ (all H-firms do nothing) and $k_L^* = 0$. The price of assets is A_L and the price of equity is $C_L + A_L + F(1+r_L)$.

(iii) If $r_H = r_L = 0$, then we have the same equilibria as in parts (iia) and (iib), except that L-firms with $k > k_L^* (= 0)$ either issue equity or do nothing.

There are three cases to consider:

High $\mathbf{r_H}$. We start with part (i), where $1 + r_H \geq \frac{E_H}{E_L}$ ensures that the investment return is sufficiently high that all firms raise financing. The choice of financing depends on both components of type. First, it depends on synergy k: there is an equilibrium threshold k_q^*, and any firm below (above) the threshold sells assets (equity). Second, it depends on quality q, because H and L use different thresholds k_q^*. The main result of part (i) is how F affects whether $k_H^* > (<)\, k_L^*$, and thus whether H is more (less) willing to sell assets than L.

The role of F again arises through the balance sheet effect. As demonstrated in condition (4), the value of F determines whether $\frac{E_H}{E_L} \lessgtr \frac{A_H}{A_L}$. If both sides of (4) are positive, it simplifies to $F \leq F^{*I}$, which generalizes the condition $F \leq F^*$ from Section 1.1. When $F < F^{*I}$, and thus $\frac{E_H}{E_L} > \frac{A_H}{A_L}$, equity exhibits higher information asymmetry than assets. As a result, H is more willing to sell assets than L, and so uses a higher cutoff ($k_H^* > k_L^*$). The different cutoffs in turn affect the valuations. Since H is more willing to sell assets, the asset (equity) price is higher (lower) than its unconditional expectation. When $F > F^{*I}$, and thus $\frac{E_H}{E_L} < \frac{A_H}{A_L}$, the balance sheet effect is sufficiently strong that equity is more attractive to H ($k_H^* < k_L^*$). The asset (equity) price is now lower (higher) than its unconditional expectation.[15] Finally, when $F = F^{*I}$, and thus $\frac{E_H}{E_L} = \frac{A_H}{A_L}$, the information asymmetry of assets and equity are the same, and so H and L use the same cutoff.

Unlike in the pooling equilibria, here the impact of a stronger balance sheet effect is nuanced – it does not make one claim universally more popular, but instead increases (reduces) the attractiveness of equity to high (low)-quality firms. This differential effect contrasts with standard frictions, such as taxes, transactions costs, liquidity, and bargaining power, which have the same directional effect on all firms. Due to this differential effect, changes in F affect the price and quality of assets sold in the real asset market, as well as the price and quality of equity. Assets (equity) that are sold for financing reasons should fetch lower (higher) prices if the sale is large, as large sales are more likely to stem from low- (high-) quality firms.

Moderate $\mathbf{r_H}$: Camouflage Effect. Part (iia) shows that if r_H is moderate, H-firms with synergistic assets will not raise capital at all, since the return on investment is insufficient to outweigh the loss from capital raising. This echoes an intuition in MM: high-quality firms forgo investment due to the cost of financing. However, H-firms with sufficiently dissynergistic assets still sell them, not so much to finance investment but to get rid of dissynergies: the gain from doing do, when added to the (minor) return on investment, outweighs the capital loss from asset sales. As before, L sells either equity or assets (depending on its synergy level), not so much to finance investment, but to exploit overvaluation.

The key result is $k_L^* > 0$: L prefers asset sales, and will sell assets even if they are synergistic. The reason is the *camouflage effect*. Since the growth opportunity is only moderate, it is too weak to induce H to issue equity. Thus, the only reason to issue equity is if it is low-quality, and so equity issuance reveals the firm as L. In contrast, asset sales may be undertaken because the asset is either low-quality (low common value, sold by L) or dissynergistic (low private value, sold by H), and so the asset price exceeds A_L. This high price induces L to sell assets ($k_L^* > 0$). Here, an increase in r_H augments k_H^*, as H is more willing to sell assets. Then assets provide even better camouflage, so k_L^* rises also.

Note that, for any semi-separating equilibrium, there may be said to be "camouflage" in that multiple types pool into the same action. MM and its extensions (e.g. Cooney and Kalay 1993, Wu and Wang 2005) also feature a non-informational motive – the desire to finance investment – which allows sellers to camouflage the disposal of an overvalued claim. However, those motives can be used to disguise both asset and equity sales, and

[15] We also have $k_H^* < 0$: H retains assets even if they are mildly dissynergistic, due to their higher information asymmetry. Similarly, for $F < F^*$, we have $k_H^* > 0$: even H-firms with positive synergies are willing to sell assets, due to their lower information asymmetry.

so do not affect a firm's choice between them.[16] We use the term "camouflage effect" to refer specifically to the ability to disguise a sale as motivated by dissynergies, rather than non-informational motives in general, which applies only to assets.[17]

Indeed, in the equilibrium of (iia), investment opportunities are too weak to motivate capital raising ($1 + r_H < \frac{E_H}{E_L}$) – the only non-overvaluation motive is dissynergies, which only apply to assets, and so they lead H to sell assets but not to issue equity. Thus, while assets are priced above A_L, equity is priced at the lowest possible value of E_L – assets offer camouflage and equity does not, and so L exhibits a strict preference for assets ($k_L^* > 0$). In contrast, when $1 + r_H > \frac{E_H}{E_L}$ (part (i)), we cannot sign k_L^*. When the investment return is good, H sells both assets and equity (to finance the investment) and so both offer camouflage; thus, L exhibits no clear preference between them.

Just like the balance sheet effect, the camouflage effect also applies to the choice between asset sales and risky debt, as shown in Appendix B. Absent a profitable growth opportunity, the issue of risky debt signals that the debt is overvalued, since it cannot be camouflaged as stemming from an operational reason, unlike an asset sale.

Low $\mathbf{r_H}$. Part (iib) shows that if r_H is low and dissynergies are not severe ($1 + r_H \leq \frac{A_H}{A_L}(1 + \underline{k})$), even H-firms with the most dissynergistic assets do nothing. Information asymmetry $\frac{A_H}{A_L}$ is so strong that the capital loss from asset sales is high relative to both the growth opportunity r_H and the dissynergy motive $\underline{k}$. Since no H-firms sell assets, asset sales do not offer camouflage. Thus, $k_L^* = 0$: L no longer prefers asset sales.

Part (iii) shows that, if $r_H = r_L = 0$, even L has no reason to issue equity: it cannot exploit overvaluation since there is no camouflage, and it cannot invest the cash raised profitably. Thus, low-quality firms with synergistic assets ($k > k_L^*(= 0)$) are indifferent between selling equity and inaction. Indeed, there exists an equilibrium where all L-firms with $k > 0$ do nothing, and so the equity market shuts down. Absent an investment opportunity, the only reason to sell equity is if it is low-quality, and so the "no-trade" theorem applies. In contrast, asset sales may be motivated by operational reasons and so the market continues to function.

We now analyze comparative statics that affect the type of semi-separating equilibrium ((i), (iia), (iib), or (iii)) that is sustainable:

Effect of $\mathbf{r_H}$. This parameter captures investment opportunities of high-quality firms which, among other things, will be correlated with the business cycle. We start with the

[16] In Eisfeldt (2004), higher investment opportunities encourage firms to issue more claims; since there is only one class of risky assets (excluding cash and realized payoffs from past projects), these claims can be interpreted as either assets or equity.

[17] In contrast, we do not label the semi-separating equilibrium of part (i) as exhibiting a camouflage effect: even though multiple firm types pool on the same action, this is similar to any semi-separating equilibrium and does not arise from H voluntarily selling assets due to dissynergies. All firms raise capital since the growth opportunity is sufficiently attractive, and so when H prefers to sell assets ($k_H^* > 0$), it is because assets exhibit less informational asymmetry than equity rather than assets being dissynergistic.

effect of r_H on asset sales. When $1 + r_H$ falls from moderate to low (i.e. drops below $\frac{A_H}{A_L}(1 + \underline{k})$), we switch from (iia) to (iib). Then, H no longer sells assets for dissynergy motives. In turn, the decline in asset sales by H is amplified by L (k_L^* falls to zero) since the camouflage effect disappears. Thus, the camouflage effect leads to multiplier effects – exogenous factors that deter H from selling assets also then deter L. Indeed, Eisfeldt and Rampini (2006) find empirically that asset sales are procyclical because, when growth opportunities are low, asset liquidity (the price of sold assets) falls. Here, when $1+r_H$ drops below $\frac{A_H}{A_L}(1 + \underline{k})$, the asset price falls to A_L.

We now turn to the effect r_H on equity issuance. When r_H is high, we are in case (i) in which both H and L sell both assets and equity. Thus, while large rises in r_H that switch the equilibrium from (iib) to (i) increase the aggregate issuance of both claims, moderate rises that switch it to (iia) increase aggregate asset sales but *decrease* equity issuance: assets respond to rises in r_H before equity does. The fall in equity issuance arises because a shift to (iia) causes H-firms to start to sell assets but not to issue equity, and such behavior encourages some L-firms to switch from equity to asset sales due to the camouflage effect.

Effect of F. The equilibrium in part (i), where all firms sell either assets or equity, exhibits greater real efficiency than the one in part (iia) since all firms are undertaking profitable investment. It is easier to satisfy the condition for part (i) ($1+r_H \geq \frac{E_H}{E_L}$) if F is high. Thus, a greater *scale* of investment opportunities (high F) encourages H to invest, even if the per-unit productivity of investment (r_H) is unchanged. The balance sheet effect reduces the per-unit cost of financing, whereas scale effects typically considered in the literature (e.g., limited supply of capital) increase the per-unit cost of financing. Thus, a higher F has beneficial real consequences by encouraging investment.

Finally, we consider the interesting special case where there is no information asymmetry about the non-core asset, i.e. $A_H = A_L$. Then, condition (ib) in Proposition 3 becomes $1 + \overline{k} \leq 1$, which can never be satisfied, and so asset-pooling is unsustainable. Since assets exhibit no information asymmetry, L makes no capital gains from selling them, and so any L with positive synergies deviates to equity. In addition, condition (iia) in Proposition 3 becomes $\frac{E_H}{E_L} \leq 1$, which can never be satisfied, and so equity-pooling is unsustainable. When assets have zero information asymmetry, any H-firm with weakly negative synergies will sell them – similar to the MM intuition that information-insensitive claims are sold first, absent operational reasons. As a result, the only possible equilibria are semi-separating – case (ia), (iia), or (iii) from Proposition 4, depending on whether r_H is high, medium, or low. Note that in cases (ia) and (iia), we now have a positive stock price reaction to asset sales regardless of the value of F – since assets have zero information asymmetry, they automatically have less information asymmetry than equity regardless of F, and so the balance sheet effect is no longer important. This special case shows that information asymmetry about A is necessary to make the balance sheet effect relevant, but is not necessary for the camouflage effect: the equilibrium in case (iia) can still hold.

3 Empirical Implications

This section discusses the main implications of the model. While some are consistent with existing empirical findings, many are new and untested, and are potential questions for future research.

3.1 Determinants of Financing Choice

The first set of empirical implications concerns the determinants of financing choice.

Amount of Financing Required. Proposition 1 shows that equity is preferred for high financing needs, due to the balance sheet effect, while asset sales are preferred for lower needs. For example, large oil and gas companies typically expand by adding individual fields, which require low F; indeed, this industry exhibits an active market for asset sales. A related implication is that equity issuances should represent a larger percentage of firm size than financing-motivated asset sales. This result may also shed light on previous empirical studies of external finance. An analysis excluding asset sales might infer from the infrequency of financing that it is subject to large, indirect costs. For example, Hennessy and Whited (2007) find that firms behave as if facing a cost of 8.3% on the first million dollars of equity raised, versus underwriting fees of only 5.1% reported in Altinkilic and Hansen (2000). Our model suggests that, if asset sales were also included in external financing, observed external financing would be both smaller and more frequent, implying lower indirect costs.

Use of Proceeds. Both the balance sheet and camouflage effects predict that the probability of equity issuance is increasing if growth opportunities improve across the board (r_L and r_H are high). Proposition 4 shows that the balance sheet effect is stronger when financing an investment opportunity that is attractive regardless of firm quality (r_L is high). Turning to the camouflage effect, if r_H is low, high-quality firms do not issue equity, and low-quality firms prefer asset sales as only they can provide camouflage. When r_H increases above a threshold, not only do high-quality firms start to issue equity to exploit the growth opportunity, but also low-quality firms issue equity to a greater extent, as they can camouflage themselves with high-quality equity issuers.

Thus, firms where growth opportunities are known to be good should raise equity. For example, a technology shock that increases investment opportunities across an industry (such as the invention of fracking for the energy sector, or an increase in processing speed for the computer sector) should make equity issuance more likely. In a strong macroeconomic environment, even low-quality firms will have good investment projects and so equity is again preferred, as found by Choe, Masulis, and Nanda (1993). Covas and den Haan (2011) show that equity issuance is procyclical, except for the very largest firms. A separate prediction from the balance sheet effect is that equity is more likely to be used for purposes with less information asymmetry, such as paying debt or replenishing capital.

Firm Characteristics. A third determinant of financing choice is firm characteristics. Single-segment firms are more likely to issue equity; firms with negatively-correlated assets prefer asset sales due to the correlation effect. Thus, conglomerates are more likely to sell assets than firms with closely-related divisions, and more likely to sell non-core assets than core assets (see Appendix D). Indeed, Maksimovic and Phillips (2001) find that conglomerates are more likely to sell peripheral divisions than main divisions. While consistent with the correlation effect, this result could also stem from operational reasons: peripheral divisions are more likely to be dissynergistic. Maksimovic and Phillips also find that less-productive divisions are more likely to be sold. This result is consistent with the idea that conglomerates can sell poorly-performing divisions without creating negative inferences on the rest of the firm, although they do not study the market reaction to such sales.

3.2 Market Reactions to Financing

A second set of empirical implications concerns the market reaction to financing. In the negative correlation case, and in the positive correlation case where $k_H^* > k_L^*$ (low F), asset (equity) sales lead to a positive (negative) stock price reaction. Indeed, Jain (1985), Klein (1986), Hite, Owers, and Rogers (1987), Slovin, Sushka, and Ferraro (1995), and Feldman (2014), among others, find evidence of the former; a long line of empirical research beginning with Asquith and Mullins (1986) documents the latter. Under positive correlation and high F, we have $k_L^* > k_H^*$, and so equity issuance leads to a positive reaction.[18] Holderness (2017) finds a positive reaction in some countries, but does not relate it to the size of the equity issue or the correlation structure of the issuer. Separately, the model also predicts that equity issuance will typically lead to a more negative reaction for conglomerates (where negative correlation is likely) than for single-segment firms.

3.3 Synergy Motives

Our next implications concern synergy motives for asset sales. Testing these implications is harder for the econometrician, who is rarely able to measure synergies, but they are still relevant for managers, who are better able to estimate synergies.

Market Depth. Firms are more willing to sell assets in deep markets where others are selling for operational reasons, providing camouflage. One potential way to estimate

[18] Cooney and Kalay (1993) and Wu and Wang (2005) show that an extension of MM can also generate positive returns to equity issuance. The sign of the return depends on the uncertainty about the growth opportunity; here it depends on the size of the equity issue and the correlation structure of the issuer.

(dis)synergies is to compare across industries. For example, in the oil and gas industry, asset sales frequently involve self-contained plants with little scope for synergies. In consumer-facing industries where multiple products are cross-sold to the same customer base, operational motives should be stronger. A more general implication of the model is that there will be multiplier effects. A rise in operational motives for asset sales also encourages overvaluation-motivated asset sales, as the seller can camouflage the disposal as resulting from dissynergies.

Interaction Between Synergies and Amount of Financing. The link between the source of financing and the amount required is stronger with fewer synergies. With weak synergies, only pooling equilibria are sustainable, and so when F is high (low), all firms sell equity (assets). With strong synergies, we have a semi-separating equilibrium, and so even when F is high (low), some firms are selling assets (equity). Put differently, with weak synergies, firms will issue the same type of claim for a given financing requirement; with strong synergies, we should observe greater heterogeneity in financing choices across firms.

Firm Quality. Equity issuers are likely to have synergistic assets, and asset sellers are likely to be parting with dissynergistic ones. Moreover, high-quality firms are more likely to sell synergistic assets if their financing needs are low, whereas low-quality firms are more likely to do so if their financing needs are high.

4 Conclusion

This paper has studied a firm's choice between financing through asset sales and the issuance of securities, such as equity, under asymmetric information. A direct extension of MM would imply that firms will issue the claim that exhibits the least information asymmetry. While information asymmetry is indeed relevant, there are two key differences between assets and equity, absent from the MM framework, which in turn lead to three new forces that govern the financing decision.

The first key difference is that a purchaser of non-core assets obtains a claim to the assets alone, whereas a purchaser of securities owns a claim to the firm's entire balance sheet. This leads to two new forces. The first is the balance sheet effect, which represents an advantage to selling equity. Since the firm's balance sheet includes the amount of funds raised, which is known, this reduces the information asymmetry of equity but not assets, particularly if the amount of funds raised is high. Thus, low (high) financing needs are met through asset (equity) sales: the amount of financing required affects the choice of financing, and consequently firm boundaries. This result is robust to using the cash to finance an uncertain investment.

The second new force is the correlation effect, which represents an advantage to selling assets. Since equity is a carbon copy of the firm's balance sheet, issuing it lead to a lemons discount not only on the equity being sold, but also the rest of the firm as a whole, reducing its stock price. In contrast, an asset sold need not be a carbon copy of the firm, because it is not a claim to the firm's balance sheet.

The second key difference is that the sale of assets – but not equity – can be motivated by operational reasons (synergies). This leads to the third new force, the camouflage effect, which also represents an advantage to selling assets. When firms have discretion over whether to raise financing, and growth opportunities are moderate, high-quality firms will not issue equity but may still sell assets if they are dissynergistic. This allows low-quality firms to pool with them, disguising their capital raising as being motivated by operational reasons rather than overvaluation. This camouflage effect leads low-quality firms to sell assets even if they are synergistic.

In sum, our model predicts that equity issuance is preferred when the amount of financing required is high, if growth opportunities are good, and for uses about which there is little information asymmetry (e.g., repaying debt or replenishing capital). Asset sales are preferred if the firm has non-core assets that exhibit little information asymmetry or are dissynergistic, if other firms are currently selling assets for operational reasons, and if the asset has a low correlation with the core business (e.g. in a conglomerate).

This paper suggests a number of avenues for future research. On the empirical side, it gives rise to a number of new predictions, particularly relating to the amount of financing required and the purpose for which funds are raised. On theoretical side, a number of extensions are possible. One would be to allow for other sources of asset-level capital raising, such as equity carve-outs.[19] Since issuing asset-level debt or equity does not involve a loss of (dis)synergies, a carve-out is equivalent to asset sales if synergies are zero – a carve-out also benefits from the correlation effect as it need not imply low quality for the firm as a whole, but not the balance sheet effect as investors only own a claim to the asset, not the parent company's balance sheet where the new funds reside. However, if synergies are non-zero, asset sales but not carve-outs benefit from the camouflage effect, so it would be interesting to analyze the case in which synergies are non-zero and the firm has a choice between asset sales, carve-outs, and equity issuance. Another restriction of the model is that, even when firms can choose whether to raise capital, they raise a fixed amount F (as in MM, Cooney and Kalay 1993, and Nachman and Noe 1994), since there is a single investment opportunity with a known scale of F. An additional extension would be to allow for multiple investment opportunities of different scale, to generate predictions for the amount of capital raised in equilibrium in addition to the source.

[19] Nanda (1991) also notes that non-core assets may be uncorrelated with the core business and that this may motivate carve-outs. In his model, correlation is always zero and the information asymmetry of core and non-core assets is identical. Our model allows for general correlations and information asymmetries, as well as synergies, enabling us to generate balance sheet, camouflage, and correlation effects.

References

[1] Abel, Andrew B. and Janice C. Eberly (1996): "Optimal Investment with Costly Reversibility." *Review of Economic Studies* 63, 581–59.

[2] Akerlof, George A. (1970): "The Market for Lemons: Quality Uncertainty and the Market Mechanism." *Quarterly Journal of Economics* 84, 488–500.

[3] Altinkilic, Oya and Robert S. Hansen (2000): "Are There Economies of Scale in Underwriting Fees?" *Review of Financial Studies* 13, 191–218.

[4] Armstrong, Mark and Jean-Charles Rochet (1999): "Multi-dimensional screening: A user's guide." *European Economic Review* 43, 959-979.

[5] Arnold, Marc, Dirk Hackbarth and Tatjana Xenia Puhan (2017): "Financing Asset Sales and Business Cycles." *Review of Finance*, forthcoming.

[6] Asquith, Paul and David Mullins (1986): "Equity Issues and Offering Dilution." *Journal of Financial Economics* 15, 61–89.

[7] Baker, Malcolm and Jeffrey Wurgler (2002): "Market Timing and Capital Structure." *Journal of Finance* 57, 1–32.

[8] Banks, Jeffrey S. and Joel Sobel (1987): "Equilibrium Selection in Signaling Games." *Econometrica* 55, 647–661.

[9] Bates, Thomas W. (2006): "Asset Sales, Investment Opportunities, and the Use of Proceeds." *Journal of Finance* 60, 105–135.

[10] Bond, Philip and Yaron Leitner (2015): "Market Run-Ups, Market Freezes, Inventories, and Leverage." *Journal of Financial Economics* 115, 155–167.

[11] Boot, Arnoud W.A. and Anjan V. Thakor (1993): "Security Design." *Journal of Finance* 48, 1349–1378.

[12] Borisova, Ginka and James R. Brown (2013): "R&D Sensitivity to Asset Sale Proceeds: New Evidence on Financing Constraints and Intangible Investment." *Journal of Banking and Finance* 37, 159–173.

[13] Borisova, Ginka, Kose John, and Valentina Salotti (2013): "The Value of Financing Through Cross-Border Asset Sales: Shareholder Returns and Liquidity." *Journal of Corporate Finance* 22, 320–344.

[14] Brown, David T., Christopher M. James, and Robert M. Mooradian (1994): "Asset Sales by Financially Distressed Firms." *Journal of Corporate Finance* 1, 233–257.

[15] Campello, Murillo, John R. Graham and Campbell R. Harvey (2010): "The Real Effects of Financial Constraints: Evidence From a Financial Crisis." *Journal of Financial Economics* 97, 470–487.

[16] Chang, Briana (2017): "Adverse Selection and Liquidity Distortion." *Review of Economic Studies*, forthcoming.

[17] Cho, In-Koo and David M. Kreps (1987): "Signaling Games and Stable Equilibria." *Quarterly Journal of Economics* 102, 179–221.

[18] Choe, Hyuk, Ronald W. Masulis, and Vikram Nanda (1993): "Common Stock Offerings Across the Business Cycle." *Journal of Empirical Finance* 1, 3–31.

[19] Cooney, John W. and Avner Kalay (1993): "Positive Information From Equity Issue Announcements." *Journal of Financial Economics* 33, 149–172.

[20] Covas, Francisco and Wouter J. Den Haan (2011): "The Cyclical Behavior of Debt and Equity Finance." *American Economic Review* 101, 877–899.

[21] DeAngelo, Harry, Linda DeAngelo, and René M. Stulz (2010): "Seasoned Equity Offerings, Market Timing, and the Corporate Lifecycle." *Journal of Financial Economics* 95, 275–295.

[22] DeMarzo, Peter M. (2005): "The Pooling and Tranching of Securities: A Model of Informed Intermediation." *Review of Financial Studies* 18, 1–35.

[23] DeMarzo, Peter M. and Darrell Duffie (1999): "A Liquidity-Based Model of Security Design." *Econometrica* 67, 65–99.

[24] Eckbo, B. Espen and Michael Kisser (2014): "Corporate Debt Issues and Leverage Dynamics." Working Paper, Dartmouth College.

[25] Edmans, Alex, Vivian W. Fang, and Katharina A. Lewellen (2017): "Equity Vesting and Investment." *Review of Financial Studies* 30, 2229–2271.

[26] Edmans, Alex, Luis Goncalves-Pinto, Moqi Groen-Xu and Yanbo Wang (2017): "Strategic News Releases in Equity Vesting Months." Working Paper, London Business School.

[27] Eisfeldt, Andrea L. (2004): "Endogenous Liquidity in Asset Markets". *Journal of Finance* 59, 1–30.

[28] Eisfeldt, Andrea L. and Adriano A. Rampini (2006): "Capital Reallocation and Liquidity." *Journal of Monetary Economics* 53, 369–399.

[29] Feldman, Emilie R. (2014): "Legacy Divestitures: Motives and Implications." *Organization Science* 25, 815–832.

[30] Fulghieri, Paolo, Diego Garcia, and Dirk Hackbarth (2016): "Asymmetric Information and the Pecking (Dis)order." Working Paper, University of North Carolina.

[31] Gopalan, Radhakrishnan, Todd Milbourn, Fenghua Song, and Anjan V. Thakor (2014): "Duration of Executive Compensation." *Journal of Finance* 69, 2777–2817.

[32] Guerreri, Veronica and Robert Shimer (2015): "Markets with Multidimensional Private Information." Working Paper, University of Chicago.

[33] He, Zhiguo (2009): "The Sale of Multiple Assets with Private Information." *Review of Financial Studies* 22, 4787–4820.

[34] Hennessy, Christopher A. and Toni M. Whited (2007): "How Costly is External Financing? Evidence from a Structural Estimation." *Journal of Finance* 62, 1705–1745.

[35] Hite, Gailen L., James E. Owers, and Ronald C. Rogers (1987): "The Market for Interfirm Asset Sales: Partial Sell-Offs and Total Liquidations." *Journal of Financial Economics* 18, 229–252.

[36] Holderness, Clifford G. (2017): "Seasoned Equity Offerings and Agency Costs: The Telling Story of Shareholder Approval Around the World." Working Paper, Boston College.

[37] Hovakimian, Gayane and Sheridan Titman (2006): "Corporate Investment with Financial Constraints: Sensitivity of Investment to Funds from Voluntary Asset Sales." *Journal of Money, Credit, and Banking* 38, 357–374.

[38] Jain, Prem C. (1985): "The Effect of Voluntary Sell-Off Announcements on Shareholder Wealth." *Journal of Finance* 40, 209–222.

[39] Jensen, Michael C. (1986): "The Agency Costs of Free Cash Flow: Corporate Finance and Takeovers." *American Economic Review* 76, 323–329.

[40] Kim, Woojin and Michael S. Weisbach (2008): "Motivation for Public Equity Offers: An International Perspective." *Journal of Financial Economics* 87, 208–307.

[41] Klein, April (1986): "The Timing and Substance of Divestiture Announcements: Individual, Simultaneous and Cumulative Effects." *Journal of Finance* 41, 685–696.

[42] Kreps, David and Joel Sobel (1994): "Signalling." *Handbook of Game Theory* 2, 850–867.

[43] Kurlat, Pablo (2013): "Lemons Markets and the Transmission of Aggregate Shocks." *American Economic Review* 103, 1463–1489.

[44] Lang, Larry, Annette Poulsen and Rene Stulz (1995): "Asset Sales, Firm Performance, and the Agency Costs of Managerial Discretion." *Journal of Financial Economics* 37, 3–37.

[45] Maksimovic, Vojislav and Gordon M. Phillips (2001): "The Market for Corporate Assets: Who Engages in Mergers and Asset Sales and Are There Efficiency Gains?" *Journal of Finance* 56, 2019–2065.

[46] McLean, R. David (2011): "Share Issuance and Cash Savings." *Journal of Financial Economics* 99, 693–715.

[47] Milbradt, Konstantin (2012): "Level 3 Assets: Booking Profits and Concealing Losses." *Review of Financial Studies* 25, 55–95.

[48] Miller, Merton H. and Kevin Rock (1985): "Dividend Policy Under Asymmetric Information." *Journal of Finance* 40, 1031–1051.

[49] Myers, Stewart C. and Nicholas S. Majluf (1984): "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have." *Journal of Financial Economics* 13, 187–221.

[50] Nachman, David and Thomas H. Noe (1994): "Optimal Design of Securities under Asymmetric Information." *Review of Financial Studies* 7, 1–44.

[51] Nanda, Vikram (1991): "On the Good News in Equity Carve-Outs." *Journal of Finance* 46, 1717–1737.

[52] Nanda, Vikram and M.P. Narayanan (1999): "Disentangling Value: Financing Needs, Firm Scope, and Divestitures." *Journal of Financial Intermediation* 8, 174–204.

[53] Narayanan, M. P. (1985): "Managerial Incentives for Short-term Results." *Journal of Finance* 40, 1469–1484.

[54] Rochet, Jean-Charles and Lars A. Stole (2003): "The Economics of Multidimensional Screening" in *Advances in Economics and Econometrics: Theory and Applications, Eighth World Congress*, edited by Mathias Dewatripont, Lars Peter Hansen, and Stephen J. Turnovsky. Cambridge University Press, Cambridge.

[55] Scharfstein, David S. and Jeremy C. Stein (1990): "Herd Behavior and Investment." *American Economic Review* 80, 465–479.

[56] Shleifer, Andrei and Robert W. Vishny (1992): "Liquidation Values and Debt Capacity: A Market Equilibrium Approach." *Journal of Finance* 47, 1343–1366.

[57] Slovin, Myron B., Marie E. Sushka and Steven R. Ferraro (1995): "A Comparison of the Information Conveyed by Equity Carve-Outs, Spin-Offs and Asset Sell-Offs." *Journal of Financial Economics* 37, 89–104

[58] Stein, Jeremy C. (1988): "Takeover Threats and Managerial Myopia." *Journal of Political Economy* 46, 61–80.

[59] Stein, Jeremy C. (1989): "Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behavior." *Quarterly Journal of Economics* 104, 655–669.

[60] Stein, Jeremy C. (1997): "Internal Capital Markets and the Competition for Corporate Resources." *Journal of Finance* 52, 111–133.

[61] Williams, Basil (2016): "Search, Liquidity, and Retention: Signaling Multidimensional Private Information." Working Paper, New York University.

[62] Wu, Xueping and Zheng Wang (2005): "Equity Financing in a Myers-Majluf Framework With Private Benefits of Control." *Journal of Corporate Finance* 11, 915–945.

A Proofs

Proof of Proposition 1

For either pooling equilibrium, let $X \in \{A, E\}$ represent the pooling claim and $\tilde{X}$ the off-equilibrium claim. Let $\tilde{\pi}$ represent the off-equilibrium path belief ("OEPB"), where $\tilde{\pi}$ is investors' posterior probability that $q = H$ for a deviating firm. We first show that D1 requires $\tilde{\pi} = 0$ under the conditions stated in the Proposition and then show that firms cooperate given this OEPB.

Firms cooperate if their "unit cost of financing" is weakly lower for X than $\tilde{X}$,

$$\frac{X_q}{\mathbb{E}[X]} \leq \frac{\tilde{X}_q}{\tilde{X}_L + \tilde{\pi}(\tilde{X}_H - \tilde{X}_L)} \quad \forall \quad q \in \{H, L\}, \tag{6}$$

which can be rewritten as

$$\frac{X_q}{\tilde{X}_q} \leq \frac{\mathbb{E}[X]}{\tilde{X}_L + \tilde{\pi}(\tilde{X}_H - \tilde{X}_L)}. \tag{7}$$

Note that the Proposition's conditions ($F \leq F^*$ for an asset-pooling equilibrium ("APE") and $F \geq F^*$ for an equity-pooling equilibrium ("EPE")) both imply that the pooling claim features weakly less information asymmetry than the off-equilibrium claim:

$$\frac{X_H}{X_L} \leq \frac{\tilde{X}_H}{\tilde{X}_L}. \tag{8}$$

First, consider the OEPBs that are allowable under D1. If (8) holds, then the LHS of (7) is maximized for L, so L has the stronger incentive to deviate. Then the set of OEPBs under which H deviates is a subset of those under which L deviates. To show that this subset is strict, note that L cooperates if $\tilde{\pi} = 0$ but deviates if $\tilde{\pi} = 1$. Because the conditions are continuous in $\tilde{\pi}$, there must be some value of $\tilde{\pi}$ at which L is indifferent. Then, because H has a strictly stronger incentive to cooperate, there must be some slightly higher value of $\tilde{\pi}$ at which L deviates but H cooperates. Thus, if (8) holds, then D1 requires $\tilde{\pi} = 0$. With this, (7) is satisfied for L, and then also for H who has the strictly stronger incentive to cooperate.

Conversely, if (8) is violated, then H has the stronger incentive to deviate. so the set of beliefs under which L deviates is a subset of those under which H deviates. Here, we can show that this subset is strict by noting that H cooperates at $\tilde{\pi} = 1$ but deviates at $\tilde{\pi} = 0$. Again, continuity implies that there is some $\tilde{\pi}$ at which H deviates while L does not. Then D1 requires $\tilde{\pi} = 1$, and given this belief the equilibrium is not sustainable, as (7) is violated for H. Thus, (8) is both necessary and sufficient for the pooling equilibria to be sustainable and satisfy D1.

Proof of Proposition 2

We first show that an EPE is unsustainable, by demonstrating that the only OEPB that satisfies D1 is that an asset seller is of type H, and that some H-firms will automatically deviate under such an OEPB. Given an OEPB $\tilde{\pi}$, type q deviates to assets if and only if

$$\omega\left[(\tilde{\pi}-\pi)((C_H-C_L)-(A_L-A_H))\right] > (1-\omega)F\left(\frac{A_q}{A_L-\tilde{\pi}(A_L-A_H)}-\frac{E_q}{\mathbb{E}[E]}\right). \tag{9}$$

The LHS is independent of q. The RHS is lower for $q = H$ than for $q = L$, so the OEPBs under which L deviates to assets are a subset of those under which H deviates. We can show that they are a strict subset using an analogous argument to the proof of Proposition 1.

Under the OEPB that a deviator is H, the stock price $C_H + A_H$ upon selling assets and being inferred as H is higher than that upon pooling on equity $\mathbb{E}[C + A]$. An H-firm deviating to assets receives this higher stock price and sells assets at a fair value compared to suffering a fundamental loss on equity issuance. Thus, any firm with $q = H$ will deviate to assets, and so EPE is unsustainable.

We now discuss the conditions under which an APE is sustainable. We first show that no firm wishes to deviate under condition (3) and the OEPB that a deviator is of type L, and then show that this is the only OEPB that satisfies D1.

Under the equilibrium, L sells assets worth A_L at the pooled price of $\pi A_H + (1-\pi)A_L$, and its stock price is $\pi(C_H + A_H) + (1-\pi)(C_L + A_L)$. If L deviates to equity, it will be valued correctly at E_L and its stock price will be $C_L + A_L$, so its objective function is simply $C_L + A_L$. L will thus cooperate with asset sales if

$$\begin{aligned}&\omega(\pi(C_H+A_H)+(1-\pi)(C_L+A_L))\\&\quad+(1-\omega)\left(C_L+A_L+F-F\left(\frac{A_L}{\pi A_H+(1-\pi)A_L}\right)\right)\geq C_L+A_L,\end{aligned}$$

which simplifies to (3). Note that both the numerator and denominator of (3) are positive.

We now show that, in APE, the only OEPB that satisfies D1 is that a deviator to equity is of type L. The proof is similar to the EPE analysis. Type q deviates if and only if

$$\omega\Big[(\tilde{\pi}-\pi)((C_H-C_L)-(A_L-A_H))\Big] > (1-\omega)F\left(\frac{E_q}{E_L+\tilde{\pi}(E_H-E_L)}-\frac{A_q}{\mathbb{E}[A]}\right) \tag{10}$$

Inequality (10) is easier to satisfy for $q = L$ than for $q = H$, since $E_L < E_H$ and $A_L > A_H$. Therefore, the beliefs under which H deviates are a subset of those under which L deviates. We can show that they are a strict subset using an analogous argument to the proof of Proposition 1. Thus, the only OEPB that satisfies D1 is that an equity issuer is type L.

Proof of Proposition 3

The conditions to ensure that neither H nor L deviate are given by:

$$\frac{c(X,q,k)}{\mathbb{E}[X]} \leq \frac{c(\tilde{X},q,k)}{\tilde{X}_L + \tilde{\pi}(\tilde{X}_H - \tilde{X}_L)} \quad \forall \quad (q,k) \in \{H,L\} \times [\underline{k}, \overline{k}] \tag{11}$$

$$1 + r_q \geq \frac{c(X,q,k)}{\mathbb{E}[X]} \quad \forall \quad (q,k) \in \{H,L\} \times [\underline{k}, \overline{k}] \tag{12}$$

The first condition (11) is similar to (6) in the proof of Proposition 1, but with some changes. First, we define a function $c(X, q, k)$ that measures the fundamental loss to a firm of type (q, k) choosing claim X. Thus, $c(A, q, k) = A_q(1 + k)$ and $c(E, q, k) = E_q$. Second, the definition of equity value E_q includes the investment return r_q, Third, the condition must hold for all k as well as both q values. Given $\tilde{\pi} = 0$ (see below), the condition holds for all k if and only if the Proposition's conditions (ib) (for APE) and (iib) (for EPE) are satisfied.

We also have a new set of conditions (12) to prevent any firms from deviating to inaction. Intuitively, the investment return must exceed the unit cost of financing. This yields the conditions $1 + r_L \geq \frac{A_L(1+\overline{k})}{\mathbb{E}[A]}$ and $1 + r_H \geq \frac{A_H(1+\overline{k})}{\mathbb{E}[A]}$ for APE, and $1 + r_L \geq \frac{E_L}{\mathbb{E}[E]}$ and $1 + r_H \geq \frac{E_H}{\mathbb{E}[E]}$ for EPE. The first APE condition is implied by (ib) since $r_L \geq 0$, and the first EPE condition is implied by $E_L < E_H$. This leaves us with conditions (ic) and (iic) stated in the Proposition.

Next, we confirm that the off-equilibrium valuation of $\tilde{X}$ at X_L is consistent with D1. Analogous to Proposition 1, conditions (ia) and (iia) guarantee that the pooling claim in either equilibrium is subject to less information asymmetry than the off-equilibrium claim, and this in turn is enough to imply that, for any value of k, (11) is more easily satisfied for type (H, k) than for type (L, k), and so the belief that a deviator is of quality L satisfies D1.[20]

Finally, we must check that, when L would prefer $\tilde{X}$ to X, it would not prefer inaction even more. This is automatic, since inequality (12) already guarantees that the firm prefers X to inaction. Thus, if L prefers $\tilde{X}$ to X, it also prefers $\tilde{X}$ to inaction.

Proof of Proposition 4

Case (i)

First, we note that $1 + r_H > \frac{E_H}{E_L}$ implies that all firms raise capital, as every firm prefers equity issuance to inaction, although some will prefer asset sales even more. Thus, r_q does not further affect case (i) except by implicitly appearing in the value of E.[21]

Second, given that all firms raise financing, we analyze each firm's choice between equity and asset sales. Define k^*_q as the equilibrium cutoff value below (above) which q sells assets

[20] We do not need to specify the OEPB about k as they do not affect the purchaser.

[21] As stated, the inequality contains r_H on both sides. We can solve for r_H to restate the condition as $1 + r_H > \frac{C_H + A_H}{C_L + A_L + F r_L}$.

(equity). If the cutoff is interior $k_q^* \in (\underline{k}, \overline{k})$, it is defined by equating the unit cost of financing of these two sources, $1 + k_q^* = \frac{E_q}{A_q} \frac{\mathbb{E}[A|X=A]}{\mathbb{E}[E|X=E]}$. If both cutoffs are interior, this definition implies $1 + k_H^* = \lambda\,(1 + k_L^*)$, where $\lambda \equiv \frac{E_H}{E_L} \Big/ \frac{A_H}{A_L}$, which is decreasing in F. Thus, any equilibrium is defined by its value of k_L^*, from which $k_H^* = \lambda(1 + k_L^*) - 1$ if this value is in the interval $(\underline{k}, \overline{k})$, and otherwise is equal to the nearer endpoint of this interval.

The proof will involve specifying candidate equilibria, which are summarized by a candidate cutoff k'_L (and implied value of k'_H by the reasoning above), then evaluating the incentives of firms at those cutoff values. The candidate cutoffs constitute an equilibrium if, for any interior cutoffs, firms at those cutoffs are exactly indifferent between asset sales and equity issuance; while for any boundary cutoffs, firms at those cutoffs weakly prefer the specified action.

Before proceeding, we make two observations:

First, observe that the value of F determines the price reaction to the financing choice, by determining whether or not $\frac{E_H}{E_L} \lesseqgtr \frac{A_H}{A_L}$. The general relationship between F and this inequality is given in condition (4). If both sides of the condition are positive, this yields $\frac{E_H}{E_L} > \frac{A_H}{A_L}$ if and only if $F < F^{*I}$, which generalizes the condition $F < F^*$ from the model of Section 1.1. If $\frac{E_H}{E_L} > (<) \frac{A_H}{A_L}$, then $\lambda > (<)\, 1$, which implies $k_H^* > (<)\, k_L^*$ from the relationship $1 + k_H^* = \lambda(1 + k_L^*)$. This ordering of the cutoffs determines the price reaction: If $k_H^* > (<) k_L^*$, then $\mathbb{E}[A|X = A] > (<) \mathbb{E}[A]$ and $\mathbb{E}[E|X = E] < (>) \mathbb{E}[E]$.

Second, define the value $\hat{k} \equiv \frac{E_L}{A_L} \frac{\mathbb{E}[A]}{\mathbb{E}[E]}$, and observe that this value is strictly between the values $\frac{E_L}{\mathbb{E}[E]}$ and $\frac{\mathbb{E}[A]}{A_L}$ from cases (ib) and (iib) respectively of Proposition 1. Thus, if synergies are stronger than allowed for in Proposition 1, then $\hat{k}$ is guaranteed to be strictly between $\underline{k}$ and $\overline{k}$.

Now consider the case $\frac{E_H}{E_L} > \frac{A_H}{A_L}$. Suppose we specify as a candidate equilibrium $k'_L = \overline{k}$, which implies $k'_H = \overline{k}$ as well. Given these cutoffs, and the assumption $1 + \overline{k} > \frac{\mathbb{E}[A]}{A_L}$, then $(L, \overline{k})$ strictly prefers equity issuance. On the other hand, suppose we specify as a candidate equilibrium $k'_L = \hat{k}$ and $1 + k'_H = \min\left(\lambda(1 + \hat{k}), 1 + \overline{k}\right)$. Given these cutoffs, $(L, \hat{k})$ strictly prefers asset sales, as can be seen by examining the relevant inequality $\frac{A_L(1+\hat{k})}{\mathbb{E}[A|X=A]} < \frac{E_L}{\mathbb{E}[E|X=E]}$, which simplifies to $\frac{\mathbb{E}[A]}{\mathbb{E}[A|X=A]} < \frac{\mathbb{E}[E]}{\mathbb{E}[E|X=E]}$, which in turn is satisfied by the price reactions given above for the case $\frac{E_H}{E_L} > \frac{A_H}{A_L}$. The continuity of the expressions implies that there is a value k_L^* between $\hat{k}$ and $\overline{k}$ at which (L, k_L^*) is indifferent between selling equity and assets. By construction, (H, k_H^*)'s incentives will also satisfy the equilibrium conditions when k_H^* is determined by $1 + k_H^* = \min(\lambda(1 + k_L^*), 1 + \overline{k})$, Thus, the value of k_L^* defines an equilibrium.

Now consider $\frac{E_H}{E_L} < \frac{A_H}{A_L}$. Suppose we specify as a candidate equilibrium $k'_H = k'_L = \underline{k}$. Given these cutoffs, and the assumption $1 + \underline{k} < \frac{E_L}{\mathbb{E}[E]}$, then $(L, \underline{k})$ strictly prefers asset sales. On the other hand, suppose we specify as a candidate equilibrium $k'_L = \hat{k}$ and $1 + k'_H = \max\left(\lambda(1 + \hat{k}), 1 + \underline{k}\right)$. Given these cutoffs, $(L, \hat{k})$ strictly prefers equity issuance, as can be seen by examining the relevant inequality $\frac{E_L}{\mathbb{E}[E|X=E]} < \frac{A_L(1+\hat{k})}{\mathbb{E}[A|X=A]}$, which simplifies to $\frac{\mathbb{E}[E]}{\mathbb{E}[E|X=E]} < \frac{\mathbb{E}[A]}{\mathbb{E}[A|X=A]}$, which in turn is satisfied by the price reactions above for the case $\frac{E_H}{E_L} < \frac{A_H}{A_L}$. The continuity of the expressions involved then implies that there is a value k_L^* between $\hat{k}$ and $\underline{k}$ at which (L, k_L^*) is just indifferent between equity issuance and asset sales. By construction, (H, k_H^*)'s incentives will also satisfy the equilibrium conditions when k_H^* is determined by $1+k_H^* = \max(\lambda(1+k_L^*), 1+\underline{k})$, Thus, the value of k_L^* defines an equilibrium.

Case (ii)

The major difference is that some firms prefer inaction to either financing source. Since H is more likely to prefer inaction, it is r_H (rather than r_L) that moves us from case (i) to case (ii). Moreover, among H firms, the ones more likely to switch to inaction are those issuing equity in case (i), i.e. those with $k > k_H^*$, as their assets are sufficiently synergistic that they choose to retain them. The fundamental loss to equity issuance is the same for all H firms regardless of k, so as r decreases compared to case (i), there is a cutoff below which all H firms with $k > k_H^*$ shift from equity issuance to inaction.

To derive this cutoff value, observe that when all H firms strictly prefer inaction to equity issuance, any equity issued is valued at E_L, and the H firms with $k > k_H^*$ weakly prefer inaction if $1 + r_H \leq \frac{E_H}{E_L}$, i.e., the capital loss from selling undervalued equity exceeds the investment return. This yields the condition $1 + r_H \lesseqgtr \frac{E_H}{E_L}$ that differentiates case (i) from case (ii).

The indifference condition defining k_H^*, if that cutoff is interior, is now $\frac{A_H(1+k_H^*)}{\mathbb{E}[A|X=A]} = 1+r_H$. On the other hand, L-firms will not deviate to inaction, as they always enjoy a weakly-positive fundamental gain plus the investment return, and thus should at least be willing to issue equity. The indifference condition for L between asset sales and equity issuance yields $k_L^* = \min\left(\overline{k}, \frac{\mathbb{E}[A|X=A]}{A_L} - 1\right)$.

We have $k_L^* > 0$ if and only if $k_H^* > \underline{k}$, that is, if and only if some H firms sell assets. In turn, we have $k_H^* > \underline{k}$ if and only if $1 + r_H > \frac{A_H}{A_L}(1 + \underline{k})$, as otherwise even $(H, \underline{k})$ would strictly prefer inaction to selling assets. This is the condition distinguishing case (iia) from case (iib). When this condition does not hold, we move to case (iib) with $k_H^* = \underline{k}$ and $k_L^* = 0$.

Case (iii)

This case is almost identical to case (iib), except that L-firms are now indifferent between equity issuance and inaction as they do not make a capital gain nor a positive investment return. Thus an equilibrium is sustainable in which no firms raise financing, except for L-firms with $k < 0$, who sell assets simply to get rid of dissynergies.

Online Appendix for "Financing Through Asset Sales"

B Risky Debt

This section allows the firm to sell debt, in addition to equity and assets. We show first the robustness of the balance sheet effect to allowing for debt issuance, and then the robustness of the camouflage and correlation effects.

We label debt issuance $X = D$. Under this action, the firm offers to repay debtholders a face value P; if it defaults, debtholders confiscate the firm's entire balance sheet. As the model currently stands, the financing decision becomes trivial since the firm can offer risk-free debt with a face value of F, since $F \leq \min(A_L, A_H)$. Thus, to make the problem nontrivial, we assume that risk-free debt capacity has been used up (as in MM) and also introduce a risk of the firm being insolvent. As in Cooley, Marimon, and Quadrini (2004), Carlstrom and Fuerst (1997), Gomes, Yaron, and Zhang (2003), and Hennessy, Livdan, and Miranda (2010), the firm faces the risk of a catastrophic event. Specifically, with probability ("w.p.") p, this event shrinks the firm's balance sheet to a fraction $\alpha \in (0, 1)$ of its original value, where α and p are type-independent and $\alpha E_H < F$, so that debt is risky for all firm types. The shock applies to the firm's entire balance sheet, i.e. both assets in place and the new funds raised, else the firm could again borrow risk-free debt of F. For example, the funds are invested in a zero-NPV project that is subject to the same risks as the firm's technology.[22] Alternatively, as argued by Hennessy, Livdan, and Miranda (2010), the catastrophic event may result from "mass tort claims for defective products or expropriation by a government,"which would apply to the new funds raised even if they were held as cash.

When the non-core asset is sold and separated from the firm, we assume that it continues to face the risk of a shock. For example, the shock could represent market demand or product liability connected with the output produced by the asset. This assumption is non-critical; if the sold assets were not subject to the shock, this would create an additional advantage to asset sales, but the effects that we demonstrate would still apply at the margin.

B.1 Comparison of Debt and Equity

We first examine the choice between debt and equity issuance under positive correlation. In the core model, the firm's fundamental value under equity issuance is $(C_q + A_q + F)(1 - x)$, where x is the fraction of the firm's balance sheet sold to new shareholders. With shocks,

[22] In a model with zero investment return, this assumption implies that financing is negative-NPV, because the firm sells claims with a market value of F but obtains capital worth only $(1 - p + p\alpha)F$ in expectation. As in Section 2, if firms have the option of inaction, we must introduce a sufficiently high investment return to induce them to raise financing; other than that, the following intuition is unchanged. For simplicity, we focus here on the case in which the firm is forced to raise capital.

it becomes $(1-p+p\alpha)(C_q+A_q+F)(1-x)$. New shareholders demand x such that $\mathbb{E}[x(1-p+p\alpha)(C_q+A_q+F)|X=E]=F$, which yields $x=\frac{F}{(1-p+p\alpha)\mathbb{E}[C_q+A_q+F|X=E]}$. Thus fundamental value becomes $(1-p+p\alpha)(C_q+A_q+F)-\left(\frac{C_q+A_q+F}{\mathbb{E}[C+A+F|X=E]}\right)\times F$.

Under debt issuance, fundamental value is $(1-p)(C_q+A_q+F-P)$: w.p. $1-p$, the firm is solvent and pays P; w.p. p, creditors liquidate the firm. Comparing fundamental values, the firm (weakly) prefers debt to equity if and only if

$$\frac{(1-p)P+p\alpha(C_q+A_q+F)}{F}\leq\frac{C_q+A_q+F}{\mathbb{E}[C_q+A_q+F|X=E]} \tag{13}$$

Creditors value their promised payment of P at $(1-p)P+p\alpha\times\mathbb{E}[C+A+F|X=D]$. This intuitively resembles a portfolio of risk-free debt and equity, which is why the core model's results for equity also apply to debt, as we show below. While P is an endogenous variable, it is independent of the firm's type, since it is set by uninformed investors. In equilibrium, creditors demand P such that $F=(1-p)P+p\alpha\times\mathbb{E}[C+A+F|X=D]$. Substituting this expression into the denominator of the LHS, (13) becomes

$$\frac{(1-p)P+p\alpha(C_q+A_q+F)}{(1-p)P+p\alpha\mathbb{E}[C_q+A_q+F|X=D]}\leq\frac{C_q+A_q+F}{\mathbb{E}[C_q+A_q+F|X=E]} \tag{14}$$

Defining $D_q\equiv(1-p)\,P+p\alpha\,(C_q+A_q+F)$, (14) becomes $\frac{D_q}{\mathbb{E}[D|X=D]}\leq\frac{E_q}{\mathbb{E}[E|X=E]}$, i.e. the unit cost of financing is lower for debt than equity, as is intuitive. This inequality will always hold, as in the standard pecking order. Ignoring the conditioning on $X=D$ and $X=E$ and the $(1-p)\,P$ terms on the LHS, both sides of (14) are equal. Adding the $(1-p)\,P$ term to the numerator and denominator of the LHS reduces the unit cost of debt below that of equity and towards 1. Intuitively, adding a probability $1-p$ of a type-independent payment P reduces the information asymmetry of debt relative to that of equity. As a result, given any valuations for debt and equity, H always has the strongest incentive to deviate from equity to debt.[23] Thus, an equity-pooling equilibrium is unsustainable: D1 would require that a debt issuer is inferred as H, and under this inference, H would deviate. Since no semi-separating equilibrium is possible either, only a debt-pooling equilibrium is sustainable.

Inequality (14) provides further intuition about the nature of debt in this model. If $p=1$, then debt is riskless; if $p=0$ (default is certain) then debt is identical to equity. Interestingly, the unit cost of debt financing *falls* as α decreases, because it lowers the information asymmetry over liquidation value. In the limit where $\alpha=0$, liquidation value is zero and the debt claim simply pays P with probability $1-p$, and so there is no information

[23] To see this, rearrange the above inequality to isolate the terms depending on q: A firm prefers debt issuance if and only if $\frac{(1-p)V+p\alpha(C_q+A_q+F)}{C_q+A_q+F}<\frac{(1-p)V+p\alpha\mathbb{E}[C_q+A_q+F|X=D]}{\mathbb{E}[C_q+A_q+F|X=E]}$. The LHS simplifies to $p\alpha+\frac{(1-p)V}{C_q+A_q+F}$ and is thus always minimized for type H.

asymmetry. Finally, the derivative of the unit cost of debt with respect to F is $\left(\frac{p\alpha}{F}\right)^2 (\mathbb{E}[C+A|X=E]-(C_q+A_q))$, which is the same as for equity up to a positive multiple. This expression is positive for $q=L$ and negative for $q=H$, so (as with the equity claim) increasing F lowers the unit cost for type H, because it lowers the amount of information asymmetry in the claim. This is the balance sheet effect, which applies to risky debt as well as equity. As a result, the remaining analysis of risky debt looks very similar to the core model's analysis of equity.

B.2 Comparison of Debt and Asset Sales

Next, we analyze the choice between asset sales and debt issuance, which is similar to the choice between assets and equity. The firm's objective function under asset sales is $(1-p+p\alpha)(C_q+A_q-xA_q(1+k)+F)$, where x is the fraction of assets that must be sold to meet the financing need. Investors set x such that $E[x(1-p+p\alpha)A_q|X=A]=F$, yielding $x=\frac{F}{(1-p+p\alpha)E[A_q|X=A]}$, so the objective function simplifies to $(1-p+p\alpha)(C_q+A_q+F)-F\left(\frac{A_q(1+k)}{E[A_q|X=A]}\right)$. The firm thus prefers debt issuance over asset sales if and only if

$$\frac{(1-p)P+p\alpha(C_q+A_q+F)}{(1-p)P+p\alpha E[C_q+A_q+F|X=D]}\leq\frac{A_q(1+k)}{E[A_q|X=A]}$$

or equivalently

$$\frac{D_q}{E[D|X=D]}\leq\frac{A_q(1+k)}{E[A|X=A]}$$

In the core model, H had a stronger incentive to deviate from an asset-pooling equilibrium to equity issuance if and only if $F\geq F^*$. Here, H has a stronger incentive to deviate from an asset-pooling equilibrium to debt issuance if and only if $\frac{D_H}{D_L}\leq\frac{A_H}{A_L}$, or more explicitly

$$\frac{(1-p)\,P+p\alpha\,(C_H+A_H+F)}{(1-p)\,P+p\alpha\,(C_L+A_L+F)}\leq\frac{A_H}{A_L}. \tag{15}$$

Inequality (15) is the analog of (2) in the core model, and highlights how the intuition for the balance sheet effect is the same. The amount of funds raised, F, only affects the information asymmetry of debt (the LHS) and not of non-core assets (the RHS) as only debt, and not assets, are a claim to the firm's entire balance sheet. Thus, if F is sufficiently high, the LHS falls below 1 and the inequality holds: the information asymmetry of debt becomes sufficiently low that H has the strongest incentive to deviate from an asset-pooling equilibrium.[24] Indeed, (15) yields:

$$F \geq F^{*D} \equiv p\alpha \left(F^* + \mathbb{E}[C + A|X = D] \right) (< F^*) \, .$$

This inequality must not hold for the off-equilibrium belief, that a deviator is of type L, to be satisfied. Formally, an asset-pooling equilibrium is sustainable if $F \leq F^{*D}$ (to satisfy D1) and $1 + \overline{k} < \frac{\mathbb{E}[A]}{A_L}$ (as in the core model), and a debt-pooling equilibrium is sustainable if $F \geq F^{*D}$ (to satisfy D1) and $1 + \underline{k} > \frac{D_L}{\mathbb{E}[D]} = 1 - \frac{p\alpha}{F} \left(\mathbb{E}[C + A] - (C_L + A_L) \right)$.[25]

Note that the above result, that debt is preferred for high financing needs and assets are preferred for low financing needs, assumes that a firm has used up its risk-free capacity and that $\alpha E_H < F$, to rule out the trivial case of risk-free debt. If we relax these assumptions and allow for risk-free debt then, as is well-known, this is the preferred claim. Then, debt is preferred for very low financing needs (that are sufficiently low for debt to be risk-free), assets for moderate financing needs, and debt again for high financing needs (due to the balance sheet effect).

A semi-separating equilibrium can be sustained with cutoffs defined analogously to the core model,

$$\frac{A_q(1 + k_q^*)}{\mathbb{E}[A|X = A]} = \frac{D_q}{\mathbb{E}[D_q|X = D]}.$$

From this we can further derive the same properties as the core model's semi-separating equilibrium with F^{*D} in place of F^*: $k_H^* > k_L^*$ if and only if $\frac{D_H}{D_L} > \frac{A_H}{A_L}$, i.e. $F < F^{*D}$. The price reaction to asset sales is positive (negative) if $k_H^* > (<) k_L^*$, and from this we can show that $k_H^* > (<) 0$ if and only if $F < (>) F^{*D}$.

We now demonstrate the robustness of the camouflage effect to allowing for debt issuance. As in Section 2, we give firms the option not to raise financing, and funds raised finance a new investment with expected return $r_q > 0$. The results are analogous to Propositions 3 and 4. The pooling and semi-separating equilibria considered above continue to hold if $1 + r_H \geq \frac{D_H}{D_L}$, because then all H-firms prefer raising financing to inaction. The camouflage effect is the analog of Proposition 4, part (iia). If $\frac{D_H}{D_L} > 1 + r_H > \frac{A_H}{A_L}(1 + \underline{k})$, then H-firms with $k > k_H^*$ forgo financing. They have no synergy motives to sell assets, as k is sufficiently high, and no investment motives to issue debt, because r_H is sufficiently low. Thus, debt is only issued by L-firms (with $k > k_L^*$); it offers no camouflage and is valued

[24] Note that there is a second effect of F in (15) which is absent in (2) and reinforces the balance sheet effect. When F rises, the amount that must be promised to debtholders P also rises. Since this is received in solvency regardless of firm quality, it is the same in the numerator and denominator and also reduces the LHS towards 1.

[25] One technical complication compared to the core model is that F^{*D} includes a conditional expectation that incorporates investor beliefs, so it will take on different values in different equilibria. In a debt-pooling equilibrium, the expectation evaluates to $\mathbb{E}[C + A]$, while in the asset-pooling equilibrium it evaluates to the strictly-smaller $C_L + A_L$. This means there is a gap between the sustainability regions of the two pooling equilibria, although a semi-separating equilibrium is still sustainable in this range if synergies are sufficiently strong.

at the lowest possible price of D_L. However, H-firms with sufficiently strong dissynergies ($k < k_H^*$, where $k_H^* > \underline{k}$) still sell assets. They thus offer camouflage and are valued at a pooled price of $\mathbb{E}[A|X = A] > A_L$. The threshold k_L^* is thus defined by $\frac{A_L(1+k_L^*)}{\mathbb{E}[A|X=A]} = 1$, which yields $k_L^* > 0$. As in Proposition 4, part (iia), L-firms exhibit a strict preference for asset sales. Even those with mildly positive synergies will sell assets, despite the loss of synergies, since doing so allows them to camouflage with H-firms.

We finally demonstrate the robustness of the correlation effect of Proposition 2 by turning to the negative correlation model. Type $(L, \overline{k})$ has the strongest incentive to issue debt, and so under an asset-pooling equilibrium, a deviator to debt is inferred as this type. Under this off-equilibrium belief, an asset-pooling equilibrium is sustainable if $\omega \geq \omega^{APE}$, where ω^{APE} is as in Proposition 2. On the other hand, a debt-pooling equilibrium is never sustainable, for the same reason that an equity-pooling equilibrium was unsustainable in the core model. Type $(H, \underline{k})$ has the strongest incentive to deviate to asset sales, so D1 requires an asset seller to be inferred as this type. Under this inference, $(H, \underline{k})$ will indeed deviate to asset sales. Thus, the correlation effect continues to hold.

C Negative Correlation, Additional Equilibria

C.1 Separating Equilibrium

No separating equilibrium was possible in the positive correlation model of Section 1.1. This subsection demonstrates that a separating equilibrium can hold in the negative correlation model of Section 1.2, if stock price concerns ω are sufficiently weak.

The equilibrium entails H selling assets and L issuing equity. Both types are fully revealed, so both fundamental value and the stock price, and thus the firm's objective function, equal $C_q + A_q$. If type H deviates to equity issuance, its payoff is

$$\omega(C_L + A_L) + (1 - \omega)\left(C_H + A_H + F - F\left(\frac{C_H + A_H + F}{C_L + A_L + F}\right)\right)$$

which is less than $C_H + A_H$ because $C_H + A_H > C_L + A_L$.

If type L deviates to asset sales, its payoff is

$$\omega(C_H + A_H) + (1 - \omega)\left(C_L + A_L + F - F\left(\frac{A_L}{A_H}\right)\right)$$

which is weakly less than $C_L + A_L$ if:

$$\omega \leq \frac{F\left(\frac{A_L}{A_H} - 1\right)}{C_H - C_L + A_H - A_L + F\left(\frac{A_L}{A_H} - 1\right)}.$$

Intuitively, if L deviates to asset sales, it suffers a capital loss on high-quality assets, but enjoys a stock price gain from being inferred as H. Thus, stock price concerns must be sufficiently low to deter deviation.

The equilibrium is formally stated in Proposition 5.

Proposition 5. *(Negative correlation, separating equilibrium). A separating equilibrium is sustainable in which type H sells assets and type L issues equity if* $\omega \leq \frac{F\left(\frac{A_L}{A_H}-1\right)}{C_H - C_L + A_H - A_L + F\left(\frac{A_L}{A_H}-1\right)}$.

C.2 Pooling Equilibria, General Model

This section shows that Proposition 2, the main result of Section 1.2, continues to hold in the general model which gives firms the choice of whether to raise capital, allows the capital raised to finance a positive-NPV investment, and introduces synergies. We impose two natural technical conditions that prevent synergies and investment returns, respectively, from dominating the other forces in the model. The first is given by

$$\mathbb{E}\left[k\right] < \frac{\pi}{F}\left(E_H - E_L\right). \tag{16}$$

Condition (16) ensures that, if a deviating firm is revealed as being low quality, it suffers a lower stock price. While this might seem automatic, deviation could technically increase the stock price if expected synergies are so large that, by deviating to equity sales, the market's expectation of saved synergies exceeds the inferred fall in firm quality and so gives the firm a higher stock price. A sufficient condition is $\mathbb{E}[k] = 0$, i.e. symmetrically-distributed synergies. In other words, (16) ensures that the asymmetry between positive and negative synergies is not so great as to swamp all other forces in the model and mean that a firm can increase its stock price by revealing itself as low-quality.

The second technical condition is given by

$$r_L < r_H + \frac{(A_L - A_H)(1+\overline{k})}{\mathbb{E}[A]}. \tag{17}$$

Intuitively, the presence of investment returns r discourages both H and L to deviate to inaction. If r_L is much greater than r_H, H could have the stronger incentive to deviate to inaction, even though L suffers the larger capital loss by pooling. Condition (17) ensures that this is not the case, so that asymmetry in investment returns does not swamp the other forces in the model. A sufficient condition is $r_L \leq r_H$, i.e. high-quality firms do not have lower-quality investment opportunities.

Our first result is that equity-pooling is never sustainable. D1 requires any deviator to be inferred as $(H, \underline{k})$: since $E_H > E_L$, this type makes the biggest capital loss by pooling on equity, and also has the strongest synergy motive to sell assets. Given this inference, $(H, \underline{k})$

will deviate to asset sales. By doing so, he sells assets for a fair value instead of issuing equity at a capital loss, and his stock price increases from $\mathbb{E}[C+A+Fr]$ to $C_H+A_H+F(r_H-\underline{k})$.[26]

Our second result is that an asset-pooling equilibrium is sustainable if ω is sufficiently high. D1 requires any deviator to be inferred as $(L,\overline{k})$, since its assets have the highest common-value and private-value components, and so it has the strongest incentive to deviate. Given this inference, $(L,\overline{k})$ would enjoy a fundamental gain by deviating, so the equilibrium requires both that deviation lowers the firm's stock price ($\mathbb{E}[C+A+F(r-k)] > C_L+A_L+Fr_L$, which holds due to condition (16)) and the stock price motive incentives ω to be sufficiently high. This requires

$$\omega \geq \frac{F\left(\frac{A_L(1+\overline{k})}{\mathbb{E}[A]}-1\right)}{\pi((C_H-C_L)-(A_L-A_H))+F\times\mathbb{E}[r-k]+F\left(\frac{A_L(1+\overline{k})}{\mathbb{E}[A]}-(1+r_L)\right)} \tag{18}$$

As in Proposition 2, asset-pooling requires ω to be sufficiently high so that the stock price decline deters $(L,\overline{k})$ from deviating from high-quality assets to low-quality equity.

Finally, we must show that neither type chooses to deviate to inaction. D1 requires any deviator to be inferred as quality L (given condition (17) and synergy $\overline{k}$ (since it has greatest incentive to retain its assets).[27] Given this inference, $(L,\overline{k})$ will deviate unless

$$\omega \geq \frac{F\left(\frac{A_L(1+\overline{k})}{\mathbb{E}[A]}-(1+r_L)\right)}{\pi((C_H-C_L)-(A_L-A_H))+F\times\mathbb{E}[r-k]+F\left(\frac{A_L(1+\overline{k})}{\mathbb{E}[A]}-(1+r_L)\right)}. \tag{19}$$

Since $r_L \geq 0$, this is a looser bound than in (18) and so can be ignored.

These results are summarized in Proposition 6, the analog of Proposition 2:

Proposition 6. *(Negative correlation, pooling equilibria, voluntary capital raising.) Assume conditions (16) and (17). An equity-pooling equilibrium is never sustainable. An asset-pooling equilibrium is sustainable if and only if*

$$\omega \geq \frac{F\left(\frac{A_L(1+\overline{k})}{\mathbb{E}[A]}-1\right)}{\pi((C_H-C_L)-(A_L-A_H))+F\times\mathbb{E}[r-k]+F\left(\frac{A_L(1+\overline{k})}{\mathbb{E}[A]}-(1+r_L)\right)}. \tag{20}$$

In this equilibrium, all firms sell assets for $\mathbb{E}[A]=\pi A_H+(1-\pi)A_L$. If equity is sold (off-equilibrium), it is inferred as type L and valued at E_L. The stock prices of asset sellers and equity issuers are $\mathbb{E}[C+A+F(r-k)]$ and $C_L+A_L+Fr_L$, respectively.

[26] Recall that $\underline{k}<0\leq r_H$. In addition, differing from Section 1.2, the stock price here incorporates both expected investment returns and, in the case of asset sales, expected synergy losses.

[27] Note that there was no need to deal with off-equilibrium beliefs about a firm deviating to inaction in Section 2.1, because $\omega=0$ meant that inactive firms were unconcerned with the stock market's inferences from inaction.

D Selling the Core Asset

D.1 Positive Correlation

This subsection extends the core positive correlation model of Section 1.1 to allow the firm to sell the core asset (in addition to the non-core asset and equity). Proposition 7 below characterizes which equilibria are sustainable and when.

Proposition 7. *(Positive correlation, selling the core asset.) Consider a pooling equilibrium where all firms sell non-core assets ($X = A$) and a firm that sells equity or the core asset is inferred as L. The prices of core assets, non-core assets, and equity are C_L, $\pi A_H + (1-\pi) A_L$, and $C_L + A_L + F$, respectively. This equilibrium is sustainable if:*

$$F \leq F^* \equiv \frac{C_H A_L - C_L A_H}{A_H - A_L} \text{ and} \tag{21}$$

$$\frac{A_H}{A_L} \leq \frac{C_H}{C_L}. \tag{22}$$

Consider a pooling equilibrium where all firms sell core assets ($X = C$) and a firm that sells equity or the non-core asset is inferred as L. The prices of core assets, non-core assets, and equity are $\pi C_H + (1-\pi) C_L$, A_L, and $C_L + A_L + F$, respectively. This equilibrium is sustainable if:

$$F \leq F^{*C} \equiv \frac{C_L A_H - C_H A_L}{C_H - C_L} \text{ and} \tag{23}$$

$$\frac{A_H}{A_L} \geq \frac{C_H}{C_L}. \tag{24}$$

Consider a pooling equilibrium where all firms sell equity ($X = E$) and a firm that sells either asset is inferred as L. The prices of core assets, non-core assets, and equity are C_L, A_L, and $\pi (C_H + A_H) + (1-\pi)(C_L + A_L) + F$, respectively. This equilibrium is sustainable if:

$$F \geq F^* \equiv \frac{C_H A_L - C_L A_H}{A_H - A_L} \text{ and} \tag{25}$$

$$F \geq F^{*C} \equiv \frac{C_L A_H - C_H A_L}{C_H - C_L}. \tag{26}$$

For the asset-pooling equilibrium, condition (21) is the same as condition (ib) in Proposition 1 of the core model: it ensures that the only admissible off-equilibrium belief under D1 is that an equity issuer is of quality L. Equation (22) is new and similarly ensures that the belief that a core asset seller is of quality L satisfies D1. Thus, the asset-pooling equilibrium can only be sustained if non-core assets have less information asymmetry than core assets, as is intuitive. For the core-asset-pooling equilibrium, equations (23) and (24) similarly guarantee that the off-equilibrium belief that a seller of the non-core asset or equity is of quality L satisfies D1. To understand the intuition, note that $F \lesseqgtr F^*$ can be rewritten as $\frac{A_H}{A_L} \lesseqgtr \frac{E_H}{E_L}$, while $F \lesseqgtr F^{*C}$ can similarly be rewritten $\frac{C_H}{C_L} \lesseqgtr \frac{E_H}{E_L}$.

The main result of Proposition 7 is to show that an equity-pooling equilibrium is still sustainable. Condition (25) is the same as condition (iib) of Proposition 1 in the core model: it means that the off-equilibrium belief that a seller of the non-core asset is of quality L satisfies D1. Equation (26) is new and guarantees that the belief that a core-asset seller is of quality L also satisfies D1. If both inequalities are satisfied, equity issuance is sustainable even though it does not exhibit the least information asymmetry (absent the balance sheet effect). One of the assets (core or non-core) will exhibit more information asymmetry than the other; since equity is a mix of both assets, its information asymmetry will lie in between. Even though equity is never the safest claim, it may still be issued if F is sufficiently large, due to the balance sheet effect.

D.2 Negative Correlation

We now move to the negative correlation case. Proposition 8 characterizes the pooling equilibria.

Proposition 8. *(Negative correlation, selling the core asset.) The only sustainable pooling equilibrium is one in which all firms sell non-core assets ($X = A$) and a firm that sells equity or the core asset is inferred as L. The prices of core assets, non-core assets, and equity are C_L, $\pi A_H + (1-\pi)A_L$, and $C_L + A_L + F$, respectively. This equilibrium is sustainable if:*

$$\omega \geq \frac{F\left(\frac{A_L}{E[A]} - 1\right)}{\pi((C_H - C_L) - (A_L - A_H)) + F\left(\frac{A_L}{E[A]} - 1\right)}. \tag{27}$$

An equity-pooling equilibrium is not sustainable by the same logic as in the main text. The same intuition rules out a core-asset-pooling equilibrium since, like equity, the core asset is positively correlated with firm quality. In either equilibrium, the only off-equilibrium belief consistent with D1 is that a deviator to non-core assets is of quality H. Under this belief, H will indeed deviate to non-core assets. Thus, even if the core asset exhibits less information asymmetry than the non-core asset, and so MM would suggest that it is more likely to be sold, a core-asset-pooling equilibrium cannot exist due to the correlation effect.

Equation (27) is the condition for L not to deviate to equity, and is the same as equation (3) in the core model. If L deviates to the core asset, his objective function is also $C_L + A_L$ and so we have the same condition. This is intuitive: regardless of whether it deviates to the core asset or equity, its claim is fairly priced as it is revealed as L. The off-equilibrium belief that a seller of the core asset or equity is of quality L is trivially consistent with D1: For either claim, L has a stronger incentive than H to issue it regardless of the off-equilibrium belief, because it will retain valuable non-core assets while selling less-valuable core assets or equity.

The semi-separating equilibria are very similar to the core model. There is a semi-separating equilibrium where H sells non-core assets and L issues equity, and also a semi-separating equilibrium where H sells non-core assets and L sells core assets, under exactly the same conditions as in the core model. In both equilibria, by deviating, L's stock price increases but his fundamental value falls by $\frac{F(A_L - A_H)}{A_H}$. Regardless of whether L sells equity or core assets in the semi-separating equilibrium, deviation involves him selling his highly-valued non-core assets and thus suffering a loss. In both cases, the off-equilibrium belief that a deviator to the off-equilibrium claim is of quality L is consistent with D1, because L has strictly stronger incentives than H to do so. There is no semi-separating equilibrium where H sells core assets and L sells equity, or when H sells equity or L sells the core asset, since L will mimic H in both cases.

E Financing from Multiple Sources

The core model assumes that firms can only raise financing from a single source. One potential justification is that the transactions costs from using multiple sources of financing are prohibitive. This section instead allows firms to choose a combination of financing sources, and shows that the equilibria of the core model continue to hold if a firm choosing multiple sources is inferred as L; we further show that this off-equilibrium belief is consistent with D1.

We start with positive correlation. The action space now consists of a fraction $\alpha \in [0, 1]$ of financing that is raised from the pooling claim, which is no longer restricted to be 0 or 1. The off-equilibrium belief consists of a potentially different value π_α for each choice of α. We use X_α to denote the valuation of claim X applying the belief π_α, i.e. $X_\alpha = \pi_\alpha X_H + (1 - \pi_\alpha) X_L$. To sustain the pooling equilibria of the core model, we specify $\pi_\alpha = 0$ for all $\alpha \in (0, 1)$, i.e. any firm using both sources is believed to be type-L. We show that this off-equilibrium belief is consistent with D1 and that the pooling equilibria of the core model continue to hold under this off-equilibrium belief.

To do so, we consider the incentive of a type q to deviate to an action $\alpha \in (0, 1)$. Given the resulting off-equilibrium belief, the type deviates if the unit cost of financing is lower,

$$\alpha \left(\frac{c(X, q)}{X_\alpha} \right) + (1 - \alpha) \left(\frac{c(\tilde{X}, q)}{\tilde{X}_\alpha} \right) < \frac{c(X, q)}{\mathbb{E}[X]}$$

Dividing both sides by $c(X, q)$, and invoking from Proposition 1 the condition $F < F^*$ for the asset-pooling equilibrium and $F > F^*$ for the equity-pooling equilibrium, we see that this deviation is most likely for type L, and so D1 requires $\pi_\alpha = 0$ for any $\alpha \neq 1$. This is sufficient to verify the sustainability of the equilibrium: Type q will not deviate, given the above off-equilibrium belief, if

$$\alpha\left(\frac{c(X,q)}{X_L}\right)+(1-\alpha)\left(\frac{c(\tilde{X},q)}{\tilde{X}_L}\right)>\frac{c(X,q)}{\mathbb{E}[X]}.$$

We have $\frac{c(X,q)}{\mathbb{E}[X]}<\frac{c(X,q)}{X_L}$, and the conditions in Proposition 1 (to guarantee incentive compatibility) yield $\frac{c(X,q)}{\mathbb{E}[X]}<\frac{c(\tilde{X},q)}{\tilde{X}_L}$. Thus, the linear combination of these inequalities continues to hold.

Moving to negative correlation, the equity-pooling equilibrium continues to be unsustainable by the same logic as in Proposition 2, since we have expanded the action space compared to the core model. Turning to the asset-pooling equilibrium, type q deviates to a given α if

$$\begin{aligned}&\omega\Big[(\pi_\alpha-\pi)((C_H-C_L)-(A_L-A_H))\Big]\\&>(1-\omega)F\left(\alpha\frac{A_q}{A_\alpha}+(1-\alpha)\frac{E_q}{E_\alpha}-\frac{A_q}{\mathbb{E}[A]}\right)\end{aligned}$$

We first show that $\pi_\alpha=0$ is consistent with D1 for any α, although we can no longer prove that this is the *only* belief consistent with D1. We seek a belief π_α under which L has the strongest incentive to deviate. If $\pi_\alpha=0$, the inequality simplifies to $\frac{E_q}{\mathbb{E}[E]}<\frac{A_q}{\mathbb{E}[A]}$, which does not depend on α. Under this belief, type L has at least as strong an incentive to deviate as any other type, so this belief is consistent with D1.

F Correlation Effect With General Correlation

While the core model allows for perfect positive correlation ($A_H>A_L$) and perfect negative correlation ($A_H<A_L$), this section considers a generalization that allows for any degree of correlation between the core and non-core assets. It shows that the correlation effect of Section 1.2 does not require perfect negative correlation; indeed, it can continue to hold even if the correlation is positive.

In this generalized model, let $C_H>C_L$ and $A_H>A_L$ throughout, where we assume $C_H+A_L>C_L+A_H$ so that a high-quality firm has a higher total asset value. Let π be the probability that core assets are of quality H and $\rho\equiv\Pr(A_H|C_H)=\Pr(A_L|C_L)$ denote the correlation between the values of the core and non-core assets. Thus, $(C,A)=(C_H,A_H)$ with probability ("w.p.") $\pi\rho$, (C_H,A_L) w.p. $\pi(1-\rho)$, (C_L,A_H) w.p. $(1-\pi)(1-\rho)$, and (C_L,A_L) w.p. $(1-\pi)\rho$. The perfect positive (negative) correlation model of Section 1.1 (1.2) corresponds to $\rho=1$ ($\rho=0$), i.e. high-quality core assets always coincide with high-quality (low-quality) non-core assets. (Indeed, in Section 1.2, we relabeled A_H and

A_L to emphasize this point.) When $\rho = \frac{1}{2}$ we have $\Pr(A_H|C_H) = \Pr(A_H|C_L)$, i.e. zero correlation. Thus, $\rho > (<) \frac{1}{2}$ corresponds to general, i.e. not necessarily perfect, positive (negative) correlation.

Proposition 9 is the analogy of Proposition 2 in the core model. It states that, when the correlation ρ is below a cutoff ρ^* (which may be strictly greater than $\frac{1}{2}$), an equity-pooling equilibrium is not sustainable for any ω but an asset-pooling equilibrium may be sustainable for sufficiently high ω. Proposition 2 was a special case of this result with $\rho = 0$.

Proposition 9. *(Correlation effect, general correlation.) An equity-pooling equilibrium is not sustainable if and only if*

$$\rho < \rho^* \equiv \begin{cases} \left(\frac{1-\pi}{2\pi-1}\right)\left(\frac{(C_H-C_L)-(A_H-A_L)}{A_H-A_L}\right) & \text{if } \pi > \frac{1}{2}, \\ \infty \text{ if } \pi \leq \frac{1}{2}, \end{cases} \tag{28}$$

An asset-pooling equilibrium is sustainable if and only if

$$\omega \geq \omega^{APE} \equiv \frac{F\left(\frac{A_H}{\mathbb{E}[A]} - 1\right)}{\mathbb{E}[C+A] - (C_L + A_H) + F\left(\frac{A_H}{\mathbb{E}[A]} - 1\right)} > 0. \tag{29}$$

In this equilibrium, all firms sell assets for $\mathbb{E}[A] = [\pi\rho + (1-\pi)(1-\rho)]A_H + [\pi(1-\rho) + \rho(1-\pi)]A_L$ *and are priced at* $\mathbb{E}[C+A]$*. If equity is sold (off-equilibrium), it is inferred as stemming from* (C_L, A_H) *and valued at* $C_L + A_H$*.*

We first discuss the asset-pooling equilibrium, and start by addressing off-equilibrium beliefs. Given an arbitrary off-equilibrium belief $(\tilde{C}, \tilde{A})$, a type (C, A) deviates to equity if and only if $\frac{C+A+F}{\tilde{C}+\tilde{A}+F} - \frac{A}{\mathbb{E}[A]} < \kappa$, where $\kappa \equiv \left(\frac{\omega}{1-\omega}\right)\left(\frac{1}{F}\right)\left(\tilde{C} + \tilde{A} - \mathbb{E}[C+A]\right)$ is independent of firm type. The inequality is most easily satisfied for $C = C_L$, so D1 requires that a deviator be inferred as having this value. D1 does not uniquely pin down a valuation for A with general ω, but to be consistent with the $\omega = 0$ model, we set $\tilde{A} = A_H$.

Given this off-equilibrium belief, consider the incentives of (C_L, A_H), the type most likely to deviate. Deviating to equity issuance allows it to break even, compared to a capital loss from pooling on asset sales), while causing the stock price to fall from $\mathbb{E}[C+A]$ to $C_L + A_H$. Thus, the stock price decline outweighs the fundamental value gain, sustaining the asset-pooling equilibrium, if and only if stock price concerns are high enough to satisfy (29).

The intuition is as in the core model of Section 1.2: Regardless of the correlation between the core and non-core assets ρ, the equity sold is perfectly positively correlated with the rest of the firm, and so deviation leads to a low stock price for both. Indeed, when $\rho = 0$, the bound ω^{APE} simplifies to the same value as in Proposition 2 of that section (in which A_H and A_L were relabeled).

We now turn to the equity-pooling equilibrium, and again start by addressing off-equilibrium beliefs. Given an arbitrary off-equilibrium belief $(\tilde{C}, \tilde{A})$, a type (C, A) deviates to asset sales if and only if $\frac{A}{\tilde{A}} - \frac{C+A+F}{\mathbb{E}[C+A]+F} < \kappa'$, where $\kappa' \equiv \left(\frac{\omega}{1-\omega}\right)\left(\frac{1}{F}\right)\left(\tilde{C} + \tilde{A} - \mathbb{E}[C+A]\right)$ is independent of type. D1 immediately requires $\tilde{C} = C_H$, but does not uniquely pin down $\tilde{A}$. To be consistent with the $\omega = 0$ model, we set $\tilde{A} = A_L$.

Now consider the incentive of type (C_H, A_L) to deviate to asset sales. If $\rho < \rho^*$, then $C_H + A_L > \mathbb{E}[C+A]$, so both the stock price and fundamental value are higher for (C_H, A_L) if he deviates to asset sales. This means the equilibrium is never sustainable, regardless of ω. If $\rho \geq \rho^*$, then $C_H + A_L < \mathbb{E}[C+A]$. In this case, both the stock price and the fundamental value are higher for (C_H, A_L) by cooperating with equity issuance than by deviating, so the equilibrium is always sustainable, again regardless of ω.

For relatively low ρ, deviation leads to negative inferences about the quality of non-core assets. This is because the type most likely to deviate has low-quality non-core assets (thus wishing to sell assets) and high-quality core assets (thus not wishing to sell equity). Even if the correlation between core and non-core assets is not perfectly negative, deviation leads to negatively-correlated *inferences* on the values of core and non-core assets. Indeed, $\rho^* > \frac{1}{2}$ if and only if $\pi < 1 - \frac{1}{2}\left(\frac{A_H - A_L}{C_H - C_L}\right)$. The correlation could be positive and yet the correlation effect still holds, again because deviation leads to negatively-correlated inferences.

While ρ does not affect the inference on the deviating firm, its role is instead to affect the pooled stock price (and thus whether deviating improves or worsens the inference on the rest of the firm compared to pooling) and pooled values of assets and equity (and thus whether deviating improves or worsens the capital gain compared to pooling). When ρ is low, type (C_H, A_H) is rare – it is unlikely that both core and non-core assets are high-quality. Thus, the pooled stock price $\mathbb{E}[C+A]$, which incorporates the possibility that the firm is of type (C_H, A_H), is lower.[28] In this case, deviation improves both the stock price and fundamental value, and so the equity-pooling equilibrium is unsustainable. For the same reason, low ρ means that $C_H + A_L > \mathbb{E}[C+A]$ and so type (C_H, A_L) was making a strictly positive fundamental loss of $\frac{C_H + A_L + F}{\mathbb{E}[C+A]+F} - 1$ under equity issuance, thus giving it fundamental value motives to deviate.

A similar effect can occur for the asset-pooling equilibrium. If $\pi < \frac{1}{2}$ and ρ is sufficiently small, we could have $\mathbb{E}[C+A] < C_L + A_H$. In this case (C_L, A_H) would enjoy a higher stock price and higher fundamental value from deviating to equity issuance, and so asset pooling never be sustainable.[29] However, $\mathbb{E}[C+A] < C_L + A_H$ is a stronger condition than $\mathbb{E}[C+A] < C_H + A_L$ (since $C_L + A_H < C_H + A_L$). Thus, the values of (π, ρ) for which

[28] (C_L, A_L) also becomes rarer if ρ falls, but the effect of this on the pooled stock price is smaller if $\pi \geq \frac{1}{2}$, as C_L is rarer than C_H to begin with. If on the other hand $\pi < \frac{1}{2}$, then $E[C+A] < C_H + A_L$ and so it is automatic that, regardless of ρ, (C_H, A_L) enjoys an increase in both fundamental value and the stock price from deviation and so an equity-pooling equilibrium is unsustainable.

[29] This is already accounted for in the statement of Proposition 9, as the value of ω^{APE} exceeds 1 in this case.

equity-pooling is sustainable is a strict subset of those for which asset-pooling is sustainable.

References

1. Carlstrom, Charles T. and Timothy S. Fuerst (1997): "Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis." *American Economic Review* 87, 893–910.

2. Cooley, Thomas F., Ramon Marimon, and Vincenzo Quadrini (2004): "Aggregate Consequences of Limited Contract Enforceability." *Journal of Political Economy* 112, 817–847.

3. Gomes, João F., Amir Yaron, and Lu Zhang (2003): "Asset Prices and Business Cycles with Costly External Finance." *Review of Economic Dynamics* 6, 767–788.

4. Hennessy, Christopher A., Dmitry Livdan, and Bruno Miranda (2010): "Repeated Signaling and Firm Dynamics." *Review of Financial Studies* 23, 1981–2023.