Financing Through Asset Sales*

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Abstract

Most research on firm financing studies the choice between debt and equity. We model an alternative source – non-core asset sales – and identify three new factors that drive a firm's choice between selling assets and equity. First, equity investors own a claim to the cash raised. Since cash is certain, this mitigates the information asymmetry of equity (the "certainty effect"). In contrast to Myers and Majluf (1984), even if non-core assets exhibit less information asymmetry, the firm issues equity if the financing need is high. This result is robust to using the cash for an uncertain investment. Second, firms can disguise the sale of a low-quality asset as instead motivated by operational reasons – dissynergies – and thus receive a higher price (the "camouflage effect"). Third, selling equity implies a "lemons" discount for not only the equity issued but also the rest of the firm, since its value is perfectly correlated. In contrast, a "lemons" discount on assets need not lead to a low stock price, as the asset is not a carbon copy of the firm (the "correlation effect").

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One of the firm's most important decisions is how to raise financing. Most existing research on this topic focuses on the choice between debt and equity. For example, the pecking-order theory of Myers (1984), motivated by the model of Myers and Majluf (1984, "MM"), posits that managers issue securities with least information asymmetry, and the market timing theory of Baker and Wurgler (2002) suggests that managers sell securities that are most mispriced.

However, another major source of financing is relatively unexplored: selling non-core assets – divisions, physical capital such as plants, or financial investments. Asset sales are substantial in practice: Securities Data Corporation records $131bn of asset sales by non-financial firms in the U.S. in 2012, versus $81bn in seasoned equity issuance. Figure 1 compares the time series of seasoned equity issuance with asset sales.

While some of these sales may have been motivated by operational reasons, financing is a key driver of many others. Empirically, asset sales are used to fund new investment and R&D (shown by Hovakimian and Titman (2006) and Borisova and Brown (2013) respectively), recapitalize firms in response to regulatory or investor concerns (as demonstrated by banks worldwide since the financial crisis[1]), and ad-

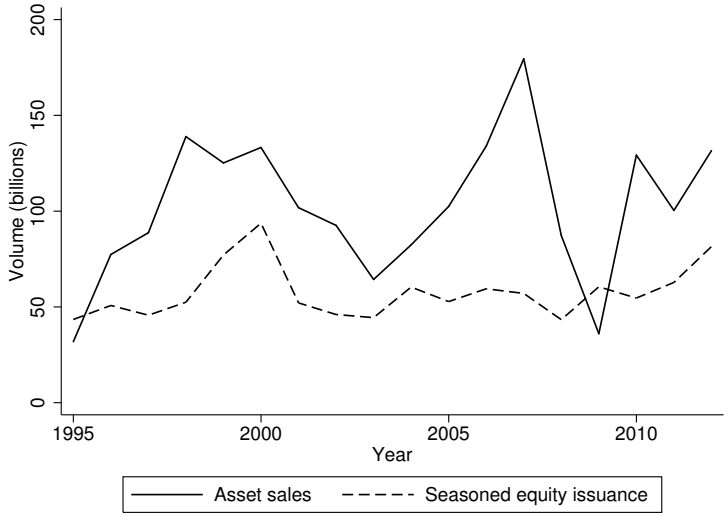

Figure 1: Seasoned equity issuance and asset sales volume. Source: SDC. Seasoned equity is all US non-IPO equity issuance. Asset sales are completed, domestic M&A transactions labeled "acquisition of assets" or "acquisition of certain assets," where the acquisition technique field includes at least one out of *Divestiture, Property Acquisition, Auction, Internal Reorganization, Spinoff*, and none out of *Buyout, Bankrupt, Takeover, Restructuring, Liquidation, Private, Tender, Unsolicited, Failed*.

[1]In September 2011, BNP Paribas and Société Générale announced plans to raise $96 billion and $5.4 billion respectively through asset sales, to create a financial buffer against contagion from other

dress one-time cash needs (BP targeted $45bn in asset sales to cover the costs of the Deepwater Horizon disaster).[2]

In each of the above cases, the firms could have met their financing needs through issuing securities, yet 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." On the one hand, asset sales are a source of funds like security issuance, and should be considered alongside security issuance in a financing decision. On the other hand, unlike security issuance, asset sales can have real effects by reallocating physical resources and changing the firm's boundaries. Thus, the role of asset sales in financing requires special investigation.

We study the conditions under which asset sales are preferable to equity issuance, and how firm boundaries are affected by financing requirements. Our model is tractable and parsimonious, enabling its economic forces to be transparent. We analyze a firm that comprises a core asset and a non-core asset, and has a financing need which it can meet by selling either equity or part of the non-core asset. The firm's quality is privately known to its manager, and the value of the core asset is higher for high-quality firms. The value of the non-core asset depends on how we specify the correlation between the core and non-core assets. With a positive (negative) correlation, the value of the non-core asset is higher (lower) for high-quality firms.

It may seem that asset sales can already be analyzed by applying the general principles of MM's security issuance model to assets, removing the need for a new theory specific to asset sales. Such an extension would suggest that assets are preferred to equity if and only if they exhibit less information asymmetry. Our model identifies three new forces that also drive the financing choice and may outweigh information asymmetry considerations.

The first new force is the *certainty effect*, which represents an advantage to selling equity. It arises because new shareholders obtain a stake in the firm's entire balance sheet, which includes not just the core and non-core assets in place (whose value is uncertain), but also the cash raised. Since the value of the cash injected is certain, this mitigates the information asymmetry of the assets in place. In contrast, an asset purchaser does not share in the cash raised, and thus bears the full information asym-

French banks. Bank of America raised $3.6 billion in August 2011 by selling a stake in a Chinese construction bank, and $755 million in November 2011 from selling its stake in Pizza Hut.

[2]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. Maksimovic and Phillips (1998) find a significant increase in asset sales upon bankruptcy.

metry associated with the asset's value. Hence, contrary to MM, even if the firm's overall assets exhibit more information asymmetry than the non-core asset alone, the manager may sell equity if enough cash is raised that the certainty effect dominates. Contrary to conventional wisdom, equity is not always the riskiest claim: if a large amount of financing is raised, equity becomes relatively safe.

This finding implies that the source of financing depends on the amount required. Formally, a pooling equilibrium is sustainable where all firms sell assets (equity) if the financing need is sufficiently low (high). This dependence contrasts standard financing models, where the choice 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 certainty effect applies to any use of cash whose expected value is uncorrelated with firm quality: retaining it on the balance sheet to replenish capital, repaying debt, or financing a risky investment whose expected return is independent of firm quality. We also analyze the case in which the investment's expected return is correlated with firm quality. It may appear that an uncertain investment return should weaken the certainty effect, but this intuition is incomplete due to a second consideration. Since investment is positive-NPV, it increases the value of the capital that investors are injecting: the certain value to which they have a claim is now higher. If the value created by investment (for firms of both quality) is large compared to the additional return generated by the high-quality firm over the low-quality firm, the second consideration dominates – somewhat surprisingly, the certainty effect can strengthen when cash is used to finance an uncertain investment. Thus, equity is more common when growth opportunities are good for firms of all quality: the source of financing depends on the use of financing. Indeed, equity is prevalent among young, growing firms (Frank and Goyal (2003), Fama and French (2005)). In contrast, if the additional return generated by the high-quality firm is large, asset sales become preferable. In almost all cases, it remains robust that asset (equity) sales are used for low (high) financing needs.

We next allow non-core assets to exhibit positive or negative synergies with the rest of the firm, which disappear if the asset is sold. This extension allows asset sales to be undertaken not only to raise capital but also for operational reasons (dissynergies), enabling us to analyze how financing and operational motives interact. We have a semi-separating equilibrium where firms sell assets if synergies are below a threshold and equity otherwise. The threshold synergy level is different for high- and low-quality firms, due to the certainty effect. If the amount of financing required is low, the information asymmetry of equity is high, making it less (more) attractive to high (low)

quality firms. Conventional wisdom is that higher financing needs cause all firms to sell more assets, which has negative real effects if assets are synergistic. Our model allows firms to raise capital also through equity; higher financing needs lead to high-quality firms substituting away from asset sales into equity issuance. Separately, greater financing needs reduce the quality, and thus price, of assets traded in equilibrium, and increase the quality and price of equity. The market reaction to equity (asset) sales is more (less) positive for a larger sale.

The second new force is the *camouflage effect*, which represents an advantage to selling assets. It arises if firms have the option not to raise financing and instead to forgo a growth opportunity. If the growth opportunity is low, high-quality firms will not issue equity, since the only motive to do so is to invest, but the adverse selection discount outweighs the value of investment. However, they will sell assets if they are sufficiently dissynergistic, not to finance investment but for operational reasons. Asset sales by high-quality firms allow low-quality firms to pool with them: they can camouflage an asset sale driven by overvaluation (the asset is of 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). A market in which firms are selling assets for operational reasons is "deep" and allows other firms to exploit their private information by selling overvalued assets. Thus, low-quality firms will sell assets even if they are moderately synergistic, to take advantage of the camouflage. In contrast, where growth opportunities are high, equity also provides camouflage as it can be undertaken for the operational reason of wishing to finance investment. Thus, we again get the prediction that young, growing firms are more likely to issue equity.

The camouflage effect also holds if high-quality firms have the option not to raise financing, but low-quality firms must do so due to poor internal cash generation, as in Miller and Rock (1985). Low-quality firms prefer to meet their financing needs through asset sales, as they can disguise their financing need as being motivated by operational reasons (dissynergies) rather than desperation (low cash generation). In the 1980s, many conglomerates shed non-core assets, stating a desire to refocus on the core business. However, outsiders did not know if the true motivation was that the non-core assets were low-quality or that the conglomerate's capital position was worse than believed.

The third new force is the *correlation effect*, which also represents an advantage to selling assets. An equity issuer suffers an Akerlof (1970) "lemons" discount – the market infers that the equity is low-quality from the firm's decision to issue it. The firm suffers not only a low price for the equity issued, but also a low valuation for

the rest of the company, because it is perfectly correlated with the issued equity. An asset seller similarly receives a low price on the assets sold, but critically this need not imply a low valuation for the company as it need not be a carbon copy. Formally, in the negative correlation model, the parameter values that support the equity-pooling equilibrium are a strict subset of those that support asset-pooling. For example, to cover the costs of Deepwater Horizon, BP is selling its mature fields and refocusing on high-risk exploration. The *New York Times* reported that analysts perceived this sale as a bet on a major new find that would displace the existing fields.[3] The sale conveyed negative information about the mature fields but a positive signal about the rest of the firm.

An implication of the correlation effect is that conglomerates issue equity less often, and sell assets more often, than firms with closely related divisions. In addition, asset sales (equity issuance) lead to positive (negative) market reactions, as found empirically. The analysis also highlights a new 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 rest of the firm.

Our paper 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. 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 certainty effect and is positively correlated with firm value; issuing debt does not affect firm boundaries and thus cannot be camouflaged as stemming from operational reasons. Like asset sales, the issuance of asset- or division-level debt or equity (e.g. an equity carve-out) benefits from the correlation effect as it need not imply low quality for the firm as a whole, but does not benefit from the certainty effect as investors do not own a claim to the cash they invest, which resides at the parent company level.

Most existing literature on asset sales is empirical. Jain (1985), Klein (1986), Hite, Owers, and Rogers (1987), and Slovin, Sushka, and Ferraro (1995) 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

[3]See the articles "With Sale of Assets, BP Bets on More Deep Wells" (July 20, 2010) and "BP to Sell Oil Assets in Gulf of Mexico for $5.6 billion" (September 10, 2012).

(1994) and Bates (2006) examine the use of proceeds. Maksimovic and Phillips (2001) and Eisfeldt and Rampini (2006) analyze operational rather than financing motives.

Existing theories generally consider asset sales as the only source of financing and do not compare them to equity, e.g., Shleifer and Vishny (1992), DeMarzo (2005), He (2009), and Kurlat (2013). Milbradt (2012) and Bond and Leitner (2013) show that selling an asset will affect the market price of the seller's remaining portfolio under mark-to-market accounting. We show that such correlation effects are stronger for equity: while a partial asset sale may imply a negative valuation of the remaining unsold non-core assets, it need not imply a negative valuation of the firm. Nanda and Narayanan (1999) also consider both asset sales and equity issuance under information asymmetry, but do not feature the certainty, camouflage, or correlation effects.[4]

Since a partial asset sale can be interpreted as a carve-out, our paper is also related to the carve-out literature. Nanda (1991) also notes that non-core assets may be uncorrelated with the core business and that this may motivate subsidiary equity issuance. 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 the three effects.[5]

Finally, while we show that the MM pecking order insight 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 (2013) 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.

This paper is organized as follows. Section 1 outlines the general model. Sections 2 and 3 study the positive and negative correlation cases, respectively. Section 4 discusses empirical implications and Section 5 concludes. The Appendix contains proofs and other peripheral material.

[4]Leland (1994) allows firms to finance cash outflows either by equity issuance (in the core analysis) or by asset sales (in an extension), but not to choose between the two. In Strebulaev (2007), asset sales are assumed to be always preferred to equity issuance, which is a last resort. Other papers model asset sales as a business decision (equivalent to disinvestment) and do not feature information asymmetry. In Morellec (2001), asset sales occur if the marginal product of the asset is less than its (exogenous) resale value. In Bolton, Chen, and Wang (2011), disinvestment occurs if the cost of external finance is high relative to the marginal productivity of capital. While those papers take the cost of financing as given, this paper microfounds the determinants of the cost of equity finance versus asset sales.

[5]Empirically, Allen and McConnell (1998) study how the market reaction to carve-outs depends on the use of proceeds. Schipper and Smith (1986) show that equity issuance leads to negative abnormal returns, but carve-outs lead to positive returns. Slovin, Sushka, and Ferraro (1995) find positive market reactions to carve-outs, and Slovin and Sushka (1997) study the implications of parent and subsidiary equity issuance on the stock prices of both the parent and the subsidiary.

1 The Framework

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 $q \in \{H, L\}$. The prior probability that $q = H$ is $\pi \in (\frac{1}{2}, 1)$.

The firm comprises two assets. 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. The first is $A_H > A_L$, so that the two assets are positively correlated. The second is $A_L > A_H$, so that they are 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:

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

i.e., H has a higher total value even if $A_H < A_L$. In MM, the key driver of financing is information asymmetry. The distinction between the two cases of $A_H > A_L$ and $A_H < A_L$ shows that it is not only the information asymmetry of the non-core asset that matters ($|A_H - A_L|$), but also its correlation with the core asset ($sign\,(A_H - A_L)$).[6]

We consider an individual firm, which must raise financing of F.[7] The cash raised remains on the firm's balance sheet. This modeling treatment nests any financing need that increases expected firm value by F, such as replenishing capital, repaying debt, or financing an uncertain investment whose expected value is uncorrelated with q.[8] In Section 2.2, the cash is used to finance an investment whose return is correlated with q and thus exhibits information asymmetry.

We currently treat F as exogenous. In MM, the firm has the option not to raise

[6] 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, whereas here it refers to the correlation between the known components. His model considers asset sales but not equity issuance.

[7] The amount of financing F does not depend on the source of financing: F must be raised regardless of whether the firm sells assets or equity. In bank capital regulation, equity issuance leads to a superior improvement in capital ratios than asset sales and so F does depend on the source of financing. We do not consider this effect here as the effect will be straightforward: it will encourage H towards the source that reduces the amount of financing required, and thus force L to follow in order to pool.

[8] If the expected value of the investment is F, all expressions are unchanged. If the expected value is F', F is simply replaced by F' in all expressions: the relevant variable becomes the (common) expected value of the investment instead of the amount of cash required to finance it.

financing and instead to forgo investment; their goal was to show that information asymmetry can deter investment by hindering financing. Since this effect is now well-known, our focus instead is the choice between asset sales and equity issuance to meet a given financing need. Section 2.4 gives firms the choice of whether to raise financing.

The firm can raise F by selling either non-core assets or equity. It cannot sell the core asset as it is essential to the firm (Appendix C relaxes this assumption) and it has exhausted other sources of finance such as risk-free debt capacity. As will be made clear later, the same certainty, camouflage, and correlation effects that drive the choice between equity and asset sales will also drive the choice between risky debt and asset sales. We specify $F \leq \min(A_L, A_H)$, so that the financing can be raised entirely through either source.[9] If the amount of financing exceeds the non-core assets available, the firm would mechanically be forced to use equity and so the source of financing would automatically depend on the amount of financing required.

In our equilibria, firms use a single source of financing. Appendix B proves that the off-equilibrium path belief ("OEPB"), that a firm that uses multiple sources is of quality L, satisfies the Cho and Kreps (1987) Intuitive Criterion ("IC"). The restriction could alternatively be motivated by the transactions costs of using multiple sources. We abstract from differences between asset sales and equity issuance in taxes, transactions costs, liquidity, bargaining power, and other frictions, because they will affect the financing choice in obvious ways: the firm will lean towards the financing source that exhibits fewest frictions. Firms cannot raise financing in excess of the requirement F; this assumption can be justified by forces outside the model such as agency costs of free cash flow.

The non-core asset is perfectly divisible so partial asset sales are possible. We do not feature nonlinearities as they will mechanically lead to the source of financing depending on the amount required. Formally, a firm of quality q issues a claim $X \in \{E, A\}$, where $X = E$ represents equity and $X = A$ assets. Investors are perfectly competitive and infer q based on X. Thus, they price both the claim being sold and the firm's stock at their expected values conditional upon X.

The price received for selling the claim affects the firm's fundamental value. The manager's objective function places weight ω on the firm's stock price and $1 - \omega$ on its fundamental value. The manager's stock price concerns can stem from a number of sources introduced in earlier work, such as takeover threat (Stein (1988)), concern for managerial reputation (Narayanan (1985), Scharfstein and Stein (1990)), or the

[9]Some of the analysis in the paper will derive bounds on F for various equilibria to be satisfied. We have verified that none of these bounds are inconsistent with $F < \min(A_L, A_H)$.

manager expecting to sell his shares before fundamental value is realized (Stein (1989)).

We solve for pure strategy equilibria.[10] We use the Perfect Bayesian Equilibrium ("PBE") solution concept, where: (i) Investors have a belief about which firm qualities 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 chooses to issue the claim X that maximizes his objective function, given investors' beliefs; (iv) Investors' beliefs satisfy Bayes' rule. In addition to the PBE, beliefs on claims X issued off the equilibrium path satisfy the IC.

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

2 Positive Correlation

We set $\omega = 0$ in the positive correlation model for ease of exposition, so that the manager maximizes fundamental value. The role of $\omega > 0$ only exists under negative correlation, as there is a trade-off to being inferred as L: market valuation falls, but the firm receives a high price if it sells assets. With a positive correlation, there is no trade-off: being inferred as L worsens both market and fundamental values. Allowing for general ω only adds additional terms to the inequalities, but does not affect their directions or the set of sustainable equilibria.

Section 2.1 studies the core model outlined in Section 1. In Section 2.2, the cash raised is instead used to finance an investment whose expected value exhibits information asymmetry. Section 2.3 introduces synergies, and Section 2.4 allows firms to have the choice over whether to raise capital.

2.1 Core Model

It is clear that there will be no separating equilibria. The use of claim X_L immediately reveals the firm to be L, and so it suffers the lowest possible price for the claim. Thus, all equilibria will be pooling equilibria. We derive the conditions under which an asset-pooling equilibrium (APE) and equity-pooling equilibrium (EPE) are sustainable, to predict when firms will use each financing channel. The analysis will demonstrate the certainty effect: equity investors obtain a claim to the cash raised, which mitigates the

[10] Mixed strategy equilibria only exist in the extension where we introduce synergies in Section 2.3, and then only 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 we specify this cutoff type as mixing or playing a pure strategy.

information asymmetry of equity. As a result, low financing needs are met by asset sales and high financing needs by equity issuance.

2.1.1 Pooling Equilibrium, All Firms Sell Assets

We consider a pooling equilibrium in which all firms sell assets, supported by the OEPB that an equity issuer is of quality L. Assets are valued at

$$\mathbb{E}[A] = \pi A_H + (1-\pi)A_L. \tag{2}$$

If equity is sold (off the equilibrium path), it is valued at E_L, where

$$E_q = C_q + A_q + F$$

is the value of equity for a firm of quality q. The F term arises because the cash raised enters the balance sheet, and so new shareholders own a claim to it.[11]

The fundamental values of H and L are respectively given by:

$$C_H + A_H - F\frac{(1-\pi)(A_H - A_L)}{\mathbb{E}[A]}, \tag{3}$$

$$C_L + A_L + F\frac{\pi(A_H - A_L)}{\mathbb{E}[A]}. \tag{4}$$

L enjoys a capital gain of $F\frac{\pi(A_H - A_L)}{\mathbb{E}[A]}$ by selling low-quality assets at a pooled price, and so he will not deviate. H suffers a capital loss of $F\frac{(1-\pi)(A_H - A_L)}{\mathbb{E}[A]}$, and thus may deviate to equity. If he does so, fundamental value becomes:

$$C_H + A_H - F\frac{C_H - C_L + A_H - A_L}{C_L + A_L + F}. \tag{5}$$

The no-deviation ("ND") condition is that (5) $\leq$ (3), which can be rewritten:

$$F \leq F^{APE,ND} \equiv \frac{\mathbb{E}[A](C_H + A_H) - A_H(C_L + A_L)}{A_H - \mathbb{E}[A]}. \tag{6}$$

Condition (6) is equivalent to the "unit cost of financing" being lower for assets, i.e.,

$$\frac{A_H}{\mathbb{E}[A]} \leq \frac{C_H + A_H + F}{C_L + A_L + F}, \tag{7}$$

[11] This is consistent with the treatment of financing in MM, although the level of financing plays no role in their analysis since both equity and debt are claims on the entire balance sheet.

where the numerator on each side is the value of the claim being sold by the firm, and the denominator is the price that investors pay for that claim.

Two forces determine H's incentives to deviate. The first is whether assets or equity exhibit greater information asymmetry ($\frac{A_H}{\mathbb{E}[A]}$ versus $\frac{C_H+A_H}{C_L+A_L}$). This effect is a natural extension of the MM principle that high-quality firms issue safe claims. If $\frac{A_H}{\mathbb{E}[A]} > \frac{C_H+A_H}{C_L+A_L}$, i.e., assets exhibit sufficiently greater information asymmetry, H will deviate to equity: for any F, (7) is violated and so an APE is unsustainable.

The second force is the amount of financing F. This is unique to a model of asset sales and arises because an equity investor has a claim to the cash raised but an asset purchaser does not. Since the value of cash is certain, it mitigates the information asymmetry of equity: the *certainty effect*. As F rises, the right-hand side ("RHS") of (7) 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), so the RHS falls towards 1. Thus, there is an upper bound on F to prevent deviation, given by (6). In particular, even if $\frac{A_H}{\mathbb{E}[A]} < \frac{C_H+A_H}{C_L+A_L}$, i.e., assets are safer than equity, a high F can lead to (7) being violated. The MM result that firms issue the claim with the least information asymmetry need not hold. Similarly, the analysis contradicts conventional wisdom that equity is the riskiest claim. If the amount of financing raised is sufficiently large, equity is relatively safe.

Note that the certainty effect would also apply to risky debt, since it is also a claim on the entire balance sheet. Thus, even if risky debt exhibits more information asymmetry than the non-core asset, it may be preferred if F is large.

We now verify that the OEPB, that an equity issuer is L, satisfies the IC. This is the case if L would issue equity if he would be inferred as H, which requires:

$$F \leq F^{APE,IC} \equiv \frac{A_L(C_H + A_H) - \mathbb{E}[A](C_L + A_L)}{\mathbb{E}[A] - A_L}. \tag{8}$$

If F is large, L will not deviate to equity even if he is inferred as H, since the certainty effect reduces the gains from doing so. Thus, we have another upper bound on F. If $\frac{C_H+A_H}{C_L+A_L} < \frac{\mathbb{E}[A]}{A_L}$, assets exhibit relatively high information asymmetry. Thus, L enjoys such a large gain from asset sales that he will never deviate to equity: the RHS of (8) is negative and so the IC condition is violated for any F.

Lemma 1 below summarizes the equilibrium. The proof shows that the IC condition is stronger than the ND condition and thus is the relevant condition for an APE to hold. (All proofs are in Appendix A.)

Lemma 1. *(Positive correlation, pooling equilibrium, all firms sell assets.) Consider a pooling equilibrium where all firms sell assets ($X = A$) and a firm that issues equity is inferred as L. The prices of assets and equity are $\pi A_H + (1-\pi)A_L$ and $C_L + A_L + F$, respectively. The equilibrium is sustainable if $F \leq F^{APE}$, where*

$$F^{APE} \equiv F^{APE,IC} \equiv \frac{A_L(C_H + A_H) - \mathbb{E}[A](C_L + A_L)}{\mathbb{E}[A] - A_L}. \tag{9}$$

2.1.2 Pooling Equilibrium, All Firms Sell Equity

We now consider the alternative pooling equilibrium in which all firms issue equity, supported by the OEPB that an asset seller is of quality L. The analysis is similar to the APE and the equilibrium is summarized in Lemma 2 below.

Lemma 2. *(Positive correlation, pooling equilibrium, all firms sell equity.) Consider a pooling equilibrium where all firms sell equity ($X = E$) and a firm that sells assets is inferred as L. The prices of assets and equity are A_L and*

$$\mathbb{E}[E] = \pi(C_H + A_H) + (1-\pi)(C_L + A_L) + F, \tag{10}$$

respectively. This equilibrium is sustainable if $F \geq F^{EPE}$, where

$$F^{EPE} \equiv F^{EPE,IC} \equiv \frac{A_L\mathbb{E}[C + A] - A_H(C_L + A_L)}{A_H - A_L}. \tag{11}$$

As in APE, L makes a capital gain, and thus has no incentive to deviate. H makes a loss, and will not deviate if and only if

$$F \geq F^{EPE,ND} \equiv \frac{A_L(C_H + A_H) - A_H\mathbb{E}[C + A]}{A_H - A_L}. \tag{12}$$

In contrast to Section 2.1.1, H's ND condition (12) now imposes a *lower* bound on F. This also results from the certainty effect. If F is high, equity exhibits little information asymmetry. Thus, H suffers a small loss from equity issuance, and so will not deviate. The IC condition is again stronger than H's ND condition, and is given by (11).

2.1.3 Comparing the Equilibria

We now analyze the conditions under which each equilibrium is sustainable. The results are given in Proposition 1 below:

Proposition 1. *(Positive correlation, comparison of equilibria.) An asset-pooling equilibrium is sustainable if $F \leq F^{APE}$, and an equity-pooling equilibrium is sustainable if $F \geq F^{EPE}$, where F^{APE} and F^{EPE} are given by (9) and (11), respectively, and $F^{APE} > F^{EPE}$. Thus, if:*

(i) $F < F^{EPE}$, only an asset-pooling equilibrium is sustainable,

(ii) $F^{EPE} \leq F \leq F^{APE}$, both the asset-pooling and equity-pooling equilibria are sustainable,

(iii) $F > F^{APE}$, only an equity-pooling equilibrium is sustainable.

Proposition 1 shows that, when the amount of financing required increases, firms switch from selling assets (APE) to equity (EPE), since the certainty effect strengthens. Thus, the type of claim issued depends not only on the inherent characteristics of the claim (its 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 limitations on financing such as limited debt capacity. Here, there are no limits as F can be fully raised by either source.

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. Moreover, if all assets are synergistic (a special case of the general synergies model considered in Section 2.3), then asset sales reduce total surplus. Surprisingly, greater financial constraints may improve real efficiency as firms hold onto their synergistic assets.

One interesting case is a single-segment firm, which corresponds to $C_q = A_q$, i.e., core and non-core assets are one and the same. Since the information asymmetry of the firm equals that of the non-core asset, the certainty effect will push the information asymmetry of equity lower, and so lead to a preference for equity.

Appendix C shows that the certainty effect is robust to allowing firms to sell the core asset (in addition to the non-core asset and equity). The intuition is as follows. 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 due to the certainty effect: an EPE can be sustained.

2.2 Cash Used For Investment

This section shows that the previous result, that asset (equity) sales are used for low (high) financing needs, continues to hold when the cash raised is used to finance an investment whose expected value exhibits information asymmetry.

Since all agents are risk-neutral, only expected values matter. Thus, the model is unchanged if we simply make the investment volatile, so that its payoff is a random variable with an expected value independent of q. For the investment to affect the analysis, it must vary with q so that it exhibits information asymmetry – a critically different concept to volatility. We thus assume that F is used to finance an investment with expected value $R_q = F(1 + r_q)$, where $r_H \geq 0$ and $r_L \geq 0$: since there are no agency problems, only positive-NPV investments are undertaken (as in MM). (Appendix E allows for $r_H < 0$ and $r_L < 0$ and shows that the core intuitions are unchanged.) We allow for both $r_H \geq r_L$ and $r_H < r_L$. The former is more common as high-quality firms typically have superior investment opportunities, but $r_H < r_L$ can occur as a firm that is currently weak may have greater room for improvement. Intuitively, it would seem that, if $r_H \geq r_L$, the uncertainty of investment will exacerbate the uncertainty of assets in place, weakening the certainty effect and making equity less desirable. However, we will show that this is not necessarily the case.

We assume that:

$$\frac{A_H}{A_L} < \frac{C_H + A_H}{\mathbb{E}[C + A]}. \tag{13}$$

Equation (13) states that the information asymmetry of assets is not too high compared to equity. If (13) is violated, the information asymmetry of assets is so high that, in the core model, an EPE is always sustainable regardless of F (the RHS of (12) is negative). We discuss the effect of relaxing (13) at the end of this section.

We first consider the APE. The analog of (7), H's ND condition, is now:

$$\frac{A_H}{\mathbb{E}[A]} \leq \frac{C_H + A_H + F(1 + r_H)}{C_L + A_L + F(1 + r_L)}. \tag{14}$$

As is intuitive, C_q and R_q $(= F(1 + r_q))$ enter symmetrically in all expressions: an equity investor receives a share of C, R, and A, but an asset purchaser receives only a share of A. From (14), H will not deviate if:

$$F[A_H(1 + r_L) - \mathbb{E}[A](1 + r_H)] \leq \mathbb{E}[A](C_H + A_H) - A_H(C_L + A_L). \tag{15}$$

Since (13) implies $\frac{A_H}{\mathbb{E}[A]} < \frac{C_H + A_H}{C_L + A_L}$, the RHS of (15) is positive. We first consider the

case of $\frac{A_H}{\mathbb{E}[A]} > \frac{1+r_H}{1+r_L}$, i.e., the information asymmetry of investment is not too high. The LHS of (15) is positive, and so we again have an upper bound on F, given by:

$$F \leq \frac{\mathbb{E}[A](C_H + A_H) - A_H(C_L + A_L)}{A_H(1 + r_L) - \mathbb{E}[A](1 + r_H)}. \tag{16}$$

In the core model (equation (6)), the denominator is $A_H - \mathbb{E}[A]$. If $r_L > r_H$, the denominator of (16) is greater than in the core model, and so it is harder to support an APE. This is intuitive: L's superior growth options counterbalance its inferior assets in place and reduce the information asymmetry of equity. One may think that the reverse intuition applies to $r_H \geq r_L$, but if $\frac{A_H}{\mathbb{E}[A]} > \frac{r_H}{r_L}$, the denominator of (16) is still higher than in the core model: The intuition is incomplete, because using funds to finance investment has two effects. They can be best seen by the following decomposition of the investment returns:

$$\begin{aligned} R_L &= F(1 + r_L) \\ R_H &= F(1 + r_L) + F(r_H - r_L). \end{aligned}$$

The first, intuitive effect is the $F(r_H - r_L)$ term which appears in the R_H equation only. The value of investment is greater for H, increasing information asymmetry. However, there is a second effect, captured by the $F(1 + r_L)$ term common to both firms. This term increases the certainty effect: 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. While investors do not know firm quality, they do know that the funds they provide will increase in value, regardless of quality.[12] Due to this second effect, $r_H \geq r_L$ is not sufficient for the upper bound to relax. Only if $\frac{A_H}{\mathbb{E}[A]} < \frac{r_H}{r_L}$ does the first effect dominate, loosening the upper bound. Finally, if $\frac{A_H}{\mathbb{E}[A]} \leq \frac{1+r_H}{1+r_L}$, i.e., investment exhibits high information asymmetry, then the LHS of (15) is non-positive and so the ND condition holds for any F.

Another way to view the intuition is as follows. 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, $\frac{A_H}{\mathbb{E}[A]}$, is less than the weighted average loss on this overall portfolio. If both the assets in place and the new investment exhibit higher information asymmetry than non-core assets, i.e., $\frac{A_H}{\mathbb{E}[A]} \leq \frac{C_H+A_H}{C_L+A_L}$ and $\frac{A_H}{\mathbb{E}[A]} \leq \frac{1+r_H}{1+r_L}$, then the loss on the portfolio is greater

[12]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."

regardless of the weights – hence, H cooperates regardless of F. Deviation is only possible if the investment is safer than non-core assets, i.e., $\frac{A_H}{\mathbb{E}[A]} > \frac{1+r_H}{1+r_L}$. In this case, the weight placed on the new investment (F) must be low for the weighted average loss to remain higher for the portfolio, and so for deviation to be ruled out.

Regardless of the specific values of r_H and r_L, in all cases the APE requires F to be below an upper bound, as in the core model.[13] The equilibrium is summarized in Lemma 3 below. The proof of the Lemma shows that the effect of uncertain investment on the IC condition is similar, and that the IC condition ((17) below) is always stronger than the ND condition (15).

Lemma 3. *(Positive correlation, pooling equilibrium, all firms sell assets, cash used for investment.) Consider a pooling equilibrium where all firms sell assets ($X = A$) and a firm that issues equity is inferred as L. The prices of assets and equity are $\pi A_H + (1-\pi)A_L$ and $C_L + A_L + F(1+r_L)$, respectively. The equilibrium is sustainable if:*

$$F\left(\mathbb{E}[A](1+r_L) - A_L(1+r_H)\right) \leq A_L(C_H + A_H) - \mathbb{E}[A](C_L + A_L). \tag{17}$$

(i) If $\frac{1+r_H}{1+r_L} \geq \frac{\mathbb{E}[A]}{A_L}$, the asset-pooling equilibrium is sustainable for all F.

(ii) If $\frac{\mathbb{E}[A]}{A_L} > \frac{1+r_H}{1+r_L}$, the asset-pooling equilibrium is sustainable if $F \leq F^{APE,I} = \frac{A_L(C_H+A_H)-\mathbb{E}[A](C_L+A_L)}{\mathbb{E}[A](1+r_L)-A_L(1+r_H)}$. Compared to the case where cash remains on the balance sheet (Lemma 1):

(a) If $\frac{r_H}{r_L} < \frac{\mathbb{E}[A]}{A_L}$, the upper bound on F is tighter and the asset-pooling equilibrium is sustainable across a smaller range of F,

(b) If $\frac{r_H}{r_L} > \frac{\mathbb{E}[A]}{A_L}$, the upper bound on F is looser and the asset-pooling equilibrium is sustainable across a larger range of F.

The effect of using cash for investment is similar in the EPE, so we defer the analysis to Appendix E. The comparison of equilibria is summarized in Proposition 2:

Proposition 2. *(Positive correlation, cash used for investment, comparison of equilibria.) An asset-pooling equilibrium is sustainable if $F \leq F^{APE,I}$, and an equity-pooling equilibrium is sustainable if $F \geq F^{EPE,I}$, where $F^{APE,I}$ and $F^{EPE,I}$ are given by:*

$$F^{APE,I} = \begin{cases} \frac{A_L(C_H+A_H)-\mathbb{E}[A](C_L+A_L)}{\mathbb{E}[A](1+r_L)-A_L(1+r_H)} & \text{if } \frac{1+r_H}{1+r_L} < \frac{\mathbb{E}[A]}{A_L}, \\ \infty \text{ if } \frac{1+r_H}{1+r_L} \geq \frac{\mathbb{E}[A]}{A_L}, \end{cases}$$

$$F^{EPE,I} = \begin{cases} \frac{A_L\mathbb{E}[C+A]-A_H(C_L+A_L)}{A_H(1+r_L)-A_L(1+\mathbb{E}[r_q])} & \text{if } \frac{1+r_H}{1+r_L} < \frac{A_H-(1-\pi)A_L}{\pi A_L} \ ; \\ \infty \text{ if } \frac{1+r_H}{1+r_L} \geq \frac{A_H-(1-\pi)A_L}{\pi A_L} \ (> \frac{\mathbb{E}[A]}{A_L}). \end{cases}$$

[13] For $\frac{A_H}{\mathbb{E}[A]} \leq \frac{1+r_H}{1+r_L}$, the upper bound is infinite and therefore greater than $\min(A_H, A_L) \geq F$, making asset-pooling sustainable for any F.

The thresholds $F^{APE,I}$ and $F^{EPE,I}$ are both increasing in r_H and decreasing in r_L, and $F^{EPE,I} < F^{APE,I}$ except when both bounds are infinite.

Proposition 2 demonstrates that the core model's results continue to hold when there is information asymmetry over the use of the cash raised. Regardless of r_H and r_L, an APE (EPE) is sustainable for low (high) F. As in the core model, the source of financing depends on the amount of financing required.

In addition to demonstrating robustness, this extension also generates a new prediction. As r_H falls and r_L rises (the information asymmetry of investment falls), the upper bound on the APE tightens and the lower bound on the EPE loosens. Thus, the source of financing also depends on the use of financing. If growth opportunities are good regardless of firm quality (if r_L is high, for example in young firms or in good macroeconomic conditions), 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. In addition, our predictions for the use of equity 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 certainty effect.

Appendix E also considers the case in which (13) does not hold, so that assets exhibit such high information asymmetry that an EPE holds in the core model regardless of F. In this rare case, *and* if also the information asymmetry of the investment is lower than that of assets ($\frac{\mathbb{E}[A]}{A_L} \geq \frac{1+r_H}{1+r_L}$), equity issuance is always possible unless the weight on the investment is high enough that the weighted average information asymmetry (of equity and the new investment) is greater than that of assets. Thus, the EPE (APE) now holds for low (high) F. If either one of the above conditions is not met, we return to the core model's result that the EPE holds for high F and the APE for low F.

2.3 Synergies

This section allows for non-core assets to be worth more or less to the current owner than to an outside purchaser, even in the absence of information asymmetry, due to synergies. Synergies may stem from transactions costs being lower within a firm than in a market (Coase (1937)), monitoring advantages (Alchian and Demsetz (1972)), economies of scope (Panzar and Willig (1981)), a reduction in hold-up problems (Grossman and Hart (1986), Hart and Moore (1990)), or firm-specificity. This extension allows

asset sales to be undertaken for operational as well as financing reasons. We will show that the introduction of synergies gives rise to a semi-separating equilibrium where firms of the same quality issue different claims depending on their level of synergies. Moreover, the cutoff synergy level, that determines whether a firm sells assets or equity, will depend on the amount of financing F due to the certainty effect.

Firm type $\theta = (q, k)$ is now two-dimensional. The synergy parameter is $k \sim U\left[\underline{k}, \overline{k}\right]$, where $-1 < \underline{k} \leq 0$, $\overline{k} > 0$, and k and q are uncorrelated. While quality q measures the standalone (common) value of a firm's assets, synergy k measures the additional (private) value created by the existing owner. Now, when a firm sells non-core assets worth F, its fundamental value falls by $F(1+k)$. Thus, the case of $k > (<) 0$ represents synergies (dissynergies).[14] In addition to synergies, $k > 0$ can also arise if investment in assets is costly to reverse (e.g., Abel and Eberly (1996)).

We sometimes use the term "H" or "H-firm" to refer to a high-quality firm regardless of its synergy parameter, and similarly for "L" or "L-firm". "Capital gain/loss" refers to the gain/loss resulting from the common value component of the asset value only, and "fundamental gain/loss" refers to the change in the firm's overall value, which consists of both the capital gain/loss and any loss of (dis)synergies. For equity issuance, the capital gain/loss equals the fundamental gain/loss.

We feature synergies in this extension, rather than the core model, as synergies are not necessary for the certainty effect of Section 2. Appendix D shows that the pooling equilibria and certainty effect of Section 2 are robust to introducing synergies. The sustainability conditions now depend not only on information asymmetry and the certainty effect, but also on synergies. As is intuitive, a higher maximum synergy $\overline{k}$ makes it harder to sustain an APE, as a firm with $k = \overline{k}$ may wish to deviate to equity to retain its synergistic asset, and a lower maximum dissynergy $\underline{k}$ makes it harder to sustain an EPE, as a firm with $k = \underline{k}$ may wish to get rid of its dissynergistic asset.

The main effect of introducing synergies is that, in addition to pooling equilibria, a semi-separating equilibrium (SSE) may be sustainable, where financing choices vary even among firms of the same quality q: a firm whose synergy lies below (above) a cutoff k_q^* sells assets (equity). H and L can use different cutoff rules, so separation will

[14] One may wonder why the firm has dissynergistic assets to begin with. Firms may acquire assets when they are synergistic, but they may become dissynergistic over time (as found by Maksimovic and Phillips (2001)). One may still wonder why the firm has not yet disposed of the dissynergistic asset. 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.

be along both type dimensions.

While investors do not directly care about k (as it only affects private values), the synergy cutoffs affect the expected quality (common value) of the claims. Using Bayes' rule, in any equilibrium the prices paid for sold assets and issued equity are, respectively:

$$\mathbb{E}[A|X=A] = \pi \frac{k_H^* - \underline{k}}{\mathbb{E}[k_q^*] - \underline{k}} A_H + (1-\pi) \frac{k_L^* - \underline{k}}{\mathbb{E}[k_q^*] - \underline{k}} A_L, \tag{18}$$

$$\mathbb{E}[E|X=E] = \pi \left(\frac{\overline{k} - k_H^*}{\overline{k} - \mathbb{E}\left[k_q^*\right]} \right) (C_H + A_H) + (1-\pi) \left(\frac{\overline{k} - k_L^*}{\overline{k} - \mathbb{E}\left[k_q^*\right]} \right) (C_L + A_L) + F, \tag{19}$$

where

$$\mathbb{E}\left[k_q^*\right] = \pi k_H^* + (1-\pi)\, k_L^*.$$

A type (q, k) will prefer equity if and only if its unit cost of financing is no greater:

$$\frac{C_q + A_q + F}{\mathbb{E}[E|X=E]} \leq \frac{A_q(1+k)}{\mathbb{E}[A|X=A]}. \tag{20}$$

The cutoff k_q^* is that which allows (20) to hold with equality. Thus, it is defined by:

$$k_q^* = \frac{C_q + A_q + F}{A_q} \frac{\mathbb{E}[A|X=A]}{\mathbb{E}[E|X=E]} - 1. \tag{21}$$

Although k_q^* is not attainable in closed form, we can study whether $k_H^* \lesseqgtr k_L^*$. Since only the $\frac{C_q + A_q + F}{A_q}$ term on the RHS depends on q, the higher cutoff k_q^* belongs to the quality q for which this term is higher. Thus, $k_H^* > k_L^*$ if and only if

$$\frac{C_H + A_H + F}{C_L + A_L + F} > \frac{A_H}{A_L} \tag{22}$$

i.e.,

$$F < F^* \equiv \frac{C_H A_L - C_L A_H}{A_H - A_L}. \tag{23}$$

Condition (22) is intuitive. It requires the certainty effect-adjusted information asymmetry to be higher for equity, which in turn requires F to be low. H dislikes information asymmetry as it increases his capital loss; conversely, L likes information asymmetry. If $F < F^*$, equity is less attractive to H than L, and so H chooses a higher cutoff ($k_H^* > k_L^*$). Indeed, when $F < F^*$, we have $k_H^* > 0$: H sells assets even if they

are mildly synergistic, due to their lower information asymmetry. The different cutoffs in turn affect the valuations. If $k_H^* > k_L^*$, H is more willing to sell assets than L, and so the asset price (18) is higher than in the APE (2).

Due to the certainty effect, changes in F alter the cutoffs and thus the quality of assets and equity sold, in turn affecting their prices. If $F > F^*$, (22) is violated: the certainty effect is sufficiently strong that equity is more attractive to H ($k_H^* < k_L^*$). More H firms sell equity, increasing (decreasing) the quality and price of equity (assets) sold. Indeed, when $F > F^*$, we have $k_H^* < 0$: H retains assets even if they are mildly dissynergistic, due to their higher information asymmetry. Now, the equity price (19) is higher than in the EPE (10). Thus, as in the model without synergies, increases in F have real effects on firm boundaries. Here, they lead to more H-firms retaining assets, even if they are dissynergistic.

The above results are summarized in Lemma 4 below, which also gives necessary and sufficient conditions for a SSE to hold.

Lemma 4. *(Positive correlation, synergies, semi-separating equilibrium): Consider a semi-separating equilibrium where quality q sells assets if $k \leq k_q^*$ and equity if $k > k_q^*$, where k_q^* is defined by (21). We have the following cases:*

(ia) If $F < F^*$, then $k_H^* > 0$ and $k_H^* > k_L^*$.

(ib) If $F > F^*$, then $k_H^* < 0$ and $k_H^* < k_L^*$.

(ic) If $F = F^*$, then $k_L^* = k_H^* = 0$.

The prices of assets and equity are given by (18) and (19), respectively.

A full semi-separating equilibrium where both qualities q strictly separate ($\underline{k} < k_q^* < \overline{k}$) is sustainable under the following conditions:

(iia) If $F < F^*$, a necessary condition is $1 + \overline{k} > \frac{E_H}{A_H}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$ and a sufficient condition is $1 + \overline{k} \geq \frac{E_H}{E_L}$.

(iib) If $F > F^*$, a necessary condition is $1 + \underline{k} < \frac{E_H}{A_H}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$ and a sufficient condition is $1 + \underline{k} \leq \frac{A_L}{A_H}$.

(iic) If $F = F^*$, this is sufficient for existence.

A partial semi-separating equilibrium where H's cutoff is at a boundary is sustainable in the following cases:

(iiia) If $F < F^*$, we can sustain a SSE where all H-firms sell assets ($k_H^* = \overline{k}$) and L-firms strictly separate ($\underline{k} < k_L^* < \overline{k}$), where $k_L^* > 0$. A necessary condition is $\frac{\mathbb{E}[A]}{A_L} < 1 + \overline{k} < \frac{E_H}{E_L}$ and a sufficient condition is $\frac{A_H}{A_L} \leq 1 + \overline{k} \leq \frac{\mathbb{E}[A]}{A_H}\frac{E_H}{E_L}$.

(iiib) If $F > F^*$, we can sustain a SSE where all H-firms sell equity ($k_H^* = \underline{k}$) and L-firms strictly separate ($\underline{k} < k_L^* < \overline{k}$), where $k_L^* < 0$. A necessary condition is $\frac{A_L}{A_H} < 1 + \underline{k} < \frac{E_L}{\mathbb{E}[E]}$ and a sufficient condition is $\frac{A_L}{A_H}\frac{E_H}{\mathbb{E}[E]} \leq 1 + \underline{k} \leq \frac{E_L}{E_H}$.

A partial semi-separating equilibrium where L's cutoff is at a boundary is sustainable in the following cases:

(iva) If $F < F^*$, we can sustain a SSE where all L-firms sell equity ($k_L^* = \underline{k}$) and H-firms strictly separate ($\underline{k} < k_H^* < \overline{k}$). A set of sufficient conditions is $\underline{k} = 0$, $1 + \overline{k} > \frac{E_H}{E_L}$, and π sufficiently close to 1.

(ivb) If $F < F^*$, we can sustain a SSE where all L-firms sell assets ($k_L^* = \overline{k}$) and H-firms strictly separate ($\underline{k} < k_H^* < \overline{k}$). A set of sufficient conditions is $\overline{k} = 0$, $1 + \underline{k} < \frac{A_L}{A_H}$, and π sufficiently close to 1.

Lemma 4 shows that it is the relative importance of operational motives (determined by the absolute values of $\overline{k}$ and $\underline{k}$) compared to certainty effect-adjusted information asymmetry (determined by the distance of F from F^*) that governs whether a SSE is sustainable. In a SSE, both claims are issued and one claim will be associated more with L. If F is very low or very high, information asymmetry is strong, and so issuing the claim associated with L leads to a large capital loss. If synergies are too weak to offset this loss, firms pool. In contrast, if F is close to F^* and $\overline{k}$ or $\underline{k}$ is extreme, synergy motives are strong, and so firms of the same quality issue different claims depending on k. We thus have a full SSE, where firms of both quality separate. In the intermediate case, where synergies are moderate relative to information asymmetry, we have a partial SSE where all firms of one quality issue the same claim, regardless of k, and firms of the other quality strictly separate. Regardless of whether we have a full or partial SSE, it remains the case that if $F > F^*$ (the certainty effect is strong), we have $k_H^* < 0$ and $k_H^* < k_L^*$ (H prefers equity); if $F < F^*$ (the certainty effect is weak), we have $k_H^* > 0$ and $k_H^* > k_L^*$ (H prefers assets).

2.4 Capital Raising is a Choice

In the core model, firms are forced to raise F. This section gives firms a choice over whether to raise capital and demonstrates the camouflage effect: firms will prefer to raise capital via asset sales rather than equity issuance, as they can disguise the capital raising as being motivated by operational reasons rather than overvaluation.

We first allow all firms to have freedom to do nothing, or instead raise capital of F for an investment that returns $F(1 + r)$.[15] We continue to allow for synergies. The possible equilibria are given in Proposition 3 below:

[15]Since the implications of $r_H \neq r_L$ have been analyzed in Section 2.2, we set the return on investment to be independent of firm quality here.

Proposition 3. *(All firms have a choice of whether to raise capital.) If all firms can either raise equity of F, sell assets of F, or do nothing, we have the following equilibria:*

(i) The pooling equilibria of Section 2 (modified for synergies in Appendix D) and the semi-separating equilibria of Section 2.3 continue to hold under the existing conditions plus an additional lower bound on $1+r$. For example, a full semi-separating equilibrium where quality q sells assets if $k \leq k_q^*$ and equity if $k > k_q^*$ holds under the conditions of Lemma 4 plus the additional condition $1 + r > \frac{E_H}{\mathbb{E}[E|X=E]}$. The additional lower bounds for the other equilibria are given in Appendix A.

(ii) If $1 + r \leq \frac{E_H}{E_L}$, we have a new semi-separating equilibrium where 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 $k > k_L^*$.

(iia) If $1 + r > \frac{A_H(1+\underline{k})}{A_L}$, the cutoff k_H^* is defined by $1 + k_H^* = \frac{\mathbb{E}[A|X=A](1+r)}{A_H}$. The cutoff k_L^* is defined by $1 + k_L^* = \frac{\mathbb{E}[A|X=A]}{A_L}$, where $k_L^* > 0$. If $1 + r > (\leq) \frac{A_H}{A_L}$, we have $k_H^* > (\leq) k_L^*$. The price of assets is $E[A|X = A] > A_L$, and the price of equity is $C_L + A_L + F$.

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

(iii) If $r = 0$, we have the same semi-separating equilibrium as in part (iib), except that L-firms with $k > k_L^*$ either issue equity or do nothing.

Part (i) of Proposition 3 shows that the equilibria of the core model are sustainable if the return on investment r is sufficiently high. Intuitively, H is only willing to sustain the losses from raising capital if the capital can be put to a sufficiently productive use.

Part (iia) shows that if r is moderate (between $\frac{E_H}{E_L} - 1$ and $\frac{A_H(1+\underline{k})}{A_L} - 1$), high-quality firms with synergistic assets will not raise capital, since the return on investment is insufficient to outweigh the loss of synergies from selling assets or the capital loss from issuing equity. However, high-quality firms with dissynergistic assets will sell them: not so much to finance investment, but for operational reasons. As before, L sells either equity or assets (depending on its level of synergy), not so much to finance investment, but to exploit overvaluation. We have $k_L^* > 0$: L prefers to sell assets rather than equity, and indeed will sell assets even if they are synergistic. The reason is the *camouflage effect*. Since the growth opportunity is low, the only reason to sell equity is if it is low-quality. No H-firms sell equity, and so equity issuance reveals the firm as L and leads to a price of E_L. In contrast, asset sales may be undertaken either because the asset is low-quality (low common value, sold by L) or because it is dissynergistic (low private value, sold by H), and so the asset price exceeds A_L. This high price induces L to sell assets ($k_L^* > 0$). Markets in which H sells assets due

to negative k are deep, similar to the notion of "market depth" in Kyle (1985). The liquidity traders in Kyle are analogous to high-quality asset sellers: they are selling assets for reasons other than them having a low common value. The presence of such traders allows informed speculators, who do have assets with a low common value, to profit by selling them.

Just like the certainty effect, the camouflage effect also applies to the choice between asset sales and risky debt. In the absence of 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.

The SSE in part (i) exhibits greater real efficiency than that in part (iia) since all firms are undertaking profitable investment. It is easier to satisfy the condition for part (i) ($1+r > \frac{E_H}{\mathbb{E}[E|X=E]}$), and harder to satisfy the condition for part (iia) ($1+r \leq \frac{E_H}{E_L}$), 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) is unchanged. The certainty effect reduces the per-unit cost of financing, whereas nonlinearities 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 allowing firms to take profitable investment opportunities.

Part (iib) shows that if r is low (below $\frac{A_H(1+\underline{k})}{A_L} - 1$), 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 the growth opportunity r and the dissynergy motive $\underline{k}$. Since no H-firms sell assets, asset sales do not offer camouflage. Thus, $k_L^* = 0$: L-firms will only sell assets if and only if they are dissynergistic, not to enjoy a camouflage effect. In sum, the camouflage effect only exists within the range $\frac{E_H}{E_L} \geq 1 + r > \frac{A_H(1+\underline{k})}{A_L}$, and this range only exists if $\underline{k}$ is sufficiently low to motivate H-firms to sell assets.

Part (iii) shows that, if $r = 0$, even L has no reason to issue equity: it cannot exploit overvaluation since there is no camouflage, and it is unable to invest the cash raised profitably. Thus, low-quality firms with sufficiently synergistic assets ($k > k_L^*$) are indifferent between selling equity and doing nothing. Indeed, there exists an equilibrium where all L-firms with $k > k_L^*$ 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.[16]

[16]Note that $\frac{E_H}{E_L} > \frac{E_H}{\mathbb{E}[E|X=E]}$, so for $\frac{E_H}{E_L} > 1+r > \frac{E_H}{\mathbb{E}[E|X=E]}$, the SSEs in parts (i) and (ii) are both sustainable. The first equilibrium is sustainable: since some H-firms are selling equity, the equity price is high, which underpins H's willingness to sell equity. The second equilibrium is also sustainable:

Comparing across the three parts of Proposition 3, when the investment opportunity is non-existent ($r = 0$), the equity market can completely shut down, as in MM. When it is moderate (parts (iia) and (iib)), only low-quality firms issue equity; only when it is high (part (i)) do firms of both quality issue equity. Thus, increases in r encourage equity issuance. Investment opportunities allow L to camouflage its issuance of equity as being motivated by operational reasons (the desire to finance growth). Without growth opportunities, only asset sales can be justified by operational reasons and thus offer camouflage.

We next consider the case in which high-quality firms can choose whether to raise financing, but low-quality firms are forced to do so. This is similar to Miller and Rock (1985), where the need to raise financing reveals that a firm's operations are not generating sufficient cash and thus are low-quality. The equilibrium is given in Corollary 1 below:

Corollary 1. *(High-quality firms have a choice of whether to raise capital, low-quality firms must raise capital.) Consider a growth opportunity r where $1 + r \leq \frac{E_H}{E_L}$. If H-firms can either raise capital of F or do nothing, and L-firms must raise capital of F, we have a semi-separating equilibrium where 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 $k > k_L^*$. The cutoffs are defined by $1 + r = \frac{A_H\left(1+k_H^*\right)}{\mathbb{E}[A|X=A]}$ and $1 = \frac{A_L\left(1+k_L^*\right)}{\mathbb{E}[A|X=A]}$, where $k_H^* < 0 \leq k_L^*$.*

(a) If $1 + r > \frac{A_H(1+\underline{k})}{A_L}$, k_H^* is interior and $k_L^* > 0$.

(b) If $1 + r \leq \frac{A_H(1+\underline{k})}{A_L}$, then $k_H^* = \underline{k}$, i.e., all H-firms do nothing, and $k_L^* = 0$.

Corollary 1 shows that the equilibria of Proposition 3, parts (iia) and (iib), continue to hold in the case in which only L must raise capital. This result also illustrates the camouflage effect. Issuing equity immediately reveals a firm as L, since H does not issue equity: it is not forced to do so (since it has no capital needs) and will not voluntarily do so (since there is no investment opportunity). By selling assets, L can disguise a financing need that is motivated by desperation (it needs to raise capital as it is low-quality) as instead being motivated by operational reasons. Thus, we have $k_L^* > 0$: L prefers to raise capital through selling assets, and will do so even if its assets are synergistic.

since no H-firms are selling equity, the equity price is low, which underpins H's reluctance to sell equity.

3 Negative Correlation

We now turn to the case of negative correlation, i.e., $A_L > A_H$. This section demonstrates the *correlation effect*: firms prefer asset sales to equity issuance, because even if the market infers that the asset sold is low-quality, this need not imply that the firm as a whole is of low quality, since it is not a carbon copy of the asset.

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 (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) simply by observing the type of asset traded. For example, the value of BP's exploration activities is likely to be negatively correlated with the mature fields that comprise the bulk of the firm, since the former may displace the latter.

In this section, we return to the case of general stock price concerns ω because, with negative correlation, there is now a trade-off involved in selling assets. Since H has higher overall value but L has more valuable non-core assets, being inferred as H maximizes the firm's stock price, but being inferred as L maximizes proceeds and thus fundamental value. Thus, without stock price concerns, no pooling equilibrium is sustainable. We return to the core model's case of no synergies and the funds being retained on the balance sheet, as neither synergies nor investment opportunities affect the sustainability of any equilibria.

We start by deriving the conditions under which a separating equilibrium (SE) exists, then turn to the two pooling equilibria APE and EPE. (Without synergies, there are only two firm types (H and L), and so we have separating equilibria rather than semi-separating equilibria as in Section 2.3.)

3.1 Separating Equilibrium

We consider a separating equilibrium in which H sells assets and L issues equity.[17] Lemma 5 gives the conditions for this equilibrium to be satisfied:

Lemma 5. *(Negative correlation, separating equilibrium.) Consider a separating equilibrium in which H sells assets and L sells equity ($X_H = A$, $X_L = E$). The prices*

[17]There is no "reverse" separating equilibrium where H issues equity and L sells assets, because L will deviate: he will enjoy a capital gain from selling lowly-valued equity at a high price, and also an increase in his market value.

of assets are given by A_H and $C_L + A_L + F$, respectively. The stock prices of asset sellers and equity issuers are $C_H + A_H$ and $C_L + A_L$, respectively. This equilibrium is sustainable if

$$\omega \leq \omega^{SE} \equiv \frac{\frac{F(A_L - A_H)}{A_H}}{\frac{F(A_L - A_H)}{A_H} + (C_H - C_L) - (A_L - A_H)}. \tag{24}$$

Since both assets and equity are sold at their fair price, there are no capital gains or losses. If L deviates, his fundamental value will fall from $C_L + A_L$ to

$$C_L + A_L + \frac{F(A_H - A_L)}{A_H}.$$

Crucially, the third term is negative, since $A_L > A_H$: L suffers a capital loss, which offsets the fact that his market value rises from being inferred as H. Thus, he will not deviate only if his stock price concerns ω are sufficiently low (i.e., satisfy (24)).[18]

H will not deviate as his stock price will fall to $C_L + A_L$, and his fundamental value will fall as he will be issuing underpriced equity rather than selling a fairly-priced asset. H's assets are correctly assessed as "lemons," and so the market timing motive for financing (e.g., Baker and Wurgler (2002)) does not exist. However, H is still willing to sell assets despite receiving a low price. Since the assets being sold are not perfectly correlated with the rest of the firm, their low price does not imply a low value for the firm. This *correlation effect* is absent in a standard model of security issuance, because both debt and equity are positively correlated with firm value. The issuance of debt may imply that debt is low-quality, and so the remainder of the firm is also low-quality.

The upper bound ω^{SE} is increasing in F – but the role of F is different from in the pooling equilibria of Section 2. The certainty effect is not relevant in SE, as equity is issued at a fair price, rather than a pooled price. Here, a greater F means that, if L deviates to selling assets, his capital loss is sustained over a larger base, deterring deviation: the "base effect". Thus, the SE can be sustained with higher stock price concerns ω.[19]

[18] In Section 2, we wrote all bounds in terms of F as we set $\omega = 0$. Here, we write the bounds in terms of ω as they are linear in ω, whereas they will be quadratic in F in Section 3.3.

[19] This separating equilibrium is also featured in Nanda and Narayanan (1999), where core and non-core assets are always negatively correlated and $\omega = 0$. (If assets are positively correlated, there is no information asymmetry in their model.) Thus, no pooling equilibria are sustainable in the absence of transactions costs. They assume that the transactions costs of asset sales are higher than for equity issuance, which sometimes supports an EPE but never an APE: the opposite result to our paper.

3.2 Pooling Equilibrium, All Firms Sell Assets

As in Section 2.1.1, we consider an APE, supported by the OEPB that an equity issuer is of quality L. Lemma 6 gives the conditions for this equilibrium to be satisfied:

Lemma 6. *(Negative correlation, pooling equilibrium, all firms sell assets.) Consider a pooling equilibrium where all firms sell assets ($X_H = X_L = A$) and a firm that sells equity is inferred as L. The prices of assets and equity are $\pi A_H + (1-\pi)A_L$ and $C_L + A_L + F$, respectively. The stock prices of asset sellers and equity issuers are $\mathbb{E}[C + A]$ and $C_L + A_L$, respectively. This equilibrium is sustainable if*

$$\omega \geq \omega^{APE} \equiv \omega^{APE,ND} \equiv \frac{F\left(\frac{A_L}{\mathbb{E}[A]} - 1\right)}{\pi((C_H - C_L) - (A_L - A_H)) + F\left(\frac{A_L}{\mathbb{E}[A]} - 1\right)}. \tag{25}$$

H will not deviate, as he is making a capital gain from selling low-quality assets. By deviating, L avoids the capital loss from selling highly-valued assets at a pooled price, but suffers a low stock price. Thus, he will only cooperate if his concern for the stock price ω is high, i.e., satisfies equation (25). This lower bound is relatively loose: it is easy to rule out a deviation to equity. Issuing equity not only leads to a low price (of $C_L + A_L + F$) on the equity being sold (as in MM), but also implies a low valuation (of $C_L + A_L$) for the rest of the firm, because the equity being sold is a carbon copy of the firm. The second effect is absent in MM, since the manager only cares about fundamental value and not the stock price.

The bound is increasing in F, so again the amount of financing required affects the choice of financing and thus firm boundaries. As in Section 3.1, F operates here through the base effect: higher F means that L's capital loss is off a higher base and increases its incentive to deviate, and so a higher ω is required to maintain indifference. The IC condition is trivially satisfied. L will indeed deviate to equity if revealed H: his stock price will rise and he will receive a capital gain by selling equity for a high price (compared to his current loss on assets).

3.3 Pooling Equilibrium, All Firms Sell Equity

We finally consider an EPE, supported by the OEPB that an asset seller is of quality L. Lemma 7 gives the conditions for this equilibrium to be satisfied:

Lemma 7. *(Negative correlation, pooling equilibrium, all firms sell equity.) Consider a pooling equilibrium where all firms sell equity ($X_H = X_L = E$) and a firm that*

sells assets is inferred as L. The prices of assets and equity are given by A_L and $\pi(C_H + A_H) + (1-\pi)(C_L + A_L) + F$, respectively. The stock prices of asset sellers and equity issuers are $C_L + A_L$ and $\mathbb{E}[C + A]$, respectively. This equilibrium is sustainable if

$$\omega \geq \omega^{EPE} \equiv \omega^{EPE,IC} \equiv \frac{F\left(\frac{A_L}{A_H} - \frac{E_L}{\mathbb{E}[E]}\right)}{(1-\pi)((C_H - C_L) - (A_L - A_H)) + F\left(\frac{A_L}{A_H} - \frac{E_L}{\mathbb{E}[E]}\right)}. \quad (26)$$

L will automatically not deviate as he is enjoying a capital gain by selling low-quality equity at a pooled price. By deviating, H avoids the capital loss from equity but suffers a low stock price from being inferred as L. He will cooperate if:

$$\omega \geq \omega^{EPE,ND} \equiv \frac{F\left(\frac{E_H}{\mathbb{E}[E]} - \frac{A_H}{A_L}\right)}{\pi((C_H - C_L) - (A_L - A_H)) + F\left(\frac{E_H}{\mathbb{E}[E]} - \frac{A_H}{A_L}\right)}. \quad (27)$$

Compared with (25) (the ND condition in the APE), the EPE condition in (27) is harder to satisfy. In the APE, deviation to equity leads to a low price of $C_L + A_L$ not only on the equity sold, but also on the rest of the firm. Here, deviation to assets leads to a low price of $C_L + A_L$ on the firm, but a high price of A_L on the asset sold, since it is not a carbon copy.

Unlike in Section 3.2, the IC condition is non-trivial, since L would suffer a capital loss if he deviated to asset sales and was inferred as H. The IC condition is given by (26) and is stronger than the ND condition. If it is violated, the only "reasonable" OEPB is that an asset seller is of quality H. Under this OEPB, while deviation to asset sales leads to a low asset price of A_H, as the market correctly infers that they are "lemons", it does not imply a low price on the rest of the firm, which is valued at $C_H + A_H$: the correlation effect. H will now deviate, as it will break even on the asset sale (compared to its current loss from issuing equity), and also receive a high stock price (compared to its current pooled stock price).

There are two effects of increasing F on the lower bound (26). As in the APE, the base effect causes the lower bound to tighten, i.e., increase. The second effect is specific to the EPE: increasing F reduces the capital loss from pooling, due to the certainty effect, making pooling easier to sustain. The second effect is always smaller, and so the bound increases overall.

3.4 Comparing the Pooling Equilibria

We now analyze conditions under which each equilibrium is sustainable. The results are given in Proposition 4 below:

Proposition 4. *(Negative correlation, comparison of equilibria.) A separating equilibrium is sustainable if* $\omega \leq \omega^{SE}$*, an asset-pooling equilibrium is sustainable if* $\omega \geq \omega^{APE}$*, and an equity-pooling equilibrium is sustainable if* $\omega \geq \omega^{EPE}$*, where* ω^{SE}*,* ω^{APE}*, and* ω^{EPE} *are given by (24), (25), and (26), respectively and* $\omega^{APE} < \omega^{SE} < \omega^{EPE}$*. Thus, if:*

(i) $0 < \omega < \omega^{APE}$*, only the separating equilibrium is sustainable,*

(ii) $\omega^{APE} \leq \omega \leq \omega^{SE}$*, both the separating and asset-pooling equilibria are sustainable,*

(iii) $\omega^{SE} < \omega < \omega^{EPE}$*, only the asset-pooling equilibrium is sustainable,*

(iv) $\omega^{EPE} \leq \omega < 1$*, both the asset-pooling and equity-pooling equilibria are sustainable.*

The correlation effect encourages firms to sell assets, which in turn manifests in two ways in Proposition 4. First, a separating equilibrium is sustainable, whereas it was unattainable in the positive correlation model without synergies. Second, the range of ω's over which the EPE is sustainable is a strict subset of that over which the APE is sustainable. Asset sales are more common than equity issuance, even though assets may exhibit greater information asymmetry than equity. If $\frac{A_L}{A_H} > \frac{C_H+A_H}{C_L+A_L}$, the MM principle would suggest that equity should be preferred, but assets are preferred due to the correlation effect.

The preference for asset sales points to an interesting 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 finance by selling a low-quality asset, without implying a low value for the rest of the firm. Non-core assets are a form of financial slack and may be preferable to debt capacity. Debt is typically positively correlated with firm value, and so a debt issue may lead the market to infer that both the debt being sold and the remainder of the firm are low-quality. (Cash remains the best form of financial slack.)

The analysis also 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 quality if an investment is sold, and thus the correlation between the asset and the rest of the firm.

Appendix C 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 that it sells, whereas the analysis thus far has considered either positive or negative correlation. Appendix C shows that a pooling equilibrium in which all firms sell the non-core asset is easier to sustain than one in which all firms sell equity, and one in which all firms sell the core asset. 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.

4 Implications

This section briefly discusses the main implications of the model. While a subset is consistent with existing stylized facts, these facts are not sharp tests of the model, given the scarcity of existing theories on the choice between asset sales and equity issuance. For the same reason, most of the empirical predictions are new and untested, and would be interesting to study in future research. In addition, the model generates other implications that may not be immediately linkable to an empirical test due to the difficulties for an empiricist to observe variables such as synergies. However, even in these cases, the model provides implications for managers when choosing how to raise capital, as they will be able to estimate synergies. Note that empirical analysis should focus on asset sales that are primarily financing-motivated.

The first set of empirical implications concerns the determinants of financing choice. One determinant is the amount of financing required: Proposition 1 shows that equity is preferred for high financing needs, due to the certainty effect, while asset sales are preferred for low financing 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 be larger on average than financing-motivated asset sales. The link between the source of financing and the amount required will be stronger where there is less scope for synergies. With low synergies, only pooling equilibria are sustainable, and so when F is high (low), all firms sell equity (assets). With high synergies, we have a semi-separating equilibrium, and so even when F is high (low), some firms are selling assets (equity). Separately, with

low synergies, firms will issue the same type of claim for a given financing requirement; with high synergies, we should observe greater heterogeneity across firms in financing choices. Estimating the potential for (dis)synergies is difficult. One potential route is to look across the business cycle: Eisfeldt and Rampini (2006) argue that operational motives are stronger in booms. An alternative direction 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 with the potential for cross-selling multiple products to the same customer base, operational motives should be stronger.

A second determinant of financing choice is the use of funds. Both the certainty and camouflage effects predict that equity issuance is increasing in growth opportunities. Starting with the former, Proposition 2 shows that the certainty effect is stronger when financing an investment opportunity that is attractive regardless of firm quality (r_L is high). Moving to the latter, Proposition 3 shows that, if growth opportunities are low, only asset sales can provide camouflage, since high-quality firms have operational reasons to sell assets but not to issue equity. If growth opportunities are high, equity also provides camouflage. Not only do high-quality firms start to issue equity to take advantage of the growth opportunity, but low-quality firms issue equity to a greater extent, as they can pool with high-quality equity issuers. Both effects predict that, along the cross-section, firms with good investment opportunities should raise equity, as documented by Frank and Goyal (2003) and Fama and French (2005). Over the time series, in a strong macroeconomic environment, even low-quality firms will have good investment projects and so the model predicts that 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 certainty effect is that equity is more likely to be used for purposes with less information asymmetry, such as paying debt or distress.

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 C). Indeed, Maksimovic and Phillips (2001) find that conglomerates are more likely to sell peripheral divisions rather than main divisions. While consistent with the correlation effect, this result could also stem from operational reasons: peripheral divisions could be 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.

A second set of empirical implications concerns the market reaction to financing. In the negative correlation case, and in the positive correlation case with synergies where $k_H^* > k_L^*$ (which arises under low F), asset sales lead to a positive stock price reaction and equity issuance leads to a negative stock price reaction. Indeed, Jain (1985), Klein (1986), Hite, Owers, and Rogers (1987), and Slovin, Sushka, and Ferraro (1995), 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. While most existing theories do not predict a positive reaction to equity issuance, Holderness (2013) finds a positive reaction in some countries. However, it is not clear whether these correspond to the cases in the model as he does not study the size of the equity issue or the correlation structure of the issuer. Separately, the model also predicts that equity issuance for conglomerates (where negative correlation is likely) will typically lead to a more negative reaction than for single-segment firms.

We now move to implications that may be less readily testable. Firms are more willing to sell assets in deep markets where others are selling for operational reasons, providing camouflage. This prediction is harder to test because it is difficult to identify the actual motive for a given asset sale. A more general implication is that there will be multiplier effects: changes in economic conditions that increase operational motives for asset sales will also increase overvaluation-motivated asset sales. Eisfeldt and Rampini (2006) present a model showing that operational motives for asset sales are procyclical, and empirically find that asset sales are indeed procyclical. This procyclicality may arise not only because operational motives rise in booms, but also because L is able to camouflage asset sales as being operationally-motivated in booms (see Proposition 3, part (iia)).

The model's implications regarding synergies are also harder to test given the difficulty in estimating synergies. 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.

5 Conclusion

This paper has studied a firm's choice between financing through asset sales and equity issuance 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, we identify three new forces that drive the firm's financing decision, and may outweigh information asymmetry considerations.

First, investors in an equity issue share in the cash raised, but purchasers of non-core assets do not. Since the value of cash is certain, it mitigates the information asymmetry of equity: the certainty effect. 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.

Second, the choice of financing may also depend on operational motives (synergies). A higher financing need pushes high-quality firms towards equity, due to the certainty effect, and reduces the quality and price of assets sold. Synergy concerns also allow firms to disguise an asset sale, that is in reality motivated by the asset's low quality, as instead being motivated by operational reasons (dissynergies): the camouflage effect.

Third, a disadvantage of equity issuance is that the market attaches a low valuation not only to the equity being sold, but also to the remainder of the firm, since both are perfectly correlated. In contrast, an asset sold need not be a carbon copy of the firm. This correlation effect can lead to asset sales being strictly preferred to equity.

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). 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, if the firm is a conglomerate, and if a firm's financing needs are privately known.

The 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 the 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. Since issuing asset-level debt or equity does not involve a loss of (dis)synergies, a carve-out is equivalent to asset sales in the core model where synergies are zero, but 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 is that, in Section 2.4, where firms can choose whether to raise capital, they raise a fixed amount F (as in MM 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, in which case a continuum of amounts will be raised in equilibrium.

References

[1] Abel, Andrew B. and Janice C. Eberly (1996): "Optimal Investment with Costly Reversibility." *Review of Economic Studies* 63, 581–593

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

[3] Alchian, Armen A. and Harold Demsetz (1972): "Production, Information Costs, and Economic Organization." *American Economic Review* 62, 777–795

[4] Allen, Jeffrey and John McConnell (1998): "Equity Carve-Outs and Managerial Discretion." *Journal of Finance* 53, 163–186

[5] Asquith, Paul, Robert Gertner, and David Scharfstein (1994): "Anatomy of Financial Distress: An Examination of Junk-Bond Issuers." *Quarterly Journal of Economics* 109, 625–658

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

[9] Bolton, Patrick, Hui Chen, and Neng Wang (2011): "A Unified Theory of Tobin's Q, Corporate Investment, Financing, and Risk Management." *Journal of Finance* 56, 1545–1578

[10] Bond, Philip and Yaron Leitner (2013): "Market Run-Ups, Market Freezes, Inventories, and Leverage." Working Paper, University of Minnesota

[11] 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

[12] Borisova, Ginka, Kose John, and Valentina Salotti (2013): "Cross-Border Asset Sales: Shareholder Returns and Liquidity." *Journal of Corporate Finance*, forthcoming

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

[14] 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

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

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

[17] Coase, Ronald H. (1937). "The Nature of the Firm." *Economica* 4, 386–405

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

[19] Datta, Sudip, Mai Iskandar-Datta, and Kartik Raman (2003): "Value Creation in Corporate Asset Sales: The Role of Managerial Performance and Lender Monitoring." *Journal of Banking and Finance* 27, 351–375

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

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

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

[23] Fama, Eugene F. and Kenneth R. French (2005): "Financing Decisions: Who Issues Stock?" *Journal of Financial Economics* 76, 549–582.

[24] Frank, Murray Z and Vidhan K. Goyal (2003): "Testing the Pecking Order Theory of Capital Structure." *Journal of Financial Economics* 67, 217–248

[25] Fulghieri, Paolo, Diego Garcia, and Dirk Hackbarth (2013): "Asymmetric Information and the Pecking (Dis)order." Working Paper, University of North Carolina

[26] Grossman, Sanford J. and Oliver D. Hart (1986): "The Costs and Benefits of Ownership: A Theory of Lateral and Vertical Integration." *Journal of Political Economy* 94, 691–719

[27] Hart, Oliver D. and John Moore (1990): "Property Rights and the Nature of the Firm." *Journal of Political Economy* 98, 1119–1158

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

[29] 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

[30] Holderness, Clifford G. (2013): "Seasoned Equity Offerings and Agency Costs: The Telling Story of Shareholder Approval Around the World." Working Paper, Boston College

[31] 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

[32] Jain, Prem C. (1985): "The Effect of Voluntary Sell-Off Announcements on Shareholder Wealth." *Journal of Finance* 40, 209–22

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

[34] John, Kose and Eli Ofek (1995): "Asset Sales and Increase in Focus." *Journal of Financial Economics* 37, 105–126

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

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

[37] Kyle, Albert S. (1985): "Continuous Auctions and Insider Trading." *Econometrica* 53, 1315–1336.

[38] 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

[39] Leland, Hayne E. (1994): "Corporate Debt Value, Bond Covenants, and Optimal Capital Structure." *Journal of Finance* 49, 1213–1252

[40] Maksimovic, Vojislav and Gordon M. Phillips (1998): "Asset Efficiency and Reallocation Decisions of Bankrupt Firms." *Journal of Finance* 53, 1495–1532

[41] 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

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

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

[44] Morellec, Erwan (2001): "Asset Liquidity, Capital Structure, and Secured Debt." *Journal of Financial Economics* 61, 173–206

[45] 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

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

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

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

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

[50] Ofek, Eli (1993): "Capital Structure and Firm Response to Poor Performance: An Empirical Analysis." *Journal of Financial Economics* 34, 3-30

[51] Panzar, John C. and Robert D. Willig (1981). "Economies of Scope." *American Economic Review* 71, 268–272

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

[53] Schipper, Katherine and Abbie Smith (1986): "A Comparison of Equity Carve-Outs and Seasoned Equity Offerings: Share Price Effects and Corporate Restructuring." *Journal of Financial Economics* 15, 153–186

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

[55] Sicherman, Neil W. and Richard H. Pettway (1987): "Acquisition of Divested Assets and Shareholders' Wealth." *Journal of Finance* 42, 1261–1273

[56] 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

[57] Slovin, Myron B. and Marie E. Sushka (1997): "The Implications of Equity Issuance Decisions within a Parent-Subsidiary Governance Structure." *Journal of Finance* 52, 841–857

[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] Strebulaev, Ilya A. (2007): "Do Tests of Capital Structure Theory Mean What They Say?" *Journal of Finance* 62, 1747–1787