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"Financing Through Asset Sales"

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Abstract

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Financing Through Asset Sales*

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November 16, 2012

Abstract

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KEYWORDS: Asset sales, financing, pecking order, synergies.
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One of the most important decisions that a firm faces is how to raise financing. Most existing research focuses on the choice between debt and equity, with various theories identifying different factors that drive a firm's security issuance decision. The pecking-order theory of Myers (1984), motivated by the model of Myers and Majluf (1984, "MM"), posits that managers issue securities that exhibit least information asymmetry. The trade-off theory argues that managers compare the benefits of debt (tax shields and a reduction in the agency costs of equity) with its costs (bankruptcy costs and the agency costs of debt). The market timing theory of Baker and Wurgler (2002) suggests that managers sell securities that are most mispriced.

While there is substantial research on financing through security issuance, another major source of financing is relatively unexplored – selling non-core assets such as a division or a plant. Asset sales are substantial in reality: US asset sales totaled \$133bn in 2010, versus \$130bn in seasoned equity issuance.[1] Although some of these sales may have been motivated by operational reasons, capital raising is an important driver of many disposals. In 2010-1, major oil and gas firms (including Chevron, Shell, and Conoco) sold non-core divisions to raise capital for liquidity and debt service. Most notably, BP set a target of \$45bn in asset sales to cover the costs of Deepwater Horizon. Banks worldwide raised billions of dollars through asset sales in the recent crisis to replenish depleted capital.[2] More broadly, Hite, Owers, and Rogers (1987) examine the stated motives for asset sales and note that "in several cases, management indicated that assets were being sold to raise capital for expansion of existing lines of business or to reduce high levels of debt. In other words, selling assets was viewed as an alternative to the sale of new securities." Borisova, John, and Salotti (2011) find that over half of asset sellers state financing motives, and Hovakimian and Titman (2006) and Borisova and Brown (2012) find that asset sales lead to increases in investment and R&D, respectively. Campello, Graham, and Harvey (2010) report that 70% of financially constrained firms increased asset sales in the financial crisis, versus 37% of unconstrained firms. Ofek (1993), Asquith, Gertner, and Scharfstein (1994), and Maksimovic and Phillips (1998) also show that firms sell assets in response to financial constraints.

This paper analyzes the role of asset sales as a means of financing. In particular,

[1] Source: Securities Data Company. This figure is an underestimate as 60% of asset sales in SDC have missing transaction values.

[2] In September 2011, Banque Nationale de Paris 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 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.

it studies the conditions under which asset sales are preferable to equity issuance and vice-versa. We build a deliberately parsimonious model to maximize tractability; this allows for the key expressions to be solved in closed form and the economic forces to be transparent. The firm comprises a core asset and a non-core asset. The firm must raise financing to meet a liquidity need, and can sell either equity or part of the non-core asset. Following MM, we model information asymmetry as the principal driver of this choice. The firm's type is privately known to its manager and comprises two dimensions. The first is quality, which determines the assets' standalone (common) values. 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. The second dimension is synergy, which determines the additional value that the non-core asset is worth to its current owner. This synergy dimension means that asset sales may occur for operational as well as financing reasons.

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 they exhibit less information asymmetry. While information asymmetry is indeed an important consideration, our model identifies several new distinctions between asset sales and equity issuance that also drive the financing choice, and may swamp information asymmetry considerations.

First, an advantage of equity issuance is that new shareholders obtain a stake in the entire firm. This includes not just the core and non-core assets in place (whose value is unknown), but also the cash raised through the issuance. Since the value of this cash is known, this mitigates the information asymmetry of the assets in place: the *certainty effect*. In contrast, an asset purchaser does not share in the cash raised, and thus bears the full information asymmetry associated with the asset's value. Hence, in contrast to MM, even if equity exhibits more information asymmetry than the non-core asset, the manager may sell equity if enough cash is raised that the certainty effect outweighs the difference in information asymmetry. Contrary to conventional wisdom, it is not the case that equity is the riskiest claim: if a large amount of financing is raised, equity becomes relatively safe. Formally, a pooling equilibrium is sustainable where all firms sell assets (equity) if the financing need is sufficiently low (high).

Since the certainty effect strengthens as the amount of financing increases, the choice of financing depends on the amount required. This dependence contrasts standard financing models, where the choice depends only on the inherent characteristics of the security (such as its information asymmetry (MM) or misvaluation (Baker and Wurgler (2002)) and not the amount required – unless one assumes exogenous frictions such as transactions costs or limits on the amount of financing that can be raised through a given channel (e.g., notions of debt capacity). Here, the amount of financing influences the choice of financing, even though there are no nonlinearities. Separately, since financing needs are a motive for selling assets, it may seem that a greater financing need will lead to more assets being sold. We show that it may reduce asset sales, as firms substitute into equity. Thus, a greater financial shock can improve real efficiency, as firms hold onto synergistic assets and instead sell equity.

The certainty effect applies to any use of cash whose expected value is uncorrelated with firm quality: for example, retaining it on the balance sheet to replenish capital, repaying debt, paying dividends, or financing an uncertain investment whose expected payoff is independent of firm type. We also analyze the case in which the investment's expected payoffs are correlated with firm quality, and thus exhibit information asymmetry. It may appear that the certainty effect should weaken, since the funds raised are no longer held as certain cash. This intuition turns out to be incomplete, because there is a second effect. Since investment is positive-NPV, it increases the value of the capital that investors are injecting. If the desirability of investment (for firms of both quality) is sufficiently high compared to the additional investment return generated by the high-quality firm over the low-quality firm, the second effect dominates – somewhat surprisingly, the certainty effect can strengthen when cash is used to finance an uncertain investment. Thus, equity issuance becomes easier to sustain. In contrast, if the additional return generated by the high-quality firm is sufficiently large, then asset sales become preferable. Thus, the source of financing depends on the use of financing, even though we have a model of pure adverse selection with no moral hazard. In almost all cases, it remains the case that asset (equity) sales are used for low (high) financing needs.

A second driver of the financing decision is the synergies between the non-core asset and the rest of the firm. High synergies discourage firms from selling assets. This effect leads to "threshold" semi-separating equilibria, in which a firm sells assets if synergies are below a cutoff and issues equity otherwise. Some high-quality firms sell assets not because they are low-quality, but because they are dissynergistic. This behavior allows low-quality firms, who are selling assets because they are indeed low-quality, to pool with them. They can thus disguise an asset sale driven by overvaluation (the asset is of low quality and thus has a low common value) as instead being driven by operational reasons (the asset is dissynergistic and thus only has a low private value): the *camouflage effect*. Some low-quality firms make greater profits than in the pooling equilibria, where the financing choice does not depend on synergies and so no such disguise is possible. A market in which firms are selling assets for operational reasons is "deep" and allows other firms to exploit their private information by selling low-quality assets. This notion of "market depth" is similar to the Kyle (1985) model of securities trading, where a deep market arises when liquidity traders are selling their securities for reasons other than a low common value. Such depth allows informed traders to profit from selling securities that do have a low common value.

The threshold synergy level is different for high- and low-quality firms and this difference is driven by the certainty effect. If the amount of financing required increases, this augments the certainty effect and makes equity issuance more (less) attractive to high (low) quality firms: even if its assets are dissynergistic, a high-quality firm chooses to retain them and instead issue equity, because it suffers a smaller adverse selection discount. Thus, higher financing needs have real effects by reducing the quality of assets traded in equilibrium, and thus their price. Conversely, they increase the quality and price of equity. The model thus implies that the market reaction to equity (asset) sales should be more (less) positive for a larger sale.

The camouflage effect continues to hold if firms have the option not to raise financing. If low-quality firms must raise financing (because their internal cash generation is low, as in Miller and Rock (1985)), but high-quality firms have a choice, we have a semi-separating equilibrium where high-quality firms with synergistic assets do nothing, and those with dissynergistic assets sell them. Low-quality firms prefer to meet their financing needs through asset sales. Issuing equity would reveal them as low-quality, since no high-quality firms do so, but asset sales allow them to disguise their financing need as being motivated by operational reasons (dissynergies) rather than desperation (low internal cash generation). Thus, only low-quality firms with the most synergistic assets issue equity; all others, including some with moderately high synergies, sell assets. If all firms have the option to do nothing, but raising financing allows the firm to exploit a growth opportunity, then if the opportunity is modest, we have the above equilibrium where high-quality firms with synergistic assets do nothing. If the opportunity is good, we have the equilibrium of the core model where such firms issue equity.

A third difference is the *correlation effect*, which represents an advantage to selling assets. When a firm issues equity, it suffers an Akerlof (1970) "lemons" discount – the market infers that the equity is low-quality, from the firm's decision to issue it. Not only does the market pay a low price for the equity issued, but also it attaches a low valuation to the rest of the firm. This is because the equity issued is perfectly correlated with the firm, since the former is a carbon copy of the latter. In contrast, when a firm sells non-core assets, it receives a low price, because the market infers they are low-quality. However, critically this need not imply a low valuation for the firm as the asset sold may not be a carbon copy – indeed, it may be negatively correlated. Thus, firms can sell poorly-performing assets without suffering negative inferences on the company as a whole. Asset sales are therefore preferable to equity issuance: formally, in the negative correlation model, the parameter values that support the equity-pooling equilibrium are a strict subset of those that support the asset-pooling equilibrium. An implication is that conglomerates (which likely have negative correlated assets) issue equity less often than firms with closely-related divisions.

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). Many of the effects also apply to other *types* of claim that the firm can issue at each level. All three effects apply to parent-company debt in the same way as parent-company equity: since 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 involve the loss of synergies. Thus, our results would also apply to the choice between selling assets and risky debt. Similarly, if a firm issues collateralized debt at the asset/division level or engages in an equity carve-out of the division, this need not imply low quality for the firm as a whole (correlation effect), and investors do not own a claim to the cash they invest, which resides at the parent company level (certainty effect). Thus, the model's forces more generally apply to the *level* at which to issue claims, rather than the *type* of claim. If these effects suggest that it is optimal to issue claims at the parent company level, then the standard pecking-order theory can be used to analyze if the type of claim should be parent-company debt or equity.

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 (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 consider asset sales as the only source of financing and do not compare it to equity issuance: a partial list includes Shleifer and Vishny (1992), DeMarzo (2005), He (2009), and Kurlat (2010). Milbradt (2012) and Bond and Leitner (2011) show that selling an asset will affect the market price of the seller's remaining portfolio under mark-to-market accounting, changing his balance sheet constraint. We show that such correlation effects are stronger for equity issuance: 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 whole 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. Eisfeldt and Rampini (2008) present a model of asset sales for operational reasons but do not study equity issuance as there is no financing motive.[3]

Since a partial asset sale in the no-synergies case can also be interpreted as a carve-out, our paper is also related to the literature on carve-outs. Nanda (1991) also points out that non-core assets may be uncorrelated with the core business and that this may motivate a firm to issue equity at the subsidiary level. 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, enabling us to generate the certainty and correlation effects.[4]

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 analyzes two extensions: the funds raised are used to finance an uncertain investment, and capital raising is a choice. Section 5 discusses empirical implications, and Section 6 concludes. Appendix A contains proofs and Appendix B allows firms to sell the core asset. The Online Appendix contains other peripheral material.

[3] 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.

[4] 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 Model

The model consists of two types of risk-neutral agents: 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 type $\theta = (q, k)$. If a firm is of type θ, we also say that the manager is of type θ.[5] The type θ consists of two dimensions. The first is the firm's quality $q \in \{H, L\}$, which measures the standalone (common) value of its assets. The prior probability that $q = H$ is $\pi > \frac{1}{2}$. The second dimension is a synergy parameter $k \sim U\left[\underline{k}, \overline{k}\right]$, where $-1 < \underline{k} \leq 0$, $\overline{k} \geq 0$, and k and q are uncorrelated. This parameter measures the additional (private) value created by the existing owner.

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.[6] For example, if a firm has unknown litigation liabilities at the parent company level, a purchaser of one of its factories is not exposed to them. 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 the assets are negatively correlated.[7] In both cases, we assume:

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

i.e. H has a higher total value. Thus, even if assets are negatively correlated, the higher value of L's non-core assets is outweighed by the lower value of its core assets. In MM, the key driver of financing is the information asymmetry of the security issued. 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 ($sign\,(A_H - A_L)$).

We consider an individual firm, which must raise financing of $F \leq \min(A_L, A_H)$.[8] [9] This need could arise from a number of sources: a liquidity need, an upcoming debt

[5]Since the manager and firm are often interchangeable, we use both the personal pronoun "he" and the impersonal pronoun "its" to refer to the firm.

[6]That the values C_q and A_q represent asset values net of liabilities, and so our model also incorporates information asymmetry about a firm's liabilities.

[7]If $A_H = A_L$, there is no information asymmetry surrounding the non-core asset. Thus, it is automatic that the firm will always raise financing by selling it (as shown by MM).

[8]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 $F \leq \min(A_L, A_H)$.

[9]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

repayment, or a dividend payment. The cash raised remains on the firm's balance sheet. This modeling treatment nests any use of cash that increases equity value by an amount F in expectation, independent of firm quality. This includes all the above cases plus using the cash for an uncertain investment whose expected value is uncorrelated with firm quality. In Section 4.1 we allow the cash to fund an investment whose value is correlated with firm quality, so that there is information asymmetry over its expected value. Firms are unable to 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.

We currently treat the firm's financing need F as exogenous. In MM, the firm has the option not to raise financing and instead to forgo investment; the goal of that paper is to show that information asymmetry can deter investment by hindering financing. Since the trade-off between forgoing a desirable investment, and suffering an adverse selection discount when financing investment, is already well-known, our focus instead is to study the choice between asset sales and equity to meet a given financing need, and so we take F as given. In Section 4.2 we extend the model to give firms the choice of whether to raise financing and for financing needs to be privately known.

The firm can raise funds either by selling non-core assets or by issuing equity; it cannot sell the core asset as it is essential for the firm. (In Appendix B, we relax this assumption.) Since $F \leq \min(A_L, A_H)$, it is possible to raise the required financing entirely through either source. We assume that the firm raises financing from a single source. This can be motivated by transactions costs associated with multiple financing sources. (Appendix C derives conditions under which the firm will not deviate to multiple financing sources, even under no transactions costs.) There are no taxes, and any transactions costs are assumed to be the same for both sources.

The non-core asset is perfectly divisible so partial asset sales are possible. We deliberately do not feature nonlinearities as they will mechanically lead to the source of financing depending on the amount required. If a firm of quality q sells non-core assets with a value of Y, its fundamental value falls from $C_q + A_q$ to $C_q + A_q - Y(1+k)$. Thus, the case of $k > (<)\, 0$ represents synergies (dissynergies), where the non-core asset is worth more (less) to the current owner than in its next-best use. That $\underline{k} \leq 0$ allows for asset sales to be motivated by operational reasons (dissynergies) rather than only financing reasons.[10] In addition to representing synergies, $k > 0$ can also arise if

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.

[10] One may wonder why the firm will have dissynergistic assets to begin with. Firms may acquire

investment in assets is costly to reverse (e.g. Abel and Eberly (1996)).

Formally, a firm of type θ issues a claim $X_\theta \in \{E, A\}$, where $X_\theta = E$ represents equity issuance and $X_\theta = A$ an asset sale. Investors infer the firm's type based on its choice of claim X_θ. These inferences affect both the firm's market valuation (also referred to as its stock price) and the terms at which it raises financing (and thus its fundamental value). Investors are perfectly competitive and price the claim being sold at its expected value.[11] The manager's objective is to maximize fundamental value; in the negative correlation case of Section 3, he will also care about the stock price.

A useful feature of the framework is that only the quality parameter q, and not the synergy parameter k, directly affects the investor's valuation of a claim and thus the price she is willing to pay. This allows our model to incorporate two dimensions of firm type – quality and synergy – while retaining tractability. Thus, 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". We use the terms "capital gain/loss" to refer to the gain/loss resulting from the common value component of the asset value only, and "fundamental gain/loss" to refer 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 use the Perfect Bayesian Equilibrium ("PBE") solution concept, which involves the following: (i) Investors have a belief about which types issue which claim X_θ; (ii) The price of the claim being issued equals its expected value, conditional on investors' beliefs in (i); (iii) Each manager type chooses to issue the claim X_θ that maximizes his objective function, given investors' beliefs; (iv) Investors' beliefs satisfy Bayes' rule. In addition to the PBE, beliefs on claims X_θ issued off the equilibrium path satisfy the Cho and Kreps (1987) Intuitive Criterion ("IC").

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

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assets when they are synergistic, but they may become dissynergistic over time. 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; more generally, our model specifies that synergy motivations are not so strong as to overwhelm the other forces in the model.

[11] Sicherman and Pettway (1987), John and Ofek (1995), and Datta, Iskandar-Datta, and Raman (2003) find insignificant returns to purchasers in asset sales.

2 Positive Correlation

We first consider pooling equilibria, which are of two types: an asset-pooling equilibrium (APE) and an equity-pooling equilibrium (EPE). We then move to semi-separating equilibria (SE). The analysis studies the conditions under which the different equilibria are sustainable, to derive predictions on what financing channels firms will use under different conditions.

2.1 Pooling Equilibrium, All Firms Sell Assets

We consider a pooling equilibrium in which all firms sell assets, supported by the off-equilibrium path belief (OEPB) that anyone who sells equity is of type $\left(L, \overline{k}\right)$. Assets are valued at

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

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 from financing enters the balance sheet, and so new shareholders own a claim to this cash in addition to the two existing assets.[12]

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

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

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

An L-firm enjoys a capital gain of $\frac{\pi F(A_H - A_L)}{\mathbb{E}[A]}$ by selling low-quality assets at a pooled price. However, it also loses the synergies from the asset. If:

$$1 + \overline{k} \leq \frac{\mathbb{E}[A]}{A_L}, \tag{5}$$

then even the L-firm with the greatest synergies, type $\left(L, \overline{k}\right)$, will weakly prefer to

[12] 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 firm, which includes the financing raised.

sell assets rather than to deviate, since the capital gain from selling low-quality assets exceeds the loss of synergies. If (5) is violated, synergies are sufficiently high that $\left(L, \overline{k}\right)$ will not sell assets, even though it enjoys a capital gain from doing so; thus, APE cannot hold. Equation (5) is necessary and sufficient for all L-firms not to deviate.

H-firms suffer a capital loss of $\frac{(1-\pi)F(A_H-A_L)}{\mathbb{E}[A]}$ in addition to any loss of synergies. A H-firm may thus deviate and issue equity. If it does so, fundamental value becomes:

$$C_H + A_H - \frac{F\left(C_H - C_L + A_H - A_L\right)}{C_L + A_L + F}. \tag{6}$$

The no-deviation ("ND") condition is that (6) $\leq$ (3). This condition is most stringent for type $\left(H, \overline{k}\right)$. Thus, no H-firms will deviate if:

$$F \leq F^{APE,ND,H} = \frac{\mathbb{E}[A](C_H + A_H) - A_H(C_L + A_L)(1 + \overline{k})}{A_H(1 + \overline{k}) - \mathbb{E}[A]}. \tag{7}$$

Condition (7) is equivalent to the "unit cost of financing" being lower for asset sales, i.e.

$$\frac{A_H\left(1 + \overline{k}\right)}{\mathbb{E}[A]} \leq \frac{C_H + A_H + F}{C_L + A_L + F}, \tag{8}$$

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

There are three forces that determine H's incentives to deviate. The first is whether equity or assets 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 wish to issue safe claims. Indeed, if there are no synergy considerations ($\overline{k} = 0$), then if $\frac{A_H}{\mathbb{E}[A]} > \frac{C_H+A_H}{C_L+A_L}$, i.e. assets exhibit sufficiently greater information asymmetry than equity, H-firms will deviate to equity: the (8) is violated and so APE is unsustainable for any F.

The second force is synergies, which are absent in MM. For APE to hold, the type with the greatest synergy $\overline{k}$ must be willing to sell assets despite the loss of synergies. Thus, we require not only assets to be safe, but also the maximum synergy level to be small. If $1 + \overline{k} > \frac{(C_H+A_H)\mathbb{E}[A]}{(C_L+A_L)A_H}$, then again (8) is violated and so APE is unsustainable for any F.

The third force is the amount of financing F. This is unique to a model of asset sales and arises because the cash raised enters the firm's balance sheet. Thus, the investor shares in the value of this cash if she purchases equity but not assets. Since the value of cash is certain, it mitigates the information asymmetry of equity: the RHS of (8) 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. Thus, there is an upper bound on F to prevent deviation (given by (7)). If F exceeds this bound, the certainty effect is sufficiently strong that $\left(H, \overline{k}\right)$ deviates to issuing equity – even though it is inferred as L by doing so. In particular, even if $\frac{A_H}{\mathbb{E}[A]} < \frac{C_H+A_H}{C_L+A_L}$ and $\overline{k} = 0$, i.e. assets are safer than equity and there are no synergies, a high F can lead to (8) being violated so H issues equity. Thus, the MM result that firms issue the claim with the least information asymmetry does not hold. In a similar vein, the above analysis contradicts the conventional wisdom that equity is the riskiest claim. If the amount of financing raised is sufficiently large, equity is relatively safe.

We now study the comparative statics on the upper bound (7). These are as follows:

$$\frac{\partial F^{APE,ND,H}}{\partial C_H} = \frac{\mathbb{E}[A]}{A_H(1+\overline{k}) - \mathbb{E}[A]} > 0,$$
$$\frac{\partial F^{APE,ND,H}}{\partial(-C_L)} = \frac{A_H(1+\overline{k})}{A_H(1+\overline{k}) - \mathbb{E}[A]} = 1 + \frac{\partial F^{APE,ND,H}}{\partial C_H} > 0,$$
$$\frac{\partial F^{APE,ND,H}}{\partial A_H} = \frac{\mathbb{E}[A](1-\pi)(A_H - A_L) + \overline{k}\mathbb{E}[A] - (1-\pi)A_L(C_H - C_L + A_H - A_L)(1+\overline{k})}{(A_H(1+\overline{k}) - \mathbb{E}[A])^2} \lesseqgtr 0,$$
$$\frac{\partial F^{APE,ND,H}}{\partial(-A_L)} = \frac{A_H(1+\overline{k})\left[(1-\pi)(C_H - C_L + A_H - A_L) + A_H(1+\overline{k}) - \mathbb{E}[A]\right]}{(A_H(1+\overline{k}) - \mathbb{E}[A])^2} < 0,$$
$$\frac{\partial F^{APE,ND,H}}{\partial \pi} = \frac{(C_H - C_L + A_H - A_L)A_H^2(1+\overline{k})}{(A_H(1+\overline{k}) - \mathbb{E}[A])^2} > 0,$$
$$\frac{\partial F^{APE,ND,H}}{\partial \overline{k}} = -\frac{A_H\mathbb{E}[A](C_H - C_L + A_H - A_L)}{(A_H(1+\overline{k}) - \mathbb{E}[A])^2} < 0.$$

For the values of the core business, C_H and C_L, the signs of the derivatives are intuitive: increasing information asymmetry $C_H - C_L$ (either by increasing C_H or reducing C_L) augments the loss that H makes by deviating to issue equity. This discourages deviation and the upper bound can relax, i.e., increase. The derivative with respect to $-C_L$ is larger because reducing C_L has an additional effect: it reduces the price H receives from deviating to sell equity $(C_L + A_L)$. He must therefore sell a greater fraction of the firm's equity to raise F, and so he bears the capital loss over a greater base (the "base effect").

Turning to the non-core asset, the negative sign of $\frac{\partial F^{APE,ND,H}}{\partial(-A_L)}$ arises because lowering A_L reduces the price H receives for selling assets, and thus encourages deviation to equity. This requires the upper bound on F to tighten, i.e. decrease. However, the sign of $\frac{\partial F^{APE,ND,H}}{\partial A_H}$ is ambiguous due to the base effect: an increase in A_L augments the asset price $\mathbb{E}[A] = \pi A_H + (1-\pi)A_L$. This reduces the quantity of assets sold and so the loss is sustained over a smaller base. The bound is also increasing in π. As H becomes more common, the price $\mathbb{E}[A]$ rises, deterring deviation. Finally, the bound is decreasing in the maximum synergy $\overline{k}$. If $\overline{k}$ is higher, $\left(H, \overline{k}\right)$ is more willing to issue equity, and so F must fall to weaken the certainty effect. Viewed differently, even if $\overline{k}$ is high (so that assets are synergistic), the firm will still be willing to sell them if F is low.

We now verify whether the OEPB, that an equity issuer is of type $\left(L, \overline{k}\right)$, satisfies the IC. This is the case if $\left(L, \overline{k}\right)$ would issue equity if inferred as H, which occurs if:

$$F \leq F^{APE,IC} = \frac{A_L(C_H + A_H)(1+\overline{k}) - \mathbb{E}[A](C_L + A_L)}{\mathbb{E}[A] - A_L(1+\overline{k})}. \tag{9}$$

It may seem that the IC should be trivial since deviation leads to a high price for selling equity rather than a pooled price for selling assets. However, if F is large, selling equity is less attractive since the certainty effect reduces the gains from being inferred as H. Thus, we have another upper bound on F, again due to the certainty effect. If $1+\overline{k} < \frac{(C_L+A_L)\mathbb{E}[A]}{(C_H+A_H)A_L}$, i.e. assets exhibit relatively high information asymmetry and synergies are small, the RHS of (9) is negative and so the IC is violated for any F. Type $\left(L, \overline{k}\right)$ enjoys such a large capital gain from pooling on assets, and loses sufficiently small synergies, that he will not deviate to selling equity even if revealed as H.[13]

Lemma 1 below summarizes the equilibrium. The proof shows that, if and only if $1+\overline{k} < \frac{\mathbb{E}[A]}{\sqrt{A_H A_L}}$ (>1), the IC condition is stronger than the ND condition and thus is the relevant condition for APE to hold.

Lemma 1. *(Positive correlation, pooling equilibrium, all firms sell assets.) Consider a pooling equilibrium where all firms sell assets ($X_q = A$) and a firm that issues equity is inferred as type $\left(L, \overline{k}\right)$. 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 the following conditions are satisfied:*

(i) $1+\overline{k} \leq \frac{\mathbb{E}[A]}{A_L}$,

[13] To eliminate an equilibrium with $F > F^{APE,IC}$ via the IC, we need to show that the only reasonable OEPB is that a deviator is of quality H, which also requires us to show that H will deviate if revealed good. This will automatically be the case, as he will break even rather than suffering a capital loss and losing synergies. In all of the other equilibria that we consider, it will similarly be automatic that H will deviate if he is revealed good, so we will not need to show this mathematically.

(ii) $F \leq F^{APE}$*, where*

$$F^{APE} = \begin{cases} F^{APE,IC} \equiv \frac{A_L(C_H+A_H)(1+\overline{k})-\mathbb{E}[A](C_L+A_L)}{\mathbb{E}[A]-A_L(1+\overline{k})} & \text{if } 1+\overline{k} \leq \frac{\mathbb{E}[A]}{\sqrt{A_H A_L}} \\ F^{APE,ND,H} \equiv \frac{\mathbb{E}[A](C_H+A_H)-A_H(C_L+A_L)(1+\overline{k})}{A_H(1+\overline{k})-\mathbb{E}[A]} & \text{if } 1+\overline{k} \geq \frac{\mathbb{E}[A]}{\sqrt{A_H A_L}}. \end{cases} \tag{10}$$

2.2 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 type $(L, \underline{k})$. Equity is valued at

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

and if assets are sold (off the equilibrium path), they are valued at A_L.

As in APE, L makes a capital gain; however, he will deviate and sell assets if they are sufficiently dissynergistic. Type $(L, \underline{k})$ has the greatest incentive to deviate. His ND condition is given by $1 + \underline{k} \geq \frac{E_L}{\mathbb{E}[E]}$, which can be rewritten

$$F \leq F^{EPE,ND,L} = \frac{\mathbb{E}[C+A](1+\underline{k}) - (C_L + A_L)}{-\underline{k}}. \tag{11}$$

A necessary condition for (11) to be satisfied is that

$$1 + \underline{k} > \frac{C_L + A_L}{\mathbb{E}[C+A]}, \tag{12}$$

i.e. dissynergies cannot be sufficiently large to outweigh the capital gain from selling low-quality assets. Equation (12) is analogous to (5) in APE which also limits the size of synergies. However, while (5) in APE is both necessary and sufficient for L not to deviate, (12) is only a necessary condition. We also require F to be low for (11) to be satisfied. If F is high, $(L, \underline{k})$ only makes a small capital gain from equity issuance, due to the certainty effect. Thus, he will deviate to get rid of a dissynergistic asset. In sum, unlike in APE, satisfying L's ND condition imposes a bound on F.

H-firms will not deviate if:

$$F \geq F^{EPE,ND,H} = \frac{A_L(C_H + A_H) - A_H \mathbb{E}[C+A](1+\underline{k})}{A_H(1+\underline{k}) - A_L}. \tag{13}$$

In contrast to Section 2.2, the ND condition now imposes a *lower* bound on F. This also results from the certainty effect. If F is high, H suffers a small loss from equity issuance due to the certainty effect, and so will not deviate.

The OEPB, that an asset seller is of type $(L, \underline{k})$, satisfies the IC if

$$F \geq F^{EPE,IC} = \frac{A_L \mathbb{E}[C+A](1+\underline{k}) - A_H(C_L + A_L)}{A_H - A_L(1+\underline{k})}. \tag{14}$$

The denominator is always positive, and so the lower bound can always be satisfied for some F: unlike in APE, there is no necessary condition that we require for the IC condition to be achievable. The condition is a lower bound, since F must be sufficiently high that the certainty effect reduces the capital gain from pooling on equity, so that L prefers to deviate and sell assets if he would be inferred as H.

Lemma 2 below summarizes the equilibrium.

Lemma 2. *(Positive correlation, pooling equilibrium, all firms sell equity.) Consider a pooling equilibrium where all firms sell equity ($X_\theta = E$) and a firm that sells assets is inferred as type $(L, \underline{k})$. The prices of assets and equity are A_L and $\pi(C_H + A_H) + (1-\pi)(C_L + A_L) + F$ respectively. This equilibrium is sustainable if the following conditions are satisfied:*

(i) $F \leq F^{EPE,ND,L} = \frac{\mathbb{E}[C+A](1+\underline{k}) - (C_L + A_L)}{-\underline{k}}$,

(ii) $F \geq F^{EPE}$, *where*

$$F^{EPE} = \begin{cases} F^{EPE,IC} \equiv \frac{A_L \mathbb{E}[C+A](1+\underline{k}) - A_H(C_L+A_L)}{A_H - A_L(1+\underline{k})} & \text{if } 1+\underline{k} \geq \frac{A_H A_L}{\mathbb{E}[A^2]} \\ F^{EPE,ND,H} \equiv \frac{A_L(C_H+A_H) - A_H \mathbb{E}[C+A](1+\underline{k})}{A_H(1+\underline{k}) - A_L} & \text{if } 1+\underline{k} \leq \frac{A_H A_L}{\mathbb{E}[A^2]}. \end{cases} \tag{15}$$

2.3 Semi-Separating Equilibria

In a semi-separating equilibrium, the financing choice depends on the synergy parameter k: there is a cutoff k_q^* so any firm below (above) the cutoff will sell assets (equity). H and L can use different cutoff rules, so separation will be along both type dimensions.

While investors do not directly care about k (as it only affects private values), the synergy cutoffs matter since they affect the expected quality (common value) of the claims. Thus, investors will infer q from the seller's choice of claim. Using Bayes' rule, the prices paid for sold assets and issued equity are, respectively:

$$\mathbb{E}[A|X=A]=\pi\frac{k_H^*-\underline{k}}{\mathbb{E}[k_q^*]-\underline{k}}A_H+(1-\pi)\frac{k_L^*-\underline{k}}{\mathbb{E}[k_q^*]-\underline{k}}A_L \tag{16}$$

$$\mathbb{E}[E|X=E]=\pi\left(\frac{\overline{k}-k_H^*}{\overline{k}-\mathbb{E}\left[k_q^*\right]}\right)(C_H+A_H)+(1-\pi)\left(\frac{\overline{k}-k_L^*}{\overline{k}-\mathbb{E}\left[k_q^*\right]}\right)(C_L+A_L)+F. \tag{17}$$

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:

$$\frac{C_q+A_q+F}{\mathbb{E}[E|X=E]}\leq\frac{A_q(1+k)}{\mathbb{E}[A|X=A]}, \tag{18}$$

where the denominators are given by (16) and (17), respectively. The cutoff k_q^* for a particular q is that which allows (18) to hold with equality. Thus, it is defined by:

$$k_q^*=\frac{C_q+A_q+F}{A_q}\frac{\mathbb{E}[A|X=A]}{\mathbb{E}[E|X=E]}-1. \tag{19}$$

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^* will belong to the quality q for which this term is higher. Thus, $k_H^*>k_L^*$ if and only if

$$\frac{C_H+A_H+F}{C_L+A_L+F}>\frac{A_H}{A_L} \tag{20}$$

i.e.

$$F<F^*\equiv\frac{C_HA_L-C_LA_H}{A_H-A_L} \tag{21}$$

Condition (20) is intuitive. It requires that the "certainty-effect" adjusted information asymmetry is higher for equity than assets, which in turn requires F not to be too high. H dislikes information asymmetry as it increases his capital loss; conversely, L likes information asymmetry. Thus, if equity is riskier (because F falls), it becomes less (more) attractive to H (L); therefore, the threshold synergy below which H sells assets is higher.

The effect of the different cutoffs is to skew the valuations. If $k_H^*>k_L^*$, H-firms are more willing to sell assets than L-firms. Thus, asset sales are a positive signal of quality, and so the asset price (16) is higher than in the APE (2). As a result, L-firms make an even greater capital gain. Their sale of assets is motivated by overvaluation: the assets are low-quality and thus have a low common value. However, they are able to disguise them as being motivated instead by operational reasons by pooling with H-firms who are indeed selling for operational reasons (the assets are dissynergistic and thus have a low private value, but are actually high quality and thus have a high common value) . Thus, they receive a higher price than under a pooling equilibrium where financing choices are independent of synergies and no such disguise is possible. We call this the "camouflage effect". 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-firms are more easily able to disguise asset sales as being operationally-motivated in booms. Such markets are deep, similar to the notion of "market depth" in the Kyle (1985) model. The liquidity traders in Kyle's model are analogous to asset sellers with high k: they are selling their assets for reasons other than them having a low common value. The presence of such traders allows informed traders, who do have assets with a low common value, to profit by selling them. In the absence of synergy motives (i.e., if $\overline{k} = \underline{k} = 0$), SE is unsustainable. It is impossible for firms to disguise their financing decisions as being motivated by operational reasons rather than overvaluation.

Moreover, the camouflage effect interacts with the certainty effect. The amount of financing required F changes the cutoffs and thus the quality of assets and equity sold in equilibrium, in turn affecting their prices. If $F > F^*$, (20) is violated: the certainty effect is sufficiently strong that equity issuance is more attractive to H. Thus, more H firms sell equity, increasing the quality and price of equity issued and decreasing the quality and price of assets sold. Indeed, when $k_H^* < k_L^*$ (i.e. (20) is violated), we have $k_H^* < 0$: since assets exhibit greater information asymmetry, H will retain them even if they are mildly dissynergistic (and conversely, when $k_H^* > k_L^*$, we have $k_H^* > 0$). Now, L-firms achieve camouflage by selling equity: they pool with H-firms who issue equity not because their equity is of low quality, but for the operational reason that they do not wish to part with synergistic assets.

The above results are summarized in Lemma 3 below, which also gives necessary and sufficient conditions for the semi-separating equilibrium to hold.

Lemma 3. *(Positive correlation, semi-separating equilibrium): Consider a semi-separating equilibrium where quality q sells assets if $k \leq k_q^*$ and sells equity if $k > k_q^*$, where k_q^* is* *defined by (19). 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 (16) and (17) respectively.

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

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

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

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

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

(iiia) If $F < F^*$, a SE where all H-firms sell assets ($k_H^* = \overline{k}$) and L-firms strictly separate ($\underline{k} < k_L^* < \overline{k}$) is sustainable only if $\frac{\mathbb{E}[A]}{A_L} < 1+\overline{k} < \frac{E_H}{E_L}$ and if $\frac{A_H}{A_L} \leq 1+\overline{k} \leq \frac{\mathbb{E}[A]}{A_H}\frac{E_H}{E_L}$. In this SE we have $k_L^* > 0$.

(iiib) If $F > F^*$, a SE where all H-firms sell equity ($k_H^* = \underline{k}$) and L-firms strictly separate ($\underline{k} < k_L^* < \overline{k}$) is sustainable only if $\frac{A_L}{A_H} < 1+\underline{k} < \frac{E_L}{\mathbb{E}[E]}$ and if $\frac{A_L}{A_H}\frac{E_H}{\mathbb{E}[E]} \leq 1+\underline{k} \leq \frac{E_L}{E_H}$. In this SE we have $k_L^* < 0$.

Lemma 3 shows that, for a full SE to be sustainable, we require F to be in a moderate range (close to F^*) and synergy motives to be high. For example, if $F < F^*$, we need $1+\overline{k} \geq \frac{E_H}{A_H}\frac{E[A]}{E[E|]}$, which requires $\overline{k}$ to be high (strong synergies) and F to be high (while still satisfying $F < F^*$, so F to be close to F^*) so that $\frac{E_H}{E[E|]}$ on the right-hand side is low via the certainty effect. If F is too low, then the certainty effect is so weak that all type H firms will sell assets rather than separating – unless synergies are sufficiently strong that some H firms still prefer to sell equity. If $F > F^*$, we need $1+\underline{k} \leq \frac{E_H}{A_H}\frac{E[A]}{E[E|]}$, which requires $\underline{k}$ to be low (strong dissynergies) and F to be low (while still satisfying $F > F^*$, so F to be close to F^*). If F is too high, then the certainty effect is so strong that all type H firms will issue equity rather than separating – unless dissynergies are sufficiently strong that some H firms still prefer to sell assets. In sum, full separation requires synergy motives to be strong relative to (certainty-adjusted) information asymmetry considerations, so that firms of the same quality issue different claims depending on their level of synergy. If this is not the case, information asymmetry considerations become dominant and all firms of one type will issue the same claim, regardless of synergy. Then, we have a partial semi-separating equilibrium where one quality pools.

Regardless of whether we have a full or partial semi-separating equilibrium, it remains the case that, if $F > F^*$ (the certainty effect is strong), we have $k_H^* < 0$ and $k_H^* < k_L^*$ (H-firms prefer equity); if $F > F^*$ (the certainty effect is weak), we have $k_H^* > 0$ and $k_H^* > k_L^*$ (H-firms prefer assets).

Appendix D shows that, if synergies are extreme, a partial SE is sustainable where L's cutoff is at a boundary (so that all L-firms issue the same claim) and H mixes. This equilibrium requires synergies to be so strong that they swamp information asymmetry conditions, and so no L-firm deviates even though it would be inferred as type H by doing so. Since the core paper considers the trade-off between information asymmetry and synergies, and this case requires synergies to be so strong that they dominate the trade-off, we defer the analysis to an Appendix. In addition, the intuition behind these equilibria are similar to the partial SEs considered in Lemma 3.

2.4 Comparing the Equilibria

We now compare the sufficient conditions for each equilibrium to be sustainable. The results are given in Proposition 1 below:

Proposition 1. *(Positive correlation, comparison of equilibria.)*

(i) If $1+\overline{k} < \frac{\mathbb{E}[A]}{A_L}$ *and* $1+\underline{k} > \frac{E_L}{\mathbb{E}[E]}$, *only pooling equilibria are sustainable.*

(ia) An asset-pooling equilibrium is sustainable if $F \leq F^{APE}$, *where* F^{APE} *is given by (10),*

(ib) An equity-pooling equilibrium is sustainable if $F \geq F^{EPE}$, *where* F^{EPE} *is given by (15),*

(ic) $F^{APE} > F^{EPE}$. *Thus, if* $F^{EPE} < F \leq F^{APE}$, *both pooling equilibria are sustainable.*

(ii) If $\frac{\mathbb{E}[A]}{A_H}\frac{E_H}{E_L} \geq 1+\overline{k} \geq \frac{A_H}{A_L}(> \frac{\mathbb{E}[A]}{A_L})$, *a partial semi-separating equilibrium where* H *pools on assets is sustainable. The upper bound* $\frac{\mathbb{E}[A]}{A_H}\frac{E_H}{E_L} \geq 1+\overline{k}$ *is equivalent to* $F \leq F^{APE,ND,H}$.

(iii) If $\frac{A_L}{A_H}\frac{E_H}{\mathbb{E}[E]} \leq 1+\underline{k} \leq \frac{E_L}{E_H}(< \frac{E_L}{\mathbb{E}[E]})$, *a partial semi-separating equilibrium where* H *pools on equity is sustainable. The lower bound* $\frac{A_L}{A_H}\frac{E_H}{\mathbb{E}[E]} \leq 1+\underline{k}$ *is equivalent to* $F \geq F^{EPE,ND,H}$.

(iv) If $1+\overline{k} \geq \frac{E_H}{E_L}(> \frac{\mathbb{E}[A]}{A_H}\frac{E_H}{E_L})$, *a full semi-separating equilibrium where* $k_H^* > 0$ *is sustainable if* $F < F^*$.

(v) If $1+\underline{k} \leq \frac{A_L}{A_H}(< \frac{A_L}{A_H}\frac{E_H}{\mathbb{E}[E]})$*, a full semi-separating equilibrium where* $k_H^* < 0$ *is sustainable if* $F > F^*$*.*

Part (i) of Proposition 1 states that, if synergies are sufficiently weak, (i.e. $\overline{k}$ and $\underline{k}$ are low in absolute value), then the only possible equilibria are pooling ones. Intuitively, in a SE, both claims are issued and one of the two claims is more likely to be associated with type-L; thus, a firm will only be willing to issue this claim if synergy motives are sufficiently strong to outweigh the cost of the negative inference. When the amount of financing required increases, firms switch from selling assets (APE) to issuing equity (EPE), since the certainty effect becomes stronger. Thus, the type of claim issued depends not only on the inherent characteristics of the claim (its information asymmetry and synergies) but also the amount of financing required – firms only issue equity to raise large amounts of financing, even though we have no fixed costs of equity issuance. In standard theories, the type of security issued only depends on the security's inherent characteristics (information asymmetry or overvaluation) unless one assumes nonlinearities such as limited debt capacity. Here, there are no limits as the amount of financing required can be fully raised by either source.[14]

It may seem that, since financing is a motive for asset sales, greater financing needs should lead to more asset sales. However, if F rises sufficiently, the firm may sell *fewer* assets, since it substitutes into an alternative source of financing: equity issuance. Surprisingly, greater financial constraints may improve real efficiency as firms hold onto their synergistic assets.[15] In particular, if $\underline{k} = 0$, all asset sales reduce total surplus since there are no dissynergies, and so higher F increases total surplus.

One interesting case is that of 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 non-core asset is exactly the same as that of the firm, APE is never sustainable without synergies, due to the certainty effect. Thus, single-segment firms sell only equity.

Parts (ii) and (iii) show that, if synergies are moderate, partial semi-separating equilibria may hold. It remains the case that, for low F, all H-firms sell assets, and for high F, all H-firms issue equity – just as in the pooling equilibria. The difference is that, now, some L-types are willing to deviate and issue a different claim from H.

[14] When financing needs become too high ($F > F^{EPE,ND,L}$), then $1+\underline{k} > \frac{E_L}{\mathbb{E}[E]}$ no longer holds and no pooling equilibrium is sustainable. Due to the certainty effect, the information asymmetry of equity becomes second-order, and so firms with synergies (dissynergies) will sell equity (assets).

[15] Equity issuance does not affect real efficiency as it leads to a pure wealth transfer between investors and firms; asset sales affect real efficiency due to the difference between common and private values.

Even though they are revealed low-quality by doing so, synergy motives are sufficiently strong that they are willing to separate despite the negative inference.

Parts (iv) and (v) show that, if synergies are strong, full semi-separating equilibria may hold. If $F < F^*$, H-firms prefer asset sales: since $k_H^* > 0$, H-firms will sell assets even if they are synergistic. If $F > F^*$, H-firms prefer equity issuance: since $k_H^* < 0$, H-firms will retain assets even if they are dissynergistic. Thus, in all equilibria (pooling equilibria and both types of semi-separating equilibria), it remains the case that H-firms prefer asset sales for low F, and equity issuance for high F because the certainty effect reduces the information asymmetry of equity.

Studying all parts of Proposition 1 together, if synergies are weak and the amount of financing required is relatively extreme (very low or very high), then only pooling equilibria are sustainable. Information asymmetry conditions are strong relative to operational considerations, and so no firm wishes to be inferred as type L as it will suffer too large a capital loss. As F moves closer to F^*, then the information asymmetries of assets and equity become more balanced and so it is less costly to issue a claim associated with type L; if synergies also become stronger, operational considerations may outweigh information asymmetry conditions and so semi-separating equilibria become sustainable. Thus, it is the relative importance of operational motives (determined by the absolute value of $\overline{k}$ and $\underline{k}$) compared to information asymmetry motives (determined by the closeness of F to F^*) that determines whether it is pooling or separating equilibria that are sustainable.

Specifically, if we fix F at a given level, as synergies rise in absolute terms, we move from a pooling equilibrium to a partial SE and finally to a full SE. If we fix synergies such that $1 + \overline{k} < \frac{\mathbb{E}[A]}{A_L}$, as F rises, we move from an APE, to a region in which both pooling equilibria hold, then to EPE, and finally to a partial SE where all H-firms sell equity (when F becomes very high, L-firms make little capital gain from equity issuance due to the certainty effect, and so some L-firms with dissynergistic assets sell them). In addition, in a neighborhood around F^* we also have SE, so three equilibria (APE, EPE, and SE) can be sustained. If we fix synergies such that $1 + \overline{k} > \frac{A_H}{A_L}$, as F rises, we move from a partial SE where all H-firms sell assets, to a full SE, then to EPE, and finally to a partial SE where all H-firms sell equity. The change in equilibrium as F changes illustrates the idea that H-firms prefer asset sales if F is low and equity issuance if F is high, due to the certainty effect.

Finally, we note that the regions in Proposition 1 do not overlap, since $\frac{\mathbb{E}[A]}{A_L}$ (the upper bound on $1 + \overline{k}$ for APE) is less than $\frac{A_H}{A_L}$ (the lower bound on $1 + \overline{k}$ for the partial SE) and $\frac{\mathbb{E}[A]}{A_H}\frac{E_H}{E_L}$ (the upper bound on $1+\overline{k}$ for the partial SE) is less than $\frac{E_H}{E_L}$ (the lower bound on $1+\overline{k}$ for the full SE) and similarly for the bound on $1+\underline{k}$. This is because the Proposition gives sufficient conditions for the equilibria to exist, which may not be necessary. The proof of Proposition 1 shows that the necessary conditions do overlap, i.e. there are no parameters for which all necessary conditions are violated.

3 Negative Correlation

We now turn to the case of negative correlation. Since $A_L > A_H$, we now use the term "high (low)-quality assets" to refer to the assets of L (H). Note that negative correlation is a mild condition: it only means that high-quality firms are not universally high-quality, as they may have some low-quality assets. It does not require the values of the divisions covary in opposite directions to each other (e.g. that a market upswing helps one division and hurts the other). It is reasonable for the market to 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 airplanes in a bank's leasing division is unlikely to be highly correlated with the bank as a whole, but the value of mortgages will be.

In this section, the manager's objective function places weight ω on the firm's stock price and $1-\omega$ on 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 manager expecting to sell his shares before fundamental value is realized (Stein (1989)). We introduce stock price concerns because, with negative correlation, there is now a trade-off involved in selling assets: being inferred as H maximizes the market value, but being inferred as L maximizes proceeds and thus fundamental value.

3.1 Pooling Equilibrium, All Firms Sell Assets

As in Section 2.1, we consider a pooling equilibrium in which all firms sell assets, supported by the OEPB that an equity issuer is of type $\left(L,\overline{k}\right)$. As before, sold assets are valued at $\mathbb{E}\left[A\right]=\pi A_H+(1-\pi)A_L$ and issued equity is valued at E_L. An asset seller has a stock price of $\mathbb{E}\left[C+A\right]$, and an equity issuer is priced at C_L+A_L.

By deviating, an L-firm avoids the capital loss from selling highly-valued assets at a pooled price as well as any loss of synergies, but suffers a low stock price. Thus, he will only cooperate if his concern for the stock price is high. Since $\left(L,\overline{k}\right)$ is most likely to deviate, all L-firms will cooperate if:

$$\omega \geq \omega^{APE,ND,L} = \frac{F\left(\frac{A_L}{\mathbb{E}[A]}(1+\overline{k})-1\right)}{\pi(C_H - C_L - (A_L - A_H)) + F\left(\frac{A_L}{\mathbb{E}[A]}(1+\overline{k})-1\right)}. \tag{22}$$

If (22) is satisfied, it is automatic that all H-firms will not deviate: their incentives to deviate are weaker as they are making a capital gain by pooling on asset sales. Thus, (22) is necessary and sufficient for all firms not to deviate.

The lower bound given by (22) is relatively loose. It is easy to rule out a deviation to equity. Issuing equity not only leads to a low price (of $C_L + A_L$) 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. This is because the equity being sold is necessarily perfectly correlated with the rest of the firm. The second effect is absent in MM, since the manager only cares about fundamental value and not the stock price.

It is automatic that the OEPB satisfies the IC. Type $\left(L, \overline{k}\right)$ will indeed deviate to equity if revealed H: his stock price will rise, he will receive a capital gain by selling equity for a high price (compared to his current loss for selling high-quality assets at a pooled price) and he avoids the loss of synergies $\overline{k} \geq 0$.

The results of this subsection are summarized in Lemma 4 below:

Lemma 4. *(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 type $\left(L, \overline{k}\right)$. The prices of assets and equity are $\pi A_H + (1-\pi) A_L$ and E_L respectively. The stock prices of asset-sellers and equity issuers are $\mathbb{E}\left[C + A\right]$ and $C_L + A_L$, respectively. This equilibrium is sustainable if*

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

The bound is increasing in F, so again the choice of financing depends on the amount required. However, F plays a different role here than in the positive correlation model, where it was important due to the certainty effect. Here, a greater F means that L's capital loss from pooling is sustained over a larger base. It increases the fundamental value motive relative to the market value motive, and requires a higher weight on the market value ω to maintain indifference. This "base effect" was absent from the positive correlation section, as there was no trade-off between stock price and fundamental value. Put differently, if F is high, L suffers such a large capital loss from selling assets that it prefers to "bite the bullet" and issue equity even though this leads to a low stock price. The bound is also increasing in $\overline{k}$: higher $\overline{k}$ increases the fundamental loss that $\left(L, \overline{k}\right)$ suffers from selling assets, and so we require a lower weight on fundamental value (a higher ω) for him not to deviate.

3.2 Pooling Equilibrium, All Firms Sell Equity

We next consider a pooling equilibrium in which all firms sell equity, supported by the OEPB that anyone who sells assets is of type $(L, \underline{k})$.[16] As before, issued equity is valued at $\mathbb{E}[C + A] + F$ and sold assets are valued at A_L. The stock price is $\mathbb{E}[C + A]$ for an equity issuer and $C_L + A_L - F\underline{k}$ for an asset seller.

By deviating, an H-firm avoids the capital loss from equity issuance and gets rid of a dissynergistic asset, but suffers a low stock price from being inferred as L. Since $(H, \underline{k})$ is most likely to deviate, all H-firms will cooperate if:

$$\omega \geq \omega^{EPE,ND,H} = \frac{F\left(\frac{E_H}{\mathbb{E}[E]} - \frac{A_H(1+\underline{k})}{A_L}\right)}{\pi(C_H - C_L - (A_L - A_H)) + F\left(\underline{k} + \frac{E_H}{\mathbb{E}[E]} - \frac{A_H(1+\underline{k})}{A_L}\right)}. \qquad (23)$$

If (23) is satisfied, it is automatic that all L-firms will not deviate: their incentives to deviate are weaker as they are making a capital gain by pooling on equity issuance. Thus, (23) is necessary and sufficient for all firms not to deviate. Comparing (23) with (22), the ND condition in APE, we can see that the EPE condition is relatively harder to satisfy. In APE, deviation to equity issuance leads to a low price of $C_L + A_L$ not only on the equity being sold, but also on the rest of the firm. Here, deviation to asset sales leads to a low price of $C_L + A_L - F\underline{k}$ on the rest of the firm, but a high price of

[16]For all equilibria, we specify the OEPB that anyone who deviates is of quality L, and are free to choose whichever synergy parameter makes the equilibrium most likely to hold. In all equilibria considered thus far, the synergy parameter only affected the IC condition and so the choice was straightforward: we choose the synergy parameter which makes the IC condition easier to satisfy. Thus, for example, the OEPB for APE under positive correlation was that a deviator is $\left(L, \overline{k}\right)$ rather than $(L, \underline{k})$. Here, the synergy parameter affects both IC and ND and so the choice is not straightforward. A lower k makes IC easier to satisfy (as $(L, \underline{k})$ is more willing to deviate to asset sales to get rid of a dissynergistic asset) but increases the stock price of a deviator (as it is deemed to be losing a dissynergistic asset) and makes ND harder to satisfy. We follow the earlier equilibria and choose the k that makes the IC easiest to satisfy. This is because the goal of this section is to show that APE is sustainable for a greater range of parameters than EPE. In Section 3.3 we show that the IC condition for EPE is tighter than the ND condition for APE, so if we chose a different k (which would make the IC condition for EPE harder to satisfy), this would still hold.

A_L on the asset being sold, since it is not a carbon copy. This difference is due to the correlation effect.

Unlike in Section 3.1, it is not automatic that the OEPB satisfies the IC, since deviation to asset sales causes $(L, \underline{k})$ to suffer a capital loss. The IC condition is satisfied if and only if:

$$\omega \geq \omega^{EPE,IC} = \frac{F\left(\frac{A_L(1+\underline{k})}{A_H} - \frac{E_L}{\mathbb{E}[E]}\right)}{(1-\pi)(C_H - C_L - (A_L - A_H)) + F\left(\underline{k} + \frac{A_L(1+\underline{k})}{A_H} - \frac{E_L}{\mathbb{E}[E]}\right)}. \tag{24}$$

This is also a lower bound. The numerator represents the fundamental loss that L suffers from deviating to asset sales and being inferred as H, which arises if the capital loss from selling good assets at a low price is greater than the gain from getting rid of a dissynergistic asset. If this loss is positive, he will only deviate if his stock price concerns are sufficiently high. The IC was trivially satisfied in APE where the deviation involved issuing equity – if the deviator is inferred as H, he receives both a high stock price and a high value for the equity being sold: both are valued at $C_H + A_H$ since the former is a carbon copy of the latter. Here, the deviation is to assets, which are not a carbon copy of the firm and so can be priced differently: even though the deviator enjoys a high market valuation (of $C_H + A_H - F\underline{k}$), he suffers a loss on the assets being sold (which fetch only A_H).

The IC condition (24) is stronger than the ND condition (23) if and only if:

$$F\underline{k}(N_2 - N_1) < [(C_H - C_L) - (A_L - A_H)]\,[\pi N_1 - (1-\pi)N_2], \tag{25}$$

where N_1 and N_2 are the parenthetical terms in the numerators of (24) and (23), i.e.:

$$N_1 \equiv \frac{A_L\,(1+\underline{k})}{A_H} - \frac{E_L}{\mathbb{E}[E]}$$
$$N_2 \equiv \frac{E_H}{\mathbb{E}[E]} - \frac{A_H\,(1+\underline{k})}{A_L}.$$

Lemma 5 below summarizes the equilibrium.

Lemma 5. *(Negative correlation, pooling equilibrium, all firms sell equity.) Consider a pooling equilibrium where all firms sell assets ($X_H = X_L = A$) and a firm that sells assets is inferred as type $(L, \underline{k})$. 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. This equilibrium is sustainable if*

$\omega \geq \omega^{EPE}$, *where*

$$\omega^{EPE} = \begin{cases} \omega^{EPE,IC} = \dfrac{F\left(\frac{A_L(1+\underline{k})}{A_H} - \frac{E_L}{\mathbb{E}[E]}\right)}{(1-\pi)(C_H - C_L - (A_L - A_H)) + F\left(\underline{k} + \frac{A_L(1+\underline{k})}{A_H} - \frac{E_L}{\mathbb{E}[E]}\right)} & \textit{if (25) holds} \\ \omega^{EPE,ND,H} = \dfrac{F\left(\frac{E_H}{\mathbb{E}[E]} - \frac{A_H(1+\underline{k})}{A_L}\right)}{\pi(C_H - C_L - (A_L - A_H)) + F\left(\underline{k} + \frac{E_H}{\mathbb{E}[E]} - \frac{A_H(1+\underline{k})}{A_L}\right)} & \textit{if (25) does not hold.} \end{cases} \tag{26}$$

There are two effects of increasing F on the lower bounds. On the one hand, the base effect makes pooling more difficult to sustain: the capital loss is suffered off a lower base, and so increases H's incentive to deviate. Thus, the lower bound tightens, i.e. increases. This is the same effect as in APE. The second effect is specific to EPE: increasing F reduces the capital loss from pooling, due to the certainty effect. However, the second effect is always smaller, so the overall effect is to increase the bounds.

3.3 Comparing the Pooling Equilibria

We now study the conditions under which each pooling equilibrium is sustainable. The goal of the comparison is to illustrate that the correlation effect leads to asset sales being preferred to equity issuance. Since this concept does not depend on synergies, we undertake the comparison for $\overline{k} = \underline{k} = 0$.[17] Since separating equilibria are not sustainable in the absence of synergies, unlike in Section 2 we compare the pooling equilibria alone. The results are given in Proposition 2 below:

Proposition 2. *(Negative correlation, comparison of pooling equilibria.) Set* $\overline{k} = \underline{k} = 0$. *An asset-pooling equilibrium is sustainable if* $\omega \geq \omega^{APE,ND,L}$ *and an equity-pooling equilibrium is sustainable if* $\omega \geq \omega^{EPE}$, *where* $\omega^{APE,ND,L}$ *and* ω^{EPE} *are given by (22) and (26), respectively and* $\omega^{APE,ND,L} < \omega^{EPE}$. *Thus, if:*

(i) $0 < \omega < \omega^{APE,ND,L}$, *neither pooling equilibrium is sustainable,*

(ii) $\omega^{APE,ND,L} \leq \omega \leq \omega^{EPE}$, *only the asset-pooling equilibrium is sustainable,*

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

The thresholds $\omega^{APE,ND,L}$ *and* ω^{EPE} *are both increasing in* F.

Proposition 2 shows that, for the case of negative correlation, asset sales are more common than equity issuance. The range of ω's over which EPE is sustainable is a

[17] In contrast, if $\overline{k} >> 0$, trivially APE would be difficult to sustain, despite the correlation effect, as firms will not wish to part with synergistic assets.

strict subset of the range of ω's over which APE is sustainable. Note that the preference for asset sales exists even though assets may exhibit more information asymmetry than equity and the MM principle would suggest that equity issuance should be preferred. We show that asset sales may be preferred due to the correlation effect. Note that this correlation effect is absent in a standard financing model of security issuance, because both debt and equity are positively correlated with firm value. Thus, the issuance of debt may imply that debt is low-quality, and thus the remainder of the firm is also low-quality.

3.4 Semi-Separating Equilibrium

As in Section 2.3, we have a semi-separating equilibrium characterized by a cutoff k_q^*. The prices paid for assets and equity are given by (16) and (17). Since the manager now places weight on the firm's stock price, we need to calculate the stock prices of asset sellers and equity issuers. These are, respectively:

$$\mathbb{E}[C+A|X=A] = \pi\left(\frac{k_H^*-\underline{k}}{\mathbb{E}[k_q^*]-\underline{k}}\right)(C_H+A_H) + (1-\pi)\frac{k_L^*-\underline{k}}{\mathbb{E}[k_q^*]-\underline{k}}(C_L+A_L) - \frac{1}{2}F\left(\frac{E[(k_q^*)^2]-\underline{k}^2}{\overline{k}-\underline{k}}\right), \tag{27}$$

$$\mathbb{E}[C+A|X=E] = \pi\left(\frac{\overline{k}-k_H^*}{\overline{k}-\mathbb{E}[k_q^*]}\right)(C_H+A_H) + (1-\pi)\left(\frac{\overline{k}-k_L^*}{\overline{k}-\mathbb{E}[k_q^*]}\right)(C_L+A_L). \tag{28}$$

The stock price of an asset seller includes an additional term, $F \times E[k|X=A]$, which reflects the expected synergy loss or gain. The term enters negatively as, if the market's inference is that the asset sold is synergistic (dissynergistic), this decreases (increases) the stock price.

The cutoff k_q^* for a particular quality q is defined by:

$$\omega\left(\mathbb{E}[C+A|X=A]-\mathbb{E}[C+A|X=E]\right) = (1-\omega)F\left(\frac{A_q(1+k_q^*)}{\mathbb{E}[A|X=A]} - \frac{C_q+A_q+F}{\mathbb{E}[E|X=E]}\right). \tag{29}$$

Only the parenthetical term on the RHS differs according by quality q. Ignoring k, this term will be higher for L, and so $k_H^* > k_L^*$. This is intuitive: since H has lower-quality assets but higher-quality equity, it is more willing to sell assets. Under positive correlation, $k_H^* > k_L^*$ only if assets are safer than equity (adjusted for the certainty effect), as this means that the capital loss from asset sales is less than from equity issuance. With negative correlation, the capital loss from asset sales is always less since it is negative (i.e., a capital gain), so we always have $k_H^* > k_L^*$. From (27) and (28), $k_H^* > k_L^*$ implies that asset (equity) sales lead to a positive (negative) stock price reaction.

The amount of financing F has two effects on the cutoffs. To illustrate, consider L's decision. On the one hand, an increase in F augments the certainty effect and makes equity issuance less attractive, because L enjoys a smaller capital gain. This tends to make L prefer asset sales and increase k_L^*. On the other hand, an increase in F augments fundamental value considerations as they are now off a higher base. Thus, the stock price boost from asset sales is less important, which tends to decrease k_L^*, so the overall effect is ambiguous. Thus, this semi-separating equilibrium combines both effects of F: the certainty effect which is present in APE under positive correlation, and the base effect which is present in APE under negative correlation.

A second contrast with the positive correlation case is that it is possible to have separation purely by quality and not by synergy, i.e. $k_H^* = \overline{k}$ and $k_L^* = \underline{k}$, where all high-quality firms sell assets and all low-quality firms sell equity. We use SE^q to denote a semi-separating equilibrium by quality only. In the positive correlation case, SE^q is unsustainable as $(L, \underline{k})$ will deviate to sell assets and enjoy a capital gain plus a loss of dissynergies. Here, SE^q may be sustainable as, even though deviation allows $(L, \underline{k})$ to get rid of a dissynergistic asset and enjoy a higher stock price, he will suffer a capital loss. Indeed, SE^q is sustainable if both of the following conditions are satisfied:

$$\omega \geq \omega^{SE^q,H} = \frac{F\left((1+\overline{k}) - \frac{E_H}{E_L}\right)}{(C_H - C_L - (A_L - A_H) - \frac{1}{2}F(\overline{k} + \underline{k})) + F\left((1+\overline{k}) - \frac{E_H}{E_L}\right)} \tag{30}$$

$$\omega \leq \omega^{SE^q,L} = \frac{F\left(\frac{A_L(1+\underline{k})}{A_H} - 1\right)}{(C_H - C_L - (A_L - A_H) - \frac{1}{2}F(\overline{k} + \underline{k})) + F\left(\frac{A_L(1+\underline{k})}{A_H} - 1\right)}. \tag{31}$$

The lower bound on ω ensures that H will not deviate. Type $\left(H, \overline{k}\right)$ may wish to deviate to retain its synergistic asset; a high ω is needed for the stock price motive to be strong enough to deter deviation. If $1 + \overline{k} < \frac{E_H}{E_L}$, i.e. synergies are less important than information asymmetry, then the loss of synergies is less than the capital loss that $\left(H, \overline{k}\right)$ would suffer by issuing equity. Thus, H's fundamental value and stock price are both higher under asset sales, and the lower bound on ω is trivially satisfied. There are two effects on F on the lower bound – it tightens it due to the certainty effect but loosens it due to the base effect – so the overall impact is ambiguous.

The upper bound ensures that L will not deviate. If $1 + \underline{k} \leq \frac{A_H}{A_L}$, i.e. dissynergies are so strong that they swamp information asymmetry motives, deviation yields L a fundamental gain and so SE^q can never hold. However, if $1 + \underline{k} > \frac{A_H}{A_L}$, type $(L, \underline{k})$ suffers a fundamental loss from deviating: the capital loss from selling high-quality assets exceeds the benefits of getting rid of a dissynergistic asset. Deviating also leads to a stock price increase. Thus, ω must be low so that the stock price motive is sufficiently weak to deter deviation. Unlike the lower bound, the upper bound on ω is unambiguously increasing in F as only the base effect exists.

The range of ω's that satisfy (30) and (31) is increasing in $\underline{k}$ and decreasing in $\overline{k}$: the weaker the synergy motive, the easier it is to sustain SE^q. Indeed, if $\overline{k} = 0$, H will never deviate and so the lower bound is always satisfied. If ω falls outside the bounds given by (30) and (31), a semi-separating equilibrium may be sustainable but will involve $k_H^* < \overline{k}$ and/or $k_L^* > \underline{k}$ (rather than SE^q).

In SE^q, assets are sold for the lowest possible price of A_H and equity is issued at the lowest price of $C_L + A_L$, so there are no capital gains or losses. Type H's assets are correctly assessed by the market as being a "lemon", and so the market timing motive for financing (e.g. Baker and Wurgler (2002)) does not exist. However, the low valuation on the assets sold does not imply a low valuation for the rest of the firm, and so H is willing to sell assets despite receiving a low price. Thus, the correlation effect – and its implications for the desirability of financing through asset sales – manifests in two ways. First, APE is sustainable over a greater range of parameters than EPE. Second, SE^q is sustainable, unlike in the positive-correlation model.[18]

This analysis points to an interesting benefit of diversification. Stein (1997) notes that an advantage of holding assets that are not perfectly correlated is that a conglomerate can engage in "winner-picking", i.e. increase investment in the division with the best investment opportunities at the time. Our model suggests that an advantage of diversification is "loser-picking": a firm can sell a low-quality asset, thus raising financing, without implying a low value for the rest of the firm. Non-core assets may thus be a form of financial slack and may even be preferable to debt capacity: the value of debt is typically positively correlated with firm value, 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.

[18] SE^q is also featured in the model of Nanda and Narayanan (1999), where core and non-core assets are always negatively correlated and $\omega = 0$. (If these 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.

In contrast, as discussed previously, single-segment firms prefer to sell equity.

Note that, in SE^q, there are no capital gains or losses, but in a SE with synergies, H-firms that sell assets and L-firms that sell equity earn capital gains. These gains arise because synergy considerations allow firms to disguise the true motive for selling claims: the camouflage effect. By selling assets, H pools with some L firms which choose to sell assets due to operational reasons (dissynergies) rather than overvaluation (since their assets are actually high-quality). Thus, H does not suffer the full lemons discount and receives a value (27) that is greater than the A_H received under than SE^q. Conversely, L-firms that sell equity earn a capital gain as they pool with H-firms who choose to sell equity, even though it is high-quality, as they do not wish to sell a synergistic asset. As with the positive correlation case, the camouflage effect disappears if there are no synergy motives ($\overline{k} = \underline{k} = 0$). In this case, the only sustainable semi-separating equilibrium is SE^q, rather than SE, and there are no capital gains or losses.

Finally, we may have partial semi-separating equilibria where one quality pools and the other quality separates. As in the positive correlation case, if the maximum synergy $\overline{k}$ is sufficiently low, we have an equilibrium where all H-firms sell assets and L-firms strictly separate. Unlike the positive correlation case, we cannot have an equilibrium where H-firms issue equity and L-firms strictly separate. Such an equilibrium would require some L-firms to be willing to sell assets but all H-firms not to be. However, since H's assets are lower-quality under negative correlation, H is more willing to sell assets than L. Similarly, if the maximum dissynergy $\underline{k}$ is sufficiently low in absolute terms, we have an equilibrium where all L-firms issue equity and H-firms strictly separate. Unlike the positive correlation case, we cannot have an equilibrium where all L-firms sell assets and H-firms strictly separate: since some H-firms are issuing equity, L-firms will enjoy both a capital gain and a stock price increase by deviating to equity issuance. Thus, the only partial semi-separating equilibria that are feasible are ones in which all H-firms sell assets, or all L-firms issue equity, which is intuitive since H's assets and L's equity are both low-quality.

The results of this section are summarized in Lemma 6 below.

Lemma 6. *(Negative correlation, semi-separating equilibrium.)*

(i) A full semi-separating equilibrium is sustainable where quality q sells assets if $k \leq k_q^*$ and equity if $k > k_q^*$, where k_q^* is defined by (29). We have $k_H^* > k_L^*$ and $k_H^* > 0$; the sign of k_L^* depends on parameter values. The prices of assets and equity are given by (27) and (28) respectively.

(ii) A partial semi-separating equilibrium where all H-firms sell assets ($k_H^* = \overline{k}$)

and L-firms strictly separate ($\underline{k} < k_L^* < \overline{k}$) is sustainable if $\overline{k}$ is sufficiently low.

(iii) A partial semi-separating equilibrium where all L-firms issue equity ($k_L^* = \underline{k}$) and H-firms strictly separate ($\underline{k} < k_H^* < \overline{k}$) is sustainable if $\underline{k}$ is sufficiently high.

(iv) A semi-separating equilibrium is sustainable in which all firms of quality H (L) sell assets (equity) is sustainable if the following two conditions are satisfied:

$$\omega \geq \omega^{SE,H} = \frac{F\left((1+\overline{k}) - \frac{E_H}{E_L}\right)}{(C_H - C_L - (A_L - A_H) - \frac{1}{2}F(\overline{k}+\underline{k})) + F\left((1+\overline{k}) - \frac{E_H}{E_L}\right)}$$

$$\omega \leq \omega^{SE,L} = \frac{F\left(\frac{A_L(1+\underline{k})}{A_H} - 1\right)}{(C_H - C_L - (A_L - A_H) - \frac{1}{2}F(\overline{k}+\underline{k})) + F\left(\frac{A_L(1+\underline{k})}{A_H} - 1\right)}.$$

4 Extensions

This section analyzes extensions of the main model. Section 4.1 studies the case in which the cash raised is used to finance an investment whose expected value exhibits information asymmetry, and Section 4.2 allows firms to have the choice over whether to raise capital.

We have also undertaken an extension in which firms may sell the core asset (in addition to selling the non-core asset and issuing equity). Since the analysis mainly demonstrates the robustness of the ideas of the core model, rather than generating new results, we defer this analysis to Appendix B. However, we discuss briefly here two results that demonstrate the model's robustness. First, one of the assets (core or non-core) will exhibit more information asymmetry than the other; since equity is a mix of both assets, the information asymmetry of equity will lie in between. It may therefore seem (from MM) that the sale of one asset will always dominate equity, since one of the assets will have lower information asymmetry than equity. However, even though equity is never the safest claim, it may still be preferred due to the certainty effect. Second, if the core (non-core) asset is positively (negatively) correlated with firm value, the firm is able to choose the correlation of the asset that it sells, whereas the analysis thus far has considered either the positive correlation case or the negative correlation case. Appendix B 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, also due to the correlation effect. Thus, the correlation effect continues to apply when firms can choose the correlation of the assets they sell.

4.1 Cash Used For Investment

This section analyzes the case in which the cash raised (F) is used to finance an investment whose expected value exhibits information asymmetry. To make the effects of investment as clear as possible, we will focus on the no-synergies case of $\overline{k} = \underline{k} = 0$. We also assume that:

$$\frac{A_H}{A_L} < \frac{C_H + A_H}{\mathbb{E}\left[C + A\right]}. \tag{32}$$

Equation (32) states that the information asymmetry of assets is not too high compared to core equity. If (32) is not satisfied, then the information asymmetry of assets is so high that, in the core model, EPE is always sustainable regardless of F. We discuss the effect of relaxing this assumption at the end of this section.

Since all agents are risk-neutral, only expected values matter. Thus, the model is unchanged if we simply make the investment opportunity volatile, so that its payoff is a random variable with an expected value that is independent of q.[19] For the investment opportunity to affect the analysis, it must vary with q so that there is information asymmetry regarding its value: information asymmetry is a critically different concept to volatility. We thus assume that F is used to finance an investment with expected value $R_q = F\left(1 + r_q\right)$, where $r_H \geq 0$ and $r_L \geq 0$: since there are no agency problems, the investment will only be undertaken if it is positive-NPV (as in MM). 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 performing poorly 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 consider the case of positive correlation here; the case of negative correlation is very similar to the core model and is in Appendix E. Appendix E also allows for $r_H < 0$ and $r_L < 0$ and shows that the core intuitions are unchanged.

We first consider APE. The analog of (8), H's ND condition, is now:

$$\frac{A_H}{\mathbb{E}[A]} \leq \frac{C_H + A_H + F\left(1 + r_H\right)}{C_L + A_L + F\left(1 + r_L\right)}. \tag{33}$$

As is intuitive, C_q and R_q $\left(= F\left(1 + r_q\right)\right)$ enter symmetrically in all expressions: an

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

equity investor receives a share of C, R, and A, but an asset purchaser receives only a share of A. From (33), H will not deviate if:

$$F\left[A_H\left(1+r_L\right)-\mathbb{E}\left[A\right]\left(1+r_H\right)\right]\leq\mathbb{E}\left[A\right]\left(C_H+A_H\right)-A_H\left(C_L+A_L\right). \tag{34}$$

Since (32) implies $\frac{A_H}{\mathbb{E}[A]}<\frac{C_H+A_H}{C_L+A_L}$, the RHS of (34) 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 (34) is positive, and so we again have an upper bound on F, given by:

$$F\leq\frac{\mathbb{E}\left[A\right]\left(C_H+A_H\right)-A_H\left(C_L+A_L\right)}{A_H\left(1+r_L\right)-\mathbb{E}\left[A\right]\left(1+r_H\right)}. \tag{35}$$

In the core model ((7)), and setting synergies to zero, the denominator is $A_H-\mathbb{E}\left[A\right]$. If $r_L>r_H$, the denominator of (35) is greater than in the core model, and so the bound is tighter: it is harder to support APE. This is intuitive: L's superior growth options counterbalance its inferior assets in place and reduce the information asymmetry of equity, making asset sales less desirable. One may think that the reverse intuition applies to $r_H\geq r_L$: the information asymmetry of the investment R increases the information asymmetry of the core asset (recall that C and R enter symmetrically), making equity issuance less attractive. Put differently, it seems that the certainty effect should weaken since cash is now used for uncertain investment. However, this is not the case: if $r_H\geq r_L$ but $\frac{r_H}{r_L}<\frac{A_H}{\mathbb{E}[A]}$, the denominator of (35) is higher than in the core model, making APE harder to sustain.

The above intuition is incomplete because financing investment has two effects. They can be best seen by the following decomposition of the investment returns:

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

The first, intuitive effect is the $F\left(r_H-r_L\right)$ term which appears in the R_H equation only. The value of investment is greater for H and so it suffers a greater capital loss from selling equity. However, there is a second effect, captured by the $F\left(1+r_L\right)$ term which is common to both types. This increases the certainty effect: since the investment is positive-NPV, an equity investor now has a claim to a larger certain value: $F\left(1+r_L\right)$ rather than F. Put differently, while investors do not know firm quality, they do know that the funds they provide will increase in value, regardless of quality. Due to this second effect, $r_H\geq r_L$ is not sufficient for the upper bound to relax. If $\frac{r_H}{r_L}<\frac{A_H}{\mathbb{E}[A]}$, the difference in returns is insufficient to outweigh the first effect, and it is harder to prevent H from deviating. Only if $\frac{r_H}{r_L} > \frac{A_H}{\mathbb{E}[A]}$ 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 (34) is non-positive and so the ND condition is always satisfied: APE is sustainable for any F.

Another way to view the intuition is as follows. Equityholders obtain a portfolio of the assets in place $(C + A)$ and the new investment (R); the size of F determines the weighting of the new investment in this portfolio. The APE is sustainable if H's capital loss from asset sales, $\frac{A_H}{\mathbb{E}[A]}$, is less than the weighted average capital 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. $\frac{C_H+A_H}{C_L+A_L} \geq \frac{A_H}{\mathbb{E}[A]}$ and $\frac{1+r_H}{1+r_L} \geq \frac{A_H}{\mathbb{E}[A]}$, then the weighted average loss on the portfolio is greater regardless of the weights – hence, APE holds regardless of F. Deviation is only possible if the investment is safer than non-core assets, i.e. $\frac{1+r_H}{1+r_L} < \frac{A_H}{\mathbb{E}[A]}$. 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. The lower the information asymmetry of investment, the lower the weight on it required for the overall portfolio to exhibit greater information asymmetry than non-core assets. Thus, holding r_L fixed, as r_H declines towards r_L, the required F goes down and APE is harder to sustain.

Regardless of the specific values of r_H and r_L, in all cases we require the weight on the investment to be low. Thus, the result of the core model, that F must be low for APE to be sustainable, continues to hold when cash is used to finance an uncertain investment, and regardless of the values of r_H and r_L.

The IC condition is satisfied if:

$$F\left(\mathbb{E}[A](1+r_L) - A_L(1+r_H)\right) \leq A_L(C_H + A_H) - \mathbb{E}[A](C_L + A_L). \qquad (36)$$

The contrast with the core model ((9)) is similar as for the ND conditions. If $\frac{1+r_H}{1+r_L} \geq \frac{\mathbb{E}[A]}{A_L}$, (36) is satisfied for all F. If instead $\frac{1+r_H}{1+r_L} < \frac{\mathbb{E}[A]}{A_L} \leq \frac{r_H}{r_L}$, the upper bound on F becomes looser than in the core model since the information asymmetry of the investment increases L's incentives to deviate and be revealed as H, since he will receive a capital gain on the investment value R as well as the core asset value C. However, if $\frac{\mathbb{E}[A]}{A_L} > \frac{r_H}{r_L}$, then the bound becomes tighter. As with the ND condition, this holds if $r_L > r_H$ (as is intuitive) but can also hold even if $r_H \geq r_L$.

The equilibrium is summarized in Lemma 7 below. The proof of the Lemma shows that the IC condition (36) is always stronger than the ND condition (34).

Lemma 7. *(Positive correlation, pooling equilibrium, all firms sell assets, cash used for investment.) Consider a pooling equilibrium where all firms sell assets ($X_q = A$) and a firm that issues equity is inferred as type 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*

$$F\left(\mathbb{E}[A](1+r_L) - A_L(1+r_H)\right) \leq A_L(C_H + A_H) - \mathbb{E}[A](C_L + A_L). \tag{37}$$

(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 $F \leq F^{APE,IC,I} = \frac{A_L(C_H+A_H)-\mathbb{E}[A](C_L+A_L)}{\mathbb{E}[A](1+r_L)-A_L(1+r_H)}$. 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 $\frac{r_H}{r_L} \geq \frac{\mathbb{E}[A]}{A_L}$, the upper bound on F is weakly looser and the asset-pooling equilibrium is sustainable across a larger range of F.

The effect of using cash for investment is similar in EPE, so we defer the analysis to Appendix E. The comparison of equilibria is summarized in Proposition 3:

Proposition 3. *(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:*

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

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

The thresholds $F^{APE,I}$ and $F^{EPE,I}$ are both increasing in r_H and decreasing in r_L. If $\frac{1+r_H}{1+r_L} < \frac{A_H}{\mathbb{E}[A]}$ we have $F^{EPE,I} < F^{APE,I}$. If $\frac{A_H}{\mathbb{E}[A]} < \frac{1+r_H}{1+r_L} < \frac{\mathbb{E}[A]}{A_L}$, we have $F^{EPE,I} < F^{APE,I}$ if and only if $\frac{1+r_H}{1+r_L} < \frac{C_H+A_H}{C_L+A_L}$. We also have $\frac{A_H-(1-\pi)A_L}{\pi A_L} > \frac{\mathbb{E}[A]}{A_L}$.

Proposition 3 demonstrates the core model's results continue to hold when cash is used for a purpose about which there is asymmetric information. Regardless of r_H and r_L, it remains the case that APE is sustainable for low F and EPE is sustainable for high F. As in the core model, the source of financing depends on the amount of financing raised.

In addition to demonstrating the robustness of this idea from the core model, this extension also generates a new result. As r_H rises and r_L falls, the upper bound on APE loosens and the lower bound on EPE tightens. If r_H is sufficiently greater than r_L, the bound becomes infinite: APE is sustainable for all F (since the upper bound is now infinity) and EPE is sustainable for no F (since the lower bound is now infinity). This can cause the equilibrium to shift from equity issuance to asset sales.[20] Thus, the source of financing also depends on the use of financing: if the funds will be used for investment and the investment may create little value (r_L is low), they are more likely to be raised from asset sales rather than equity issuance. The source of financing can depend on the use of financing in models of moral hazard (uses that are more likely to be subject to agency problems will be financed by debt rather than equity, to avoid the agency costs of outside equity) or bankruptcy costs (purchases of tangible assets are more likely to financed by debt rather than equity); here we deliver this dependence in a model of pure adverse selection. In addition, our predictions for the use of equity differ from a moral hazard model. With moral hazard, if cash is to remain on the balance sheet, debt will be preferred to equity to avoid 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 equation (32) does not hold. In this rare case, assets exhibit such high information asymmetry that EPE holds in the core model regardless of F. In this case, *and* if also the information asymmetry of the investment is sufficiently higher than that of assets, equity issuance is always possible unless the weight on the investment is sufficiently high that the weighted average information asymmetry is greater than that of assets. Thus, EPE is now satisfied for *low* F (and similarly APE is now satisfied for *high* F). If either one of the above conditions is not satisfied, we return to the core model's result that EPE is satisfied for high F and APE for low F.

4.2 Capital Raising is a Choice

In the core model, firms are forced to raise capital of F. This section gives firms a choice over whether to raise capital. We first allow all firms to have freedom on whether to do nothing, or raise capital of F through selling equity or assets. If capital is raised,

[20] Formally, a given F under which both pooling equilibria were sustainable in the core model may now support only APE, when cash is used for investment. A given F under which only EPE was sustainable in the core model may now support both equilibria, or only APE.

it is invested in a project that generates a return of $F(1+r)$.[21] As in MM, there is a single investment opportunity with a known investment requirement of F, so firms only choose between raising either 0 or F: any other amount reveals the firm to be of type L. We continue to consider the case of positive correlation and reintroduce synergies into the model. The possible equilibria are given in Proposition 4 below:

Proposition 4. *(All firms have a choice on 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 equilibria in Section 2 continue to hold under the conditions in that Section 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 $k > k_q^*$ under the conditions of Lemma 3 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.[22]

(ii) If $1+r < \frac{E_H}{E_L}$, we have a semi-separating equilibrium where quality H sells assets if $k \leq k_H^*$ and does nothing if $k > k_H^*$, and quality 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 interior and defined by $1+r = \frac{A_H\left(1+k_H^*\right)}{\mathbb{E}[A|X=A]}$. The cutoff k_L^* is defined by $1 = \frac{A_L\left(1+k_L^*\right)}{\mathbb{E}[A|X=A]}$, where $k_L^* > 0$. If $1+r > (\leq) \frac{A_H}{A_L}$, we have $k_H^* > (\leq) k_L^*$.

(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 $k_L^* = 0$.

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

Part (i) of Proposition 4 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 raised can be put to a sufficiently productive use.

Part (ii) shows that if the return on investment r is sufficiently low, high-quality firms with synergistic assets will not raise capital at all: selling assets is undesirable since assets are synergistic, and issuing equity is undesirable due to the adverse selection discount. Thus, the cost of either method of capital raising exceeds the gain from investing capital. However, high-quality firms with dissynergistic assets will sell them for operational reasons. As before, low-quality firms either issue equity or sell assets, depending on their level of synergy. It is interesting to compare this semi-separating

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

[22] The additional lower bounds for the equilibria studied in Appendix D are given in that section.

equilibrium with the semi-separating equilibrium that exists if r is high, i.e. part (i). The main difference is that, in part (ii), equity issuance automatically reveals the firm as being of quality L: the equity price $\mathbb{E}[E|X = E]$ equals the low equity value E_L. Since the investment opportunity is sufficiently undesirable, the only reason for issuing equity is if equity is low-quality (rather than to exploit an investment opportunity). There is no camouflage effect with equity issuance. In contrast, asset sales may be undertaken either because the asset is low-quality, or if the asset is dissynergistic. This camouflage effect means that asset sales can stem from high-quality as well as low-quality firms, and so we have $\mathbb{E}[A|X = A] > A_L$: the asset price exceeds the low asset price. As a result, we have $k_L^* \geq 0$: low-quality firms prefer to sell assets than issue equity, to take advantage of this camouflage effect.

The semi-separating equilibrium in part (i) exhibits greater real efficiency than that in part (ii) since all firms are exploiting profitable growth opportunities. It is easier to satisfy the requirement for part (i) ($1 + r > \frac{E_H}{\mathbb{E}[E|X=E]}$), and harder to satisfy the requirement for part (ii) ($1 + r < \frac{E_H}{E_L}$), if F is high, i.e. the certainty effect is strong. A high F has beneficial real consequences: it encourages H to issue equity and invest (rather than doing nothing), because the certainty effect reduces the capital loss from issuing equity. As in the core model, it is easier to raise equity to finance large projects rather than small ones.

Part (iii) shows that, if $r = 0$, even low-quality firms have no reason to issue equity: they are unable to exploit overvaluation since high-quality firms do not issue equity and so there is no camouflage, and they are unable to use the issued equity productively. Thus, equity issuance gives a return of zero, and so 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 completely shuts down: in the absence of a profitable 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 operate. Note also that this extension is mathematically equivalent to a special case of the semi-separating equilibrium in Proposition 3 in which $F = \infty$, and so the certainty effect wipes out any overvaluation motive to issue equity.

Finally, 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 semi-separating equilibria in parts (i) and (ii) are both sustainable. The first equilibrium is sustainable: since some high-quality firms are selling equity, the equity price is high, which underpins high-quality firms' willingness to sell equity. However, the second equilibrium is also sustainable: since no high-quality firms are selling equity, the equity price is low, which underpins high-quality firms' reluctance to sell equity.

We next consider the case in which high-quality firms can choose whether to raise financing, but low-quality firms are forced to raise financing. This is similar to the model of 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. Since some firms are now forced to raise financing, we do not need a profitable investment opportunity to induce them to do so, and so set $r = 0$. The equilibrium is given in Proposition 5 below:

Proposition 5. *(High-quality firms have a choice on whether to raise capital, low-quality firms must raise capital.) 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 quality H sells assets if $k \leq k_H^*$ and does nothing if $k > k_H^*$, and quality L sells assets if $k \leq k_L^*$ and issues equity if $k > k_L^*$. The cutoffs k_q^* are defined by $1 = \frac{A_q\left(1+k_q^*\right)}{\mathbb{E}[A|X=A]}$, where $k_H^* < 0 < k_L^*$.*

(a) If $1 + r > \frac{A_H(1+\underline{k})}{A_L}$, the cutoff k_H^* is interior. The cutoffs k_q^* are defined by $1 = \frac{A_q\left(1+k_q^*\right)}{\mathbb{E}[A|X=A]}$, where $k_H^* < 0 < k_L^*$.

(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 $k_L^* = 0$.

Proposition 5 shows that the equilibrium of Proposition 4, part (ii), holds in the case in which only low-quality firms must raise capital. This result also illustrates the camouflage effect. Issuing equity immediately reveals a firm as being low-quality, since high-quality firms do not issue equity: they are not forced to do so (since they have no capital needs) and will not voluntarily do so (since there is no operational reason to issue equity). By selling assets, they 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 $k_L^* \geq 0$: low-quality firms prefer to raise capital through selling assets, and will do so even if their assets are synergistic.

5 Implications

This section briefly discusses the main implications of the model. Some of the implications are empirically testable; a subset of these have already been tested, while others are as yet untested and would be interesting to explore in future research. In addition, the model generates other implications that may not be immediately linkable to an empirical test. 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 issuance is preferred for high financing needs, because the certainty effect reduces the information asymmetry of equity, while asset sales are preferred for low financing needs. Thus, equity issuances should be larger on average than financing-motivated asset sales.

A second determinant is the purpose for which funds are being raised: Proposition 3 demonstrates that equity is more likely to be used in two cases. First, it will be used for purposes with less information asymmetry, such as paying debt or dividends, because these uses reduce the information asymmetry of the entire firm to which equityholders have a claim. Thus, a firm that is raising financing due to distress (the need to repay debt) is more likely to issue equity. Second, it will also be used for uncertain investment projects, if it is likely that the investment will have a significantly positive-NPV even for low-quality firms (i.e. r_L is high). This implication generates predictions both along the cross-section and over the time series. Along the cross-section, growth firms with good investment opportunities should raise equity. Over the time series, in a strong macroeconomic environment, even low-quality firms will have good investment projects and so equity is again preferred. In contrast, asset sales will be preferred in mature firms or in poor economic conditions where investment quality is uncertain.

Third, the type of firm will affect financing choice. The analysis of Section 3 shows that asset sales are preferred to equity issuance for firms with negatively-correlated assets due to the correlation effect: even if selling assets implies that they are overvalued, it does not imply overvaluation of the firm as a whole. Thus, conglomerates should be more likely to sell assets, and firms with closely related divisions are more likely to issue equity. Note that the preference for selling non-core assets does not arise simply because they are dissynergistic with the rest of the firm (they can even exhibit positive synergies), but because negative market inferences regarding the value of the assets does not imply negative inferences for the rest of the firm.

A second set of empirical implications concerns the market reaction to financing. If $k_H^* > k_L^*$, which holds always in the negative correlation case, and in the positive correlation case under high 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. The positive correlation model also shows how the market reactions to financing should depend on the amount of financing raised. In particular, the reaction to equity issuance will be more positive for larger issues, since they are more likely to come from high-quality firms; conversely, the reaction to financing-motivated asset sales will be more negative for larger sales. The comparison between the positive and negative correlation models suggests that the market reaction to asset sales should be more positive for assets that are negatively-correlated with the remainder of the firm, i.e. assets that are not in the firm's core line of business.

We now move to implications for financing choices that may be less readily testable. Firms are more willing to sell assets in deep markets where other firms are selling assets due to operational reasons, due to the possibility of camouflage. This prediction is harder to test due to a simultaneity issue: greater asset sales due to camouflage will occur at the same time as asset sales for operational reasons, and 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, and lead to an even greater increase in trading volumes. The model's implications regarding synergies are also harder to test given the difficulty in estimating synergies. For example, equity issuers are likely to have synergistic assets, and asset sellers are likely to be parting with dissynergistic assets. In addition, 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.

6 Conclusion

This paper has studied a firm's choice between raising financing through asset sales and equity issuance. One relevant consideration is the relative information asymmetry of non-core assets and equity, a natural extension of the MM insight. This paper introduces three important additional effects that drive a firm's financing decision. First, investors in an equity issue share in the value of the cash raised from the issue, but purchasers of non-core assets do not. Since the value of cash is certain, this mitigates the information asymmetry of equity: the certainty effect. Thus, even if the firm's equity exhibits more information asymmetry than its non-core assets, an equity issue may be preferred to an asset sale (in contrast to MM) if the financing need is sufficiently high. A firm's choice of financing thus depends on the amount required – low (high) financing needs are met through asset (equity) sales. This result is robust to allowing the cash to be used to finance an uncertain investment.

Second, the choice of financing may also depend on operational motives (synergies). In a semi-separating equilibrium where a firm's level of synergy affects its financing choice, a higher financing need pushes high-quality firms towards equity issuance, due to the certainty effect, and reduces the quality and price of assets sold in equilibrium. The synergy motive also allows 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) – and thus enjoy a capital gain: 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. This need not be the case for an asset sale, since the asset being sold need not be a carbon copy of the firm. This correlation effect can lead to asset sales being strictly preferred to equity issuance.

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 extension 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 our model if 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 4.2, where firms can choose whether to raise capital, they raise a fixed amount F (as in MM), since there is a single investment opportunity with a known investment requirement of F. An additional extension would be to allow for multiple investment opportunities of different scale, in which case a continuum of amounts may be raised in equilibrium.

Table 1: Key variables and abbreviations in the model.

Variable	Description
θ	Firm type
q	Firm quality
k	Firm synergy
F	Level of financing required
C_q	Value of core asset in firm of quality q
X	Claim issued by firm
A_q	Value of non-core asset in firm of quality q
APE	Asset-pooling equilibrium
EPE	Equity-pooling equilibrium
SE	Semi-separating equilibrium
SE^q	Semi-separating equilibrium where all firms of quality q issue the same claim X
k_q^*	"Threshold" synergy level. Quality q with $k \leq (>)\, k_q^*$ sell assets (equity)
Positive Correlation Model	
$F^{APE,IC}$	Upper bound on F in APE to satisfy the intuitive criterion condition
$F^{APE,ND,q}$	Upper bound on F in APE to satisfy the no-deviation condition for all firms of quality q
F^{APE}	The applicable upper bound on F, $= \min\left\{F^{APE,IC}, F^{APE,ND,H}\right\}$
$F^{EPE,IC}$	Lower bound on F in EPE to satisfy the intuitive criterion condition
$F^{EPE,ND,q}$	Lower bound on F in EPE to satisfy the no-deviation condition for all firms of quality q
F^{EPE}	The applicable lower bound on F, $= \max\left\{F^{EPE,IC}, F^{EPE,ND,H}\right\}$
$F^{APE,IC,I}$	Upper bound on F in APE to satisfy the intuitive criterion condition in investment model. Other variables with superscript I defined analogously
Negative Correlation Model	
ω	Manager's weight on the stock price
$\omega^{APE,IC}$	Upper bound on ω in APE to satisfy the intuitive criterion condition. Other ω variables defined analogously

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A Proofs

Proof of Lemma 1

The IC condition (9) is stronger than the ND condition (7) if and only if

$$\frac{(C_H + A_H)A_L(1+\overline{k}) - \mathbb{E}\left[A\right]\left(C_L + A_L\right)}{\mathbb{E}[A] - A_L(1+\overline{k})} < \frac{(C_H + A_H)\mathbb{E}[A] - (C_L + A_L)A_H(1+\overline{k})}{A_H(1+\overline{k}) - \mathbb{E}[A]}$$

This yields $(1+\overline{k}) < \frac{\mathbb{E}[A]}{\sqrt{A_H A_L}}$.

Proof of Lemma 2

$F^{EPE,IC}$ is greater than $F^{EPE,ND,H}$ if and only if

$$\frac{A_L\mathbb{E}[C+A](1+\underline{k}) - A_H(C_L + A_L)}{A_H - A_L(1+\underline{k})} > \frac{A_L(C_H + A_H) - A_H\mathbb{E}[C+A](1+\underline{k})}{A_H(1+\underline{k}) - A_L}$$

which becomes:

$$1+\underline{k} > \frac{A_H A_L}{\pi A_H^2 + (1-\pi)A_L^2} = \frac{A_H A_L}{\mathbb{E}[A^2]}.$$

Proof of Lemma 3

We start by analyzing the magnitudes of the cutoffs k_H^* and k_L^*; these results apply regardless of whether the semi-separating equilibrium is full or partial. We then derive conditions under which we have a full SE, or a partial SE.

From the cutoff equation (19), we have

$$\frac{A_L(1+k_L^*)}{E_L} = \frac{A_H(1+k_H^*)}{E_H} = \frac{\mathbb{E}[A|X=A]}{\mathbb{E}[E|X=E]}.$$

These equations mean that, in any SE, k_L^* and k_H^* obey the following relationship:

$$1+k_H^* = \lambda\left(F\right)\left(1+k_L^*\right), \tag{38}$$

where $\lambda\left(F\right) \equiv \frac{A_L}{A_H}\frac{E_H}{E_L}$ and is decreasing in F. If $F < (>)\, F^*$, then $\lambda > (<)\, 1$ so $k_H^* > (<)\, k_L^*$ from (38). To ascertain the sign of k_H^*, cross-multiplication of (19) shows that $k_H^* > 0$ if and only if

$$E_H\mathbb{E}[A|X=A] > A_H\mathbb{E}[E|X=E]. \tag{39}$$

We start with case (ia), i.e. $F < F^*$. Since $k_H^* > k_L^*$, there is a positive (negative) price reaction to asset (equity) sales, and so $\mathbb{E}[A|X = A] > \mathbb{E}[A]$ and $\mathbb{E}[E|X = E] < \mathbb{E}[E]$. Thus, a sufficient condition for (39) is $E_H\mathbb{E}[A] > A_H\mathbb{E}[E]$. This condition is equivalent to $F < F^*$, the condition required for case (ia) in the first place. Moving to case (ib), $k_H^* < 0$ if and only if (39) is violated. Since $k_H^* < k_L^*$, we now have $\mathbb{E}[A|X = A] < \mathbb{E}[A]$ and $\mathbb{E}[E|X = E] > \mathbb{E}[E]$. This, a sufficient condition is $E_H\mathbb{E}[A] < A_H(\mathbb{E}[E])$. This condition is equivalent to $F > F^*$, the condition required for case (ib) in the first place. For case (ic), we have $\lambda(F^*) = 1$, and so $k_H^* = k_L^*$. If both types follow the same cutoff strategies, assets and equity are valued at their unconditional expectations. Thus, the quantities on the RHS of (19) are both equal to one, implying that both cutoffs are equal to zero.

We now derive conditions under which a "full" SE exists. We start with part (iia), where $F < F^*$. The ND condition for (H, k_H^*) is $1 + k_H^* = \frac{E_H}{A_H}\frac{\mathbb{E}[A|X=A]}{\mathbb{E}[E|X=E]}$. Given a pair of cutoff rules k_H^* and k_L^*, and associated valuations $\mathbb{E}[A|X = A]$ and $\mathbb{E}[E|X = E]$, for some H-firms to be willing to issue equity, we must have

$$1 + \overline{k} > \frac{E_H}{A_H}\frac{\mathbb{E}[A|X = A]}{\mathbb{E}[E|X = E]}. \tag{40}$$

The RHS is bounded below by $\frac{E_H}{A_H}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$ (since $k_H^* > k_L^*$, we have $\mathbb{E}[A] < \mathbb{E}[A|X = A]$ and $\mathbb{E}[E] > \mathbb{E}[E|X = E]$) and above by $\frac{E_H}{E_L}$. Thus, a sufficient condition for some H-types to issue equity is $1 + \overline{k} \geq \frac{E_H}{E_L}$ and a necessary condition is $1 + \overline{k} \geq \frac{E_H}{A_H}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$. Intuitively, if F and $\overline{k}$ are too low, the certainty effect is sufficiently weak that the (certainty-adjusted) information asymmetry of equity is so much higher than that of assets, that even the H-type with greatest synergies (i.e. $(H, \overline{k})$) will sell assets.

We now turn to the indifference condition for (L, k_L^*), which is

$$1 + k_L^* = \frac{E_L}{A_L}\frac{\mathbb{E}[A|X = A]}{\mathbb{E}[E|X = E]}. \tag{41}$$

We use the intermediate value theorem ("IVT") to derive necessary and sufficient conditions for (L, k_L^*) not to deviate. Suppose we specify a candidate pair of cutoffs k_L' and $k_H' \equiv \lambda(F)(1 + k_L') - 1$, where types (q, k_q') sell assets for $k < k_q'$ and issue equity for $k > k_q'$. This constitutes an equilibrium if and only if (L, k_L') is indifferent between the two claims. The incentive of (L, k_L') to sell assets is a function continuous in k_L':

$$f(k_L') \equiv \frac{E_L}{\mathbb{E}[E|X = E]} - \frac{A_L(1 + k_L')}{\mathbb{E}[A|X = A]}.$$

If $f(k'_L) > (<) 0$, (L, k'_L) will sell assets (equity). Thus, k'_L is an equilibrium cutoff if and only if $f(k'_L) = 0$. Our proof strategy is the following: for a given $F < F^*$, we show that (L, k'_L) sells assets if $1 + k'_L = \frac{E_L}{A_L}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$, and equity if $1 + k'_L = \frac{1+\overline{k}}{\lambda(F)}$. (The latter is the highest possible k'_L given that k'_L and k'_H are related by (38), and k'_H is capped at $\overline{k}$.) Then, by the IVT, there exists a k^*_L between these two values of k'_L for which $f(k^*_L) = 0$ and so the firm is indifferent.

To show that (L, k'_L) sells assets if $1 + k'_L = \frac{E_L}{A_L}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$, we use the fact that $F < F^*$ implies $\lambda(F) > 1$ and so $k'_H > k'_L$. We thus have $\mathbb{E}[A|X = A] > \mathbb{E}[A]$ and $\mathbb{E}[E|X = E] < \mathbb{E}[E]$, which yields $f(k'_L) > 0$. In addition, $1 + k'_L = \frac{1+\overline{k}}{\lambda(F)}$ yields

$$f(k'_L) = \frac{E_L}{\mathbb{E}[E|X = E]} - \frac{A_H(1 + \overline{k})}{\mathbb{E}[A|X = A]}\frac{E_L}{E_H},$$

and so $f(k'_L) < 0$ holds if and only if $1 + \overline{k} > \frac{E_H}{A_H}\frac{\mathbb{E}[A|X=A]}{\mathbb{E}[E|X=E]}$, which is the same condition as (40). Thus, the sufficient condition for H, $1 + \overline{k} > \frac{E_H}{E_L}$, is also sufficient for L, and so is sufficient for the SE to exist.

The analysis for part (iib) ($F > F^*$) is analogous. The ND condition remains (40). With $F > F^*$ we now have $\mathbb{E}[A] > \mathbb{E}[A|X = A]$ and $\mathbb{E}[E] < \mathbb{E}[E|X = E]$, so now the RHS of (40) is bounded *below* by $\frac{E_H}{A_H}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$. Thus, a sufficient condition for some H-types to sell assets is $1 + \underline{k} \leq \frac{A_L}{A_H}$ and a necessary condition is $1 + \underline{k} \leq \frac{E_H}{A_H}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$. Intuitively, if F and $\underline{k}$ are too high, the certainty effect is sufficiently strong that the (certainty-adjusted) information asymmetry of equity is so much lower than that of assets, that even the H-type with greatest dissynergies (i.e. $(H, \underline{k})$) prefers to sell equity.

We now turn to the ND condition for (L, k^*_L), which remains (41), and again use the IVT. We can easily show that (L, k'_L) will deviate to equity issuance at $1+k'_L = \frac{E_L}{A_L}\frac{\mathbb{E}[A]}{\mathbb{E}[E]}$. A sufficient condition for (L, k'_L) to deviate to asset sales at $1+k'_L = \frac{1+\underline{k}}{\lambda(F)}$ is $1+\underline{k} < \frac{A_L}{A_H}$, which is the same as the sufficient condition for H, and so is sufficient for the SE to exist.

We finally turn to the "partial" SEs where all H firms issue the same claim. There are two such equilibria. In case (iiia), all H-firms sell assets and L-firms choose an interior cutoff. Assets are priced at $\mathbb{E}[A|X = A] > \mathbb{E}[A]$ and equity is priced at E_L. The ND condition for H-firms is:

$$1 + \overline{k} < \frac{\mathbb{E}[A|X = A]}{A_H}\frac{E_H}{E_L} = \lambda(F)\frac{\mathbb{E}[A|X = A]}{A_L}. \tag{42}$$

A sufficient condition for (42) is $1+\overline{k} \leq \frac{E_H}{E_L}\frac{\mathbb{E}[A]}{A_L}$ and a necessary condition is $1+\overline{k} < \frac{E_H}{E_L}$.

The indifference condition for (L, k_L^*) yields

$$1 + k_L^* = \frac{\mathbb{E}[A|X = A]}{A_L}, \tag{43}$$

and so $k_L^* > 0$: since asset sales are met with a positive price reaction (camouflage effect), L is willing to sell them even if they are synergistic. Combining (42) with (43), we have $\frac{\mathbb{E}[A|X=A]}{A_L} < 1 + \overline{k} < \lambda(F)\frac{\mathbb{E}[A|X=A]}{A_L}$. Since $\lambda(F^*) = 1$ and $\lambda'(F) < 0$, both conditions can be simultaneously satisfied only if $F < F^*$.

Intuitively, $\frac{\mathbb{E}[A|X=A]}{A_L} < 1 + \overline{k} < \lambda(F)\frac{\mathbb{E}[A|X=A]}{A_L}$ shows that synergies must be so strong that $\left(L, \overline{k}\right)$ eschews the capital gain from selling overvalued assets and chooses to retain synergistic assets. However, synergies cannot be so strong as to induce $\left(H, \overline{k}\right)$ to deviate to equity. These conditions can simultaneously be satisfied because L considers the gain from selling overvalued *assets*, and H considers the loss from selling undervalued *equity*. Since equity exhibits higher information asymmetry, H will not deviate.

Moreover, for (43) to hold, we must have $1 + \overline{k} > \frac{\mathbb{E}[A|X=A]}{A_L}$, for which $1 + \overline{k} > \frac{A_H}{A_L}$ is a sufficient condition and $1 + \overline{k} > \frac{\mathbb{E}[A]}{A_L}$ is a necessary condition. Intuitively, if $\overline{k}$ is sufficiently low, then all Ls would sell assets, even the type with the highest synergies, since they will get a capital gain of $\frac{\mathbb{E}[A|X=A]}{A_L}$ that is greater than the loss of synergies.

Finally, we need to show that a cutoff k_L^* actually exists at which the cutoff type (L, k_L^*) is indifferent between asset sales and equity issuance (at which the equilibrium condition (43) is satisfied). We again employ the IVT. If we specify a cutoff $1+k_L'$ equal to the necessary lower bound $\frac{\mathbb{E}[A]}{A_L}$ on $1 + \overline{k}$, (L, k_L') deviates to asset sales. Meanwhile, if we specify $1 + k_L' = \frac{A_H}{A_L}$, (L, k_L') deviates to equity issuance. Thus, a pair of sufficient conditions for existence of the equilibrium is $1 + \overline{k} \geq \frac{A_H}{A_L}$ and $1 + \overline{k} \leq \frac{E_H}{E_L}\frac{\mathbb{E}[A]}{A_L}$.

In case (iiib), all H-firms issue equity and L-firms choose an interior cutoff. Assets are priced at A_L and equity is priced at $\mathbb{E}[E|X = E] > \mathbb{E}[E]$. The indifference condition for (L, k_L^*) yields

$$1 + k_L^* = \frac{E_L}{\mathbb{E}[E|X = E]}, \tag{44}$$

and so $k_L^* < 0$. For (44) to hold, we must have $1 + \underline{k} < \frac{E_L}{\mathbb{E}[E|X=E]}$, for which $1 + \underline{k} < \frac{E_L}{E_H}$ is a sufficient condition and $1 + \underline{k} < \frac{E_L}{\mathbb{E}[E]}$ is a necessary condition. Intuitively, if $\underline{k}$ is sufficiently high, then all Ls would sell equity, even the type with the highest synergies, since they will get a capital gain of $\frac{\mathbb{E}[E|X=E]}{E_L}$ that is greater than the avoidance of dissynergies.

The ND condition for H-firms is

$$1+\underline{k} > \frac{A_L}{A_H}\frac{E_H}{\mathbb{E}[E|X=E]} = \lambda(F)\frac{E_L}{\mathbb{E}[E|X=E]}. \tag{45}$$

A sufficient condition for (45) is $1+\underline{k} > \frac{A_L}{A_H}\frac{E_H}{\mathbb{E}[E]}$ and a necessary condition is $1+\underline{k} > \frac{A_L}{A_H}$. Combining (45) with (44), we have $\lambda(F)\frac{E_L}{\mathbb{E}[E|X=E]} < 1+\underline{k} < \frac{E_L}{\mathbb{E}[E|X=E]}$. Since $\lambda(F^*) = 1$ and $\lambda'(F) < 0$, both conditions can be simultaneously satisfied only if $F > F^*$.

Finally, we need to show that a cutoff k_L^* actually exists at which the cutoff type (L, k_L^*) is indifferent given the resulting equilibrium valuations. We again employ the IVT. If we specify a cutoff $1+k'_L$ equal to the necessary upper bound $\frac{E_L}{\mathbb{E}[E]}$ on $1+\underline{k}$, (L, k'_L) deviates to equity issuance. Meanwhile, if we specify $1+k'_L = \frac{E_L}{E_H}$, (L, k'_L) deviates to asset sales. Thus, a pair of sufficient conditions for existence of the equilibrium is $1+\underline{k} < \frac{E_L}{E_H}$ and $1+\underline{k} > \frac{A_L}{A_H}\frac{E_H}{\mathbb{E}[E]}$.

Proof of Proposition 1

Parts (i), (ia), and (ib) follow from the discussion of the various equilibria in Lemmas 1-3. For (ic), we first prove $F^{EPE,IC} < F^* < F^{APE,IC}$. Suppose $F < F^{EPE,IC}$. This means that the IC condition is violated for EPE, so that $\frac{A_L(1+\underline{k})}{A_H} > \frac{E_L}{\mathbb{E}[E]}$. This implies $\frac{A_L}{A_H} > \frac{E_L}{E_H}$ and so $F < F^*$. Thus $F^{EPE,IC} < F^*$. Similarly, suppose $F > F^{APE,IC}$. This means the IC is violated for APE, so that $\frac{E_L}{E_H} > \frac{A_L(1+\overline{k})}{\mathbb{E}[A]}$. This implies $\frac{E_L}{E_H} > \frac{A_L}{A_H}$, and so $F > F^*$. Thus $F^{APE,IC} > F^*$.

Next, we prove $F^* < F^{APE,ND,H}$. This inequality is satisfied if and only if $F > F^{APE,ND,H}$ implies $F > F^*$. Suppose $F > F^{APE,ND,H}$, so that some type H would deviate under APE, i.e. $\frac{A_H(1+\overline{k})}{\mathbb{E}[A]} > \frac{E_H}{E_L}$. For this to imply $F > F^*$ or equivalently $\frac{A_H}{A_L} > \frac{E_H}{E_L}$, we would need $\frac{A_H(1+\overline{k})}{\mathbb{E}[A]} < \frac{A_H}{A_L}$, or equivalently $1+\overline{k} < \frac{\mathbb{E}[A]}{A_L}$. This final inequality is a necessary condition for APE to hold, from part (i). Thus, whenever APE is sustainable, we have $F^* < F^{APE,ND,H}$.

Finally, we prove $F^{EPE,ND,H} < F^*$. This inequality is satisfied if and only if $F < F^{EPE,ND,H}$ implies $F < F^*$. Suppose $F < F^{EPE,ND,H}$, so that some type H would deviate under EPE, i.e. $\frac{E_H}{\mathbb{E}[E]} > \frac{A_H(\underline{k})}{A_L}$. For this to imply $F < F^*$ or equivalently $\frac{E_H}{E_L} > \frac{A_H}{A_L}$, we would need $1+\underline{k} > \frac{E_L}{\mathbb{E}[E]}$. This final inequality is a necessary condition for EPE to hold, from part (i). Thus, whenever EPE is sustainable, we have $F^{EPE,ND,H} < F^*$.

Taking these three points together, whenever both pooling equilibria are sustainable, the greater of the lower bounds required for EPE will be less than the lesser of the upper bounds required for APE, and so $F^{EPE} < F^{APE}$.

Points (ii)-(v) also follow from the discussion of the equilibria in Lemmas 1-3.

Proof of Proposition 2

After the derivation of Lemmas 4 and 5, it only remains to show the ordering $\omega^{APE,ND,L} < \omega^{EPE}$.

First, since synergies are zero, (25) becomes

$$\frac{A_L}{A_H} - \frac{E_L}{\mathbb{E}[E]} > \frac{E_H}{\mathbb{E}[E]} - \frac{A_H}{A_L}$$

or equivalently

$$\frac{A_L}{A_H} + \frac{A_H}{A_L} > \frac{E_H}{\mathbb{E}[E]} + \frac{E_L}{\mathbb{E}[E]}$$

Since $\pi \geq \frac{1}{2}$, this inequality holds if the LHS is greater than 2, which is equivalent to

$$A_L^2 + A_H^2 > 2A_H A_L$$
$$(A_L - A_H)^2 > 0.$$

Since (25) holds, we have $\omega^{EPE} = \omega^{EPE,IC}$. We thus need to prove that $\omega^{APE,ND,L} < \omega^{EPE,IC}$. Since $\pi \geq \frac{1}{2}$, it is sufficient to replace $1-\pi$ with π in the denominator of $\omega^{EPE,IC}$ and show that this new quantity is greater than $\omega^{APE,ND,L}$. These expressions only differ in the numerator, and the numerator of the $\omega^{APE,ND,L}$ is smaller if

$$\frac{A_L}{A_H} - \frac{E_L}{\mathbb{E}[E]} > \frac{A_L}{\mathbb{E}[A]} - 1,$$

which holds because $\frac{A_L}{A_H} > \frac{A_L}{E[A]}$, and $\frac{E_L}{\mathbb{E}[E]} < 1$.

Proof of Lemma 6

To prove (i), we first derive a linear relationship between the cutoffs:

$$1 + k_H^* = \frac{A_L}{A_H}(1 + k_L^*) + \frac{C_H - C_L + A_H - A_L}{\mathbb{E}[E|X = E]}$$

Thus we can focus on the deviations at cutoff values for only one type, knowing that we can define the other type's cutoff as necessary to make him indifferent.

Now we need to find permissible values of k_L' at which L will deviate to asset sales and to equity issuance. First, L will deviate to asset sales if

$$\omega\left(\mathbb{E}[C + A|X = A] - \mathbb{E}[C + A|X = E]\right) > (1-\omega)F\left(\frac{A_L(1 + k_L^*)}{\mathbb{E}[A|X = A]} - \frac{E_H}{\mathbb{E}[E|X = E]}\right)$$

When we specify a candidate cutoff of $1 + k'_L = \frac{A_H}{A_L}$, then (L, k'_L) will deviate to asset sales. Meanwhile, we have imposed no upper bound on synergies, so for sufficiently high k'_L there will be some type L who will retain his assets and issue equity.

To prove (ii), the condition for H to cooperate works out to

$$1 + \overline{k} < \frac{\mathbb{E}[A|X = A]}{A_H} \left[\frac{E_H}{E_L} + \frac{\omega}{F(1-\omega)} Pr(q = H|X = A)(C_H - C_L + A_H - A_L) \right]$$

This can only be evaluated in the context of a candidate cutoff k'_L that will pin those down. However, for any such candidate equilibrium, this upper bound will be greater than 1, which is the only condition we've imposed on $1 + \overline{k}$ so far.

Next, we seek a candidate value of k^*_L (which we'll label k'_L since it's not an equilibrium) at which L will optimally deviate to equity issuance, given the price reactions that result from this cutoff. Clearly, L will do this if k^*_L is sufficiently high. Formally, L will deviate to equity issuance if

$$1 + k'_L > \frac{\mathbb{E}[A|X = A]}{A_L} \left[1 + \frac{\omega}{F(1-\omega)} Pr(q = H|X = A)(C_H - C_L + A_H - A_L) \right]$$

To satisfy this inequality, we start with a low value of k'_L and raise it until we satisfy the inequality. This will happen eventually, even though raising k'_L also changes the RHS of the inequality, since the RHS is bounded above – the asset valuation cannot rise above $\mathbb{E}[A]$ and the probability cannot rise above 1 – while we can keep raising k'_L forever. Moreover, and crucially, the upper bound on $1 + \overline{k}$ derived above will also respond to changes in k'_L, such that it is always strictly greater than this lower bound. So a value of k'_L that is just high enough to satisfy the lower bound will also satisfy that upper bound.

Finally, we just need to find a value of k'_L at which L will deviate to asset sales, which is easier to do. The condition for this is just the opposite of the previous one,

$$1 + k'_L < \frac{\mathbb{E}[A|X = A]}{A_L} \left[1 + \frac{\omega}{F(1-\omega)} Pr(q = H|X = A)(C_H - C_L + A_H - A_L) \right]$$

We previously imposed $1+\underline{k} > \frac{A_H}{A_L}$, so it's natural to check the deviation there. Indeed, when we plug that value into the LHS, we find that the inequality is satisfied.

To prove (iii), the no-deviation condition for L works out to

$$1 + \underline{k} > \frac{A_H}{A_L} \left[\frac{E_L}{\mathbb{E}[E|X = E]} + \frac{\omega}{F(1-\omega)} Pr(q = L|X = E)(C_H - C_L + A_H - A_L) \right]$$

Where will H deviate to asset sales? This condition is

$$1 + k'_H < \frac{E_H}{\mathbb{E}[E|X = E]} + \frac{\omega}{F(1-\omega)} Pr(q = L|X = E)(C_H - C_L + A_H - A_L)$$

As with HAPE, there is always overlap between these conditions so we can adjust k'_H until this inequality is just satisfied, without violating the restriction on $1 + \underline{k}$.

Where will H deviate to equity issuance? The condition is

$$1 + k'_H > \frac{\omega}{F(1-\omega)} Pr(q = L|X = E)(C_H - C_L + A_H - A_L) + \frac{E_H}{\mathbb{E}[E|X = E]}$$

and with no upper bound imposed on synergies, we can push k'_H high enough to satisfy this inequality.

Finally, (iv) follows from the discussion in the text.

Proof of Lemma 7

We first consider the case of $\frac{1+r_H}{1+r_L} > \frac{\mathbb{E}[A]}{A_L}$. Since $\frac{\mathbb{E}[A]}{A_L} > \frac{A_H}{\mathbb{E}[A]}$, this case implies that the LHS of both (34) and (37) are negative so they are trivially satisfied, and so the upper bound on F is ∞). If $\frac{A_H}{\mathbb{E}[A]} < \frac{1+r_H}{1+r_L} < \frac{\mathbb{E}[A]}{A_L}$, the ND upper bound is ∞ (the LHS of (34) is negative) but the IC upper bound is finite and as stated in the Lemma. Finally, if $\frac{1+r_H}{1+r_L} < \frac{A_H}{\mathbb{E}[A]}$, both upper bounds are nontrivial (less than ∞). From (32), $\frac{A_H}{\mathbb{E}[A]} < \frac{C_H+A_H}{C_L+A_L}$ and so $\frac{1+r_H}{1+r_L} < \frac{C_H+A_H}{C_L+A_L}$. This is a sufficient condition for the IC condition to be stronger, and so it appears in the Lemma.

Proof of Proposition 3

It only remains to show that $F^{EPE,I} < F^{APE,I}$ (i.e. the equilibria overlap) if and only if $\frac{1+r_H}{1+r_L} < \frac{C_H+A_H}{C_L+A_L}$. When the APE bound is not trivial ($\frac{1+r_H}{1+r_L} < \frac{\mathbb{E}[A]}{A_L}$), the relevant bound is always given $F^{APE,IC}$, as explained in the proof of Lemma 7. We first wish to show that, when the IC bound is also the relevant bound for EPE, $F^{APE,IC,I} > F^{EPE,IC,I}$. This inequality is equivalent to:

$$\begin{aligned}&(C_H + A_H)(1 + r_L)[\pi A_L \mathbb{E}[A] - A_H A_L + (1-\pi)A_L^2] \\ &> (C_L + A_L)(1 + r_H)[\pi A_L \mathbb{E}[A] - A_H A_L + (1-\pi)A_L^2]\end{aligned}$$

The bracketed term is positive, so the above inequality is equivalent to $\frac{1+r_H}{1+r_L} < \frac{C_H+A_H}{C_L+A_L}$, which holds since the IC bound is the relevant one for EPE.

When ND is the relevant bound for EPE, we need to compare $F^{APE,IC,I}$ and $F^{EPE,ND,I}$. The proof of Lemma 9 will later show that ND is the relevant bound

$(F^{EPE,ND,I} > F^{EPE,IC,I})$ when $\frac{1+r_H}{1+r_L} \geq \frac{C_H+A_H}{C_L+A_L}$, and the paragraph above showed that, if $\frac{1+r_H}{1+r_L} \geq \frac{C_H+A_H}{C_L+A_L}$, $F^{EPE,IC,I} > F^{APE,IC,I}$. Thus, $F^{EPE,I} < F^{APE,I}$ if and only if $\frac{1+r_H}{1+r_L} < \frac{C_H+A_H}{C_L+A_L}$.

Proof of Proposition 4

For part (i), we start with the semi-separating equilibrium, which is similar to Proposition 3. Low-quality firms will not deviate to doing nothing, as they are enjoying a fundamental gain and exploiting a desirable investment opportunity. A high-quality equity issuer will not deviate to doing nothing if

$$1 + r > \frac{E_H}{\mathbb{E}\left[E|X = E\right]}, \tag{46}$$

i.e. the capital loss from selling undervalued equity is less than the value of the growth opportunity. Similarly, a high-quality asset seller will not deviate if

$$1 + r > \frac{A_H\left(1 + k_H\right)}{\mathbb{E}\left[A|X = A\right]}.$$

Since k_H^* is defined by $\frac{E_H}{\mathbb{E}[E|X=E]} = \frac{A_H\left(1+k_H^*\right)}{\mathbb{E}[A|X=A]}$, we have $\frac{A_H(1+k_H)}{\mathbb{E}[A|X=A]} < \frac{E_H}{\mathbb{E}[E|X=E]}$ for all asset sellers (because $k_H \leq k_H^*$). Thus, (46) is necessary and sufficient for no firm to deviate and is the condition given in the Proposition.

For the APE of Lemma 1, the additional condition is

$$\frac{A_H\left(1 + \overline{k}\right)}{\mathbb{E}\left[A\right]} < 1 + r,$$

where the LHS is the per-dollar loss suffered by type $\left(H, \overline{k}\right)$ the type that loses the most, and the RHS is the per-dollar gain from raising capital. Similarly, for the EPE of Lemma 2, the additional condition is

$$\frac{E_H}{\mathbb{E}\left[E\right]} < 1 + r.$$

For the partial SE of Lemma 3, where all H-firms sell assets, the additional condition is

$$\frac{A_H\left(1 + \overline{k}\right)}{\mathbb{E}\left[A|X = A\right]} < 1 + r,$$

and for the partial SE where all L-firms sell assets, the additional condition is

$$\frac{E_H}{\mathbb{E}\left[E|X=E\right]} < 1+r.$$

Turning to part (ii), we start by considering the case of interior cutoffs. The definitions of k_H^* and k_L^* in the Proposition are given by the indifference conditions. Since $1 = \frac{A_L\left(1+k_L^*\right)}{\mathbb{E}[A|X=A]}$, we have $k_L^* > 0$. Low-quality firms will not deviate to doing nothing, as they are enjoying a (weakly positive) fundamental gain and exploiting a desirable investment opportunity. A high-quality firm doing nothing will not deviate to equity issuance if

$$1+r < \frac{E_H}{E_L},$$

i.e. the capital loss from selling undervalued equity exceeds the value of the growth opportunity. If the above is satisfied, it is easy to show that a high-quality asset seller will not deviate either to doing nothing or to issuing equity.

Combining $1+r = \frac{A_H\left(1+k_H^*\right)}{\mathbb{E}[A|X=A]}$ and $1 = \frac{A_L\left(1+k_L^*\right)}{\mathbb{E}[A|X=A]}$ yields

$$(1+r)\,\frac{A_L}{A_H} = \frac{1+k_H^*}{1+k_L^*}.$$

When r is high (specifically, $1+r > \frac{A_H}{A_L}$), we have $k_H^* > k_L^*$: H-firms are more willing to sell assets than L-firms because, if they switch to doing nothing, they will lose the valuable growth opportunity (whereas L continues to exploit the growth opportunity if it does not sell assets, since it issues equity instead). When $r \leq \frac{A_H}{A_L} - 1$, we have $k_H^* \leq k_L^*$: H-firms are less willing to sell assets than L-firms, because they are undervalued. Note that r is bounded above, since $1+r < \frac{E_H}{E_L}$ for this equilibrium to hold. Thus, we have

$$\begin{aligned} 1+r &= \frac{1+k_H^*}{1+k_L^*}\frac{A_H}{A_L} \\ \frac{E_H}{E_L} &> \frac{1+k_H^*}{1+k_L^*}\frac{A_H}{A_L}. \end{aligned}$$

If $\frac{E_H}{E_L} < \frac{A_H}{A_L}$ in Proposition 3, we had $k_H^* < k_L^*$; we similarly have $k_H^* < k_L^*$ here. If $\frac{E_H}{E_L} > \frac{A_H}{A_L}$ in Proposition 3, we had $k_H^* > k_L^*$. However, $k_H^* > k_L^*$ does not necessarily follow here, since it is possible to have $k_H^* < k_L^*$. As is intuitive, giving the firms the option to do nothing makes H relatively less willing to sell assets, as he has the outside option of doing nothing.

Finally, if $1+r<\frac{A_H(1+k)}{A_L}$, then all H-firms do nothing: we have a boundary cutoff. The investment opportunity is sufficiently unattractive, and dissynergies are sufficiently weak, that no H-firm wishes to sell its high-quality assets for a low price.

For part (iii), the cutoff k_H^* is defined by the synergy level at which type H is indifferent between selling assets and doing nothing. We thus have

$$F = F\left(1+k_H^*\right)\frac{A_H}{\overline{A}}$$

which yields

$$k_H^* = \frac{\overline{A}}{A_H} - 1 < 0.$$

Similarly, we have

$$F = F\left(1+k_L^*\right)\frac{A_L}{\overline{A}}$$

which yields

$$k_L^* = \frac{\overline{A}}{A_L} - 1 > 0.$$

B Selling the Core Asset

This section verifies robustness of the results of the core model to allowing the firm to sell the core asset. For simplicity we consider the case of no synergies, and thus check robustness of the certainty and correlation effects.

B.1 Positive Correlation

In an APE, assets are sold for $\mathbb{E}\left[A\right]=\pi A_H+\left(1-\pi\right)A_L$. An issuer of another claim is inferred as type L. Thus, the core asset is sold for C_L, and equity is sold at C_L+A_L+F.

As in the core model, H's capital loss is $\frac{F(1-\pi)(A_H-A_L)}{\mathbb{E}[A]}$ from pooling on assets and $\frac{F(C_H-C_L+A_H-A_L)}{C_L+A_L+F}$ from deviating to equity. Thus, H does not deviate to equity if:

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

If it sells the core asset, its capital loss is $\frac{F(C_H-C_L)}{C_L}$. Thus, to prevent deviation to the core asset, we require:

$$\frac{\left(1-\pi\right)\left(A_H-A_L\right)}{\mathbb{E}\left[A\right]} \leq \frac{C_H-C_L}{C_L}.$$

The OEPB that a seller of the core asset is of type L satisfies the IC if $\frac{C_L}{C_H} < \frac{A_L}{\mathbb{E}[A]}$, which is weaker than the above condition.

In an EPE: equity is sold for $\mathbb{E}[C+A]+F = \pi(C_H+A_H)+(1-\pi)(C_L+A_L)+F$. Core assets are sold for C_L, and non-core assets are sold for A_L. Quality H will not deviate to selling the non-core asset if:

$$F \geq \frac{A_L(C_H+A_H) - A_H\mathbb{E}[C+A]}{A_H - A_L},$$

and the OEPB that a seller of the non-core asset is of quality L satisfies the IC if:

$$F \geq \frac{A_L\mathbb{E}[C+A] - A_H[C_L+A_L]}{A_H - A_L},$$

Analogously, H will not deviate to selling the core asset if:

$$F \geq \frac{C_L(C_H+A_H) - C_H\mathbb{E}[C+A]}{C_H - C_L},$$

and the OEPB that a seller of the core asset is of quality H satisfies the IC if:

$$F \geq \frac{C_L\mathbb{E}[C+A] - C_H[C_L+A_L]}{C_H - C_L}.$$

As expected, H is more likely to deviate to whichever asset (core or non-core) exhibits the least information asymmetry: this will be the tighter lower bound. More interesting is that equity issuance may be sustainable even though it does not exhibit the least information asymmetry (absent the certainty effect). One of the assets (core or non-core) will exhibit more information asymmetry than the other, and so the information asymmetry of equity will lie in between. It may therefore seem (from MM) that the sale of one asset will always dominate equity, since one of the assets will have lower information asymmetry than equity. However, even though equity is never the safest claim, its issuance may still be sustainable, if F is sufficiently large, due to the certainty effect.

Finally, we now consider a core-asset-pooling equilibrium (CPE). The core asset is sold for $\mathbb{E}[C] = \pi C_H + (1-\pi)C_L$, the non-core asset is sold for A_L, and equity is sold at $C_L + A_L + F$. As in the core model, F does not deviate to equity issuance if:

$$F < \frac{(C_H+A_H)\mathbb{E}[C] - (C_L+A_L)C_H}{C_H - \mathbb{E}[C]},$$

and he does not deviate to selling the non-core asset if:

$$\frac{(1-\pi)(C_H - C_L)}{\mathbb{E}[C]} < \frac{A_H - A_L}{A_L}.$$

The IC conditions are trivially satisfied.

Comparing CPE and APE, the former is harder to sustain if

$$\frac{(C_H + A_H)\mathbb{E}[C] - (C_L + A_L)C_H}{C_H - \mathbb{E}[C]} < \frac{(C_H + A_H)\mathbb{E}[A] - (C_L + A_L)A_H}{A_H - \mathbb{E}[A]}$$
$$\frac{A_H}{A_L} < \frac{C_H}{C_L}.$$

Thus, as is intuitive, if the core asset exhibits greater information asymmetry, it is more difficult to sustain its sale. This result is a natural extension of MM and is not the main contribution of the paper. More important is that one of the main insights – the certainty effect and thus the importance of F – remains robust to allowing sales of the core asset.

B.2 Negative Correlation

In this extension, the core (non-core) asset is positively (negatively) correlated with firm value. Thus, the firm is able to choose the correlation of the asset that it sells (whereas in the main model, we either have the positive correlation case or the negative correlation case).

In an APE, L's objective function is

$$\omega E[C + A] + (1-\omega)\left(C_L + A_L + F - F\frac{A_L}{\mathbb{E}[A]}\right).$$

As in the main paper, if it deviates to equity, its objective function is $C_L + A_L$ and so we require

$$\omega > \frac{F\left(\frac{A_L - A_H}{\mathbb{E}[A]}\right)}{(C_H - C_L) - (A_L - A_H) + F\left(\frac{A_L - A_H}{\mathbb{E}[A]}\right)}.$$

If L deviates to selling the core asset, his objective function is also $C_L + A_L$ and so we have the same condition. This is intuitive: regardless of whether he deviates to the core asset or equity, the claim he issues is fairly priced as he's revealed to be of quality L, and so his objective function ends up the same. The IC condition that a seller of the core asset is of quality L is trivially satisfied.

In an EPE, H's objective function is

$$\omega\mathbb{E}[C+A]+(1-\omega)\left(C_H+A_H+F-F\frac{C_H+A_H+F}{\mathbb{E}\left[C+A\right]+F}\right).$$

If he deviates to non-core assets, his objective function becomes:

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

and if he deviates to core assets, his objective function becomes:

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

H will always deviate to non-core assets than core assets, since $\frac{A_H}{A_L}<1<\frac{C_H}{C_L}$. Thus, we have the same ND condition as before:

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

Again, the IC condition that a seller of the core asset is of quality L is trivially satisfied.

In a CPE, H's objective is

$$\omega E\left[C+A\right]+(1-\omega)\left(C_H+A_H+F-F\frac{C_H}{\mathbb{E}\left[C\right]}\right).$$

If he deviates to equity, his objective function becomes:

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

and if he deviates to non-core assets, his objective function becomes:

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

He will always prefer to deviate to non-core assets, since $\frac{A_H}{A_L}<1<\frac{C_H+A_H+F}{C_L+A_L+F}$. The

ND condition is

$$\omega \geq \frac{F\left(\frac{C_H}{\mathbb{E}[C]} - \frac{A_H}{A_L}\right)}{\mathbb{E}\left[C + A\right] - (C_L + A_L) + F\left(\frac{C_H}{\mathbb{E}[C]} - \frac{A_H}{A_L}\right)}.$$

The CPE bound is tighter than the APE bound if

$$\frac{\pi F\left(\frac{A_L - A_H}{\mathbb{E}[A]}\right)}{\pi\left(C_H - C_L\right) - \left(A_L - A_H\right) + \pi F\left(\frac{A_L - A_H}{\mathbb{E}[A]}\right)} < \frac{F\left(\frac{C_H}{\mathbb{E}[C]} - \frac{A_H}{A_L}\right)}{\mathbb{E}\left[C + A\right] - (C_L + A_L) + F\left(\frac{C_H}{\mathbb{E}[C]} - \frac{A_H}{A_L}\right)}$$

Algebraic manipulation shows that the denominators of both expressions are equal. The numerator of the CPE bound is tighter if

$$\begin{aligned} \frac{C_H}{\mathbb{E}[C]} - \frac{A_H}{A_L} &> \frac{A_L}{\mathbb{E}[A]} - 1 \\ \frac{C_H}{\mathbb{E}[C]} &> \frac{\pi(A_L - A_H)^2 + A_H A_L}{\pi A_L(A_L - A_H) + A_H A_L}. \end{aligned}$$

The RHS is less than 1, and so the above inequality is satisfied. Thus, the APE is easier to sustain than the CPE. This is a simple extension of the camouflage effect of the core model. A deviation from APE to selling either the core asset or equity is relatively unattractive, since the firm suffers a "lemons" discount on both the security being issued and the rest of the firm as a whole. This is because both the core asset and equity are positively correlated with the value of the firm. In contrast, a deviation from either CPE or EPE to selling the non-core asset is more difficult to rule out, because even if a low price is received for the non-core asset, this does not imply a low valuation for the firm as a whole.

The semi-separating equilibria are very similar to the core model. As in the core model, there is a SE where H sells non-core assets and L issues equity. There is also a SE where H sells non-core assets and L sells core assets. The conditions for this equilibrium to hold are exactly the same as in the core model. In both equilibria, by deviating, L's stock price increases but his fundamental value falls by $\frac{F(A_L - A_H)}{A_H}$. Regardless of whether L sells equity or core assets in the SE, deviation involves him selling his highly-valued non-core assets and thus suffering the loss. There is no SE where H sells core assets and L sells equity, or when H sells equity or L sells the core asset, since L will mimic H in both cases. The only possible SE is where H sells non-core assets, as L will not wish to mimic him as this will involve selling assets at a fundamental loss.

B.3 A Three-Asset Model

The previous sub-section showed that, in the case of negative correlation, it is easier to sustain an equilibrium in which all firms sell the non-core asset than one in which all firms sell the core asset. While this result is suggestive of the correlation effect, it may also arise from the fact that the non-core asset exhibits less information asymmetry, because $A_L - A_H < C_H - C_L$. If we reversed this assumption, then firm value would be higher for type L than type H, and so we would have the same model but with reversed notation. Since firm value is higher for type L, then L is effectively H. Since A is positively correlated with firm value, A is effectively C and C is effectively A. We will obtain the result that it is easier to sustain CPE than APE, but this would be because C exhibits less information asymmetry rather than C being negatively correlated.

Thus, to allow for both positively and negatively correlated assets, and also for either to exhibit higher information asymmetry, we need to move to a 3-asset model. Let the three assets be C, P, and N. Asset C cannot be sold as it is the core asset, but assets P and N can be. Asset P is the positively correlated asset ($P_H \geq P_L$) and asset N is the negatively correlated asset ($N_H \leq N_L$). We allow for both $P_H - P_L > N_L - N_H$ and $P_H - P_L < N_L - N_H$: either asset may exhibit more information asymmetry. The only assumption that we make is $C_H + P_H + N_H > C_L + P_L + N_L$: the existence of the third asset C means that H has a higher firm value than L, even if N exhibits more information asymmetry than P.

A firm can either sell P, N, or equity. In a NPE, all firms sell the negatively-correlated asset and any firm that sells P or equity is inferred as being of type L. L has the greatest incentive to deviate and his objective function is

$$\omega\left(\mathbb{E}\left[C+A\right]\right) + (1-\omega)\left(E_L - F\left(\frac{N_L}{\mathbb{E}\left[N\right]}\right)\right).$$

If L deviates to equity (or to P), it becomes

$$\omega\left(C_L + A_L\right) + (1-\omega)\left(E_L - F\right).$$

The ND condition is:

$$\omega\pi\left(E_H - E_L\right) > (1-\omega)\,F\left(\frac{N_L}{\mathbb{E}\left[N\right]} - 1\right)$$
$$\omega > \frac{F\left(\frac{N_L}{\mathbb{E}[N]} - 1\right)}{\pi\left(E_H - E_L\right) + F\left(\frac{N_L}{\mathbb{E}[N]} - 1\right)}. \tag{47}$$

The IC conditions that L will deviate to P or equity if it were revealed good are trivially satisfied. L would make a capital gain on selling low-quality P or low-quality equity, compared to its capital loss on selling high-quality N, and enjoy a higher stock price.

In a PPE, all firms sell P and any firm that sells N or equity is inferred as being of type L. H has the greatest incentive to deviate and his objective function is

$$\omega\left(\mathbb{E}\left[C+A\right]\right) + (1-\omega)\left(E_H - F\left(\frac{P_H}{\mathbb{E}\left[P\right]}\right)\right).$$

H is strictly better off by deviating to N than to equity, as he will make a capital gain on selling low-quality N rather than a capital loss on selling high-quality equity. If H deviates to N, his objective function becomes

$$\omega\left(C_L + A_L\right) + (1-\omega)\left(E_H - F\left(\frac{N_H}{N_L}\right)\right).$$

Note that $\frac{N_H}{N_L} < 1$: due to the correlation effect, H makes a capital gain from selling the non-core asset. The ND condition is:

$$\omega\pi\left(E_H - E_L\right) > (1-\omega)\,F\left(\frac{P_H}{\mathbb{E}\left[P\right]} - \frac{N_H}{N_L}\right)$$
$$\omega > \frac{F\left(\frac{P_H}{\mathbb{E}[P]} - \frac{N_H}{N_L}\right)}{\pi\left(E_H - E_L\right) + F\left(\frac{P_H}{\mathbb{E}[P]} - \frac{N_H}{N_L}\right)} \tag{48}$$

The IC condition that L would deviate to N if it were revealed good is:

$$\omega > \frac{F\left(\frac{N_L}{N_H} - \frac{P_L}{\mathbb{E}[P]}\right)}{\pi(C_H - C_L + A_L - A_H) + F\left(\frac{N_L}{N_H} - \frac{P_L}{\mathbb{E}[P]}\right)} \tag{49}$$

and the IC condition that L would deviate to equity if it were revealed good is:

$$\omega > \frac{F\left(\frac{E_L}{E_H} - \frac{P_L}{\mathbb{E}[P]}\right)}{\pi(C_H - C_L + A_L - A_H) + F\left(\frac{E_L}{E_H} - \frac{P_L}{\mathbb{E}[P]}\right)} \tag{50}$$

Note that (49) is satisfied, (50) will be trivially satisfied since $\frac{N_L}{N_H} > 1 > \frac{E_L}{E_H}$, so we will ignore (50).

Comparing the ND conditions (47) and (48), to show that NPE is easier to sustain, it is sufficient to show that

$$\frac{P_H}{\mathbb{E}[P]} - \frac{N_H}{N_L} > \frac{N_L}{\mathbb{E}(N)} - 1. \tag{51}$$

Note that (51) will not be satisfied for all possible parameter values. For example, if we have $P_H = P_L$ (so that P exhibits no information asymmetry), then $\frac{P_H}{\mathbb{E}[P]} = 1$ and (51) becomes $2 > \frac{N_L}{\mathbb{E}(N)} + \frac{N_H}{N_L}$, which does not hold if N_H is close to 0 since then the RHS becomes (just below) $\frac{1}{1-\pi}$, which exceeds the LHS of 2 since $\pi > \frac{1}{2}$. This result is intuitive: N exhibits so much more information asymmetry than P that it swamps the correlation effect and makes it easier to sell P than N.

To isolate the correlation effect, we set the information asymmetries of N and P to be identical so that we shut down information asymmetry considerations and have only the correlation effect at work. If we set $P_H = N_L$ and $P_L = N_H$, then condition (51) becomes:

$$\frac{N_H - N_L}{\mathbb{E}[N]} > \frac{N_H - N_L}{N_L}$$

which always holds because $\mathbb{E}[N] < N_L$. Thus, the correlation effect tilts firms towards selling the non-core asset.