JOBS vs. SOX: On Information Releases, Crowdfunding and the Profitability of IPOs.

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Abstract: In the context of the slowdown in economic activity of 2009-11, the United STates Congress approved legislation that eases the regulation of trade in securities of small companies. In particular it allows these companies to issue their IPOs under much less stringent requirements on information disclosure than the existing regulation. This policy has been criticized by analysts who consider that the exposure of investors to less forthcoming information will reduce their willingness to invest and, hence, the value of equity raised by the issuing firm. In this paper we argue that this view of the problem is excessively pessimistic. We show that the risk-sharing motive for asset trading implies that the provisions of the new legislation are indeed consistent with their intended goal, and that a full disclosure requirement, in fact, minimizes the amount of capital that the issuer can raise in the IPO.

The *Sarbanes-Oxley Act of 2002*, or SOX, is the general regulatory framework governing the informational, financial, accounting and remuneration practices of publicly traded companies in the United States. It was introduced in response to the corporate scandals that affected flagship companies as large as Enron and WorldCom in 2000 and 2001.[1] Among other regulatory restrictions, the SOX act imposes very strict rules requiring the disclosure of all internal information that may be of relevance to the potential investors in *any* publicly traded firm.[2] Strict disclosure rules apply, in particular, during the period in which a company prepares to float its stock on the markets, for the first time, in an *Initial Public Offering*, or IPO. It requires, for instance, that the intention to issue an IPO be publicly informed immediately after the company communicates it to the Securities Exchange Commission, SEC, and that all communications between the SEC and the company in regards to the IPO be made available to the public; it also establishes minimum periods of time that have to pass between different phases of the IPO, in order to give potential buyers ample opportunity to scrutinize the information made available by the company.

In the context of the slowdown in economic activity of 2009-11, concerns arose about the inability of small companies to raise the equity needed to fund the start of their economic activities. As a measure of response to this concern, the U.S. Congress approved the *Jumpstart Our Business Startups Act*, or JOBS, which was signed into law in April 2012.[3] Substantively, this act eases the securities regulations in the case of small companies[4] in a significant manner: it allows for confidentiality of the declaration of the company to the SEC that it plans to issue an IPO, and of the communications between these two parties; and it drastically reduces the times that have to be maintained between the planning and the actual occurrence of the IPO.

The rationale behind the JOBS Act was that forcing small firms to engage in extensive information disclosure was detrimental to their funding,[5] in particular in respect to the so-called *crowdfunding communities* in which many small startups seek funding from investors, usually of small size too, in a rapid manner. The Act, on the other hand, has been criticized by analysts who consider that the exposure of investors to less forthcoming information will not only decrease their welfare, but, as a consequence, will also reduce their willingness to invest in the IPO and, hence, the value of equity ultimately raised by the issuing firms.

These criticisms are consistent with existing literature. The canonical result of Hirshleifer [5] indicates how the release of information, or lack of it, affects the volume of trading. More in general, the intuition derived from the literature on *persuasion games*, started with Milgrom and Roberts [7], would indicate that the easier provisions of the JOBS Act would not be of benefit to the issuer of an IPO: in a general framework in which an informed party tries to withhold her private knowledge from a sophisticated agent, at equilibrium she is unable to do so. In the language of an IPO, the intuition is that a potential buyer would interpret the limited disclosure of information as an indication that the firm is of low value,[6] and would lower his willingness to pay for it. In particular, Kurlat and Veldkamp [6] submit that less-than-full disclosure of information by equity issuers would result in higher risk premia demanded by investors, which would go in the direction opposite to the intentions of the JOBS Act.[7]

The message of this paper is, to a large extent, that this view of the problem is excessively pessimistic. To begin, note that the SOX Act regulations may force startups to disclose information that is not related to the quality of their venture, so the *unraveling* mechanism of [7] need not apply. Also, note that the equity of the firm has two roles from the point of view of potential buyers: it is an instrument to transfer wealth from the present to the future, but it is also a tool that can be used to share risks that derive from distinct future shocks. The criticism that less information disclosure makes equity less valued by potential investors takes into account only the first role. Here, we emphasize the second one: does the valuation of the equity as a risk-sharing instrument increase when potential investors are subject to more risk? We consider a set-up in which (i) the Hirshleifer effect is cancelled, and investors do benefit from information disclosure unambiguously; and (ii) the main motive for trade is risk sharing. This we do by assuming that all investors have quasi-linear, homogeneous preferences, but trade because they are submitted to different future wealth shocks.

In this set-up, we show that, for a broad class of preferences of the issuer, which encompasses all non-risk-loving behavior, and as long as the investors have decreasing absolute risk aversion, the least preferred information disclosure policy is the one required by the JOBS act. The mechanism through which this result operates is the effect of limited information release on the average marginal utility of income, state by state, across investors. With less forthcoming information, investors are, typycally, unable to share their risks perfectly, so that a wedge opens between their wealth levels in each given state. Under decreasing absolute risk aversion, their marginal utility is a (positive, decreasing and) convex function, so these wedges increase the average of marginal utilities across investors.[8] With this increase taking place at all states (at least weakly), the pricing kernel of the market exhibits a first-order stochastic dominance increase, which may be preferred by the issuer -- it certainly is, for the class of preferences we consider here.

Put simply, in the case of crowdfunding communities it may be beneficial to the issuer to withhold some information, so as to increase the marginal willingness to pay of potential investors via the impact of information on their risk-sharing needs. We show that, via the risk-sharing effect, the provisions of the JOBS Act are indeed consistent with their intended goal, while those in the SOX Act, in fact, minimize the amount of capital that the issuer can raise in the IPO.[9]

1. The Setting

Consider a partial equilibrium problem over three periods $t = 0, 1, 2$.

1.1. *The firm*

At date 0, a firm needs to raise capital to fund the research and development phase, R&D, of an investment project. The outcome of this first stage is uncertain, so the project returns an *ex-ante* uncertain payoff at date 2. To model the uncertainty of these returns, let set $\mathcal{S}$ denote a finite state space, and for each $s \in \mathcal{S}$, let r_s be the return of the project in that state. There is a common, prior belief $\Pr(s) > 0$ that state s will occur.

1.2. *The investors*

There are finitely many investors, $i = 1, \ldots, I$, for $I \geqslant 2$. Investor i's income in period 2 is w_s^i, when the firm's state is s. This means that, after trading in all other existing assets, we allow for correlation between the investors wealth and the investment project's risk.[10]

Investors are risk averse, have a common cardinal utility index $u : \mathbb{R} \to \mathbb{R}$, and have quasi-linear preferences with respect to date-1 wealth. That is, given a wealth x in period 1, and uncertain income $(x_s)_{s \in \mathcal{S}}$ in period 2, their date-1 utility is

$$x + \sum_{s \in \mathcal{S}} \Pr(s) \cdot u(x_s).$$

We assume that the cardinal utility index is differentiable twice, strictly increasing and strictly concave. Importantly, we also assume that the investors' marginal utility is strictly convex, so that they exhibit decreasing absolute risk aversion.

The assumption that all investors have common preferences means that their motive for trading is risk sharing, and not any kind of betting.[11] Allowing for betting would introduce ambiguity to the direction of our effects, and, in general, our analysis would be inconclusive.

1.3. *The investment bank*

The firm borrows funds in period 0 from risk-neutral investment banks. Once the R&D stage is completed, at date 1, the firm privately learns the realized state s, after which the underwriting investment bank sells the firm's stock to public investors in the IPO.

We assume that there is a competitive set of risk-neutral investment banks, with free entry of them to the market. All these banks share the common prior beliefs of the firm and the investors. The risk-free interest rate, $\bar{r}$, is exogenously given.

2. Information Disclosure and the Initial Loan

2.1. Information disclosure

The firm *may* release its private information, fully or partially, before the IPO takes place.[12] Importantly, while it need not disclose all its private information, it cannot mislead the market about the return of the investment project, which we model by assuming that, after realizing state s, the firm annunces an event $E \subset \mathcal{S}$, such that $s \in E$.[13]

With this information, the stock of the firm is traded in a competitive IPO, and the resulting price is $p(E)$, which will be determined endogenously.

2.2. The investment bank as commitment device

We assume that, at the moment when the bank extends the loan to it, the firm commits to disclosing information according to a partition, $\mathcal{P}$, of the state space. That is, in period 1, if the firm realizes state s, it will make public the event E of the partition that contains s.[14] This commitment implies that the investors cannot discer any of the firm's private information beyond the revealed event E. In other words, the commitment of the firm to $\mathcal{P}$, via its contract with the investment bank, means that the unraveling mechanism of Milgrom and Robers [7] does not operate, so that the posterior beliefs of investors for state s, upon revelation of event E, is simply $\Pr(s \mid E)$.

Recalling that at date 1, after the firm has announced event E, the price of the project's stock is $p(E)$, it follows that, foreseeing these prices, the liquidity provided by the investment bank to the firm at date 0 is

$$L = \frac{1}{1+\bar{r}} \cdot \sum_{E \in \mathcal{P}} \Pr(E) \cdot p(E). \tag{1}$$

2.3. Information partitions

The partition chosen by the firm before at date 0 will determine the information with which trade occurs in period 1. We shall refer to the case when the firm chooses the finest partition, $\mathcal{P}^* = \{\{s\} \mid s \in \mathcal{S}\}$, as *full information release*.[15] The opposite case, when the firm chooses $\mathcal{P}_* = \{\mathcal{S}\}$, amounts to *no information release*. Any other partition will be referred to as a case of *partial information release*.

2.4. The firm's preferences over partitions, I

Once the firm chooses a partition $\mathcal{P}$, the price of its stock is induced as a random variable over $\mathcal{S}$: $s \mapsto p(E_s)$, where E_s denote the cell of the partition that contains s. Abusing notation slightly, we refer to this random variable as p.

We assume that the preferences of the firm are a binary relation $\succsim$ over the set of partitions; these preferences are defined by how the chosen partition affects the random variable p.[16]

3. The Stock Price in the IPO

3.1. Determination of the price

After event E has been announced, at price p investor i trades an amount $y_E^i(p)$ of the stock, so as to solve program

$$\max_{y \in \mathbb{R}} \left\{ -p \cdot y + \sum_{s \in E} \Pr(s \mid E) \cdot u(w_s^i + y \cdot r_s) \right\}.$$

Note that the only trade taking place in this optimization problem is the issuer's IPO, which is why we consider our approach to be one of partial equilibrium. Importantly, we are not allowing for secondary trade of the firm's equity, which is in accord with the provisions of the JOBS Act (see the appendix below).

The stock price after the announcement of event E, $p(E)$, is such that the total equity of the firm is absorbed by the public: $\sum_{i=1}^{I} y_E^i[p(E)] = 1$.

In order to have a well-defined objective function for the firm, we require that the stock price be defined, in a unique manner, for each event in the partition. Under our assumptions on the preferences of the investors, this is indeed the case. Following [3], define $X(E)$ as the set of all double arrays

$$((x_s^i)_{s\in E})_{i=1}^I \in \mathbb{R}^{\|E\|\times I}$$

that satisfy the following conditions: (1) for each $s \in E$, $\sum_{i=1}^I (x_s^i - w_s^i) = r_s$; and (2) for each i, there exists some y^i such that $x_s^i = w_s^i + y^i \cdot r_s$ for all $s \in E$.

Next, let $x(E)$ be the unique solution to program

$$\max\left\{\sum_{i=1}^I \sum_{s\in E} \Pr(s \mid E) \cdot u(x_s^i) \mid ((x_s^i)_{s\in E})_{i=1}^I \in X(E)\right\}, \tag{2}$$

and let, for each $s \in E$,

$$\kappa(E, s) = \frac{1}{I} \cdot \sum_{i=1}^I u'[x_s^i(E)]. \tag{3}$$

The latter will be referred to as the (*ex-post*) pricing kernel, since it follows from Lemma 2 in [3] that

$$p(E) = \sum_{s\in E} \Pr(s \mid E) \cdot \kappa(E, s) \cdot r_s. \tag{4}$$

3.2. The firm's preferences over partitions, II

Eq. (4) gives us an explicit expression for random variable p. Underlying this random variable, we have a second one: the pricing kernel, $s \mapsto \kappa(E_s, s)$, where E_s denotes the cell in the partition that contains s. Abusing notation again, we refer to the latter as κ, and take it as defined by Eq. (3).

We shall say that the firm's preferences *are monotonic* if whenever a partition $\mathcal{P}$ induces a first-order stochastic improvement in the pricing kernel, κ, relative to that of partition $\mathcal{P}'$, the firm strictly prefers the former partition, so $\mathcal{P} \succ \mathcal{P}'$. If, under the same premise, we only have that $\mathcal{P} \succsim \mathcal{P}'$, we say that the preferences are *weakly monotonic*. Similarly, we shall say that preferences are *monotonic over information coarsening* if whenever $\mathcal{P}$ is a coarsening of $\mathcal{P}'$ that induces a first-order stochastic improvement in the pricing kernel, we have that $\mathcal{P} \succ \mathcal{P}'$. The weak version of this property is defined as above.

3.2.1. The JOBS preferences

The goal of the regulatory change that motivates this paper was to improve the ability of small firms to fund their business startups. To model this, we shall consider the possibility that the firm's preferences are solely determined by the amount of liquidity they can borrow from the investment bank. In particular, we say that the firm *has expected liquidity preferences* if it prefers $\mathcal{P}$ over $\mathcal{P}'$ when, and only when, the loan extended upon commitment to partition $\mathcal{P}$ is higher than that upon commitment to $\mathcal{P}'$.[17] For reasons that will be clear shortly, we denote these preferences as $\succsim_0$. Formally,

$$\mathcal{P} \succsim_0 \mathcal{P}' \Leftrightarrow \sum_{E \in \mathcal{P}} \Pr(E) \cdot p(E) \geqslant \sum_{E \in \mathcal{P}'} \Pr(E) \cdot p(E).$$

LEMMA 1. *If the return of the project is positive in all states of the world, then the expected liquitidy preferences are strictly monotonic.*

Proof: Using Eq. (4),

$$\sum_{E \in \mathcal{P}} \left[\Pr(E) \cdot \sum_{s \in E} \kappa(E, s) \cdot r_s \right] = \sum_{s \in \mathcal{S}} \Pr(s) \cdot \kappa(E_s^{\mathcal{P}}, s) \cdot r_s,$$

where $E_s^{\mathcal{P}}$ denotes the event of $\mathcal{P}$ that contains s. It is then immediate that, if $r_s > 0$ for all s, then an increase in κ for some s, without a decrease in it for any other s', increases this value. *Q.E.D.*

3.2.2. Worst-case scenario liquidity preferences

Expected liquidity preferences capture risk neutrality in the firm. The extreme risk aversion of a firm would be the case when it is concerned *only* about the lowest possible price it could attain in the IPO. Denoting these preferences by $\succsim_1$, this is to say that

$$\mathcal{P} \succsim_1 \mathcal{P}' \Leftrightarrow \min_{E \in \mathcal{P}} p(E) \geqslant \min_{E \in \mathcal{P}'} p(E).$$

LEMMA 2. *If the return of the project is positive in all states of the world, then the worst-case scenario preferences, $\succsim_1$, are weakly monotonic over information coarsening.*

Proof: Let $\mathcal{P}$ be a coarsening of $\mathcal{P}'$ that induces a first-order stochastic dominance increase in the pricing kernel, and fix $E' = \text{argmin}_{\tilde{E} \in \mathcal{P}'} p(\tilde{E})$.

Fix any $E \in \mathcal{P}$, and let $\Xi \subseteq \mathcal{P}'$ be such that $\cup_{\tilde{E} \in \Xi} \tilde{E} = E$. Using again Eq. (4),

$$\begin{aligned}
p(E) &= \sum_{s \in E} \Pr(s \mid E) \cdot \kappa(E, s) \cdot r_s \\
&= \sum_{\tilde{E} \in \Xi} \sum_{s \in \tilde{E}} \Pr(s \mid E) \cdot \kappa(E, s) \cdot r_s \\
&\geqslant \sum_{\tilde{E} \in \Xi} \sum_{s \in \tilde{E}} \Pr(s \mid \tilde{E}) \cdot \Pr(\tilde{E} \mid E) \cdot \kappa(\tilde{E}, s) \cdot r_s \\
&= \sum_{\tilde{E} \in \Xi} \Pr(\tilde{E} \mid E) \cdot p(\tilde{E}) \\
&\geqslant \sum_{\tilde{E} \in \Xi} \Pr(\tilde{E} \mid E) \cdot p(E') \\
&= p(E'),
\end{aligned}$$

where the first inequality comes from the improvement in the pricing kernel, and the second from the definition of event E'.

Since the latter holds true for any $E \in \mathcal{P}$, it follows that

$$\min_{E \in \mathcal{P}} p(E) \geqslant p(E') = \min_{E \in \mathcal{P}'} p(E).$$

Q.E.D.

3.2.3. A family of risk-averse preferences

The difficulty with applying directly the usual definition of risk aversion in the present case is that there need not be a partition that delivers as value of the firm the expectation of the random value induced by another partition. Using the two extremes of risk-neutrality and worst-case risk aversion, we can however parameterize a family of preferences over partitions that captures the situations between those two extremes. For each $\lambda \in [0, 1]$, define the relation $\succsim_\lambda$ by saying that $\mathcal{P} \succsim_\lambda \mathcal{P}'$ when, and only when,

$$\lambda \min_{E \in \mathcal{P}} p(E) + (1 - \lambda) \sum_{E \in \mathcal{P}} \Pr(E) \cdot p(E) \geqslant \lambda \min_{E \in \mathcal{P}'} p(E) + (1 - \lambda) \sum_{E \in \mathcal{P}'} \Pr(E) \cdot p(E).$$

Evidently, $\lambda = 0$ corresponds to the case of expected liquidity preferences, while $\lambda = 1$ amounts to worst-case scenario preferences. The higher the value of λ the more weight is given to the worst-case price in the IPO, so we interpret λ as a measure of risk aversion.

LEMMA 3. *Let $\lambda \in (0,1)$. If the return of the project is positive in all states of the world, then $\succsim_\lambda$ is monotonic over information coarsening.*

Proof: As in the proof of Lemma 2, let $\mathcal{P}$ coarsen $\mathcal{P}'$ and induce a first-order stochastic dominance increase in the pricing kernel. By that Lemma,

$$\min_{E \in \mathcal{P}} p(E) \geqslant \min_{E \in \mathcal{P}'} p(E),$$

while

$$\sum_{E \in \mathcal{P}} \Pr(E) \cdot p(E) > \sum_{E \in \mathcal{P}'} \Pr(E) \cdot p(E)$$

by Lemma 1. Since $\lambda < 1$,

$$\lambda \min_{E \in \mathcal{P}} p(E) + (1-\lambda) \sum_{E \in \mathcal{P}} \Pr(E) \cdot p(E) > \lambda \min_{E \in \mathcal{P}'} p(E) + (1-\lambda) \sum_{E \in \mathcal{P}'} \Pr(E) \cdot p(E).$$

Q.E.D.

For future reference, we shall denote by Λ the class of all preferences $\succsim_\lambda$, for $\lambda \in [0,1)$, while $\bar{\Lambda} = \Lambda \cup \{\succsim_1\}$.

3.3. Expected utility preferences

Of the preferences considered so far, only the expected liquidity relation satisfies the Independence Axiom and can be given a von Neumann-Morgenstern representation. We now consider, in addition, the class of all relations that have such representation, restricting our attention to risk-averse preferences (using the usual definition of risk aversion for this case). As usual, we say that $\succsim$ has an expected utility representation if there exists a function $v : \mathbb{R} \to \mathbb{R}$ such that[18]

$$\mathcal{P} \succsim \mathcal{P}' \Leftrightarrow \sum_{E \in \mathcal{P}} \Pr(E) \cdot v[p(E)] \geqslant \sum_{E \in \mathcal{P}'} \Pr(E) \cdot v[p(E)].$$

LEMMA 4. *Suppose that the firm's preferences, $\succsim$, have an expected utility representation with concave and strictly increasing utility index v. If the return of the project is positive in all states of the world, then $\succsim$ is monotonic over information coarsening.*

Proof: Once again, let $\mathcal{P}$ coarsen $\mathcal{P}'$ and induce a first-order stochastic dominance increase in κ. Let p and p' be, respectively, the (random) prices induced by the two partitions, using Eq. (4), and let π be an auxiliary random variable constructed as follows: for each $E \in \mathcal{P}$, let $\{E'_1, \ldots, E'_N\} \subseteq \mathcal{P}'$ be such that $\cup_{n=1}^{N} = E$, and let

$$\pi(E) = \sum_{n=1}^{N} \left[\Pr(E'_n \mid E) \sum_{s \in E'_n} \Pr(s \mid E'_n) \cdot \kappa(E'_n, s) \cdot r_s \right].$$

This variable gives us the counter-factual prices that would arise under the coarser partition $\mathcal{P}$, under the assumption that the pricing kernel is the one induced by the finer partition $\mathcal{P}'$.

Note that p' is a mean-preserving spread of π, so it follows that π is at least as large as p' in the sense of second-order stochastic dominance. Since $r_s > 0$ at all s, and the pricing kernel under $\mathcal{P}$ first-order stochastically dominates that under $\mathcal{P}'$, it follows that p first-order stochastically dominates the auxiliary variable π. By transitivity, then, p second-order stochastically dominates p', which suffices since ν is concave and increasing. *Q.E.D.*

Again for future reference, we denote by $\mathcal{V}$ the class of all relations (over partitions) that are representable with a concave an strictly increasing cardinal utility index. Following our comment at the beginning of this subsection, note that $\bar{\Lambda} \cap \mathcal{V} = \{\succsim_0\}$.

4. Non-Optimality of Full Information Release

Our main claim in this paper is that if the firm is risk averse, its least preferred information release would be the one imposed by the SOX regulation: any partial information release partition will be preferred to the information release. The key mechanism is the effec of information on the pricing kernel, which is given by the following proposition.

Proposition 1. *Suppose that $r_s \neq 0$ for all s. Generically on the wealth of investors, any partition with no or partial information release induces a pricing kernel that first-order stochastically dominates the one resulting from the full release partition.*

In the negligible, complement subset of investor wealth profiles, all partitions induce pricing kernels that are at least as large as the one of the full release partition.

Proof: For each state s, let

$$\bar{x}_s = \frac{1}{I} \cdot \left(r_s + \sum_{i=1}^{I} w_s^i \right) \cdot (1, 1, \ldots, 1).$$

By definition, $X(\{s\})$ is

$$\left\{x \in \mathbb{R}^I \mid \sum_{i=1}^{I}(x_s^i - w_s^i) = r_s \text{ and } \exists y \in \mathbb{R}^I : x^i = w_s^i + y^i \cdot r_s \text{ and } \sum_{i=1}^{I} y^i = 1\right\},$$

and we have that $\bar{x}_s \in X(\{s\})$.[19]

On the other hand, suppose that $s, s' \in E$, $s \neq s'$, and $\bar{x}_s \in X(E)$. This means that, $w_s^1 - w_s^2 = r_s \cdot (y^2 - y^1)$, for some pair of numbers (y^1, y^2). If, in addition, $\bar{x}_{s'} \in X(E)$, we further have that $w_{s'}^1 - w_{s'}^2 = r_{s'} \cdot (y^2 - y^1)$, and hence that

$$\frac{w_s^1 - w_s^2}{r_s} = \frac{w_{s'}^1 - w_{s'}^2}{r_{s'}}.$$

This condition fails in an open subset of $\mathbb{R}^{S \times I}$ with full Lebesgue measure.[20]

Since $\mathcal{S}$ is finite, it follows that in a generic set of profiles of investors' wealth, for any event $E \subseteq \mathcal{S}$ that contains more than one state, there exists at least one $s \in E$ such that $\bar{x}_s \notin X(E)$. Let us denote by $\mathcal{W}$ such generic set.

It is immediate from concavity of u that $x(\{s\}) = \bar{x}_s$. By convexity of u', we further have that $\bar{x}_s$ also solves the problem

$$\min_{x_s \in X(\{s\})} \left\{\frac{1}{I}\sum_{i=1}^{I} u'(x_s^i)\right\}.$$

In $\mathcal{W}$, then, for any non-singleton event E, $\kappa(E, s) \geqslant \kappa(\{s\}, s)$ for all $s \in E$, with strict inequality for some. *Q.E.D.*

The intuition of this result is not obscure. In the full information partition, the firm eliminates all risk at the moment of the IPO, so the investors trade the stock only for intertemporal considerations. Under our assumptions, in this case all investors *ex-post* have the same wealth in all states. If a partition releases less information, at the IPO some risk remains. Generically, the investors will be unable use the firm's equity to trade away all the remaining risk, and, as a consequence, they will not all have the same *ex-post* wealth in at least one state. Since the marginal utility of wealth is convex, this dispersion in wealth will increase the average marginal utility in that state.

The following result is an implication of the proposition, together with Lemmata 1, 2 and 3.

Proposition 2. *Suppose that the return of the project is strictly positive in all states of the world. If the firm's preferences are weakly monotonic in information coarsening, then any partition that releases no or partial information is strictly preferred to the full release partition, generically in investors' wealth profiles. In the negligible complement subset of investors' wealth profiles, all partitions are at least as good as the full information release. If the preferences are weakly monotonic in information coarsening, all partitions are at least as good as the full information release for all values of investors' wealth.*

In particular, for any $\mathcal{P} \neq \mathcal{P}^*$*:*

1. *for any* $\succsim \in \Lambda \cup \mathcal{V}$*,* $\mathcal{P} \succ \mathcal{P}^*$*, generically in the wealth of investors; and*

2. *for any* $\succsim \in \bar{\Lambda} \cup \mathcal{V}$*,* $\mathcal{P} \succsim \mathcal{P}^*$*.*

It is important to note that Proposition 2 states that the full release partition is the least preferred one, but it does not imply that releasing no information is the optimal decision of the firm. This is because the result of Proposition 1 cannot be strenghtened to say that the kernel induced by the no release partition first-order stochastically dominates the ones of all finer partitions. Example 2 in Carvajal, Rostek and Weretka [3] shows that this is not the case, *mutatis mutandis*.

Corollary 1. *Suppose that there are only two states, and the return of the project is strictly positive in both. Generically on the wealth of the investors,* $\mathcal{P}_* \succ \mathcal{P}^*$*, for all* $\succsim \in \Lambda \cup \mathcal{V}$*. Moreover,* $\mathcal{P}_* \succsim \mathcal{P}^*$*, for all* $\succsim \in \bar{\Lambda} \cup \mathcal{V}$

5. Further Results for the JOBS Preferences

We now study two further issues: first, we endogenize the size of the IPO; then, keeping the size exogenous, we allow the return of the asset to be negative in some states. These problems are addressed for the case of expected liquidity preferences, which we understand as the ones that underlie the motivation for the regulatory change.

5.1. *The size of the IPO*

The more lenient information disclosure requirements of the JOBS act apply only to small IPOs. If the firm has control over the size of its project, the difference in profitability of the IPO may give the firm incentives, endogenously, to invest in larger or smaller projects.[21] We now show that, if the firm's objective is to maximize its expected liquidity, the JOBS requirements may induce larger investment projects, which is benefitial to both the firm and prospective investors.[22]

Suppose that there are two equally likely states of the world and two investors, with utility index $u(x) = \ln(x)$ and incomes $w^1 = (2, 1)$ and $w^2 = (1, 2)$. Suppose that the firm's project is riskless, but it can be undertaken at different scales: if the scale chosen is K, the project returns $r = (1, 1) \cdot K$.[23] The cost of undertaking a project of scale K is $c(K)$, which is increasing and convex on the scale.

At date 0, the firm chooses both the scale of the project and the information partition it will follow. The cost of the investment is independent of the partition chosen by the firm, but the revenue on the IPO depends on both of those decisions. Intuitively, we want to see the price p as corresponding to each "unit" of the project, so that we can write the revenue as $R = p \cdot K$. Importantly, the scale will affect the firm's revenue via p, and not just directly.

To keep with our previous notation, for an event E and a scale K, (re-)define the set $X(E; K)$ as the set of arrays $(x_s^1, x_s^2)_{s \in E}$ such that (1) for each $s \in E$, $(x_s^1 - w_s^1) + (x_s^2 - w_s^2) = K$, and (2) for both i, there exists Y^i such that $x_s^i = w_s^i + Y^i$ at all $s \in E$. Here, y^i is the number of units of investment purchased by i, each of which pays 1 unit of revenue in each state of the world. The first condition simply says, then, that $Y^1 + Y^2 = K$, so that the whole project is sold.

With this definition, the allocation of revenue, given an event and a scale, continues to be characterized by Program (2), and the pricing kernel of Eq. (3) continues to be valid, with the obvious change of notation, so long as we modify the pricing equation to

$$p(E; K) = \sum_{s \in E} \Pr(s \mid E) \cdot \kappa(E, s; K). \tag{5}$$

5.1.1. Revenue under SOX

If the state of the world is revealed before trade, in equilibrium both investors will have the same income *ex-post*: the investor that receives bad news will buy one more unit of investment. This implies that

$$x_s^1(\{s\};K) = x_s^2(\{s\};K) = \frac{3+K}{2}$$

and

$$\kappa(\{s\}, s; K) = \frac{2}{3+K}.$$

The IPO's expected revenue, conditional on the scale, is then

$$R^*(K) = \frac{4K}{3+K}.$$

5.1.2. Revenue under JOBS

Suppose now that trade is carried under no information disclosure. By symmetry, each investor will buy one half of the IPO, and the *ex-post* incomes will differ, with one of the investors having $2 + K/2$, and the other having $1 + K/2$. The pricing kernel will, thus, be

$$\kappa(\{1,2\}, s; K) = \frac{1}{2}\left(\frac{2}{4+K} + \frac{2}{2+K}\right).$$

The resulting revenue is, then,

$$R_*(K) = \frac{4K(3+K)}{(4+K)(2+K)}.$$

5.1.3. Optimal scales of the project

It is immediate from above that, for each scale of the project, the revenue under JOBS is higher. It turns out, however, that how the *marginal* revenue changes is *not* independent from the scale.[24] Immediately, this means that the two regulatory frameworks will have different effects on the scale of the project, since it is the equality between that marginal revenue and the marginal cost of the investment that will determine the optimal scale.

Figure 1 depicts the marginal revenue functions under both regulations. The function full no revelation lies above the one under full revelation for scales below some threshold, $\bar{K}$.[25] The optimal scale for each regulation will be given by the intersection of the corresponding function and the marginal cost, which is nondecreasing. Suppose, for simplicity, that the cost function is linear, with marginal cost $c > 0$. It is immediate from the figure that if $c > \bar{\delta}$, the optimal scale will be

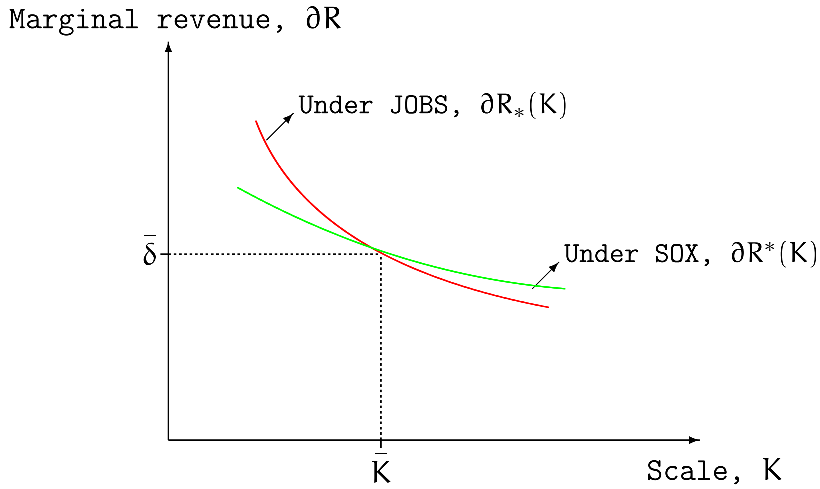

Figure 1: Marginal expected revenue at the IPO, under full revelation and under no revelation, as a function of the scale of the project.

larger under JOBS than under SOX. From the point of view of stimulating start-ups, this is a good, if perhaps unintended, result. Importantly, while the investors will face higher uncertainty, the larger scale of the IPO will be beneficial for them.[26]

Of course, the opposite result holds if $c < \bar{\delta}$, and the firm will choose a smaller scale when issuing under JOBS. Importantly, since a maximum scale is imposed before the less stringet JOBS regulation can be accessed,[27] it may occur that a firm whose optimal scale would put it above that maximum would choose to issue at that maximum scale, to be able to use the more profitable JOBS act. In the graph, this could occur when $c < \bar{\delta}$, but the optimal scale is above the legal maximum: the firm may prefer a sub-optimal scale under JOBS, since the optimal (larger) scale would force to issue under SOX. This (presumably unintended) effect is detrimental to all agents.[28]

5.2. Unlimited Liability

If the investors are protected by limited liability regulations, the assumption that returns are positive is not very restrictive. If the goal of the issuer of the asset was to dispose of a loss, so that the returns of the project are negative in all states, it follows immediately from Proposition 2 that for expected liquidity preferences the most preferred partition is the full revelation partition.

A more challenging result, on the other hand, is the case when the returns are positive in some states and negative in others. Suppose that

$$r_1 \geqslant r_2 \geqslant \ldots \geqslant r_{\bar{s}} > 0 > r_{\bar{s}+1} \geqslant r_{\bar{s}+1} \geqslant \ldots \geqslant r_S, \tag{6}$$

And define the following two partitions:

$$\mathcal{P}^{\bullet} = \{\{1, 2, \ldots, \bar{s}\}, \{\bar{s}+1\}, \{\bar{s}+2\}, \ldots, \{S\}\}$$

and

$$\mathcal{P}_{\bullet} = \{\{1\}, \{2\}, \ldots, \{\bar{s}\}, \{\bar{s}+1, \bar{s}+2, \ldots, S\}\}.$$

Partition $\mathcal{P}^{\bullet}$ discloses detailed information in states where the firm loses money, and only the fact it is not losing money in states where it makes positive returns. We call this the *candid* partition. Partition $\mathcal{P}_{\bullet}$ does the opposite: in states where the firm makes positive profits, it reveals all information; but if the firm is to lose money, this partition only reveals that profits will not be positive. We refer to $\mathcal{P}_{\bullet}$ as the *braggart* partition.

An interesting implication of Proposition 1 is the following result.

Proposition 3. *Suppose that Eq.* (6) *holds true, and that the firm has expected liquidity preferences. Generically on investors' endowments, the candid partition is strictly preferred to the braggart partition. In the negligible complement subset of endowments, the former is at least as good as the latter.*

Proof: It follows from the proof of Proposition 2 that, generically on endowments,

$$\forall s \leqslant \bar{s}, \kappa(\{1, 2, \ldots, \bar{s}\}, s) \geqslant \kappa(\{s\}, s), \tag{7}$$

with strict inequality for some such s; and,

$$\forall s > \bar{s}, \kappa(\{s\}, s) \leqslant \kappa(\{\bar{s}+1, \bar{s}+2, \ldots, S\}, s), \tag{8}$$

also with strict inequality for some s.

Using Eq. (4) as in the proof of Lemma 1, generically,

$$
\begin{aligned}
&\sum_{E \in \mathcal{P}^{\bullet}} \left[\Pr(E) \cdot \sum_{s \in E} \kappa(E, s) \cdot r_s \right] \\
&\quad = \sum_{s \in \mathcal{S}} \Pr(s) \cdot \kappa(E_s^{\mathcal{P}^{\bullet}}, s) \cdot r_s \\
&\quad = \sum_{s \leqslant \bar{s}} \Pr(s) \cdot \kappa(\{1, 2, \dots, \bar{s}\}, s) \cdot r_s + \sum_{s > \bar{s}} \Pr(s) \cdot \kappa(\{s\}, s) \cdot r_s \\
&\quad > \sum_{s \leqslant \bar{s}} \Pr(s) \cdot \kappa(\{s\}, s) \cdot r_s + \sum_{s > \bar{s}} \Pr(s) \cdot \kappa(\{\bar{s}+1, \bar{s}+2, \dots, S\}, s) \cdot r_s \\
&\quad = \sum_{s \in \mathcal{S}} \Pr(s) \cdot \kappa(E_s^{\mathcal{P}_{\bullet}}, s) \cdot r_s \\
&\quad = \sum_{E \in \mathcal{P}_{\bullet}} \left[\Pr(E) \cdot \sum_{s \in E} \kappa(E, s) \cdot r_s \right],
\end{aligned}
$$

where the inequality comes from Eqs. (6), (7) and (8). By definition, then, $\mathcal{P}^{\bullet} \succ_0 \mathcal{P}_{\bullet}$.

On the complement of the generic set of endowments, the inequality above is weak, and, hence, $\mathcal{P}^{\bullet} \succsim_0 \mathcal{P}_{\bullet}$. *Q.E.D.*

Appendix: Crowdfunding and the JOBS Act

The key principles of the (investment) crowdfunding model are the following:

1. it allows for general solicitation/advertising by the issuer of equities;[29]
2. there is no secondary market for equities acquired through the crowdfunding platform;
3. it lowers the cost of issuing equities, and gives the possibility of exemption from registration with the SEC;
4. it allows the issuer to raise funds from a large base of (accredited and unaccredited) investors (crowd);
5. the issuer cannot raise more than USD 1 million every 12 months;
6. investors are constrained not to invest more than 10 percent of their income or assets each year.

Title II of JOBS Act is characterized by the first two principles. Title III is expected to include the six principles. With respect to crowdfunding, Title II allows for general solicitation/advertising, but funds can only be raised from *accredited* investors, namely those with more than USD 200,000 in annual income, or USD 1 million in assets. In that sense, one may say that accredited-crowdfunding is possible as of today and that the more pertinent part of the JOBS Act for crowdfunding is Title III, which, importantly, will allow companies to raise funds from unaccredited investors.[30]

When the totality of the regulation is enacted, issuers will have access to three types of equity to be raised: [31] firstly, they can issue under the rules stated by the SEC No-Action Letter issued in 1996, which allows for accredited investors to view private investment opportunities on a password-protected website. Rule 506 of Regulation D in this letter allows the issuer to raise an unlimited amount of capital from an unlimited number of accredited investors. Secondly, they can rely on Title II of the JOBS Act, which went into effect in September 2013, and allows entrepreneurs to publicly advertise their need for funding. Under this rule, issuers can raise an (unlimited) amount of capital from an (unlimited) number of accredited investors. Finally, under the rules expected to go into effect later this year [Title III of the JOBS act], will have access to unaccredited investors, for limited amounts of funding.

In the UK,[32] the proposed rules require firms promoting unlisted securities via crowdfunding platforms (or other media) to communicate direct offer financial promotions only to certain types of investor. These are: professional clients; or retail clients who confirm that, in relation to the investment promoted, they will receive regulated investment advice or investment management services from an authorised person; or retail clients who are venture capital contacts or corporate finance contacts; or retail clients who are certified or self-certify as sophisticated investors; or retail clients who are certified as high net worth investors; or retail clients who certify that they will not invest more than 10 percent of their net investible financial assets in unlisted equity and debt securities (i.e. they certify that they will only invest money that does not affect their primary residence, pensions and life cover). In the UK, however the regulation for disclosure of information, it seems, would not be relaxed.

Notes

[1] Analogous legislation was enacted in Australia, Canada, France, Germany, Holland, India, Italy, Japan, South Africa, and Turkey.

[2] The original scope intended for this regulation was limited to large companies only, but this qualification was removed and the scope extended to govern all publicly traded stock.

[3] Title II of the act was signed on 5 April 2012. Title III, which further opens the possibilities of fundraising for small firms, was under evaluation by the SEC until February 2014. It is expected that this title be enacted as early as May 2014. For the interested reader, an appendix to the paper includes a summary of the differences between these two titles of the act.

[4] Broadly speaking, those with annual revenue of at most USD1B.

[5] As in the mechanism proposed by Shin [9], for example.

[6] Otherwise, the buyer interprets, it would have released detailed information showing that its value is high.

[7] The focus of [6] is whether these higher-risk, higher-premium investment opportunities are better or worse for the investors. The stance that they offer less liquidity to sellers is, nonetheless, unambiguous.

[8] The mechanism at play is similar to the one under which recent work provided conditions for endogenous market incompleteness, in Carvajal, Rostek and Weretka [3].

[9] A recent paper by Andolfatto, Berentsen and Waller, [1], differs from ours in many respects. It takes a mechanism design approach to analyse whether efficient production is incentive compatible depending on information disclosure or private costly information acquisition. Agents are risk neutral in the subperiod when the risky asset delivers its return so the only motive for (lack of) information disclosure is to alleviate a potential incentive to not participate in the mechanism. Not participating in the mechanism is interpreted as default and punished by T years of autarky, thereby giving rise to participation constraints. Their paper studies only direct mechanisms; with two states of nature, we conjecture that, generically, prices would render private information public as in Radner [8] showed, so it is unclear how their analysis of constrained efficient allocations could be used for decentralized mechanisms.

[10] Our partial-equilibrium approach consists precisely in leaving the trade in all other existing assets unmodelled, and in assuming that such trade will be unaffected by the IPO of the firm. We believe that this approach is acceptable, since the policy we want to study, the JOBS act, covers only "small" IPOs, by design.

[11] In view of Note 10, the reader may want to impose further structure on the distribution of investors' incomes. Of particular interest is the assumption that investors may have traded in a riskless asset, in which case one would like to impose that for all investors i and i',

$$\sum_{s\in\mathcal{S}} \Pr(s)\cdot u'(w_s^i) = \sum_{s\in\mathcal{S}} \Pr(s)\cdot u'(w_s^{i'}). \tag{$*$}$$

Our results remain unaffected by this assumption.

[12] As allowed, for instance, by the JOBS act.

[13] The prior belief over event E is $\Pr(E) = \sum_{s \in E} \Pr(s)$.

[14] Under the SOX act, this assumption would be untenable, as the firm would have no legal choice but to reveal all its private information (by allowing a long enough window before the investment bank launched the IPO's road shows). Under JOBS, this is no longer the case. The firm can sign a contract with the investment bank, under which the bank will impose a penalty if the information disclosure does not agree with the partition. If the stipulated fine is high enough, the bank will have incentive to enforce this contract, and the courts would uphold the penalty: the firm can commit to a short window before the road shows; this is legal under JOBS.

[15] This would be the only enforceable partition under the SOX regulations.

[16] It is natural to assume that a partition that generates a first-order stochastic improvement in the stock price is preferred by the firm.

[17] Under the assumption that the investement banks are risk-neutral, it is immaterial whether the firm gets the loan at date 0, or if it wants to maximize its expected value in the IPO, at time 1. This is why we can refer to them as *expected* liquidity preferences.

[18] We denote the firm's cardinal utility index, if it exists, by ν, to avoid confusion with the one of the investors.

[19] Since $r_s \neq 0$, simply let $y^i = (\bar{x}_s - w_s^i)/r_s$.

[20] Following the remarks in Notes 10 and 11, notice that Eq. $(*)$ in Note 11 does not disrupt this argument, so long as u' remains monotonically decreasing.

[21] Gale and Stiglitz [4] emphasize how potential investors may change their perception of the conditions of the firm as a result of the size of the intended IPO. This change in perception does not take place in our framework.

[22] And which, indeed, seems perfectly consistent with the goals of the regulatory change.

[23] These specifications are borrowed from Example 4 in Carvajal, Rostek and Weretka [2].

[24] By direct computation,

$$\partial R^*(K) = \frac{12}{(3+K)^2} \quad \text{and} \quad \partial R_*(K) = \frac{12(K^2+4K+8)}{(2+K)^2(4+K)^2}.$$

[25] The actual value is $\bar{K} \approx 1.425$, with $\bar{\delta} \approx 0.614$.

[26] This effect is different from the one driving the result in [6]. There, the investors may benefit from higher uncertainty when this results in a higher risk premium and, hence, a less profitable IPO for the firm. Here, increasing the uncertainty of the investors, by issuing the IPO under JOBS, is beneficial for the firm and detrimental for the investor, but the larger scale induced by the more profitable IPO can offset this detrimental effect.

[27] Such maximum is *not* the threshold $\bar{K}$ of Figure 1.

[28] The caveat that our analysis is applicable so long as the firm remains small is important to qualify these last statements.

[29] Usually through an internet platform such as *Indiegogo* or *Kickstarter*.

[30] The delays in enacting Title III seem to be due to the difficulties of designing regulations that protect unaccredited investors while keeping the desired simplicity of soliciting funds through crowdfunding platforms without stringent disclosure requirements. The reasons why unaccredited investors would need to be protected are not clearly stated, but it appears that the SEC considers that unaccredited investors may be inexperienced and need not have enough wealth to stay clear of the risk of financial ruin.

[31] See Eric Wagner (2014), "Equity crowdfunding 101: is it right for your startup?", *Forbes (Entrepreneurs)*, 18 March. This report is available at

http://www.forbes.com/sites/ericwagner/2014/03/18/equity-crowdfunding-101-is-it-right-for-your-startup/

[32] See Consultation Paper CP13/3 and Policy Statement PS14/4 by the Financial Conduct Authority. These documents are available, respectively, at

http://www.fca.org.uk/static/documents/consultation-papers/ps13-03.pdf

and

http://www.fca.org.uk/static/documents/policy-statements/ps14-04.pdf

References

[1] Andolfatto, D., Beresten, A., and Waller, C. Optimal disclosure policy and undue diligence. *Journal of Economic Theory 149*, 1 (2014), 128-152.

[2] Carvajal, A., Rostek, M., and Weretka, M. Bundling without price discrimination. The Warwick Economics Research Paper Series (TWERPS) 936, 2010.

[3] Carvajal, A., Rostek, M., and Weretka, M. Competition in financial innovation. *Econometrica 80*, 5 (2012), 1895-1936.

[4] Gale, I., and Stiglitz, J. The informational content of initial public offerings. *Journal of Finance 44*, 2 (1989), 469-477.

[5] Hirshleifer, J. The private and social value of information and the reward to inventive activity. *American Economic Review 61*, 4 (1971), 561-574.

[6] Kurlat, P., and Veldkamp, L. Should we regulate financial information? Working Paper No EC-12-15, Stern School of Business, NYU, 2012.

[7] Milgrom, P., and Roberts, J. Relying on the information of interested parties. *RAND Journal of Economics* (1986), 18-32.

[8] Radner, R. Rational expectations equilibrium: generic existence and the information revealed by prices. *Econometrica 47*, 3 (1979), 655-678.

[9] Shin, H. S. Disclosures and asset returns. *Econometrica 71*, 1 (2003), 105-133.