JOBS and SOX: 'Evolving with New Paths to Capital Formation'[1]

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Following the economic slowdown of 2009-11, the U.S. Congress approved legislation that weakens the information disclosure requirements for small companies seeking financing in public and private markets. This policy has been criticized by analysts who warn against a reduction in investors' willingness to invest and, hence, in the capital raised by firms. We argue that a risk sharing motive for trading implies that the new legislation is indeed consistent with its intended goal, and that a full disclosure requirement, in fact, minimizes the capital that a firm can raise, given its business scale. Disclosure requirements that become more stringent at a larger scale, as in the new legislation, may improve economic efficiency in the Pareto sense, benefitting both financing of small and large firms and investors' welfare. If there is unlimited liability, the effect of disclosure on the price of the firm's asset is *ex ante* favorable for the firm if the negative returns are to be announced in detail. (*JEL* G18, G32, G38, D80)

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The *Sarbanes-Oxley (SOX) Act* of 2002 is the general regulatory framework governing the informational, financial, accounting and remuneration practices of firms whose shares are traded on the U.S. securities exchanges. It was introduced in response to the scandals that affected flagship corporations as large as Enron and WorldCom in 2000 and 2001. Among other restrictions, the SOX Act imposes rules requiring disclosure of all internal information that may be of relevance to potential investors in *any* publicly traded firm.[3] Strict disclosure rules apply, in particular, during the period in which a company prepares to float its stock on the market for the first

[1] From the keynote address of the SEC Chair, Mary Jo White, on the upcoming changes in the securities regulation embraced by the SEC. See "The SEC in 2014," January 27, 2014, available at `http://www.sec.gov/News/Speech/Detail/Speech/1370540677500`.

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[3] The original scope of this regulation was limited to large companies, but this qualification was removed in the final version approved by Congress, and the scope was extended to include all publicly traded stocks.

time, in an *Initial Public Offering* (IPO). The Act requires that all communications between the company and the Securities Exchange Commission (SEC) in regards to the IPO be made available to the public; it also establishes minimum time periods between different phases of the IPO, which are meant to give potential buyers ample opportunity to scrutinize the information made available by the company. Analogous legislation was enacted in Australia, Canada, France, Germany, Holland, India, Italy, Japan, South Africa, Turkey and the United Kingdom.

In the context of the economic slowdown of 2009-2011, with a decline in IPOs and mergers and acquisitions, concerns arose about the inability of small companies to raise the equity needed to fund the start of their economic activities.[4] In response to this concern, the U.S. Congress approved the *Jumpstart Our Business Startups (JOBS) Act*, which was signed into law in April 2012. This act substantially eases the securities regulations for small companies going public: it lightens the reporting requirements, reduces the time to be maintained between the planning and the actual occurrence of the IPO, and permits confidentiality of the communications between the company and the SEC, including the company's intention to issue an IPO and information about its finances, until just before shares are sold. Perceived by some as a "historic turning point,"[5] the intent of this change in the regulatory framework is not only to make it easier for companies to go *public* in an IPO process, but also to enhance the ability of smaller business to raise capital in *private* markets through *crowdfunding*, subject to even lighter regulation.[6] The rationale has been that forcing small firms to engage in extensive information disclosure was detrimental to their funding, particularly for young, high-growth companies seeking capital from the public market, and for small startups looking for financing in the private market in a rapid manner. Apart from receiving bipartisan support in Congress, the bill was widely supported by the National Venture Capital Association, many startup founders, investors and entrepreneurs.

At the same time, the JOBS Act has been criticized by state regulators and investor advocate groups,[7] who argue that the practice of less information disclosure will not only decrease investors' welfare, but thereby also reduce their willingness to invest and, hence, the value of

[4] After peaking in 1997, with 8,823 exchange-listed companies, public company listings in the United States declined for 15 consecutive years to only 4,916 companies at the end of 2012 (Weild, Kim and Newport, 2013).

[5] Harvard Law School Forum on Corporate Governance and Financial Regulation, `http://blogs.law.harvard.edu /corpgov/2014/01/15`. The JOBS Act has been called "a potential game-changer" for startups by President Obama; "the start of what promises to be a period of transformative change in capital formation" by SEC Chair White; and "the most significant change to United States federal securities laws for developing companies in modern history" in a report for OECD by David Weild IV (former Vice-chairman of NASDAQ), Edward Kim and Lisa Newport.

[6] The U.S. private markets already provide larger access to capital than the public ones. In 2013, capital raised in public offerings totaled \$1.3 trillion, in comparison to \$1.6 trillion raised in offerings not registered with the SEC.

[7] Including the American Association of Retired Persons, or AARP, the Consumer Federation of America, the Council of Institutional Investors, the North American Securities Administrators Association, and Americans for Financial Reform.

equity ultimately raised by the issuing firms.

To a large extent, these criticisms are consistent with the existing literature. The arguments based on the classic information unraveling mechanism suggest that the easier provisions of the JOBS Act would not be of benefit to firm financing through issuance: a potential buyer would interpret the limited disclosure of information as an indication that the firm is of low value, which would in turn lower his willingness to pay.

Main results

The message of this paper is that these criticisms are excessively pessimistic and, in fact, the provisions of the new legislation are in line with their intentions. To begin, the unraveling mechanism is not of first order: the very nature of the innovations and startups explicitly targeted by the JOBS Act is that the seeking of financing occurs at an early, often experimental stage of project development, when uncertainty about the return is faced by both investors and entrepreneurs. Information gathering by entrepreneurs themselves requires a certain advancement in project development. Thus, the canonical information asymmetry in which the 'quality' of innovation (or the state of the world) is known to one of the parties is largely absent at the funding seeking phase. Indeed, the *ex-ante* risk involved in the innovator's ability to generate equity value by building a company, and not just to deliver the product, is seen as the main characteristic of equity-based crowdfunding, relevant to our analysis, compared to nonequity (reward-based or donation) crowdfunding (Agrawal, Catalini and Goldfarb, 2014).

We present three sets of results. We first show that as long as the investors differ in their risk sharing needs but have the same utility over consumption, with convex marginal utility, the SOX Act, in fact, *minimizes* the amount of capital that the issuer can raise in the issuance, for a fixed business scale. The key mechanism is that full disclosure lowers the (convex) *average* marginal utility of income across investors, state by state. With less disclosure, instead, investors typically cannot share their risks perfectly, which opens a wedge between their wealth levels. The resulting increase in the average marginal utility across investors takes place in all states of the world, at least weakly, so (the pricing kernel of) the firm's price in the market for investors increases. We show that *any* partial disclosure is, hence, preferred over full disclosure by a firm seeking financing, for a large class of firm objectives encompassing all non-risk-loving behaviour.

Apart from the effectiveness in raising capital, a major concern of the JOBS Act's critics has been efficiency and investor welfare — a concern due to the limited transparency permitted by the Act and the high riskiness of the businesses it intends to promote.[8] The second finding

[8] Investor protection was a key notion for many state regulators in opposing the new Regulation A+ in the JOBS Act (see Appendix A) and blocking the usage of pre-existing Regulation A — practice that excluded entire industries from taking advantage of Regulation A, such as biotech, which generates little if any revenue in the early years and expects to be profitable only after 3 to 5 years, and high-tech development-stage companies. Numerous businesses, including Apple Computer, were denied financing this way. In fact, major grounds for the

of the paper suggests that, when applied appropriately to small and large firms, less stringent requirements on information gathering and disclosure are not only consistent with the objective to facilitate raising capital, but may also benefit the investors. Our argument has two parts. We first show that by affecting the investors' *ex-ante* risk sharing needs and, hence, willingness to pay, any limitation on information to investors also *alters the marginal expected revenue function of the entrepreneurs.* A key insight is that this marginal revenue effect differs at small and large business scales. Limited disclosure raises more capital than stricter disclosure requirements for small-scale (i.e., high-marginal-cost) firms, whereas disclosing *more* may be the preferred choice by large-scale (i.e., low-marginal-cost) firms. In addition, with non-decreasing marginal cost of innovation, limited disclosure encourages greater innovations (firm size) from small firms than full disclosure does. Furthermore, the larger firm size is more efficient, as defined by maximization of investors' *ex-ante* welfare.[9] Likewise, large innovations can be greater and more efficient under strict disclosure requirements. By recognizing that the disclosure policy transforms the firms' marginal revenues and indirectly impacts the choice of business scale, our analysis suggests that the new financing framework exploits the *differential* impact of disclosure between small and large firms in a way that can be Pareto-improving. This qualifies the negative conclusion about strict disclosure — which continues to apply to large firms in the new financing framework — that one might draw from the analysis for a fixed business size. Indeed, along with the SOX Act, the financing options introduced by the JOBS Act design a regulatory model allowing for *limited disclosure that scales with business size*; we review these options (crowdfunding, IPO On-Ramp and Regulation A+) in Appendix A.

We show that the benefits of limited disclosure for small enough firms hold so long as investors' marginal utility is convex (essentially, absolute risk aversion is decreasing in wealth). A sufficient condition for large enough firms to prefer full disclosure is that investors dislike fat tails.[10]

Third, two properties of the optimal disclosure strategy we establish shed light on other debated aspects of the JOBS Act. We show that, even without accounting for the additional effect of disclosure on the business scale, lifting the mandate of full disclosure does *not* imply that (small or large) firms will necessarily choose maximal withdrawal. In general, firms will benefit from providing investors with some information — the value of information is not monotone in

SEC's non-participation (under its prior Chair) in creating the federal legislation of the JOBS Act and in its lack of support of crowdfunding for profit was the perceived inconsistency with the Commission's obligation to protect investors.

[9] Equating investor protection with maximal transparency used to be the traditional view at the SEC. Our analysis offers support to an apparent shift away from that view (`https://www.sec.gov/News/Speech/Detail/Speech/1370540677500`).

[10] Let us remark that the Act also scales the investments allowed in firms of certain size, imposing a limit on investments in small firms and accreditation requirements for investors in large firms. An implication of decreasing absolute risk aversion is that the differential-with-scale disclosure framework aligns investments of small investors, whose capacity to bear risk is lower with small firms and larger investors, whose capacity to bear risk is greater, with large firms.

disclosure. Additionally, we show that a policy that requires firms to disclose detailed information about *losses* and only the fact that it is not losing money in states with positive returns would be preferred by firms to one that reveals all information in states where the firm makes positive profits and only that profits will not be positive when the firm loses money. This, too, follows from the investors' convex marginal utility: with absolute risk aversion decreasing in wealth, the equilibrium price (hence, the firm's funding) is affected more by more detailed disclosure of negative vs. positive returns. To highlight one implication, if investors are not protected by limited liability so that returns can be negative, when firms choose to disclose some information, they will tend to commit to disclosing information about losses rather than high returns. This contrasts sharply with the classic "good news/bad news" result in asymmetric information environments.

These two results also suggest that, insofar as the arguments concerning investor protection intrinsically value that a certain degree of transparency be preserved, a regulation that requires the firm to disclose some information, if or when they have it, can be aligned with the incentives of capital-seeking firms. Furthermore, so can a regulation mandating that investors be informed about any losses, as is often deemed appropriate for investor protection. In this sense, the disclosure requirements are self-enforcing, which indicates a low regulatory monitoring burden.

The key economic mechanism that this paper highlights as relevant in the design of the financing framework is that disclosure policy can be an effective instrument in impacting firm financing, incentives and welfare *even absent inference effects*. The mechanism through which limited disclosure can increase capital raised operates by introducing less than full risk sharing among investors. While this conflicts with efficiency for a fixed size of innovation, efficiency may improve in the Pareto sense when the effect of information disclosure on the size of innovations is recognized. The results hold for any distributions of firm returns and distributions of investors' wealth, and, thus, demand little knowledge from regulatory bodies. Our results are developed for a single firm whose asset is traded by competitive investors and continue to apply with multiple entrepreneurs who strategically choose disclosure. The conclusions hold regardless of other assets traded by the investors, even if investors can insure against the shocks of the firm, as long as they cannot insure against all — if they could, disclosure would be irrelevant. To the best of our knowledge, the strong predictive link between the behaviour of risk aversion (the convexity of marginal utility) and the effects of changes in information (partition) is new. That the convexity matters reflects that imperfect risk sharing affects the market's valuation of the asset.[11]

[11] The utility functions most common in economic models (e.g., CARA, CRRA, logarithmic) have globally convex marginal functions. If the marginal utility function were linear, imperfect risk sharing would have no impact on the equilibrium price of the asset, which would depend on the *average consumption* alone; disclosure of any events would have no effect. Let us also note that the convexity of marginal utility matters for the implications of information disclosure through the heterogeneity in marginal utilities *across* investors and in *every* state. This differs from the precautionary saving motive, operating through the *individual* optimization effects of marginal

Finally, as we have argued, analysis of early stage financing requires a model in which asymmetric information among the parties need not be present. Our model captures the impact of information through the coarseness of the partition over the states of the world rather than asymmetric information over these states. The model presents a new application of the class of games in which players' strategies are spans, introduced by Carvajal, Rostek and Weretka (2012), who did not study information-related questions or welfare. Our analysis of efficiency contributes to other applications in this class of games. Additionally, our results demonstrate that economic implications of information changes that occur through the coarseness of the (symmetric) partition over the set of states are distinct from those based on asymmetric information about the likelihood of the states. In particular, the canonical results of unraveling and "good news/bad news" (the incentive to reveal good news and withhold bad news; Milgrom, 1981) do not play a role. Instead, the following general results hold: (i) there are incentives to disclose detailed information (i.e., fine partition) on states with negative return and coarse information on states with positive returns; (ii) full disclosure is suboptimal, holding the quantity (firm size) fixed; but (iii) disclosure that increases with quantity can be preferred by all parties. We assume that investors' wealth and project return are defined over the same set of states, so our results do not rely on informational asymmetries in this sense either.

Related Literature

The idea that less information can make agents better off has been recognized at least since Hirshleifer (1971). The economic mechanism we present differs from the Hirshleifer effect — i.e., that uncertainty helps risk sharing. In our setting, investors would benefit *unambiguously* if information were to be disclosed fully. Furthermore, the argument that agents can benefit from *ex ante* uncertainty would not suffice to explain strict disclosure requirements for large firms in the new financing framework.

Important lessons concerning the impact of information disclosure have come from the theory based on *asymmetric* information. In particular, the influential strand of literature on *persuasion games* examines how, in an attempt to benefit from privately known information, the informed party manages the disclosure of these facts (Grossman and Hart, 1980; Milgrom and Roberts, 1986; Shin, 2003; Kamenica and Gentzkow, 2011; Che, Dessein and Kartik, 2013; and Gentzkow and Kamenica, 2014).[12] As we have argued, though, the adverse selection effects between the investors and the firm do not bind for early-stage financing, given that the information about return is limited on the part of entrepreneurs seeking funding and investors alike.[13] Likewise, the

utility differences *across* states.

[12] Milgrom (2008) offers an early review of this literature.

[13] Or, these effects are only part of the challenge in designing a regulatory framework for capital access, for which, familiar institutional solutions are available. In fact, the screening measures stipulated in the JOBS Act apply to investors, in terms of their capacity to bear risk, rather than to firms (other than large businesses).

moral hazard effects of improved incentives through disclosure that ties stock prices to managerial actions and, thus, enhances investment efficiency at the firm level (e.g., Fishman and Hagerty, 1989) are less likely to play a role at the stage where the information about return needed for structuring incentives is unavailable.

In the past decade, some authors have discussed the potential welfare-reducing effects of disclosing public information about fundamentals, when agents learn from public (price) and private signals (e.g., Morris and Shin, 2002; Angeletos and Pavan, 2007; and Amador and Weill, 2010). These arguments, too, explore inference and coordination externalities among investors when information is asymmetric among the investors.[14]

In the context of the economic crisis, several authors have put forward new arguments according to which less transparency ensures more *market liquidity*. Pagano and Volpin (2008) and Dang, Gorton and Holmstrom (2009) suggest that security design itself may give rise to adverse selection and shut down trade. Morris and Shin (2012) argue how market confidence, defined as approximate common knowledge, can shut down trade in the presence of adverse selection. The closely related discussion of regulatory reforms regarding transparency has pointed to trade-offs between providing accuracy and commonality of beliefs (Morris and Shin, 2007; Holmstrom, 2009). Again, all these effects of asymmetric information, either direct or through higher-order beliefs, are absent in our analysis and, to the extent that they are more relevant for the risky, small firm innovations covered by the JOBS Act, would strengthen our conclusions.[15]

Broadly speaking, the problem we study is one of information design: the information to be made available in the market is chosen *ex ante* (i.e., when information is *symmetric* across agents). While the recent and growing literature on information design (referenced in Gentzkow and Kamenica, 2014) focuses on the strategic effects of information through beliefs, this paper develops market-based (risk sharing) implications of information through allocations.[16]

[14] A major advantage of crowdfunding is seen in 'leveraging the wisdom of the crowd.' Low communication costs via online platforms facilitate information gathering and progress monitoring for funders, also enabling them to participate in the very development of the idea. In any case, the mechanisms deriving from the information dispersed among investors, as proposed by these authors, would reinforce our conclusions.

[15] Let us note that the asymmetric information considerations – adverse selection, moral hazard and, in a game-theoretic jargon, persuasion and pandering – continue to shape the new regulatory framework through the strict disclosure, audit and reporting requirements for financing of large businesses going public, or medium size firms beyond their exemption period. One insight from our results is that the financing benefits from more complete disclosure for large businesses suggest that at the stage of company development when entrepreneurs will have gained knowledge about returns, taking measures against adverse selection or moral hazard can be self-enforcing.

[16] The main results in Kamenica and Gentzkow (2011) suggest that if the value function of the sender is convex in the belief of the receiver, then information disclosure creates a dispersion in posterior beliefs, which benefits the sender (since the concavification lies strictly above a convex value function). This paper argues that, with convex marginal utility, the value function of the sender is convex in the allocation; full information disclosure minimizes the dispersion in the allocation, which minimizes the benefit of the sender.

1. The Setting

Let us consider an information disclosure problem in a monopolistic model with a firm, competitive investors, and an investment bank who interact over three periods, $t = 0, 1, 2$.

In period 0, the firm wishes to raise capital to fund the research and development (R&D) phase of an investment project. The outcome of this project — namely, the firm's return in period 2 — is *ex-ante* uncertain. Denote by $\mathcal{S}$ the finite set of states and for each $s \in \mathcal{S}$, let r_s be the return in that state. There is a commonly held prior belief, $\Pr(s) > 0$, that state s will occur.

There are $I \geq 2$ classes of investors, indexed by $i = 1, \ldots, I$. We assume without loss that each of these classes is of equal, unit mass. They differ in their future wealth: investors of type i have an income w_s^i in period 2, when the state is s. In particular, after trading in all other existing assets, the investors' wealth and the project's return can be correlated.[17] We will assume that no other assets are traded until Section 5.1.[18] Investors are risk averse and given wealth x in period 1 and uncertain wealth $(x_s)_{s\in\mathcal{S}}$ in period 2, their *ex-ante* utility is

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

We assume that function u is twice continuously differentiable, strictly increasing and strictly concave, and satisfies the standard Inada conditions. Throughout, 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.

In period 0, the firm receives liquidity from a risk-neutral investment bank. These funds represent the amount that the bank and the firm agree upon in the underwriting contract,

[17] Indeed, otherwise, there would be no basis for equity-based investment. Incidentally, much of the funding collected via crowdfunding platforms comes from investors within the same economic and business communities as the entrepreneur, in particular during the early stages of the project's development. Despite transactions occurring online, the average distance between the lead venture capitalist and the project seeking funding is approximately 70 miles. Similarly, investors who provide capital for a business start-up in exchange for convertible debt or ownership equity, often known as *angel investors*, are typically located less than half a day of travel from the business they fund (Sohl, 1999; Stuart and Sorenson, 2005; Wong, Bhatia and Freeman, 2009; and Agrawal, Catalini and Goldfarb, 2011). When each category of funding is considered independently, geographic concentration is even higher in *all* categories than it is in the aggregate (Mollick, 2014). In addition, often being potential users, investors are attracted by having early access to the product.

[18] 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 a riskless asset, in which case one would like to impose that for all investors i and i',

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

Our results remain unaffected by this assumption.

discounted at a risk-free interest rate, $\bar{r}$.[19] Once the R&D stage is completed, at date 1, the firm privately learns the realized state of nature, after which the underwriting investment bank sells the firm's stock to investors.

1.1. Information Disclosure and Liquidity

As allowed by the JOBS Act, the firm *chooses* how much of its private information to disclose before selling of its asset takes place. While the firm need not disclose all its information, its statements are assumed to be verifiable and cannot mislead the market about the return of its investment project. For this, we assume that, after realizing state s, the firm announces an event $E \subset \mathcal{S}$ such that $s \in E$. For all agents, the prior belief over event E is $\Pr(E) = \sum_{s \in E} \Pr(s)$. With this information, the asset of the firm is traded in a competitive investor market.

When choosing one of the financing options of the JOBS or SOX Acts, the firm commits to respecting associated with it disclosure requirements. Under the provisions of the existing regulation, the firm can use the investment bank as a commitment device. Accordingly, we assume that when the bank and the firm sign the underwriting contract, the firm commits to how it will disclose information to be discovered, captured by a partition, $\mathcal{P}$, of the state space.[20] Then, in period 1, if the firm realizes state s, it will make public the event E of the partition that contains s.[21] Thus, as in the JOBS Act, prices will be event-contingent. The *ex-ante* commitment of the firm to a partition implies that the investors cannot discern any of the firm's private information beyond the event that is revealed: the "unraveling" argument of Milgrom and Roberts (1986) does not operate, and the posterior belief of investors for state s is, simply, $\Pr(s \mid E)$.[22]

[19] E.g., in the most commonly used types of contracts, *firm commitment contract* or the *best effort contract*, the bank guarantees to sell the entire or possible amount at this agreed upon price. Implicitly, we assume that there is a set of competitive risk-neutral investment banks, with free entry to the market, who share the common prior beliefs of the firm and the investors. This is why we assume that the underwriting bank does not extract any surplus, and discount the price at rate $\bar{r}$.

[20] All our conclusions carry over even if not all partitions are feasible or if the choice is dictated by a policy requirement rather than optimization. Also, an alternative way of understanding the choice of a partition does not require this *ex-ante* commitment. That is, suppose that at date 0, the firm chooses how much information it will *gather* to be published in the future prospecti. Then, the R&D phase will consist in finding out the realized *cell* of the partition, but no more. This interpretation may be favoured if information gathering is considered to be costly.

[21] At the risk of being repetitive, note that under the SOX Act, the firm would have no legal choice but to reveal all its private information. Under JOBS, however, this is no longer the case. For instance, 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 an incentive to enforce this contract, and the courts would uphold the penalty.

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We will refer to the case when the firm chooses the finest partition, $\mathcal{P}^* = \{\{s\} \mid s \in \mathcal{S}\}$, as *full information disclosure.* This would be the only option under the SOX regulations. The opposite case, when the firm chooses $\mathcal{P}_* = \{\mathcal{S}\}$, amounts to *no information disclosure.* Any other partition will be referred to as a case of *partial information disclosure.*

The partition chosen by the firm at date 0 will determine the information with which investors trade in period 1. Denote by $p(E)$ the price, to be determined endogenously, when the investors are informed of event E. Foreseeing these event-contingent prices, the liquidity provided by the investment bank to the firm at date 0 is

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

consistent with verifiability. Relatedly, it has become common for the underwriters in IPOs under the emerging growth status to voluntarily impose a contractual research-quiet period. For IPOs that will be listed on a national securities exchange registered with the SEC, this period typically lasts for 25 calendar days following the IPO effective date. This practice comes from the view, shared by many industry participants, that investors ought to be looking at the information provided in the prospectus (Latham & Watkins LLP, 2013).

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Formally, once the firm chooses a partition $\mathcal{P}$, the price of its stock is induced as a random variable p over the state space $\mathcal{S}$: this is the mapping $s \mapsto p(E_s)$, where E_s denotes the partition cell that contains state s.

1.2. The Price of the Firm-Financing Asset

After event E has been announced, if the price of the stock is $\bar{p}$, investor i trades an amount $y^i_E(\bar{p})$ of the stock to solve the following optimization problem

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

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: $\sum_i y^i_E(p(E)) = 1$. The price of its stock is uniquely determined for each event in the partition; hence, the objective function for the firm is well-defined.[26] Let $x(E)$ be the unique maximizer of

$$\max \left\{ \sum_i \sum_{s\in E} \Pr(s \mid E)\cdot u(x^i_s) \ : \ [(x^i_s)_{s\in E}]^I_{i=1} \in X(E) \right\}, \tag{3}$$

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

$$\kappa(E,s) = \frac{1}{I}\cdot \sum_i u'\left(x^i_s(E)\right). \tag{4}$$

Eq. (4) defines a random variable, $s \mapsto \kappa(E_s, s)$, where, as before, E_s denotes the cell in $\mathcal{P}$ that contains s, which will be key in the analysis and which we refer to it as the *pricing kernel.* This is so, because the equilibrium price of the stock satisfies

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

Thus, as in the competitive model, the kernel relates the investors' willingness to pay to price of the firm's asset and is a measure of priced relative scarcity in a state in the asset market created by the monopolist (the firm) seeking financing.

[26] To see this, define $X(E)$ as the set of all period-2 investor wealth levels that may result from the trade of the stock after event E has been announced. That is, $X(E)$ contains all profiles

$$[(x^i_s)_{s\in E}]^I_{i=1} \in \mathbb{R}^{\|E\|\times I} \tag{2}$$

that satisfy the following conditions: (1) for each $s \in E$, $\sum_i (x^i_s - w^i_s) = r_s$; and, (2) for each i, there exists some y^i such that $x^i_s = w^i_s + y^i \cdot r_s$ for all $s \in E$.

1.3. The Firm's Objective

The stated goal of the regulatory change that motivates this paper was to improve the ability of small firms to fund their business start-ups. For that reason, we will assume, for the moment, that the firm ranks partitions according to the liquidity (price distribution) they generate. Namely, the firm with *expected liquidity preferences* prefers $\mathcal{P}$ over $\mathcal{P}'$ if, and only if, the liquidity under partition $\mathcal{P}$ is higher than that under $\mathcal{P}'$, namely[27]

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

With this criterion, the firm prefers a partition that induces a higher pricing kernel.

Lemma 1 (Monotonicity of Firm Preferences). *If the return of the firm is positive in all states of the world, then the expected liquidity preferences are strictly monotonic in the following sense: whenever a partition induces a first-order stochastic improvement in the pricing kernel, relative to that of another partition, the firm strictly prefers the former to the latter.*

2. Fixed Firm Size: Suboptimality of Full Disclosure

Our first main claim is that when the firm has expected liquidity preference (and is, hence, risk neutral), then its least preferred information disclosure strategy is the one imposed by the SOX regulation: *any* partial disclosure partition will be preferred to full disclosure. The key mechanism is the relation between information disclosure and the pricing kernel, which the following proposition establishes to hold in the strong sense of the first-order stochastic dominance.

Proposition 1 (Suboptimality of Full Disclosure). *Suppose that the return of the firm is positive in all states of the world. If the firm has expected liquidity preferences, then any partition that discloses no or only partial information is strictly preferred to the full disclosure partition, generically in the investors' wealth profiles. For all wealth profiles, all partitions are at least as good as the full disclosure partition.*

The intuition behind this result is not obscure. In the full information partition, the firm eliminates all risk present during asset issuance, so the investors trade the stock only because it provides riskless savings rather than risk sharing. Then, all investors have the same wealth *ex post*.[28] Instead, if a partition discloses less information, some risk remains at issuance. Generically, the investors will be unable to use the firm's equity to trade away the remaining risk,

[27] With risk-neutral investment banks, it is immaterial whether the firm gets the loan at date 0, or if it wants to maximize its expected value at time 1. This is why we can refer to this relation as *expected* liquidity preferences.

[28] That is, for all s, $x^i_s = x^j_s$, for all i and all j.

and, consequently, they will not all have the same *ex-post* wealth in at least one state. Since the marginal utility of wealth is convex (the utility function displays decreasing in wealth absolute risk aversion), this dispersion in wealth will increase the average marginal utility of investors in that state.

Proposition 1 shows that the firm prefers any disclosure that allows only partial information over full disclosure. This holds for all distributions of investor wealth and not just in expected terms. Notably, the issuer does not need to know the wealth profiles of the investors in order to determine that full disclosure is suboptimal. We will show below that Proposition 1 applies to a general class of firm preferences that includes essentially any form of non-risk loving behaviour.

Let us highlight additional properties of the optimal disclosure: Note that Proposition 1 asserts that the full disclosure partition is the least preferred one, but does not imply that disclosing no information is the optimal decision of the firm, if they have information, or that acquiring none is. The first-order stochastic kernel dominance of Proposition 1 does not necessarily hold for finer partitions. It is easy to show that with more than two states, the partition that discloses no information need not be optimal; e.g., if $S = \{1, 2, 3\}$, it can happen that $L(\{\{1, 2\}, \{3\}\}) > L(\{\{1\}, \{2\}, \{3\}\})$. Furthermore, note that it follows from our results that in its optimal partition, the firm will fully disclose *at most one* contingency (state). Otherwise, when combining any two singleton states in the same event, the pricing kernel would increase in the first-order stochastic dominance sense. Intuitively, whether a contingency will be disclosed depends on the heterogeneity in the distribution of investors' wealth, i.e., how they correlate with the returns of the firm.[29]

With two states, it follows, no contingency will be disclosed. Formally:

Corollary 1 (**Optimality of no disclosure when there are only two states**). *Suppose that there are only two states of nature, and that the return of the firm is positive in both of them. If the firm has expected liquidity preferences, the optimal disclosure strategy for the firm is the partition that reveals no information. Generically in the investors' wealth profiles, this strategy is strictly preferred to the one that reveals the states of the world.*

[29] Precisely, suppose that the optimal choice of the entrepreneur is $\mathcal{P} = \{E_1, \ldots, E_N, \{S\}\}$, so that state S is the contingency that is fully disclosed, when realized. A necessary condition for optimality is that for all $n \leq N$:

$$\sum_{s \in E_n} \Pr(s) \cdot [\kappa(E_n, s) - \kappa(E_n \cup \{S\}, s)] \cdot r_s \geq \Pr(S) \cdot [\kappa(E_k \cup \{S\}, S) - \kappa(\{S\}, S)] \cdot r_S,$$

which can be expressed as

$$\sum_{s \in E_n} \frac{\Pr(s)}{\Pr(S)} \cdot \left[\sum_i u'\left(x_s^i(E_n)\right) - \sum_i u'\left(x_s^i(E_n \cup \{S\})\right) \right] \cdot \frac{r_s}{r_S} \geq \sum_i u'\left(x_S^i(E_n \cup \{S\})\right) - \sum_i u'\left(x_S^i(\{S\})\right).$$

The right-hand side of this inequality is strictly positive, generically in investors' wealth.

3. Disclosure and the Scale of the Firm

In the previous section, we held fixed the size of the firm. However, since the more lenient information disclosure requirements of the JOBS Act apply only to small businesses, the disclosure exemptions introduced in the new regulatory framework may impact the choice of business scale. We examine this impact from the perspective of capital raised and investor welfare. We show that the limited disclosure and reporting permitted by the JOBS Act may increase capital raised by small and large firms, induce *larger* investments and benefit prospective investors.[30]

3.1. Disclosure and the Marginal Revenue of the Firm

Consider a market with two equally likely states of the world and two (classes of) investors, who have cardinal utility $u(x) = \ln(x)$ and incomes $w^1 = (2, 1)$ and $w^2 = (1, 2)$, respectively. Suppose that the firm's project is riskless, but can be undertaken at different scales: if the business scale chosen is K, the return is $r = (1, 1) \cdot K$.[31] The cost of undertaking a project of scale K is $c(K)$, which is increasing and convex in the scale.

At date 0, the firm chooses both the scale of the project and the information partition it will follow. While the investment cost is independent of the partition chosen by the firm, the revenue from the asset issuance depends on both of those decisions. We can treat the price p as corresponding to each "unit of scale" of the project, so that we can write the revenue as $R = p \cdot K$. 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 $(x^1_s, x^2_s)_{s\in E}$ such that: (i) for each state $s \in E$, $(x^1_s - w^1_s) + (x^2_s - w^2_s) = K$; and (ii) for both investor classes i, there exists y^i such that $x^i_s = w^i_s + y^i$ at all $s \in E$. Here, y^i is the number of units of investment purchased by i, each paying 1 unit of revenue in each state of the world. The first condition simply says, then, that the whole project is sold: $y^1 + y^2 = K$. The investors' allocation, given an event and a scale, continues to be characterized by optimization problem (3), and the pricing kernel of Eq. (4) holds, with the pricing equation written as

$$p(E; K) = \sum_{s\in E} \Pr(s \mid E) \cdot \kappa(E, s; K). \tag{6}$$

Under full disclosure, the state of the world is reported to investors before trade. In equilibrium, investors will have the same income *ex post*: the investor who receives bad news will invest one more unit. This implies that

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

[30] Gale and Stiglitz (1989) 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.

[31] This particular specification is borrowed from Example 4 in Carvajal, Rostek and Weretka (2011).

and

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

and the firm's expected revenue from the asset issuance, conditional on the scale, is given by

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

Suppose, instead, that trade occurs under no information disclosure. (An analogous argument can be provided for partial disclosure. For simplicity, we develop the argument with two states, to compare the provisions of JOBS and SOX.) By symmetry, each investor will buy one half of the asset issued, 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

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

and the revenue brought by the issuance is, then,

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

Turning to the optimal business scale, it is immediate that, for any given scale of the project, the revenue under no disclosure is higher. Nevertheless, how the *marginal* revenue changes is *not* independent of the scale. As a result, the regulatory frameworks under full and no disclosure differ in their impact on the entrepreneurs' incentives at the margin and, consequently, give rise to different choices of the optimal firm scale.

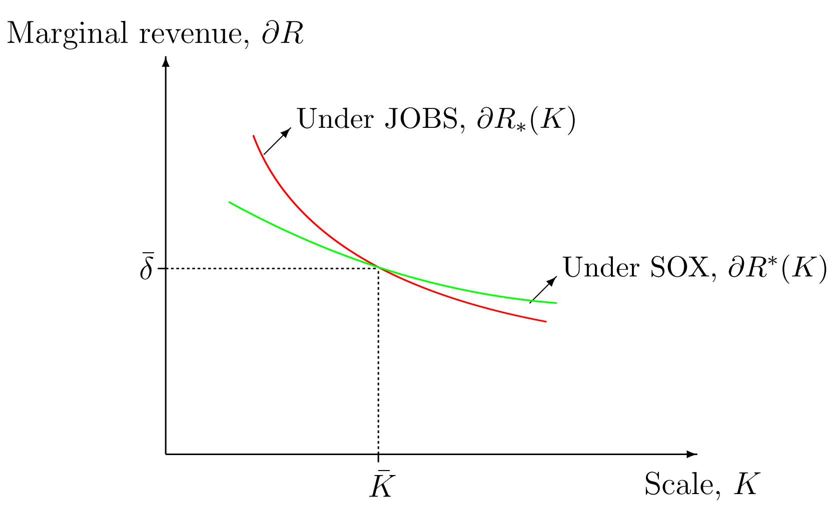

Figure 1: *Marginal expected revenue as a function of the scale of the project, under full disclosure and under no disclosure.*

Figure 1 depicts the entrepreneur's marginal revenue functions under both regulations. Marginal revenue under no disclosure dominates that under full disclosure, for all project scales below a certain threshold, $\bar{K}$. For either regulation, the optimal scale is determined by equalization of the induced marginal revenue with the entrepreneur's primitive marginal cost, which is nondecreasing. To illustrate, when the cost function is linear with marginal cost $c > 0$, if $c > \bar{\delta}$, the optimal scale will be larger under no information disclosure than under full disclosure. The larger investment scale, induced by the more profitable issuance under no disclosure, can offset the detrimental welfare effect of the distortion in efficient risk sharing due to uncertainty. In turn, a firm with sufficiently small marginal costs, $c < \bar{\delta}$, would choose a smaller business scale when issuing under no disclosure, compared to full disclosure. *Stricter* disclosure requirements, therefore, enhance efficiency for large businesses.

These conclusions are not specific to the example above. Proposition 2 gives sufficient conditions for the scale effect. To elaborate further on the economics behind the scale effect on the marginal revenue, let us write the revenue function as

$$R(K;\mathcal{P}) = \sum_{s\in S} \Pr(s) \cdot \kappa(\mathcal{P}, s, K) \cdot r_s \cdot K;$$

the marginal revenue, $\partial R(K;\mathcal{P})$ is, then,

$$\sum_{s\in S} \Pr(s) \cdot \left[\frac{\partial \kappa(\mathcal{P}, s, K)}{\partial K} \cdot r_s \cdot K + \kappa(\mathcal{P}, s, K) \cdot r_s\right]. \tag{7}$$

Increasing the scale has two effects on the marginal revenue: a direct *scale effect* and an indirect *price effect*; respectively,

$$\sum_{s\in S} \Pr(s) \cdot \kappa(\mathcal{P}, s, K) \cdot r_s$$

and

$$\sum_{s\in S} \Pr(s) \cdot \frac{\partial \kappa(\mathcal{P}, s, K)}{\partial K} \cdot r_s.$$

The direct effect is positive and decreases with scale while the indirect effect is negative and increases (i.e., becomes less negative) with scale. The marginal revenue also depends on the disclosure requirements: the direct effect of scale is larger under JOBS than under SOX (cf. Proposition 1) whereas, as Proposition 2 shows, if investors also dislike fat tails, the indirect effect is larger (less negative) under SOX than JOBS.

To characterize the indirect (pecuniary) effect of an increase in scale, recall that

$$\frac{\partial \kappa(\mathcal{P}, s, K)}{\partial K} = \frac{1}{I} \cdot \sum_i u''\left(x_s^i(\mathcal{P}, K)\right) \cdot \frac{\partial x_s^i(\mathcal{P}, K)}{\partial K}.$$

This motivates restricting attention to a symmetric market for which $\partial x_s^i(\mathcal{P}, K)/\partial K = 1/I$ for all i, all s, and all $\mathcal{P}$: we maintain the assumptions of the example that there is a market with two equally likely states of the world and two classes of investors of equal mass, with incomes $w^1 = (2,1)$ and $w^2 = (1,2)$. In this market, if u^4 is strictly negative, Jensen's inequality implies that, for a generic set of investors' endowments (defined in the proof of Proposition 1),

$$\frac{1}{I}\sum_i u''\left(x_s^i(\mathcal{P}_*, K)\right) < u''\left(\frac{1}{I}\sum_i x_s^i(\mathcal{P}_*, K)\right) = \frac{1}{I}\sum_i u''\left(x_s^i(\mathcal{P}^*, K)\right).$$

That is, the indirect pecuniary effect is strictly smaller under $\mathcal{P}_*$ (JOBS) than under $\mathcal{P}^*$ (SOX), generically in endowments.

Proposition 2 provides sufficient conditions under which the differential regulation for small and large firms improves efficiency: for small firms (i.e., those with high marginal cost), the lighter information disclosure requirements induce a larger scale. This holds robustly, so long as the investors' marginal utility is convex ($u''' > 0$). If investors dislike fat tails sufficiently, i.e., $u^4 < 0$, it is full disclosure that induces a larger scale for large firms (i.e., those with low marginal cost).[32] Namely, when u^4 is sufficiently negative, the effect of Jensen's inequality on u'' dominates its effect on u', and, hence, the indirect price effect outweighs the direct scale effect in Eq. (7). This is intuitive: just as a condition on the convexity of marginal utility (u''') determines the optimality of full (as opposed to partial) information disclosure given the scale (cf. Proposition 1), a condition on the convexity of risk preferences (u^4) matters for the effect that disclosure has on the marginal revenue.

Proposition 2 (Marginal Revenue and Scale). *In the above symmetric market:*

(i) *There exists a threshold $\underline{K}$ for the scale of the firm such that for all $K < \underline{K}$ the marginal revenue is higher under no disclosure of information than under full disclosure, strictly so for a generic set of investors' endowments.*

(ii) *Suppose that u^4 is strictly negative, and sufficiently so in the sense that there exists a strictly convex, twice continuously differentiable function f, with $f' > 1$ and such that $-u'' = f \circ u'$. Then, there exists a threshold $\hat{K}$ for the scale of the firm such that for all $K > \hat{K}$ the marginal revenue is higher under full disclosure than under no disclosure, strictly so for a generic set of investors' endowments.*

Figure 2 illustrates Proposition 2.

We can now formalize that disclosure requirements that are more stringent at larger scale induce *both* small and large firms to choose a larger scale.[33]

[32] Investors with $u^4 < 0$ tend to exhibit aversion to kurtosis; a risk attitude called temperance — cf. Kimball (1993).

[33] Denote by δ^h (respectively, δ^l), the marginal revenue under SOX (respectively, JOBS) associated with scale $\underline{K}$ (respectively, $\bar{K}$) from Proposition 2. We say that a firm is *small* if its marginal cost is above the threshold δ^h for some K smaller than $\underline{K}$. We say that a firm is *large* if its marginal cost is below the threshold δ^l for some K larger than $\bar{K}$. In other words, to equalize marginal revenue to marginal cost, small firms choose a scale smaller than $\underline{K}$ and large firms choose a scale larger than $\bar{K}$, where $\underline{K} \leq \bar{K}$.

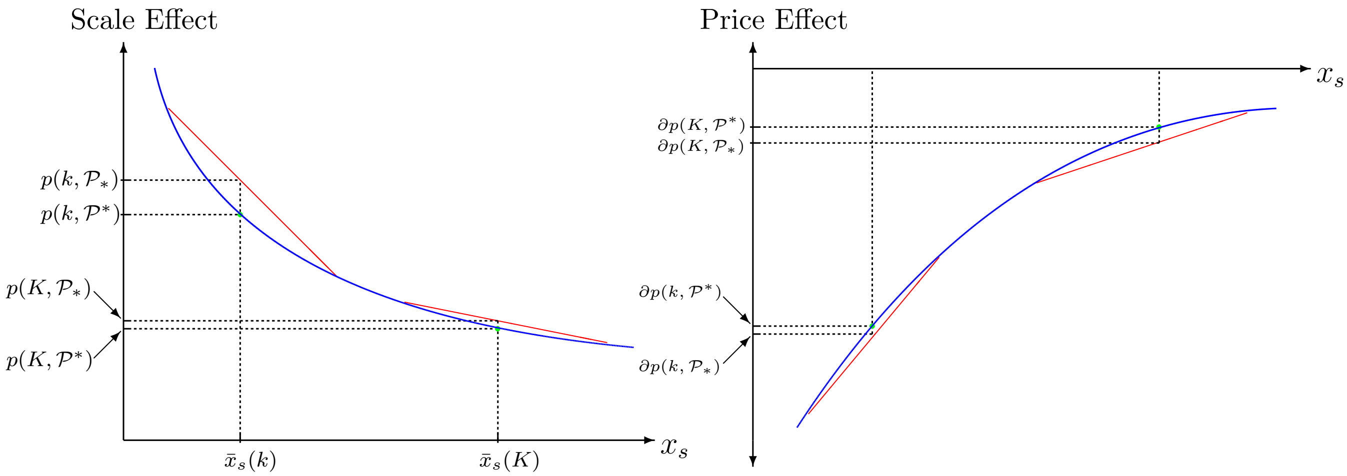

Figure 2: *The effect of differential disclosure and scale on marginal revenue. $\mathcal{P}^*$ and $\mathcal{P}_*$ denote full and partial disclosure respectively, and $k < K$. A marginal unit of scale increases capital raised by the price (scale effect) but decreases the revenue by the decrease in price (price effect) for every unit of the firm. Temperance ($u^4 < 0$) ensures that the price effect is concave: the price is more sensitive to scale when investors face risk. The concavification (f) ensures that the differential effect of disclosure on the price effect does not vanish too fast with scale. Not shown in the picture is that the total price effect on marginal revenue is proportional to the size of the firm since an additional unit of scale decreases the price for every unit sold; this reinforces the domination of the price effect for large firms.*

Corollary 2 (**Differential Disclosure and Scale**). *In the above symmetric market, if the condition stated in Proposition 2 (ii) holds, full disclosure induces large firms to choose a larger scale than no disclosure does, whereas no disclosure induces small firms to choose a larger scale than full disclosure does.*

3.2. Welfare

Information disclosure has the potential to affect investors' ex-ante welfare in two ways: information reduces the risk that investors face (the spanning effect), and, as a by product of this risk reduction, it also dampens the risk-sharing motive (the Hirshleifer effect). This paper focuses on the effect that information has through spanning: with quasi-linear preferences, the Hirshleifer effect is muted. With a muted Hirshleifer effect, the welfare of investors is monotonic in the fineness of the information disclosure, for a given scale of the firm.

It follows from the analysis so far that for a fixed project scale, partial disclosure of information requires investors to face some risk, which promotes capital formation by the firm (cf. Proposition 5). Nevertheless, *while investors face greater uncertainty, the larger scale of the firm is, in* *fact, beneficial for them.*[34] The *ex-ante* efficient scale, given an information partition $\mathcal{P}$, solves the following (information constrained) social planner's problem:

$$\max_{K, x_s^i} \left\{ -c(K) + \sum_i \sum_s \Pr(s) \cdot u(x_s^i) \mid [(x_s^i)_{s \in E}]_{i=1}^I \in X(E) \text{ for } E \in \mathcal{P} \right\}.$$

For a given information disclosure, the *ex-ante* efficient scale, which we denote $\hat{K}$, equalizes the marginal cost to the marginal social benefit of scale (i.e., the average revenue):

$$c'(K) = \sum_s \Pr(s) \cdot \left[\frac{1}{I} \cdot \sum_i u'(x_s^i(K)) \right] \cdot r_s.$$

In contrast, an entrepreneur would choose a scale to equate the marginal cost to the marginal revenue (cf. Eq. (7)), which is the sum of the direct and indirect effects. The direct effect is equal to the marginal social benefit of scale. The indirect pecuniary effect captures the entrepreneur's exercise of market power over the choice of scale. The indirect (pecuniary) effect is negative which, together with the convexity of the cost function, implies an inefficiently low choice of scale $K(\mathcal{P}) < \hat{K}$, generically, for any information disclosure $\mathcal{P}$.[35] In particular, Corollary 2 then implies that $K(\mathcal{P}^*) < K(\mathcal{P}_*) < \hat{K}$ for small firms, whereas $K(\mathcal{P}_*) < K(\mathcal{P}^*) < \hat{K}$ for large firms. That is, JOBS (respectively, SOX) encourages a more efficient choice of scale for small (respectively, large) firms.

We conclude that, with endogenous project scale, while partial disclosure of information leaves risk for investors to face, it promotes a more efficient choice of scale for small firms and promotes capital formation. For large firms, full disclosure of information eliminates the risk investors face while still promoting a more efficient choice of scale, and the total capital raised may still increase.

[34] This effect differs from the one underlying the result of Kurlat and Veldkamp (2013), who also examine the requirements to disclose payoff-relevant information as a measure of investor protection. There, the investors may benefit from higher uncertainty when this results in a higher risk premium and, hence, a less profitable issuance for the firm. Here, increasing the uncertainty of the investors by issuing equity under the JOBS Act is beneficial for the firm and detrimental for the investor, but the larger scale induced by the more profitable issuance can offset this detrimental effect. Moreover, the authors find that whether the welfare impact of mandatory disclosure is detrimental for investors depends on the extent of informational asymmetry and the costs of information, which our result is independent of.

[35] The argument goes as follows: for a given scale and information disclosure, the equilibrium allocations and the solution to the Social Planner's problem coincide. If there were no indirect effect, the choice of scale by the entrepreneur would thus be efficient. The equations characterizing equilibrium allocations and choice of scale as well as efficient scale and allocations are continuous in scale. It follows that the negative indirect effect, together with a non-decreasing marginal cost function, imply that the entrepreneur chooses an inefficient choice of scale.

4. Unlimited Liability: Negative vs. Positive Returns

If the investors are protected by limited liability regulations, the assumption that returns are positive is not very restrictive. We now examine how the possibility of negative return interacts with the firm's preferred disclosure strategy. To allow the returns to be negative in some states and positive in others, suppose that

$$r_1 \geq r_2 \geq \ldots \geq r_{\bar{s}} > 0 > r_{\bar{s}+1} \geq \ldots \geq r_S, \tag{8}$$

and consider 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.

Proposition 3 (**Optimality of Detailed Disclosure of Losses**). *Suppose that the firm generates positive and negative returns, as in Eq.* (8)*. Generically in investors' endowments, the candid partition is strictly preferred by the firm to the braggart partition. For all endowments, the former is at least as good as the latter.*

In fact, for any return distribution, for negative returns, informing investors in detail is preferred by the issuer to informing them coarsely:

$$\kappa(\{1, \ldots, \bar{s}\}, s) \geq \kappa(\{s\}, s) \text{ for all } s \leq \bar{s}, \tag{9}$$

while for positive returns, the opposite is true:

$$\kappa(\{s\}, s) \geq \kappa(\{\bar{s}+1, \ldots, S\}, s) \text{ for all } s > \bar{s}. \tag{10}$$

It follows that when partial disclosure of information (rather than full or none) is optimal for the firm, the firm will tend to commit to disclosing information about losses rather than high returns.

The result that the firm would choose to commit to disclosing detailed information about negative returns and only coarse information about positive returns contrasts with the classic "good news/bad news" prediction (cf. Milgrom, 1981) of asymmetric information models; namely, when information is asymmetric, it is optimal for the seller of a product to test it and reveal "good news," and to withhold "bad news" by not testing the product. In that literature, when missing detailed information, the uninformed buyers reduce their purchases, though to a lesser extent than if they learned actual bad news about the good: the seller can thus benefit from not conducting and reporting verifiable tests.[36]

As in the "good news/bad news" problem, here the "positive return/negative return" news translates into more or less trade. However, here return distributions matter through how they impact risk sharing, and not through the returns' intrinsic value or 'quality.' Unlike the case of value that derives from information, the returns' effect on the average valuation is *ex ante* favorable for the issuer if the negative returns are to be announced in detail. Thus, the auditing, verification and reporting conditions associated with some financing options introduced by the JOBS Act can be aligned with the firms' incentives.[37]

5. Extensions

This section revisits some of the assumptions maintained so far to highlight further the key structure underlying the relationship between disclosure and firm financing. In particular, we allow investors to trade other assets and consider alternative assumptions concerning the firm's objective.

5.1. Trading in Other Assets

So far, the analysis has assumed that the investors only trade the asset issued to finance the firm and that the trade of other assets would not be affected. We now introduce multiple assets and allow investors to insure against the shocks of the firm. Proposition 4 shows that our conclusions continue to apply as long as investors cannot insure against all shocks, in which case disclosure would be irrelevant.

Suppose that other assets can be traded in addition to the equity of the firm, and whose

[36] Similarly, the issuers would not choose to pander — strategically bias disclosed information as conditionally *better*-looking (Che, Desssein and Kartik, 2013) — Proposition 3 holds for any distribution of firm returns and any distribution of the investors' endowments and, if the firms were to exploit the correlation between the returns and wealth distributions to tailor the particulars of disclosure, they would aim for a presentation that *enhances* the riskiness from the investors' perspective.

[37] Reviewing the disclosure practices, the report on the JOBS Act by Latham & Watkins LLP (2013) shows that many firms selecting to use the exemptions under the *emerging growth company* (EGC) status also choose to disclose in the registration statement additional information beyond what is required, even when *not* requested by the SEC Staff reviewing the statement. As the most frequent additions, the report singles out (i) additional risk factors related to the EGC status, such as a warning that the reduced requirements for EGCs could make the issued securities less attractive to investors; (ii) that the issuer's costs from operating as a public company may have increased and these costs will increase further when the issuer loses EGC status; and (iii) that the issuer's exemption from Sarbanes-Oxley's auditor attestation requirements may result in unsuccessful internal controls.

returns are random variables over the same state space. Let there be K such assets, indexed by $k = 1, \ldots, K$, and denote their returns by the random variable ρ^k, so that the return of the k-th asset in state of the world s is ρ^k_s. For simplicity, assume that these assets are available in zero net supply.

The following notation will be useful. Taking all assets as column vectors, define $\rho = (\rho^1, \ldots, \rho^K)$, which we interpret as an $S \times K$ matrix, and let $R = (r, \rho)$ be the $S \times (K+1)$ matrix where the first column is the return of the firm. For this matrix, let $\langle R \rangle$ denote its column span, namely the set

$$\{x \in \mathbb{R}^S \mid \exists y \in \mathbb{R}^{K+1} : R \cdot y = x\}.$$

Also, for any random variable x defined over $\mathcal{S}$ and any event $E \subseteq \mathcal{S}$, let x_E denote the restriction of x to E.[38] We assume that the rank of matrix R is less than S, so that there are revenue transfers across states in S that are not possible using only the instruments in R.

Let $\pi \in \mathbb{R}^K$ denote the prices of the new assets, while p continues to represent the price of the firm's equity. Taking π as a row vector, let $P = (p, \pi)$ represent the complete vector of prices in the market. Similarly, let υ^i denote investor i's demand for the extra assets, while y^i continues to represent her demand for the firm's stock. With υ^i taken as a column, the individual's portfolio will be

$$Y^i = \begin{pmatrix} y^i \\ \upsilon^i \end{pmatrix}.$$

With the new assets, after event E is announced, if the vector of asset prices is $\bar{P}$, investor i trades a portfolio $Y^i_E(\bar{P})$ of the stock to solve

$$\max_{Y \in \mathbb{R}^{K+1}} \left\{ -\bar{P} \cdot Y + \sum_{s \in E} \Pr(s \mid E) \cdot u(w^i_s + R_s \cdot Y) \right\}.$$

Asset prices after the announcement of event E, $P(E) = [p(E), \pi(E)]$, are such that the total equity of the firm is absorbed by the public, while all demands for the other assets are met by corresponding short supply in the aggregate: $\sum_i y^i_E(P(E)) = 1$ and $\sum_i \upsilon^i_E(P(E)) = 0$.

For Eq. (4) to continue to apply, we weaken the second condition of the definition of the set $X(E)$ (Subection 1.2), as follows: (2') for each i, there exist some y^i and some υ^i such that $x^i_s = w^i_s + r_s \cdot y^i + \rho_s \cdot \upsilon^i$, for all $s \in S$. Now,

$$\pi(E) = \sum_{s \in E} \Pr(s \mid E) \cdot \kappa(E, s) \cdot \rho_s. \tag{11}$$

Proposition 4 (**Suboptimality of Full Disclosure**). *Suppose that the return of the firm is positive in all states of the world.*

[38] In particular, R_E denotes the $\|E\| \times (K+1)$ matrix that includes only the rows of R that corresponds to states in event E. For any singleton event, we will still use x_s for $x_{\{s\}}$.

1. *Any partition $\mathcal{P}$ such that for some event $E \in \mathcal{P}$ the rank of matrix R_E is less than the number of states in E raises more liquidity than the full disclosure partition, generically in the investors' wealth profiles. In particular, this is true of the no disclosure partition.*

2. *For all wealth profiles, all partitions raise at least as much liquidity as the full disclosure partition.*

5.2. General Firm Objective

The riskiness of the funding raised is, in practice, a common consideration in the financing process. It is of concern not only to business innovators; often, investment banks are reluctant to take all the risk of an offering and, instead, a syndicate of underwriters is formed. This is relevant even for the smaller firms that qualify for the JOBS Act exemptions (Latham & Watkins LLP, 2013). Let us consider firm objectives that are not invariant to riskiness.

We treat the preferences of the firm as a binary relation $\succsim$ over the set of all partitions of the state space. The firm ranks partitions as a function of how they affect the price (i.e., the distribution of the capital raised by the firm). In particular, a partition that generates a first-order stochastic improvement in the stock price is preferred by the firm. We 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 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 $\mathcal{P} \succ \mathcal{P}'$, with the weak version defined as above.

It follows from the proof of Proposition 1 that its result holds true for any monotonic preference relation, and not just for the expected liquidity preferences. The next result strengthens this insight and shows that the disclosure partition induced by the SOX Act is the least preferred one according to any preferences that are monotonic over information coarsening.

Proposition 5 (**Optimality of Partial Disclosure**). *Suppose that the return of the firm is positive in all states of the world. If the firm's preferences are monotonic in information coarsening, then any partition that discloses no or only partial information is strictly preferred to the full disclosure partition, generically in the investors' wealth profiles. For all wealth profiles, if the firm's preferences are weakly monotonic in information coarsening, all partitions are at least as good as the full disclosure partition.*

With two states, it follows, no contingency will be disclosed. Formally:

Corollary 3 (**Optimality of no disclosure when there are only two states**). *Suppose that there are only two states of nature, and that the return of the firm is positive in both of them. If the firm's preferences are weakly monotonic in information coarsening, the optimal disclosure* *strategy for the firm is the partition that reveals no information. Generically in the investors' wealth profiles, this strategy is strictly preferred to the one that reveals the states of the world.*

5.2.1. Worst-case Scenario Liquidity Preferences

Expected liquidity preferences capture risk neutrality in the firm. A firm seeking financing exhibits extreme risk aversion if it is concerned only about the lowest possible price it could attain in the issuance. That is, denoting these preferences by $\succsim_1$,

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

5.2.2. A Family of Risk Averse Preferences

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

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

is at least as large as

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

Expected liquidity preferences are nested by $\lambda = 0$ and worst-case scenario preferences correspond to $\lambda = 1$.[39] The higher the value of λ, the more weight is given to the worst-case price in the issuance, so we interpret λ as a measure of risk aversion. Denote by Λ the class of all preferences $\succsim_\lambda$, for $\lambda \in [0, 1)$, and let $\bar{\Lambda} = \Lambda \cup \{\succsim_1\}$.

5.2.3. 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 the class of all relations that have such representation, restricting attention to risk averse preferences (using the usual definition of risk aversion). As usual, we say that $\succsim$ has an expected utility representation if there exists a function $v : \mathbb{R} \to \mathbb{R}$ such that $\mathcal{P} \succsim \mathcal{P}'$ when, and only when,

$$\sum_{E \in \mathcal{P}} \Pr(E) \cdot v\left(p(E)\right) \geq \sum_{E \in \mathcal{P}'} \Pr(E) \cdot v\left(p(E)\right).$$

[39] We denote by $\succsim_0$ the expected-liquidity preference relation and use $\succsim$ to denote arbitrary preference relations.

We denote by $\mathcal{V}$ the class of all relations (over partitions) that are representable with a concave and strictly increasing cardinal utility index. Note that $\bar{\Lambda} \cap \mathcal{V} = \{\succsim_0\}$.

5.2.4. Suboptimality of Full Disclosure

The results we have obtained in the previous sections for the expected liquidity preferences extend to a large class of firm preferences, satisfying a mild assumption: the monotonicity of the firm preferences in information coarsening is the key property.

Lemma 2. *Suppose that the return of the firm is positive in all states of the world. Then:*

(i) *The worst-case scenario preferences are weakly monotonic over information coarsening;*

(ii) *All risk averse preferences in class Λ are monotonic over information coarsening; and*

(iii) *All preferences that admit an expected utility representation with concave and strictly increasing utility index are monotonic over information coarsening.*

Then, the prediction about suboptimality of full disclosure from Proposition 5 holds.

Proposition 6 (General Optimality of Partial Disclosure). *Suppose that the return of the firm is strictly positive in all states of the world. For any preferences in classes Λ and $\mathcal{V}$, any partition that discloses no or only partial information is strictly preferred to the full disclosure partition, generically in investors' wealth profiles.*

For all the preference relations in classes $\bar{\Lambda}$ and $\mathcal{V}$, and for all investors' wealth profiles, any partition that discloses no or only partial information is at least as good as the full disclosure partition.

With two states, disclosing no information is optimal for the firm, strongly so in a generic set of investors' wealth profiles.

More generally, our predictions — for both fixed and endogenous business size — hold for the firm objectives that are affected by ambiguity of returns. Intuitively, the rankings of full disclosure and partial disclosure we have established hold state by state (in particular, the Hirshleifer effect plays no role). Hence, small firm financing can benefit from limited disclosure even if the firm does not know the distribution of returns and not just the realization of the state. The availability of greater financing for large firms under more complete disclosure provides incentives to acquire the knowledge necessary for reporting.

6. Discussion

Since its inception, the JOBS Act has been expected to transform the possibilities for financing. In fact, it already has — through the considerable volume of public and private financing that opted for exemptions provided by the Act.[40] While the new legislation was prompted by the objective to stimulate job creation in a post-crisis economy, the JOBS Act — the first major change in securities regulation in eight decades — is seen as modernizing the financing of innovation by taking advantage of the possibilities previously unavailable for raising capital.[41] [42]

This paper shows that the investors' risk sharing motive itself offers support to the Act's (i) *weakening* disclosure requirements of small companies and (ii) *differential* regulation of disclosure for small and large companies. While prices are determined in the competitive investor market, by altering the marginal revenue of investors, the choice of disclosure (i.e., the choice of one of the financing options of JOBS and SOX) along with business scale jointly determines the firms' ability to *de facto* affect the equilibrium price and, thus, capital raised. Our analysis suggests that the contingent-on-size disclosure framework of the JOBS Act encourages firms to use this form of market power (without allowing price setting) in the market for a firm's equity in a way that is consistent with improving efficiency, in contrast to the pre-JOBS regulation.

When applied to the specific provisions of the JOBS Act, our analysis thus suggests that the logic of lighter disclosure for small or high-growth, high-risk businesses, and stricter disclosure for large projects appears consistent with the goals of the regulatory change, with respect to (1) efficiency, (2) effectiveness in raising capital, and (3) investor protection, the three statutory missions of the SEC:

1. (Efficiency) Lighter disclosure for small firms (efficiently) increases their scale (cf. Figure 1 and Proposition 2). In addition, the *contingent on the scale* exemptions from strict disclosure (Regulation A+ and IPO On-Ramp) incentivize innovative companies with high growth potential to aim to develop a larger business scale (or create an option which can be foregone during a certain period) by allowing them to raise initial capital under lighter disclosure and then change their status, as appropriate for larger companies, subject to stricter disclosure.

[40] Looking just at Title I provisions, over 90% of companies that publicly filed their first registration statement during the first year after April 5, 2012 chose at least one accommodation offered by the JOBS Act. Especially popular is confidential submission — approximately 65% of those confidentially submitted at least one draft of a registration statement prior to public filing (Latham & Watkins LLP, 2013).

[41] The majority of small companies view accessing new investors to raise capital as their biggest challenge (`http://money.cnn.com/2014/01/07/smallbusiness/crowdfunding-investments`). For the past 80 years, any public announcement by a startup that they were seeking investment — be it at speaking engagements, through videos, or via a post on their website or social networks — was deemed illegal by Rule 506 of Regulation D and Rule 144A of the Securities Act of 1933. Title IV, approved on March 25, 2015, lifted the solicitation ban with respect to unaccredited (as well as accredited) investors, subject to limitations on their investment.

[42] The Act legislates and leverages the usage of communication technology for private capital markets, allowing investment firms to go digital and use the Internet to crowdfund new companies and take advantage of the speed and lower search costs online to match and communicate with potential investors. Internet platforms connect accredited investors to startups who need their capital, and verify their accreditation status.

2. (Firm financing) The exemptions increase the capital raised for small and high-growth companies and may also increase capital for large firms (cf. Propositions 1 and Proposition 2).

3. (Investor welfare) Lighter disclosure requirements for small firms increase investors' welfare, despite *greater* uncertainty (Section 3.2). To ensure investor protection, the financing options maintain restrictions on individual investment caps to limit individual risk exposure.[43] In light of our model, implicitly, the differential disclosure framework endogenously aligns investors' risk capacity and the size of businesses by scaling investment and accreditation restrictions. Subject to accreditation, the framework allows investors with large incomes and less convex u' (greater capacity to bear risk) to make large investments in larger firms, while imposing disclosure to incentivize large investments for financing these large firms. Small firms are financed with investments from lower-income investors and more convex u' (lower capacity to bear risk) who are subject to small-investment restrictions.

Additionally, the financing framework in which disclosure and investor protection scale with business size changes the market structure for financing by leveraging capital potential that may otherwise not be available, or utilized. Namely, crowdfunding, along with the recent extension of business financing to unaccredited investors, gives rise to a *private* market with a new asset class and a new investor class for early stage investment.[44]

Appendix A: Some Details of the JOBS Act and Our Results

The new financing options introduced by the JOBS Act are:

- *Crowdfunding*: This option enables financing through a large number of small investors in the private market, with light disclosure requirements for small businesses — up to \$1 million in equity.

- *Regulation A+*: This option offers disclosure exemptions for financing through the public market that are *contingent* on the scale of business for a certain time period. It increases the equity dollar ceiling from \$5 million to \$50 million, and lowers the regulatory cost burden, at the cost of additional reporting and audit.[45]

[43] Part of the rationale behind legalizing Internet solicitation is the expectation that online technology can help protect investors, by screening purchasers of securities to ensure that risky securities are purchased by investors who can afford the risk. The usage of online platforms also seeks to reduce risk exposure by making funding in small increments economically feasible.

[44] A study by CrowdFund IQ (2013) reports that 58% of all adults in the United States are interested in participating in crowdfunding with the average investment estimated at \$1,300, and the size of the market of unaccredited investors estimated as a multiple of that of accredited investors and venture capital combined.

[45] It aims to improve upon Regulation A, which intended to ease the process of going public for small firms (up to \$5 million in equity). Available for over 20 years, Regulation A was rarely used — a fact attributed to the

- *IPO On-Ramp*: This option makes it easier for young, high-growth firms to raise capital in the public market at an early stage by extending the period that temporarily lowers the cost of accessing the capital markets from 2 to up to 5 years. To "enter the ramp," a company must qualify as an *emerging growth company* — a newly defined class with annual gross revenue of less than \$1 billion in the prior fiscal year. A company "exits the ramp" when it has more than \$1 billion in gross revenue, completes the five-year transitionary period, issues more than \$1 billion in non-convertible debt within a three-year period, or becomes classified as a large accelerated filer (e.g., due to market capitalization starting at \$700 million).

Also scaled across the new financing options are investor restrictions (i.e., individual investment limits based on income, aggregate offering limits, and investor accreditation requirements).[46]

Title I (IPO On-Ramp) of the JOBS Act entitles firms with annual gross revenues of up to \$1 billion to reduced regulatory and reporting requirements. Title II lifts the ban on general solicitation and general advertising. Under review by the SEC is Title III, or the *Capital Raising Online While Deferring Fraud and Unethical Non-Disclosure* Act (CROWDFUND Act), allowing small firms to raise capital from unaccredited investors through crowdfunding. Title IV (Regulation A+) is an exemption from the registration, auditing and reporting requirements mandated by the Securities Act, applicable to *small public* offerings. The SEC Staff Report issued in December 2013 (SEC, 2013) provides a summary of the studies and solicited comments on disclosure requirements, as mandated by the JOBS Act.

Appendix B: Proofs

Proof of Lemma 1: Using Eq. (5),

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

where $E_s^{\mathcal{P}}$ denotes the event of $\mathcal{P}$ that contains s.

It is 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.*

small scale threshold and high regulatory costs. In addition, many states *de facto* prohibited utilizing Regulation A on the grounds of investor protection.

[46] It is understood that many small businesses could not be expected to meet the heightened audit and ongoing disclosure requirements of the new Regulation A+. The JOBS Act left unchanged the pre-Title IV Regulation A for small businesses seeking to raise up to \$5 million in the public market. At the same time, the SEC has solicited another round of comments on increasing the aggregate investment limit above \$1 million for crowdfunding investments.

Proof of Proposition 1: For each state s, let

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

denote the average income realized in period 2 in state s. As defined by Eq. (2), the set of period-2 incomes that can result from trade, $X(\{s\})$, is

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

and we have that $(\bar{x}_s, \ldots, \bar{x}_s) \in X(\{s\})$.[47]

Consider $s, s' \in E$, $s \neq s'$. Suppose that $(\bar{x}_s, \ldots, \bar{x}_s) \in X(E)$. This means that, $w_s^1 - w_s^2 = r_s \cdot (y^2 - y^1)$, for some pair of scalars (y^1, y^2). If, in addition, $(\bar{x}_{s'}, \ldots, \bar{x}_{s'}) \in X(E)$, 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.[48]

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 $(\bar{x}_s, \ldots, \bar{x}_s) \notin X(E)$. Let us denote by W such a generic set.

It is immediate from the quasi-linearity and strict concavity of u that the unique solution to maximization problem (3) for $E = \{s\}$ is $x(\{s\}) = (\bar{x}_s, \ldots, \bar{x}_s)$. By convexity of u', we further have that $\bar{x}_s$ also solves problem

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

It follows that in W, for any non-singleton event E, $\kappa(E, s) \geq \kappa(\{s\}, s)$ for all $s \in E$, with a strict inequality for some. *Q.E.D.*

Proof of Proposition 2: Let W be the generic set constructed in the proof of Proposition5.

(i) For $K = 0$, the direct effect is strictly larger under $\mathcal{P}_*$ (JOBS) than under $\mathcal{P}^*$ (SOX), in set W. Therefore, by continuity of u' and since for any i and s, $u''\left(x_s^i(\mathcal{P}^*, K)\right)$ is bounded below for any $K \geq 0$, there exists a sufficiently small $\underline{K} > 0$ such that the difference in direct effects outweighs the difference in indirect effects for any $K \leq \underline{K}$.

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

[48] Following the remarks in Ft. 18, notice that Eq. $(*)$ in Ft. 18 does not disrupt this argument, so long as u' remains monotonically decreasing.

(ii) Let f be the convex increasing function such that $-u'' = f \circ u'$. Since both u' and f are convex and f is increasing:

$$f\left(u'\left(x_s^1(\mathcal{P}^*), K\right)\right) < f\left(\frac{1}{I} \cdot \sum_i u'\left(x_s^i(\mathcal{P}_*, K)\right)\right) < \frac{1}{I} \cdot \sum_i f\left(u'\left(x_s^i(\mathcal{P}_*, K)\right)\right).$$

It follows that

$$f\left(\frac{1}{I} \cdot \sum_i u'\left(x_s^i(\mathcal{P}_*, K)\right)\right) - f\left(u'\left(x_s^1(\mathcal{P}^*, K)\right)\right) < \frac{1}{I} \cdot \sum_i f\left(u'\left((x_s^i(\mathcal{P}_*, K)\right)\right) - f\left(u'\left(x_s^1(\mathcal{P}^*, K)\right)\right),$$

and therefore,

$$f\left(\frac{1}{I} \cdot \sum_i u'\left(x_s^i(\mathcal{P}_*, K)\right)\right) - f\left(u'\left(x_s^1(\mathcal{P}^*, K)\right)\right) < \left|\frac{1}{I} \cdot \sum_i u''\left(x_s^i(\mathcal{P}_*, K)\right) - u''\left(x_s^1(\mathcal{P}^*, K)\right)\right|.$$

Since f has slope larger than 1, we have

$$\frac{1}{I} \cdot \sum_i u'\left(x_s^i(\mathcal{P}_*, K)\right) - u'\left(x_s^1(\mathcal{P}^*, K)\right) < f\left(\frac{1}{I} \cdot \sum_i u'\left(x_s^i(\mathcal{P}_*, K)\right)\right) - f\left(u'\left(x_s^1(\mathcal{P}^*, K)\right)\right).$$

Combining the two inequalities above, it follows that, for any $K > I$,

$$\frac{1}{I} \cdot \sum_i u'\left(x_s^i(\mathcal{P}_*, K)\right) - u'\left(x_s^1(\mathcal{P}^*, K)\right) < \left|\frac{1}{I} \cdot \sum_i u''\left(x_s^i(\mathcal{P}_*, K)\right) - u''\left(x_s^1(\mathcal{P}^*, K)\right)\right| \cdot \frac{K}{I};$$

that is, for any $K \geq \bar{K} = I$, the difference in indirect effects outweighs the difference in direct effects.

(With u^4 strictly positive, Jensen's inequality implies that, generically in W,

$$\frac{1}{I} \cdot \sum_i u''\left(x_s^i(\mathcal{P}_*, K)\right) > u''\left(\frac{1}{I} \cdot \sum_i x_s^i(\mathcal{P}_*, K)\right) = \frac{1}{I} \cdot \sum_i u''\left(x_s^i(\mathcal{P}^*, K)\right).$$

It follows that both the direct and the indirect effects are larger under $\mathcal{P}_*$ than under $\mathcal{P}^*$.

Q.E.D.

Proof of Proposition 3: Recall Eqs. (9) and (10), noting that, generically in endowments, each of them is strict for at least one state of nature. Using Eq. (5), generically,

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

where the first equality is as in the proof of Lemma, and the inequality comes from Eqs. (8), (9) and (10). Then, by definition, $\mathcal{P}^{\bullet} \succ_0 \mathcal{P}_{\bullet}$.

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

Proof of Proposition 4: The argument generalizes the proof of Proposition 1. As in that proof, define, for each s, the average income $\bar{x}_s$. The set of period-2 incomes that can result from trade, $X(\{s\})$, is now

$$\left\{ x \in \mathbb{R}^I \mid \sum_i (x_s^i - w_s^i) = r_s \text{ and } \exists Y \in \mathbb{R}^{(1+K)I} : x^i = w_s^i + R_s \cdot Y^i \text{ and } \sum_i Y^i = (1,0) \right\},$$

and we still have that $(\bar{x}_s, \ldots, \bar{x}_s) \in X(\{s\})$.

Consider $E \in \mathcal{P}$ such that the rank of R_E is less than $\|E\|$, and suppose that $(\bar{x}_E, \ldots, \bar{x}_E) \in X(E)$. Then, denoting the column span of R_E by $\langle R_E \rangle$, for all investors it must be true that

$$\bar{x}_E - w_E^i = \frac{1}{I} \cdot \left(\sum_j w_E^j + r_E \right) - w_E^i \in \langle R_E \rangle,$$

which is generically not true on $(w_E^1, \ldots, w_E^I)$, given that $\langle R_E \rangle$ is a proper subspace of $\mathbb{R}^{\|E\|}$.

It follows again that, generically, $\kappa(E, s) \geq \kappa(\{s\}, s)$ for all $s \in E$, with a strict inequality for some, which suffices to imply that $L(\mathcal{P})$ is strictly higher than the liquidity raised by the full information partition.

The second statement follows immediately from the first one, under the assumption that the rank of matrix R is less than S. *Q.E.D.*

Proof of Proposition 5: This assertion follows from the proof of Proposition 1, which shows that a coarsening of information induces a first-order stochastic dominance increase in κ, generically on investors' endowments. *Q.E.D.*

Proof of Lemma 2:

(i) 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 $\mathcal{E} \subseteq \mathcal{P}'$ be such that $\cup_{\tilde{E} \in \mathcal{E}} \tilde{E} = E$. Using again Eq. (5),

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

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 for any $E \in \mathcal{P}$, it follows that

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

(ii) Fix $\succsim_\lambda$, $\lambda \in (0,1)$, and, as above, let $\mathcal{P}$ coarsen $\mathcal{P}'$ and induce a first-order stochastic dominance increase in the pricing kernel. By the previous argument,

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

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 $\lambda < 1$,

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

(iii) Let $\succsim$ be an expected utility preference relation with concave and strictly increasing utility index v. 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. (5), 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 $\cup_{n=1}^N E_n = E$, and let

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

This variable gives us the counterfactual 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 v is concave and increasing.

Q.E.D.

Proof of Proposition 6: This follows immediately from Proposition 5, given Lemma 2. *Q.E.D.*

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