On the Shareholder- versus Stakeholder-Firm Debate

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Abstract

When externalities are present, is the inclusion of the affected stakeholders in the firm's decision process a better solution than government regulation? Magill, Quinzii, and Rochet (2015) argue that it is, and propose an objective for the stakeholder corporation as well as a market mechanism to implement it. This paper shows that: (1) within the framework of Magill, Quinzii, and Rochet's (2015) model, the shareholder-oriented firm and the government can implement the same outcome even when the government *does not know the firm's costs*; (2) outside that framework, the proposed stakeholder objective fails to address the inefficiency. The results help garner more insight into the difficulties and limitations of embedding the stakeholder corporation into a general equilibrium model.

Keywords: firm's objective, incomplete markets, shareholders versus stakeholders, externalities and regulation

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1 Introduction

The notions of stakeholder society and corporate social responsibility have become central to the modern business discourse. While the basic ideas can be traced back several decades ago, the society's and lawmakers' demands for individual and corporate social responsibility have become more prominent in the recent years, refueled in part by the accounting scandals, which have shed doubt on the business practice of focusing on "shareholder value".

The traditional, shareholder view of a corporation asserts that firms should be run in the interest of their shareholders, while other stakeholders should be protected by contracts and regulation. This principle is founded on the concept of private property: shareholders are the owners of the firm, and thus the firm should serve to advance their interests. The argument is compelling as long as the firm does not exert any externality on third parties. However, most large firms do. This is precisely the point of departure for the support of a stakeholder view of a corporation. Under this view, the purpose of the firm is to serve as a vehicle for coordinating the interests of all its stakeholders: shareholders as well as customers, employees and local communities. Since corporations impose externalities on their various stakeholders they, the argument goes, should be the ones assuming the responsibility for internalizing those externalities and thus sacrificing profits for the broader social interest. In essence, the stakeholder-value approach expects corporations to assume a responsibility which is typically taken by a government. The argument in favor of such role shifting is that firms may have superior information (regarding costs or local demand) compared to regulatory agencies and thus, they might be better equipped to correct the externality-induced inefficiencies. While the need for a proper internalization of externalities is well understood, the "best" way to attain it is not. The debate is, therefore, on *how* to achieve the goals, rather than the goals themselves.

These issues are addressed only scarcely in the current literature. Most papers on corporate governance focus on how to resolve agency problems and provide management with incentives to maximize shareholder value (see Becht, Bolton, and Röell (2003) for a survey). This is partly motivated by the standard practice in the United States and other Anglo-Saxon economies, where the law makes it clear that shareholders are the owners of firms and that managers have a fiduciary responsibility to act in the interests of shareholders. However, in other European countries, as well as in Japan, profitability is being seen more as a means to promote growth and a stable, secure employment for their workforce, rather than a goal in itself. Such views are often reflected in the institutional design. Germany's system of "co-determination" dictates, for example, that employees and shareholders in large companies must share the seats on the companies' supervisory boards, and the interests of both parties must be taken into account in decision making. Other countries in Europe (such as Denmark or Sweden) have similar laws that require larger companies to have labor representatives, with equal rights and duties, appointed to the board. In Japan, executives do not have a fiduciary responsibility to stockholders, and it is a widely accepted practice that firms pursue the interests of a variety of stakeholders.

A number of papers have taken the positive approach and investigated the implications of stakeholder governance for shareholder value. Allen, Carletti, and Marquez (2015) view a stakeholder-orientation as a way to commit managers to focus more on firm survival and show that stakeholder orientation can be beneficial or detrimental to the firm's market value depending on the type of competition a firm is facing, and whether its competitors are shareholder- or stakeholder-oriented. Pagano and Volpin (2005) argue that stakeholder orientation in the form of long-term labor contracts discourages hostile takeovers, thus benefiting inefficient managers. Cespa and Cestone (2007) acknowledge that connections with local communities, politicians, and unions represent a valuable entrenchment tool for incumbent managers, but they also argue that the *institutionalization* of stakeholder protection can increase managerial turnover and shareholder value as it reduces entrenchment of inefficient CEOs.

A few other papers have been concerned with the normative issue of whether it is socially desirable for firms to pursue anything other than shareholder interests. Allen (2005) argues that changing firms' objective functions from just focusing on shareholder wealth can correct for market failures and provide a Pareto improvement in welfare. Several authors have pointed out, though, that a firm's objective needs to be clear, and performance measurable, otherwise it leaves its managers empowered to exercise their own preferences in spending the firm's resources (see, for instance, Tirole (2001), Tirole (2006)).

Magill, Quinzii, and Rochet (2015) seem to offer a solution, in an environment in which firms exert externalities on their customers and employees by controlling the risk in the economy. The authors propose to instruct the firm to maximize its stakeholders' surplus, and demonstrate how that can be measured by creating Coasian-type markets for customer and worker "rights". The authors then prove that, by maximizing the total value of its customer and worker rights plus the present value of profits, the firm will select the efficient level of investment in the prevention of risk.

This paper takes a closer look at the rationale behind the stakeholder corporation and the implementability of its objective. More precisely, it analyzes the arguments that a stakeholder (rather than shareholder) focus is *needed* to attain efficiency in the presence of externalities, that it is *better* than government regulation, and that it can be pursued through a well-defined, *measurable* objective. Ideally, a (general equilibrium) model attempting to justify the stakeholder corporation should address all these issues. Magill, Quinzii, and Rochet (2015) seem to suggest that theirs does.[1] While the measurability issue is indeed ad-

[1]Their abstract opens with the statement that "large corporations should act in the interests of a broader group of agents than just their shareholders" and the assertion that their "paper presents a framework where this idea can be justified." On page 1687 the authors

dressed, I show that, in the context of their model, there is neither a need for the stakeholder corporation nor a clear advantage to it, if achieving efficiency is the only goal. Several characteristics of Magill, Quinzii, and Rochet's (2015) model are responsible for each of these results, and quasi-linearity of preferences is common between the two. However, I also show that, without quasi-linearity, the proposed stakeholder objective fails to select an efficient level of investment, and the suggested market mechanism no longer serves to measure that objective. The insights obtained from Magill, Quinzii, and Rochet's (2015) model suggest that any general equilibrium model addressing all three issues is bound to be applicable to a very restricted, specific environment.

By recasting Magill, Quinzii, and Rochet's (2015) model in a standard framework with exogenous uncertainty, I show that the direct externality of the original formulation becomes the standard pecuniary externality a monopolist exerts on its customers, through prices. Value maximization, with the restriction of using linear pricing, leads to the standard monopoly under-investment problem. However, a two-part tariff can achieve efficiency while extracting all the surplus from non-shareholder stakeholders, and thus maximizing shareholder value. The value of the fixed fee in the two-part tariff is exactly the price of the consumer rights in Magill, Quinzii, and Rochet's (2015) formulation. Therefore, a socially efficient outcome can be obtained with a shareholder-focused objective under the same informational requirements (for the firm) as the stakeholder surplus maximization objective. At this efficient allocation, the shareholders get all the surplus, an outcome that may be seen as undesirable. On the other hand, to argue in favor of a different, particular welfare distribution, one has to provide some arguments —either based on some notion of fairness or institutional design— of why such distribution would be preferable to, or more likely than another.

Even with an agreement about what a desirable welfare distribution between shareholders and stakeholders would be, one still needs to ask whether the task of implementing it is better suited for the firm or a regulatory agency. In Section 4.2 I show that *any* efficient welfare distribution can be attained either by altering the firm's objective, as Magill, Quinzii, and Rochet (2015) propose, or by some government intervention. It is typically argued that, since firm's costs are not easily observable by a regulatory agency, the firm can be better at implementing a particular efficient outcome. This is precisely the argument used by Magill, Quinzii, and Rochet (2015). I show, however, that to implement

state that "[...]'shareholder value maximization' is not the correct 'social criterion' and leads to systematic under-investment by the firm." Later on the same page they explain that "the internal nature of the investment and the possible improvements to which it leads make it difficult for a regulator to have sufficient information to subsidize exactly the type of expenses that would reduce the risks of adverse outcomes or improve the productive efficiency of the firm", but the "agents close to the firm [...] have better information than a regulator about the costs and possible improvements to the technology of a company". These statements seem to suggest that, unlike the stakeholder firm, neither the government nor the firm itself, while operating under a shareholder-oriented objective, could achieve an efficient outcome.

any efficient welfare distribution of the model considered there, the government does not need to know the firm's cost function.

Magill, Quinzii, and Rochet (2015) recognize some of the limitations of their model: it does not work for more than one firm, or for heterogeneous populations of consumers and workers. In Section 4.3 I show that the results of their model also fail if preferences are not quasi-linear (even when consumers/workers are homogenous). Without quasi-linear preferences, the competitive market prices for consumers' (and workers') rights do not capture the relevant information to help the firm (which was instructed to maximize the value of those rights plus the market value of its assets) select the efficient level of investment.

The paper is organized as follows. Sections 2 and 3 extend Magill, Quinzii, and Rochet's (2015) results to an economy in which all agents are risk-averse with regards to their money holdings (rather than risk-neutral, as in the original model). Sections 4.1 and 4.2 show that, under the conditions of the model, the stakeholder-focused firm re-organization presents no advantage, since the same outcome can also be implemented by the traditional shareholder-oriented firm and/or government intervention (even when firm's costs are unknown to the regulator). Section 4.3 shows that if preferences are not quasi-linear, there is no clear definition of the stakeholder objective. Section 5 concludes.

2 The Benchmark Model

Consider a two-date economy ($t = 0, 1$) with two goods: a composite good, m, called *money* (used as numéraire) and a *consumption good*, c. Money is available and it is "consumed" at both dates, while the consumption good is produced and consumed only at date 1.

There is only one firm and two types of agents: *consumers* and *capitalists*, with a continuum of mass 1 of each type. The firm produces the consumption good (at date 1) and uses money to finance its investment expenditures (at date 0). It can produce either $y_G > 0$ units of the consumption good or $y_B \in (0, y_G)$. By choosing its investment expenditure at date 0, the firm determines the probability π of obtaining the high production at date 1. Let $\gamma(\pi)$ be the cost (in terms of money), at date 0, of producing y_G units of consumption at date 1 with probability π (and y_B with probability $1-\pi$). It is assumed that $\gamma(\cdot)$ is increasing and strictly convex, with $\lim_{\pi \to 1} \gamma(\pi) = \infty$. This production structure can have several interpretations. For example, one can think of the "bad" state B as the occurrence of some adverse outcome, such as an accident, and interpret date-0 cost as the firm's investment on maintenance, or quality and safety control of its product. A higher investment on maintenance and safety control measures reduces the probability of a production accident. Alternatively, one can think of the "good" state, G, as some successful technological advance, in which case the cost function γ describes the company's investment in research and development.

The utility functions for the representative consumer and capitalist are given by

$$\begin{aligned} U^c(m,c) &= m_0 + \delta\left(\pi(v(m_G)+u(c_G)) + (1-\pi)(v(m_B)+u(c_B))\right) &\quad (1)\\ U^k(m) &= m_0 + \delta\left(\pi f(m_G) + (1-\pi) f(m_B)\right), &\quad (2)\end{aligned}$$

where u, v, f are increasing, continuously differentiable and strictly concave, with $u(0) = 0$ and $u'(c) \to \infty$ when $c \to 0$. All agents have endowments of money, $\mathbf{e}^i := (e_0^i, e_1^i, e_1^i)_{i=k,c}$, which are state-independent at date-1, and no endowment of the consumption good. The capitalists fully own the firm. It is also assumed that

$$\begin{aligned} \gamma'(0) &< \delta(u(y_G) - u(y_B)),\\ y_G \cdot u'(y_G) &> y_B \cdot u'(y_B).\end{aligned}$$

The first condition ensures that it is socially optimal to make a positive investment at date 0 (thus making the problem non-trivial), while the second ensures that the firm's equity is a risky financial instruments and thus different than the risk-free bond.

Given the quasi-linearity of the agents' preferences, every (symmetric)[2] Pareto optimal allocation must maximize the sum of the agents' utilities subject to the feasibility constraints:

$$m_0^k + m_0^c + \gamma(\pi) = e_0^k + e_0^c, \tag{3}$$

$$m_s^k + m_s^c = e_1^k + e_1^c,\ s = G, B, \tag{4}$$

$$c_s = y_s,\ s = G, B. \tag{5}$$

Since utilities are strictly concave and endowments are risk-free, every (symmetric) Pareto optimal allocation must satisfy $m_G^i = m_B^i$ for $i = c, k$. First order conditions imply then that consumer's date-1 money holdings $m_1^c := m_G^c = m_B^c$ must satisfy

$$v'(m_1^c) = f'(e_1^k + e_1^c - m_1^c), \tag{6}$$

and the socially efficient probability, π^*, must solve

$$\gamma'(\pi^*) = \delta(u(y_G) - u(y_B)). \tag{7}$$

Because v and f are strictly concave, and γ is strictly convex, both m_1^c and π^* are unique. Therefore, consumption allocation $(c_G, c_B) = (y_G, y_B)$ together with date-1 money holdings $(\mathbf{m}_1^k, \mathbf{m}_1^c)$ given by $\mathbf{m}_1^c = (m_1^c, m_1^c), \mathbf{m}_1^k = (e_1^k +$

[2]Symmetry refers to agents of the same type receiving identical allocations. Restricting attention to symmetric allocations is without loss of generality here because strict concavity of the utility functions implies that all agents of the same type —except for, possibly, a measure zero of them— must have the same date-1 money holdings. Date-0 allocations need not be the same across agents at a Pareto optimal allocation, but those which are not symmetric cannot be supported as equilibria.

$e_1^c - m_1^c, e_1^k + e_1^c - m_1^c)$, and any distribution of date-0 money holdings satisfying $m_0^k + m_0^c = e_0^k + e_0^c - \gamma(\pi^*)$ –with m_1^c and π^* given by (6) and (7)– forms a *(symmetric) Pareto optimal allocation.*

The market is organized as follows. There are two assets available for trade at date 0: a bond that pays 1 unit of money in each state at date 1, and the firm's equity contract. Spot markets for the consumption good also open in each state at date 1. If p_s denotes the spot price of consumption (in terms of money) in state $s = G, B$, then the firm's equity pays $p_G y_G$ and respectively $p_B y_B$ in the two states. Date-0 prices for the equity and the bond are denoted by q and, respectively, r.

All agents (consumers and capitalists) take the firm's choice and market prices as given, and choose their consumption and portfolio holdings to maximize their utilities, subject to their respective budget constraints. For consumers, the budget constraint $\mathcal{B}^c(\mathbf{p}, r, q; \pi, \mathbf{e}^c)$ consists of allocations $(\mathbf{m}^c, \mathbf{c})$ and portfolio holdings (b^c, θ^c) that satisfy:

$$\begin{aligned} m_0^c + r \cdot b^c + q \cdot \theta^c &= e_0^c, \\ m_s^c + p_s c_s &= e_1^c + b^c + \theta^c p_s y_s, \;\; s = G, B, \\ m_0^c, m_s^c, c_s &\geq 0, s = G, B, \end{aligned}$$

where $\mathbf{m}^c := (m_0^c, m_G^c, m_B^c)$, $\mathbf{c} := (c_G, c_B)$, and $\mathbf{p} := (p_G, p_B)$.

For capitalists, their budget constraint, $\mathcal{B}^k(\mathbf{p}, r, q; \pi, \mathbf{e}^k)$ is given by the set of allocations and portfolio holdings $\left(\mathbf{m}^k, b^k, \theta^k\right)$ that satisfy:

$$\begin{aligned} m_0^k + r \cdot b^k + q \cdot \theta^k &= e_0^k + q - \gamma(\pi), \\ m_s^k &= e_1^k + b^k + \theta^k p_s y_s, \;\; s = G, B, \\ m_0^k, m_s^k &\geq 0, s = G, B, \end{aligned}$$

where $\mathbf{m}^k := (m_0^k, m_G^k, m_B^k)$.

For every $\pi \in [0, 1)$, a vector of allocations $\left(\mathbf{m}^k(\pi), (\mathbf{m}^c(\pi), \mathbf{c}(\pi))\right)$, portfolio holdings, $(b^i(\pi), \theta^i(\pi))_{i=k,c}$, and prices $(\mathbf{p}(\pi), r(\pi), q(\pi))$ is a *security market equilibrium corresponding to* π if

1. $(\mathbf{m}^k(\pi), b^k(\pi), \theta^k(\pi))$ maximizes $U^k(\cdot)$ on $\mathcal{B}^k(\mathbf{p}, r, q; \pi, \mathbf{e}^k))$,
2. $(\mathbf{m}^c(\pi), \mathbf{c}(\pi), b^c(\pi), \theta^c(\pi))$ maximizes $U^c(\cdot, \cdot)$ on $\mathcal{B}^c(\mathbf{p}, r, q; \pi, \mathbf{e}^c))$,
3. all markets clear:
   (a) $m_0^k(\pi) + m_0^c(\pi) + \gamma(\pi) = e_0^k + e_0^c$
   (b) $m_s^k(\pi) + m_s^c(\pi) = e_1^k + e_1^c, \;\; s = G, B,$
   (c) $c_s(\pi) = y_s, \;\; s = G, B,$
   (d) $b^c(\pi) + b^k(\pi) = 0,$
   (e) $\theta^c(\pi) + \theta^k(\pi)$=1.

As shown in Proposition A.1 in the Appendix, at a stock market equilibrium corresponding to a fixed π, agents fully insure each others' money holdings, and thus the equilibrium allocations of money are constant across states for both, the capitalists and the consumers. An immediate implication is that capitalists must then be selling their firm to the consumers. Letting $m^i(\pi) := m^i_B(\pi) = m^i_G(\pi)$ for $i = k, c$, an equilibrium corresponding to π has spot prices $p_s(\pi) := \frac{u'(y_s)}{v'(m^c(\pi))}$ and asset prices given by

$$\begin{aligned} r(\pi) &= \delta v'(m^c(\pi)) = \delta f'(m^k(\pi)), && (8)\\ q(\pi) &= \delta\big(\pi u'(y_G)y_G + (1-\pi)u'(y_B)y_B\big) && (9)\\ &= \delta v'(m^c(\pi))(\pi p_G y_G + (1-\pi)p_B y_B). \end{aligned}$$

Equation (8) together with the market clearing condition for date-1 money holdings implies that:

$$v'(m^c(\pi)) = f'(e_1^c + e_1^k - m^c(\pi)). \tag{10}$$

Since both v and f are strictly concave, equation (10) has a unique solution, which does not depend on π.[3] Hence, the equilibrium date-1 money holdings, spot prices for consumption, as well as the price of the bond do not depend on π. Let $\bar{m}^c := m^c(\pi), \bar{r} := r(\pi)$ and $\bar{p}_s := p_s(\pi)$, for $s = B, G$.

Since the bond price does not depend on π, the capitalists' welfare is affected by the firm's choice only through the share of profits they receive. Therefore, the indirect utility of the capitalists (as a function of π) is an increasing transformation of the firm's market value, and thus a higher value makes every owner better off. A shareholder-oriented firm would therefore want to maximize profits and hence it solves

$$\max_{\pi\in[0,1)} \{\delta(\pi u'(y_G)\cdot y_G + (1-\pi)u'(y_B)\cdot y_B) - \gamma(\pi)\}, \tag{11}$$

choosing π^M that satisfies: $\gamma'(\pi^M) = \delta(u'(y_G)\cdot y_G - u'(y_B)\cdot y_B)$. It is assumed that such π^M exists. Strict convexity of γ guarantees then that the solution is unique. Moreover, since the function $x \mapsto u(x) - u'(x)\cdot x$ is increasing, it follows that

$$u(u_G) - u(y_B) \geq u'(y_G)\cdot y_G - u'(y_B)\cdot y_B,$$

which shows that the equilibrium is suboptimal and it is characterized by under-investment ($\pi^M < \pi^*$ because $\gamma(\pi^M) < \gamma(\pi^*)$).

3 The Stakeholder Firm

Commenting on the inefficiency of the outcome described above, Magill, Quinzii, and Rochet (2015) remark that: "'shareholder value maximization' is not the

[3]To guarantee the existence of an interior solution it is enough to assume, for example that $\lim_{x\to 0} v'(x) = \lim_{x\to 0} f'(x) = +\infty$.

correct 'social criterion' [...]." They go on to say that the government may not have sufficient information to intervene to induce the efficient choice, and therefore they argue in favor of the stakeholder-firm: "Assuming that agents close to the firm –the shareholders, the consumers, and certainly the workers– have better information than a regulator about the costs and possible improvements to the technology of a company, it seems natural to study whether the firm can be led to internalize the externality by including the interests of consumers and workers in the criterion it uses for its choice of investment." To that end, they propose to instruct the firm to maximize the expected total value for the stakeholders, which equals the sum between the (present value of) profit and consumers' surplus.

Let $V^c(\pi)$ denote the utility obtained by the representative consumer at the asset market equilibrium corresponding to a choice π made by the firm:

$$V^c(\pi) := e_0^c + \bar{r}e_1^c - \bar{r} \cdot \bar{m}^c + \delta v(\bar{m}^c) - q(\pi) + \delta\big(\pi u(y_G) + (1-\pi)u(y_B)\big). \quad (12)$$

The objective proposed by Magill, Quinzii, and Rochet (2015) amounts to maximizing $V^c(\pi) + q(\pi) - \gamma(\pi)$, which reduces to

$$\max_{\pi\in[0,1)} \left\{\delta\big(\pi u(y_G) + (1-\pi)u(y_B)\big) - \gamma(\pi)\right\}, \quad (13)$$

and thus leads to the selection of the socially optimal investment, $\gamma(\pi^*)$.

As discussed in Tirole (2001), consumer surplus (represented by $V^c(\pi)$, here) may be difficult to measure. Magill, Quinzii, and Rochet (2015) address this difficulty by drawing on Coase idea of creating property rights for all the stakeholders: "If the firm can issue consumer [...] rights and if these rights can be traded on reasonably liquid markets, then their market prices will reveal the benefits that consumers [...] derive from being stakeholders of the firm."

Assume that such market is introduced in the model above. A consumer needs one customer right to purchase the output of the firm and every consumer, except a measure-0 subset, is endowed with 1 unit of such rights. There is a continuum of equilibrium prices for customer rights, but only one that can generate trade in the market. That is the price at which consumers who are endowed with customer rights are indifferent between holding them (and thus consuming the firm's output) or selling them in the market. Let $F(\pi)$ be the value of that equilibrium price.

Consumers who sell their endowment of customer rights cannot buy the consumption good but they can still transfer money across dates and states by trading the risk-free bond and the firm's shares at prices $\bar{r}$ and, respectively, $q(\pi)$. Let $V_0^c(\pi, F)$ be the value such consumers would get when selling their endowment of customer rights at the price F. Then $F(\pi)$ must satisfy $V^c(\pi) = V_0^c(\pi, F(\pi))$.

Proposition 3.1 *Given the equilibrium prices $\bar{r}$ and $q(\pi)$ for the bond and, respectively, the firm's stock (as above), a consumer who sells his/her initial* *endowment of customer rights at price $F > 0$ obtains the utility*

$$V_0^c(\pi, F) = e_0^c + F + \bar{r}e_1^c - \bar{r} \cdot \bar{m}^c + \delta v(\bar{m}^c), \tag{14}$$

with $\bar{m}^c$ as defined by (10)*.*

Proof. The crux of the argument is to show that such consumer will not trade in firm's shares. Suppose that is not the case and let (b, θ), with $\theta \neq 0$, be the consumer's optimal portfolio. The utility such consumer obtains is:

$$e_0^c + F - \bar{r}b - q(\pi)\theta + \delta\big(\pi v(e_1^c + b + \theta p_G(\pi)y_G) + (1-\pi)v(e_1^c + b + \theta p_B(\pi)y_B)\big).$$

I show next that the representative consumer is strictly better off by choosing instead the portfolio $(b^*, 0)$, with $b^* = b + \theta \cdot \frac{q(\pi)}{\bar{r}}$. Indeed, such a portfolio would allow the same consumption at date 0 as under (b, θ) and risk-free money holdings at date 1 equal to

$$\widetilde{m}_1 := e_1^c + b + \theta(\pi p_G(\pi)y_G + (1-\pi)p_B(\pi)y_B),$$

in every state. Since v is strictly concave,

$$\pi v(e_1^c + b + \theta p_G(\pi)y_G) + (1-\pi)v(e_1^c + b + \theta p_B(\pi)y_B) < v(\widetilde{m}_1),$$

which contradicts optimality of (b, θ). Hence, $\theta = 0$.

On the other hand, the first order condition implies $\bar{r} = \delta v'(e_1^c + b)$, and thus $e_1^c + b = \bar{m}^c$ (i.e., consumers do not change their date-1 money holdings, they only increase their date-0 money holdings). ■

Therefore,

$$F(\pi) = \delta\big(\pi(u(y_G) - u'(y_G)y_G) + (1-\pi)(u(y_B) - u'(y_B)y_B)\big),$$

and a firm that maximizes $F(\pi) + q(\pi) - \gamma(\pi)$ does indeed select the socially optimal value, π^*, hence proving that Magill, Quinzii, and Rochet's (2015) model can be extended to incorporate agents' risk aversion.

4 Shareholders, Stakeholders or the Government?

I will argue next that further generalizations of Magill, Quinzii, and Rochet's (2015) model may not be possible and that, under the current assumptions, the outcome achieved through the proposed stakeholder-oriented objective can also be obtained via the traditional profit maximization, or through government intervention. More precisely, I will prove the following:

1. If efficiency alone is the desired outcome then, in the context of Magill, Quinzii, and Rochet's (2015) model, that can also be obtained with a shareholder-oriented objective.

2. In the context of the model, there is no clear advantage to the stakeholder corporation relative to government intervention. More precisely, I show that the government can induce a value-maximizing (shareholder-oriented) firm to adopt the efficient level of investment through taxes and subsidies, *even when the government does not know the firm's costs.*

3. If consumers' preferences are not quasi-linear, then the proposed objective for the stakeholder corporation fails to select the socially optimal investment.

The first two points weaken the arguments in favor of the stakeholder corporation. Quasi-linearity of preferences is important for these results. However, the last point argues that, without quasi-linearity, the objective of the stakeholder corporation is not well-defined and the market for consumer rights described in Magill, Quinzii, and Rochet (2015) fails to extract sufficient information to guide a stakeholder-oriented firm towards selecting a socially-optimal investment level. Therefore, a stakeholder firm which maximizes the value of customer rights plus the present value of profits, will still choose an inefficient level of investment.

4.1 Efficient monopoly

I argue below that if the sole goal is that of achieving an efficient outcome, then that can be done by focusing on shareholders' interests alone. As shown in the Appendix Section A.1, the externality (and the ensuing inefficiency of the equilibrium) is equivalent to the pecuniary externality generated by a monopoly. It is well-known that, with a homogenous population of consumers, a monopolistic firm can achieve a socially efficient outcome through two-part pricing. The same result holds here. If a (shareholder-) net value maximizing firm collects a membership fee in addition to a price per-unit of commodity sold, then such a firm chooses the socially optimal level of risk, and thus invests efficiently in the superior technology. Of course, such a firm would extract all the surplus that its non-shareholder stakeholders get from the consumption of the output good and redistribute it to its shareholders.

Assume therefore that the firm can choose not only the probability π but also a fixed fee $\widetilde{F}(\pi)$ to be charged to every consumer who buys its product. A consumer who does not buy the firm's product enjoys a life-time utility equal to the utility derived from the initial endowment. Following a similar argument as in Proposition 3.1, the value of that utility is $e_0^c + \bar{r}e_1^c - \bar{r} \cdot \bar{m}^c + \delta v(\bar{m}^c)$, with $\bar{m}^c$ as defined by (10). A consumer who intends to buy the product at date 1, has to pay the fixed fee $\tilde{F}(\pi)$ at date 0, thus achieving the utility $V^c(\pi) - \tilde{F}(\pi)$, with $V^c(\pi)$ given by (12). Therefore, for every $\pi \in [0, 1)$, the maximum fee the firm can charge is

$$\tilde{F}(\pi) = \delta \left[\pi \left(u(y_G) - u'(y_G)y_G \right) + (1 - \pi) \left(u(y_B) - u'(y_B)y_B \right) \right], \qquad (15)$$

and thus firm's value, as a function of π, is

$$V(\pi) = \tilde{F}(\pi) + \delta(\pi u'(y_G)y_G + (1-\pi)u'(y_B)y_B) - \gamma(\pi) = \delta(\pi u(y_G) + (1-\pi)u(y_B)) - \gamma(\pi),$$

which coincides with the total social surplus.

The following Proposition summarizes these results.

Proposition 4.1 *A net value maximizing firm that charges a two-part tariff chooses the efficient level of investment in the reduction or risk.*

The fee that the firm charges in this formulation of the model coincides with the market price for the customer rights in the market mechanism proposed by Magill, Quinzii, and Rochet (2015): $\widetilde{F}(\pi) = F(\pi)$. To implement the efficient two-part tariff, the firm needs to be able to compute $\widetilde{F}(\cdot)$. Computing $\widetilde{F}(\cdot)$ poses the same challenges to the firm as computing the inverse market demand *function* for consumer rights, because the two functions coincide. A firm which is instructed to maximize its stakeholders' value needs to be able to compute $F(\cdot)$, therefore the informational sophistication needed by the firm is the same, whether the firm is expected to implement the optimal two-part tariff or follow the stakeholder objective. With a heterogeneous consumer population (and no price discrimination), the two-part pricing does not lead to an efficient allocation, but Magill, Quinzii, and Rochet's (2015) Coasian implementation suffers from the same limitation.

Because in Magill, Quinzii, and Rochet's (2015) model consumers are endowed with the rights, the final distribution of welfare is different than what is obtained here. The welfare distribution arising under the optimal two-part tariff coincides with the outcome that would prevail in a Coasian-type market like the one proposed by Magill, Quinzii, and Rochet (2015), should the consumer rights be initially assigned to the shareholders. One may argue that the allocation described here, although efficient, would be less desirable than the one implemented by Magill, Quinzii, and Rochet's (2015) trading mechanism, because it leaves consumers with no surplus from their consumption of the output good. However, that can be addressed with a government mandate that forces the firm to make some (date-0) lump-sum transfer to consumers, and so efficiency alone does not seem to offer enough ground to support the stakeholder objective in this context.

4.2 Government intervention

Government regulation could correct externality-induced inefficiencies, but the design of the appropriate policy requires the knowledge of the firm's costs, in general. It is typically argued that, compared to a regulatory agency, the firm has superior information about its own costs, and therefore it is better suited to deal with the externality. This is precisely the argument used by Magill, Quinzii, and Rochet (2015) who remark that: "the internal nature of the investment and the possible improvements to which it leads make it difficult for a regulator to have sufficient information to subsidize exactly the type of expenses that would reduce the risk of adverse outcomes or improve the productive efficiency of the firm" (page 1687). With that argument in mind, the question addressed here is whether a central planner who does not know the cost function $\gamma(\cdot)$ could still design appropriate policy to induce the firm to make the efficient investment at date 0.

I show next that this is indeed possible within the specific framework of this model. More precisely, I show that the two efficient outcomes –corresponding to the firm or the consumers owning all the initial consumption rights– as well as any other efficient welfare distribution can be obtained via government intervention either through a system of taxes and subsidies or through simple mandates that require the firm to pay a fine (to the consumers) in the bad state (similar to penalty payments following accidents) or consumers to pay a fee to the firm in the good state. The role of taxation is to change the relative price the firm receives for its outcome in the two states. By increasing the *relative* price of output in the good state, the government provides incentives to the firm to increase the probability of that state. As shown below, computing the appropriate values for the tax and subsidy does not require knowledge of the firm's cost function.

Consider the government intervention consisting of a unit tax τ on the sale of the output good in state B, followed by a lump-sum subsidy T to the consumers. The government's budget balances if and only if $T = \tau y_B$. For every vector of before-tax spot prices $\mathbf{p} := (p_G, p_B)$, let $\mathbf{p}^\tau := (p_G, p_B - \tau)$ be the vector of after-tax spot prices. Let also $\mathbf{e}^{c,T} := (e_0^c, e_1^c, e_1^c + T)$ denote a consumer's initial wealth after receiving the subsidy T in state B.

Fix $\pi \in [0,1), \tau > 0$ and $T = \tau \cdot y_B > 0$. A vector of allocations $\big(\mathbf{m}^k(\pi,\tau), (\mathbf{m}^c(\pi,\tau), \mathbf{c}(\pi,\tau))\big)$, portfolio holdings, $(b^i(\pi,\tau), \theta^i(\pi,\tau))_{i=k,c}$, and prices $(\mathbf{p}(\pi,\tau), r(\pi,\tau), q(\pi,\tau))$ is a *security market equilibrium corresponding to* (π,τ) if

1. $(\mathbf{m}^k(\pi,\tau), b^k(\pi,\tau), \theta^k(\pi,\tau))$ maximizes $U^k(\cdot)$ in $\mathcal{B}^k(\mathbf{p}^\tau, r, q; \pi, \mathbf{e}^k)$,
2. $(\mathbf{m}^c(\pi,\tau), \mathbf{c}(\pi,\tau)), b^c(\pi,\tau), \theta^c(\pi,\tau)$ maximizes $U^c(\cdot,\cdot)$ in $\mathcal{B}^c(\mathbf{p}^\tau, r, q; \pi, \mathbf{e}^{c,T})$,
3. all markets clear; That is,
   (a) $m_0^k(\pi,\tau) + m_0^c(\pi,\tau) + \gamma(\pi) = e_0^k + e_0^c$
   (b) $m_s^k(\pi,\tau) + m_s^c(\pi,\tau) = e_1^k + e_1^c,\ s = G, B,$
   (c) $c_s(\pi,\tau) = y_s,\ s = G, B,$
   (d) $b^c(\pi,\tau) + b^k(\pi,\tau) = 0,$
   (e) $\theta^c(\pi,\tau) + \theta^k(\pi,\tau)$=1.

Following a reasoning similar to that used in Section 2 one can show that $m_G^i(\pi,\tau) = m_B^i(\pi,\tau)$ for $i = k, c$ and consumers' (and capitalists') date-1 money holdings at an equilibrium corresponding to (π, τ) do not depend on (π, τ). Moreover, they satisfy equation (10), and thus coincide with each agent's money holdings in the economy without taxes. Therefore, the tax does not distort date-1 money holdings, the bond price or consumption spot prices (before-tax). Hence, $p_s(\pi, \tau) = \bar{p}_s = \frac{u'(y_s)}{v'(\bar{m}^c)}$ and $r(\pi, \tau) = \bar{r} = \delta v'(\bar{m}^c)$. On the other hand,

$$\begin{aligned} q(\pi, \tau) &= \delta\big(\pi u'(y_G)y_G + (1-\pi)u'(y_B)y_B\big) - (1-\pi)\bar{r}T \\ &= \bar{r}(\pi \bar{p}_G y_G + (1-\pi)(\bar{p}_B - \tau)y_B). \end{aligned}$$

Given the tax, a value-maximizing firm chooses π such that

$$\gamma'(\pi) = \bar{r}\big(\bar{p}_G y_G - (\bar{p}_B - \tau)y_B\big).$$

To induce efficient investment, the government should choose τ such that:

$$\bar{r}\big(\bar{p}_G y_G - (\bar{p}_B - \tau)y_B\big) = \delta\big(u(y_G) - u(y_B)\big),$$

which implies that

$$T = \tau y_B = \frac{\delta\big(u(y_G) - u(y_B) - (u'(y_G)y_G - u'(y_B)y_B)\big)}{\bar{r}} = \frac{F'(\pi)}{\bar{r}},$$

or, equivalently, $\tau := \frac{F'(\pi)}{\bar{r} \cdot y_B}$.

The welfare distribution resulting from this policy is the same as the one selected by the stakeholder objective proposed by Magill, Quinzii, and Rochet (2015). The government can, however, implement *any* efficient welfare distribution by dividing the lump-sum subsidy between consumers and capitalists. Of course, any welfare distribution is also possible with the mechanism described by Magill, Quinzii, and Rochet (2015) by changing the initial allocation of consumer rights (α to consumers, $1-\alpha$ to capitalists, with $\alpha \in [0,1]$). Similarly, an efficient welfare distribution can also be obtained via a unit subsidy, τ, on the produced output if state G occurs, coupled with the appropriate state-contingent, budget balancing lump-sum tax T (paid by the consumers).

In each of these examples, the entire revenue collected from taxes from one side of the market is redistributed as subsidies to the other. This suggests that the resulting outcomes can also be implemented, as in Blanchard and Tirole (2008), by letting the firm do the transfers. For instance, when state G is interpreted as the status-quo and state B captures the occurrence of an accident, then instructing the firm's manager to maximize market value but having the firm pay the fixed fine T to consumers if state B occurs implements an efficient allocation.

In all the above cases, the transfer amount, T, can be linked to consumer's surplus, because $\delta T = F'(\pi)$, where $F(\cdot)$ is given by (15). To implement the stakeholder objective in Magill, Quinzii, and Rochet (2015), the organization of a market for consumer rights is needed, and the firm should be able to compute the price in that market as a function of π. That is, the firm should have an understanding of $F(\cdot)$. The same knowledge (albeit on the part of the government) is required to implement either one of the government interventions above. It is debatable whether the firm or the government is better equipped to measure consumer surplus,[4] but this is not the argument made by Magill, Quinzii, and Rochet (2015).[5] The authors' main argument is that the firm's stakeholders are in a better position than the government to understand the firm's costs. Note, however, that to implement either of the policies described above, the government does not need to know the firm's cost function, making the stated "advantage" of the stakeholder corporation irrelevant in this model.

The result is striking and, perhaps not surprisingly, of very little generality, since it is driven by particular artifacts of the model. The government does not need to know firm's costs to implement the efficient tax policy here because both, the price of the firm's equity and the social surplus are linear in π (and thus their derivatives are constant in π). Efficiency dictates that the marginal cost must be equal to the marginal social surplus, and the latter depends on utilities and spot prices, but not on π. On the other hand, a net value-maximizing firm chooses π so that its marginal cost is equal to its marginal (date-0) equity value. The latter is also independent of π and only depends on spot prices. Therefore, to induce the efficient choice of π, the government needs to manipulate spot prices so that the marginal social surplus is equal to the firm's marginal equity value, none of which depends on π. Quasi-linearity of preferences and the specific form of the production function are two of the model characteristics that drove this negative result. However, as argued in the next section, quasi-linearity is also essential for obtaining the positive results in Magill, Quinzii, and Rochet (2015).

4.3 The stakeholder corporation without quasi-linearity

Quasi-linear utilities allows for a well-defined functional form for the total stakeholder welfare as $V^c(\pi)+V^k(\pi)$. Maximization of the sum of the indirect (equilibrium) utilities leads, in that case, to the choice of the efficient probability. Since the price of customer rights and the firm's profit are translations of those indirect utilities, maximizing their sum leads to the same solution. However, when preferences are not quasi-linear, maximizing the sum of indirect utilities may not lead to the choice of the efficient investment and therefore the objective of the stakeholder firm, as defined by Magill, Quinzii, and Rochet (2015), does not achieve the desired result. Moreover, the information obtained through the

[4]For instance, is the government or a firm better at measuring the impact (on consumers) of investing in nuclear energy?

[5]The authors do say that "a stakeholder approach can be made operational only if the stakeholders are sufficiently close to the firm to permit precise evaluations of their benefits" and that "externalities that affect agents widely dispersed in the economy will be more effectively resolved by government intervention." However, *all* agents in the economy are stakeholders of the firm in their model.

Coasian market in the form of the price for customer rights, $F(\pi)$, is now a concave (and increasing) transformation of consumer's indirect utility, $V^c(\pi)$ (rather than a translation), and thus the problems $\max_\pi \left\{V^c(\pi) + V^k(\pi)\right\}$ and $\max_\pi \{F(\pi) + q(\pi) - \gamma(\pi)\}$ might have different solutions. These arguments are made precise below.

Assume that the utilities for the consumers and, respectively, the capitalists, are given by:

$$\begin{aligned} U^c(\mathbf{m}, \mathbf{c}) &= v(m_0) + \delta\left(\pi(v(m_G) + u(c_G)) + (1-\pi)(v(m_B) + u(c_B))\right) \quad (16) \\ U^k(\mathbf{m}) &= m_0 + \delta\left(\pi m_G + (1-\pi) m_B\right). \quad (17) \end{aligned}$$

where u, v are increasing, twice continuously differentiable and strictly concave.

A probability $\bar{\pi}$ together with an allocation $(\bar{\mathbf{m}}^k, (\bar{\mathbf{m}}^c, \bar{\mathbf{c}}))$ is efficient if it maximizes, for some $\lambda \in [0,1]$, the social welfare function

$$\lambda\left(m_0^k + \delta \sum_{s\in\{G,B\}} \pi_s m_s^k\right) + (1-\lambda)\left(v(m_0^c) + \delta \sum_{s\in\{G,B\}} \pi_s (v(m_s^c) + u(c_s))\right), \quad (18)$$

subject to feasibility constraints

$$\begin{aligned} m_0^k + m_0^c + \gamma(\pi) &= e_0^k + e_0^c, \\ m_s^k + m_s^c &= e_1^k + e_1^c, \forall s \in \{G, B\}, \\ c_s &= y_s, \forall s \in \{G, B\}, \end{aligned}$$

where $\pi_G = \pi$ and $\pi_B = 1 - \pi$.

The first order conditions for this problem –which are necessary and sufficient– together with strict concavity of v imply that every efficient allocation must satisfy:

$$\begin{aligned} \bar{m}_0^c = \bar{m}_G^c &= \bar{m}_B^c, \\ \gamma'(\bar{\pi}) &= \frac{\delta\left(u(y_G) - u(y_B)\right)}{v'(\bar{m}_0^c)}. \quad (19) \end{aligned}$$

Assume, as before, that the firm's equity as well as a risk-free bond are traded in the market. Then, for every choice of π made by the firm, there exists an equilibrium in the ensuing stock market as described below.

Proposition 4.2 *For every $\pi \in [0, 1)$, there exists an equilibrium of the corresponding stock market economy at which the bond price is equal to δ.*[6]

[6] Money holdings are strictly positive at this equilibrium for both, the consumers and the capitalists. Equilibria at which some agents have zero money holdings in some date/state may also exist, depending on the values of the model parameters. Characterizing the entire equilibrium set is beyond the scope of this paper.

Proof. Let $m(\pi)$ denote the unique solution of the following equation:

$$(1+\delta)m + \delta \cdot \frac{(\pi u'(y_G)y_G + (1-\pi)u'(y_B)y_B)}{v'(m)} = e_0^c + \delta e_1^c. \qquad (20)$$

I will show that the following allocations for the consumer and, respectively, the capitalist,

$$(\mathbf{m}^c, \mathbf{c}) := ((m(\pi), m(\pi), m(\pi)), (y_G, y_B)),$$
$$\mathbf{m}^k := (e_0^c + e_0^k - m(\pi) - \gamma(\pi), e_1^c + e_1^k - m(\pi), e_1^c + e_1^k - m(\pi)),$$

together with prices

$$\bar{r} := \delta,\ p_s(\pi) := \frac{u'(y_s)}{v'(m(\pi))}, s = G, B,$$
$$q(\pi) = \delta\left(\pi p_G(\pi)y_G + (1-\pi)p_B(\pi)y_B\right), \qquad (21)$$

and portfolio holdings

$$(b^c, \theta^c) := (m(\pi) - e_1^c, 1),$$
$$(b^k, \theta^k) := (e_1^c - m(\pi), 0),$$

form an equilibrium for the stock market economy corresponding to π.

It is straightforward to verify that the above allocations clear the markets for consumption, money, and assets, and that they also satisfy each agent's budget constraint at the stated prices. Since the price of every asset, as given above, is the discounted expected value of its payoff, the capitalists are indifferent among all the allocations in their budget constraint and therefore the stated allocations are optimal for capitalists. The proposed allocations and prices also satisfy the first order conditions for the representative consumer's optimization problem:

$$r \cdot v'(m_0^c) = \delta\left(\pi v'(m_G^c) + (1-\pi)v'(m_B^c)\right),$$
$$q \cdot v'(m_0^c) = \delta\left(\pi p_G y_G + (1-\pi)p_B y_B\right),$$
$$p_s = \frac{u'(c_s)}{v'(m_s^c)}.$$

Since consumers' utilities are strictly concave, these first order conditions are necessary and sufficient, thus proving that the proposed allocations are optimal for the consumer at the stated prices. ■

Let $V^c(\pi)$ be the representative consumer's utility at the asset market equilibrium corresponding to π described above. Thus

$$V^c(\pi) := (1+\delta)v(m(\pi)) + \delta(\pi u(y_G) + (1-\pi)u(y_B)),$$

where $m(\pi)$ is given by (20). The representative capitalist's utility at the stock market equilibrium corresponding to π is $V^k(\pi) := e_0^k + \delta e_1^k + q(\pi) - \gamma(\pi)$, and thus shareholders's interest is to maximize firm's market value, $q(\pi) - \gamma(\pi)$.

If the maximizer of $V^c(\cdot)$ coincides with the maximizer of the firm's market value, then there is no scope for the shareholder corporation, because the shareholders' interests are aligned with those of the other stakeholders. The relevant case happens when there is disagreement between the two. To restrict attention to that case, I assume that the following condition is satisfied.

Condition A: *There is no $\pi \in [0,1)$ for which $\frac{d}{d\pi}V^c(\pi) = q'(\pi) - \gamma'(\pi) = 0$.*

Assume, as before, that a market for consumer rights is organized and, for every $\pi \in [0,1)$, let $F(\pi)$ be the equilibrium price at which trade can occur in that market. As argued in Section 3 this is the price at which consumers who were endowed with the rights are indifferent between selling them (thus, not consuming the firm's output) and using the rights to purchase consumption. If $V_0^c(\pi, F)$ denotes, as before, the indirect utility obtained by those consumers who sell their customer rights at a given price F, then $F(\pi)$ satisfies $V^c(\pi) = V_0^c(\pi, F(\pi))$. An analogue of Proposition 3.1 holds here.

Proposition 4.3 *Given the prices δ and $q(\pi)$ (as in (21)) for the bond and, respectively, the firm's equity, a consumer who sells his/her initial endowment of customer rights at a price F obtains the utility*

$$V_0^c(\pi, F) = (1+\delta)v\left(\frac{e_0^c + \delta e_1^c + F}{1+\delta}\right). \tag{22}$$

Proof. The same arguments used in the proof of Proposition 3.1 can be applied here to show that consumers who sell their customer rights will not purchase firm's shares.[7] Therefore, their date-1 money holdings are risk-free. The first order condition together with the strict concavity of v implies then that date-0 and date-1 (state-contingent) money holdings are equal and thus, using the budget constraint, $m_0 = m_1 = \frac{e_0^c+\delta e_1^c+F}{1+\delta}$. ■

Since, at the equilibrium, consumers must be indifferent between keeping or selling their endowment of customer rights, $F(\pi)$ satisfies

$$v(m(\pi)) + \frac{\delta}{1+\delta}\left(\pi u(y_G) + (1-\pi)u(y_B)\right) = v\left(\frac{e_0^c + \delta e_1^c + F(\pi)}{1+\delta}\right). \tag{23}$$

Assume, as in Magill, Quinzii, and Rochet (2015), that the firm is instructed to maximize its market value plus the total value of consumer rights, and let $\pi^* := \arg\max\{q(\pi) - \gamma(\pi) + F(\pi)\}$ be its choice. Let $(\mathbf{m}^k(\pi^*), (\mathbf{m}^c(\pi^*), \mathbf{c}))$ be the equilibrium money holdings and consumption allocation corresponding to π^*. The next proposition shows that, unlike in the quasi-linear specification of the model, the firm's choice cannot lead to a socially optimal investment unless the shareholders' interests are already aligned with those of the other stakeholders.

[7] The proof relied only on the concavity of the Bernoulli utility for date-1 money holdings and the relationship between the price of the bond and the price of firm's shares. The same conditions hold here.

Proposition 4.4 *Assume that condition A is satisfied. Then π^*, together with the allocation $(\mathbf{m}^k(\pi^*), (\mathbf{m}^c(\pi^*), \mathbf{c}))$, cannot be Pareto optimal.*

Proof. Since $\pi^* := \arg\max\{q(\pi) - \gamma(\pi) + F(\pi)\}$, it must satisfy

$$\gamma'(\pi^*) = q'(\pi^*) + F'(\pi^*). \tag{24}$$

Using equation (23) to compute $F'(\pi)$ and observing that consumer's budget constraint implies $(1+\delta)m'(\pi) + q'(\pi) = 0$, equation (24) can be rewritten as:

$$\gamma'(\pi^*) = \frac{\delta(u(y_G) - u(y_B))}{v'\left(\frac{e_0^c + \delta e_1^c + F(\pi^*)}{1+\delta}\right)} + q'(\pi^*)\left(1 - \frac{v'(m(\pi^*))}{v'\left(\frac{e_0^c + \delta e_1^c + F(\pi^*)}{1+\delta}\right)}\right). \tag{25}$$

According to equation (19), such choice is efficient if and only if $\gamma'(\pi^*) = \frac{\delta(u(y_G)-u(y_B))}{v'(m(\pi^*))}$, which, together with (25), leads to

$$\left(\frac{v'(m(\pi^*))}{v'\left(\frac{e_0^c + \delta e_1^c + F(\pi^*)}{1+\delta}\right)} - 1\right) \cdot \left(\frac{\delta\left(u(y_G) - u(y_B)\right)}{v'(m(\pi^*))} - q'(\pi^*)\right) = 0. \tag{26}$$

Note that if v is strictly concave, then $v'(m(\pi^*)) \neq v'\left(\frac{e_0^c + \delta e_1^c + F(\pi^*)}{1+\delta}\right)$. Therefore, the choice of π^* by the stakeholder firm is efficient if and only if

$$q'(\pi^*) = \frac{\delta\left(u(y_G) - u(y_B)\right)}{v'(m(\pi^*))}. \tag{27}$$

Using again $q'(\pi^*) = -(1+\delta)m'(\pi^*)$, equation (27) is equivalent to

$$\frac{d}{d\pi}V^c(\pi^*) = 0. \tag{28}$$

On the other hand, implicit differentiation in equation (23) together with equation (28) gives

$$F'(\pi^*) = \frac{\frac{d}{d\pi}V^c(\pi^*)}{v'\left(\frac{e_0^c + \delta e_1^c + F(\pi^*)}{1+\delta}\right)} = 0, \tag{29}$$

and since $\gamma'(\pi^*) = q'(\pi^*) + F'(\pi^*)$, this implies that $\gamma'(\pi^*) = q'(\pi^*)$, thus contradicting Condition A. ■

Following a similar line of argument as in the previous proposition, it can be shown that maximization of the sum $V^c(\pi) + V^k(\pi)$ does not lead to the choice of an efficient investment level either. Moreover, the two problems, $\max_\pi \left\{V^c(\pi) + V^k(\pi)\right\}$ and $\max_\pi \left\{F(\pi) + q(\pi) - \gamma(\pi)\right\}$, lead to different solutions, in general.

5 Final remarks

As argued in the previous section, maximizing the sum of agents' indirect utilities may not lead to the choice of an efficient investment by the firm if preferences are not quasi-linear. A weighted sum of those indirect utilities would, but the weights depend on the efficient π and require the knowledge of consumers' marginal utility (the weights should be equal to the inverse of the marginal utility of date-0 consumption at the efficient allocation). It is not clear how the relevant information to evaluate such objective could be obtained from markets. Maximizing the sum of the appropriate money metric utilities of the agents would also lead to the selection of the efficient π, but the "appropriate" money metric utilities are those computed at the stock market equilibrium prices corresponding to the *efficient* π (see Schlee and Khan (2020)).

The problem of defining an appropriate objective function for the stakeholder firm is more complex than it appears through Magill, Quinzii, and Rochet's (2015) paper or the example of the previous section. The example was chosen with the goal of illustrating the point in the simplest framework and, as such, it is particular in the sense that it generates an equilibrium price for the bond which does not depend on the choice of the firm, π. That would not be the case in a more general model and, when r depends on π, shareholders' indirect utility, $V^k(\pi)$, may no longer be a monotonic transformation of the profit, $q(\pi) - \gamma(\pi)$, implying that firm's market value may no longer capture "shareholder value" accurately. An "adjusted value" that does capture it was defined in Bejan (2008) for a monopolistic firm in a complete markets model (and in Bejan (2020) for incomplete markets).[8]

The observation that "shareholder value" may not always be captured by the firm's market value is also related to the reason why framing the issue as a shareholder-vs-stakeholder dichotomy may be misguided. Imagine that, in Magill, Quinzii, and Rochet's (2015) model, capitalists and consumers share the ownership of the firm equally, so that all stakeholders are also shareholders. Giving consumers shares in the firm's profit solves nothing. It merely transforms the problem into a different one: the profit maximization criterion no longer reflects the interests of all shareholders. Defining the objective of the stakeholder corporation is no different than finding an appropriate objective for the firm outside of the complete markets, perfectly competitive, no externalities framework.

Finally, one might suspect that the results of Sections 4.1 and 4.2 are driven by the simplified version of the production set adopted here (whereas Magill, Quinzii, and Rochet's (2015) model also includes labor). That is not true. A

[8]The adjusted value can be used to define an objective for the stakeholder corporation. However, when all agents in the economy are stakeholders of the firm (as it happens in this model), maximization of the adjusted value selects the competitive equilibrium production. Since a competitive equilibrium does not exist in this model (firm's production set is not convex here), the adjusted value objective would not generate an equilibrium either.

shareholder-oriented firm can still make the efficient investment if, in addition to the membership fee charged to its customers, it also charges its (prospective) workers a job application fee at date 0. As in the case of the consumers, that fee would be equal to the market price for workers rights in Magill, Quinzii, and Rochet's (2015) model. Similarly, the government can still design a tax-subsidy policy which induces the firm to choose the socially optimal level of investment, even when date-0 cost function *and* date-1 state-contingent production functions are unknown. Since, as proved by Magill, Quinzii, and Rochet (2015), the firm's (state-contingent) choice of labor *is* socially efficient, the government does not need to alter it, but rather design a policy that is non-distortionary for the labor market. That can be achieved if the tax on the firm's output in the bad state is coupled with the appropriate subsidy for its labor expenditures. The details of such policy are sketched below.

Assume, as in Magill, Quinzii, and Rochet (2015) that the firm's technology is given by one of two production functions $y_s = g_s(l)$, where $s = G, B$. Each function $g_s : \mathbb{R}_+ \to \mathbb{R}_+$ is differentiable, increasing, concave and satisfies $g_s(0) = 0, {g_s}'(0) = \infty$, with $s = G, B$. It is also assumed that the marginal product of g_G is uniformly higher than that of g_B: ${g_G}'(l) > {g_B}'(l)$, for all $l \in \mathbb{R}_+$. As before, by choosing its investment expenditure at date 0, the firm determines the probability π of having the good outcome at date 1.

In addition to the consumers and capitalists described in Section 2, there is also a continuum of mass 1 of workers, each of whom is endowed with 1 unit of labor at date 1, consumes only money, and has the utility function

$$U^w(\mathbf{m}^w, \mathbf{l}) = m_0 + \delta\left(\pi(h(m_G) - n(l_G)) + (1-\pi)(h(m_B) - n(l_B))\right), \tag{30}$$

where $\mathbf{m}^w := (m_0, m_G, m_B)$ is the vector of money holdings, and $\mathbf{l} := (l_G, l_B)$ is the amount of labor the worker supplies to the firm each state. It is assumed that functions h and $-n$ are twice continuously differentiable and strictly concave, with $h(0) = h'(0) = n(0) = n'(0) = 0$ and $n'(l) \to \infty$ if $l \to 1$. In addition to their unit of labor, workers also have endowments of money $\mathbf{e}^w := (e_0^w, e_1^w, e_1^w)$, but no endowment of the consumption good.

Consider the government intervention consisting of a unit tax τ on the sale of the output good in state B, coupled with a subsidy to the firm of $\frac{\tau}{p_B}$ per dollar spent on labor. The remaining government revenue is then paid, as a lump-sum subsidy, to the consumers. Given this tax policy, the firm's choice of labor in state B is given by

$$\bar{l}_B := \arg\max_{l \geq 0}\left\{(p_B - \tau)g_B(l) - w_B\left(1 - \frac{\tau}{p_B}\right)l\right\}, \tag{31}$$

and thus it satisfies

$$(p_B - \tau){g_B}'(\bar{l}_B) = w_B\left(1 - \frac{\tau}{p_B}\right) \Leftrightarrow p_B {g_B}'(\bar{l}_B) = w_B, \tag{32}$$

showing that the tax does not distort the labor market.

Following a reasoning similar to that of Section 2 it can be shown that the agent's money holdings and firm's (state-contingent) labor choices do not depend on π. Therefore, $\bar{\mathbf{l}}$ does not depend on π and thus letting $y_s := g_s(\bar{l}_s)$, for $s = G, B$, the results of Section 4.2 carry through.

Note also that the net government revenue (from taxing and subsidizing the firm) is positive, since it is equal to:

$$\tau g_B(\bar{l}_B) - w_B \cdot \frac{\tau}{p_B} \cdot \bar{l}_B = \frac{\tau}{p_B} \big(p_B g_B(\bar{l}_B) - w_B \bar{l}_B \big) = \frac{\tau}{p_B} \cdot \Pi_B,$$

where Π_B is the firm's (pre-tax) equilibrium profit in state B.

The ensemble of these results, together with Magill, Quinzii, and Rochet's (2015), show that, to use the prices of customers (and workers) rights as proxies for stakeholders value, one is restricted to a model with quasi-linear (or, otherwise, very specific) preferences as well as homogenous populations of consumers and workers. On the other hand, under those conditions, a profit-maximizing firm that charges a two-part tariff for its product (and requires workers to pay a "job application fee") would also select the efficient level of investment, leaving the justification for the stakeholder corporation questionable.

A Appendix: Sunspot formulation of the model

This section shows that the endogenous uncertainty model described before is equivalent to a "standard" model in which the space of states of the world is exogenous. It also shows that the risk externality described earlier is, in fact, equivalent with the traditional pecuniary externality resulting from monopoly power.

Let $(0, 1]$ together with Lebesgue σ-algebra, $\mathcal{L}$, and Lebesgue measure, λ, be the space of exogenous states of the world at date 1. Allocations (of consumption and money holdings) for the representative consumer (indexed by c) and capitalist (indexed by k) are denoted by $\big((m_0^k, \mathbf{m}^k), (m_0^c, \mathbf{m}^c, \mathbf{c})\big)$, with $(m_0^k, m_0^c) \in \mathbb{R}_+^2$ and $\mathbf{m}^k, \mathbf{m}^c$ and $\mathbf{c}$ non-negative-valued, measurable mappings on $(0, 1]$.

Let $\gamma : [0, 1) \to \mathbb{R}_+$ be increasing, strictly convex and satisfying $\lim_{\pi \to 1} \gamma(\pi) = \infty$. The firm's production set, Y, consists of vectors $y := (y_0, \mathbf{y})$, with $y_0 = -\gamma(\pi)$ for some $\pi \in [0, 1)$ and $\mathbf{y} : (0, 1] \to \mathbb{R}_+$ a measurable mapping of the form:[9]

[9]This particular structure of the production set was chosen because of its simplicity, but alternative formulations deliver the same result. That is, the production set of the firm could have been defined as follows:

$$y(t) = \begin{cases} -\gamma(\pi) & \text{if } t = 0, \\ y_G & \text{if } t \in S_G, \\ y_B & \text{if } t \in S_B, \end{cases}$$

where $S_G, S_B \in \mathcal{L}$ form a partition of $(0, 1]$ with $\lambda(S_G) = \pi$.

$$y(t)=\left\{\begin{array}{ll} y_G & \text{if } t\in(0,\pi], \\ y_B & \text{if } t\in(\pi,1]. \end{array}\right. \tag{33}$$

For every measurable mapping $x:(0,1]\to\mathbb{R}$ and every $t\in(0,1]$, $x(t)$ and x_t will be used interchangeably to denote the value of x at t.

The utility functions for the representative consumer and capitalist are given by

$$U^c(m_0^c,\mathbf{m}^c,\mathbf{c}) \;:=\; m_0^c+\delta\int_0^1 (v(m_s^c)+u(c_s))ds, \tag{34}$$

$$U^k(m_0^k,\mathbf{m}^k) \;:=\; m_0^k+\delta\int_0^1 f(m_s^k)ds, \tag{35}$$

where u,v,f are increasing, continuously differentiable and strictly concave, with $u(0)=0$ and $u'(c)\to\infty$ when $c\to 0$. Every representative agent $i=k,c$ has endowments of money $(e_0^i,\mathbf{e}^i)$ with $e_0^i\in\mathbb{R}_+$ and $\mathbf{e}^i:(0,1]\to\mathbb{R}_+$ such that $e_t^i=e_1^i,\forall t\in(0,1]$. There is no endowment of the consumption good, and capitalists fully own the firm.

It is assumed that a bond (paying one unit of money in each state at date 1) and the firm's stock are the only assets available for trade at date 0, while money and the consumption good can be traded in spot markets which are open in each state. Since there is a continuum of (exogenous) states of the world and only two assets, markets are incomplete. The spot prices for consumption (in terms of money) are represented by the measurable mapping $\mathbf{p}:(0,1]\to\mathbb{R}_+$ while the prices for the equity and the bond are denoted by q and, respectively, r.

Agents (consumers and capitalists) take the firm's choice as well as all the prices as given, and choose their consumption and portfolio holdings to maximize their utilities, subject to their respective budget constraints. For consumers, the budget constraint $\mathcal{B}^c(\mathbf{p},r,q;y)$ consists of allocations $(m_0^c,\mathbf{m}^c,\mathbf{c})$ and portfolio holdings $(b^c,\theta^c)\in\mathbb{R}^2$ that satisfy:

$$\begin{aligned} m_0^c+r\cdot b^c+q\cdot\theta^c &= e_0^c, \\ m_s^c+p_sc_s &= e_1^c+b^c+\theta^c p_s y_s,\ \forall s\in(0,1]. \end{aligned}$$

For capitalists, their budget constraint, $\mathcal{B}^k(\mathbf{p},r,q;y)$ is given by the set of allocations and portfolio holdings $\left(m_0^k,\mathbf{m}^k,b^k,\theta^k\right)$ that satisfy:

$$\begin{aligned} m_0^k+r\cdot b^k+q\cdot\theta^k &= e_0^k+q+y_0, \\ m_s^k &= e_1^k+b^k+\theta^k p_s y_s\ \forall s\in(0,1]. \end{aligned}$$

For every $y\in Y$, let $\mathcal{E}^{im}(y)$ denote the incomplete markets stock-exchange economy described above. A vector of allocations, $\left((m_0^k(y),\mathbf{m}^k(y))\right)$ for the representative capitalist and $((m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y)))$ for the representative consumer, together with portfolio holdings, $(b^i(y), \theta^i(y))_{i=k,c}$, and prices $(\mathbf{p}(y), r(y), q(y))$ is a *security market equilibrium*[10] *for* $\mathcal{E}^{inc}(y)$ if

1. $(m_0^k(y), \mathbf{m}^k(y), b^k(y), \theta^k(y))$ maximizes U^k in $\mathcal{B}^k(\mathbf{p}, r, q; y)$,
2. $(m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y), b^c(y), \theta^c(y))$ maximizes U^c in $\mathcal{B}^c(\mathbf{p}, r, q; y)$,
3. all markets clear:
   (a) $m_0^k(y) + m_0^c(y) = e_0^k + e_0^c + y_0$
   (b) $m_s^k(y) + m_s^c(y) = e_1^k + e_1^c,\ s \in (0, 1]$
   (c) $c_s(y) = y_s,\ s \in (0, 1]$,
   (d) $b^c(y) + b^k(y) = 0$,
   (e) $\theta^c(y) + \theta^k(y) = 1$.

An equilibrium of $\mathcal{E}^{im}(y)$ can be mapped into an equilibrium of the model with endogenous uncertainty described in Section 2 if and only if the money holdings and consumption spot prices of that equilibrium are constant on the intervals $(0, \pi]$ and $(\pi, 1]$. Such equilibria are called *lottery equilibria*. It will be shown that all equilibria of $\mathcal{E}^{im}(y)$ are lottery equilibria.

Assume now that, instead of the bond and firm's equity, agents can trade, at date 0, in a full set of Arrow securities.[11] Let $\rho : (0, 1] \to \mathbb{R}_+$ denote the price mapping of Arrow securities (or *state prices*), where ρ_s denotes the price, at date 0, of the Arrow security corresponding to state s. For a given $y \in Y$, the representative consumer's budget set, $\bar{\mathcal{B}}^c(\rho, \mathbf{p}; y)$, at state prices ρ and spot prices $\mathbf{p}$ consists of allocations $(\mathbf{m}^c, \mathbf{c})$ that satisfy:

$$m_0^c + \int_0^1 \rho_s(m_s^c + p_s c_s) ds = e_0^c + e_1^c \int_0^1 \rho_s ds. \tag{36}$$

For capitalists, their budget constraint, $\bar{\mathcal{B}}^k(\rho; y)$, consists of allocations $\mathbf{m}^k$ that satisfy:

$$m_0^k + \int_0^1 \rho_s m_s^k ds = e_0^k + e_1^k \int_0^1 \rho_s ds + y_0 + \int_0^1 \rho_s p_s y_s ds. \tag{37}$$

Let $\mathcal{E}^{cm}(y)$ denote this complete-markets economy. A vector of allocations, $\big((m_0^k(y), \mathbf{m}^k(y)), (m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y))\big)$, and prices, $((\rho(y), \mathbf{p}(y)))$, is an equilibrium for $\mathcal{E}^{cm}(y)$ if

1. $(m_0^k(y), \mathbf{m}^k(y))$ maximizes U^k in $\mathcal{B}^k(\rho(y), \mathbf{p}(y); y)$,

[10] This definition implicitly assumes that the equilibrium is symmetric across agents of the same type. This is without loss of generality here because date-1 utilities are strictly concave.

[11] The Arrow security for state $s \in (0, 1]$ pays 1 unit of money in state s and nothing in all the other states.

2. $(m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y))$ maximizes U^c in $\mathcal{B}^c(\rho(y), \mathbf{p}; y)$,

3. all markets clear:

   (a) $m_0^k(y) + m_0^c(y) = e_0^k + e_0^c + y_0$

   (b) $m_s^k(y) + m_s^c(y) = e_1^k + e_1^c, \forall s \in (0, 1]$

   (c) $c_s = y_s, \forall s \in (0, 1]$.

For every $y \in Y$, let $\mathcal{F}(y)$ be the set of feasible allocations for $\mathcal{E}^{cm}(y)$ (that is, allocations satisfying (a), (b) and (c) above). A feasible allocation in $\mathcal{F}(y)$ is called *distributionally-efficient*[12] given y if there is no other allocation in $\mathcal{F}(y)$ that makes all agents better off and at least one strictly better off.[13]

Given the strict concavity of the utility functions v and f and the fact that date-1 endowments of money are risk-free, it can be shown that for every $y \in Y$, consumers' date-1 money holdings must also be risk-free at every distributionally-efficient allocation corresponding to y. Moreover, by the first welfare theorem, every equilibrium allocation of $\mathcal{E}^{cm}(y)$ must be distributionally-efficient and thus, at every complete markets equilibrium, date-1 money holdings must be risk-free.

As shown below, although markets are incomplete in $\mathcal{E}^{im}(y)$, the absence of some markets is irrelevant for consumers and capitalists, because every equilibrium of $\mathcal{E}^{im}(y)$ can be supported as an equilibrium of $\mathcal{E}^{cm}(y)$. Reciprocally, every equilibrium allocation of $\mathcal{E}^{cm}(y)$ can be supported via trading in the firm's equity and the risk-free bond and thus it is an equilibrium allocation of $\mathcal{E}^{im}(y)$. Allocations corresponding to equilibria of $\mathcal{E}^{im}(y)$ are distributionally-efficient, despite the fact that trade is restricted to only two assets, and thus markets are *effectively complete*.

Proposition A.1 *Fix $y \in Y$ and let $\big((m_0^k(y), \mathbf{m}^k(y)), (m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y))\big)$ be an equilibrium allocation for $\mathcal{E}^{im}(y)$ corresponding to spot prices $\mathbf{p}(y)$. Then there exist state prices $\rho(y) : (0, 1] \to \mathbb{R}_+$ such that the vector of allocations and prices $\big((m_0^k(y), \mathbf{m}^k(y)), (m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y)), \rho(y), \mathbf{p}(y)\big)$ is an equilibrium for $\mathcal{E}^{cm}(y)$.*

Reciprocally, if $\big((m_0^k(y), \mathbf{m}^k(y)), (m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y)), \rho(y), \mathbf{p}(y)\big)$ is an equilibrium for $\mathcal{E}^{cm}(y)$, then there exist bond and stock prices $(r(y), q(y))$ and portfolio holdings $(b^i(y), \theta^i(y))_{i=k,c}$ which, together with spot prices $\mathbf{p}(y)$, support it as an equilibrium for $\mathcal{E}^{im}(y)$.

Proof. Let $\big((m_0^k(y), \mathbf{m}^k(y)), (m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y))\big)$ be an equilibrium allocation for $\mathcal{E}^{im}(y)$ corresponding to spot prices $\mathbf{p}(y)$ and security prices $r(y)$ and $q(y)$. Let also $(b^i(y), \theta^i(y))_{i=k,c}$ be the corresponding equilibrium portfolios.

[12]In contrast to efficiency for the production economy, this weaker version only requires that the economy's total resources, including a particular production plan, are distributed efficiently among agents, without requiring that the production itself is efficient.

[13]The assumption of symmetric allocations across agents of the same type is implicitly used here again without loss of generality.

The proof will proceed in several steps:

Step 1: *Every equilibrium allocation of $\mathcal{E}^{im}(y)$ is distributionally-efficient.*

Suppose that is not the case and let $\big((\bar{m}_0^k(y), \bar{\mathbf{m}}^k(y)), (\bar{m}_0^c(y), \bar{\mathbf{m}}^c(y), \mathbf{c}(y))\big)$ in $\mathcal{F}(y)$ be a feasible allocation that dominates it. Define $\tilde{\mathbf{m}}^{\mathbf{i}}(y) := \tilde{m}^i(y) \cdot \mathbf{1}$, where

$$\tilde{m}^i(y) := \int_0^1 \bar{m}^i(s)ds, \text{for } i = c, k,$$

and $\mathbf{1}(t) = 1, \forall t \in (0,1]$. Then $\big((\bar{m}_0^k(y), \tilde{\mathbf{m}}^k(y)), (\bar{m}_0^c(y), \tilde{\mathbf{m}}^c(y), \mathbf{c}(y))\big)$ is feasible and dominates the original allocation as well. Moreover, date-1 money holdings and consumption for this allocation can be supported through trading in the risk-free asset and the firm's equity via portfolios $(\bar{b}^i(y), \bar{\theta}^i(y))_{i=k,c}$ with $\bar{\theta}^k(y) = 0, \bar{\theta}^c(y) = 1, \bar{b}^k(y) = e_1^k - \tilde{m}^k(y), \bar{b}^c(y) = e_1^c - \tilde{m}^c(y)$. Since the original allocation was optimal within each agent's budget constraint, it follows that

$$\begin{aligned} \bar{m}_0^k(y) + r(y) \cdot \bar{b}^k(y) &\geq e_0^k + q(y) + y_0, \\ \bar{m}_0^c(y) + r(y) \cdot \bar{b}^c(y) + q(y) &\geq e_0^c, \end{aligned}$$

with at least one strict inequality. Adding the two inequalities leads to a contradiction, thus proving that the original allocation must be distributionally-efficient.

Step 2: *Every equilibrium of $\mathcal{E}^{im}(y)$ is a lottery equilibrium.* Since the allocation is distributionally-efficient, date-1 money holdings must be risk-free for every agent and thus $m_s^i(y) = m_1^i(y)$ for every $s \in (0,1]$ and every $i = k, c$. The first order conditions for the representative consumer, together with the market clearing for consumption imply that

$$p_s(y) = \begin{cases} \frac{u'(y_G)}{v'(m_1^c(y))} & \text{if } s \in (0, \pi], \\ \frac{u'(y_B)}{v'(m_1^c(y))} & \text{if } s \in (\pi, 1], \end{cases}$$

thus proving that every equilibrium of $\mathcal{E}^{im}(y)$ is a lottery equilibrium.

Step 3: *Every equilibrium allocation of $\mathcal{E}^{im}(y)$ can be supported as an equilibrium of $\mathcal{E}^{cm}(y)$.*

An immediate implication of Step 2 (together with the assumption that $y_G \cdot u'(y_G) \neq y_B \cdot u'(y_B)$) is that, at every equilibrium of $\mathcal{E}^{im}(y)$, capitalists sell the firm to the consumers, and thus $\theta^c(y) = 1$, which implies that $m_s^i(y) = m_1^i(y) = e_1^i + b^i(y)$ for $i = k, c$. Defining $\rho_s(y) := r(y)$ for every $s \in (0,1]$, it is straightforward to verify that $(m_0^k(y), \mathbf{m}^k(y))$ And $(m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y))$ satisfy the complete markets budget constraints for the capitalist and, respectively, the consumer. Moreover, for every allocation that maximizes U^i on $\mathcal{B}^i(\rho(y), \mathbf{p}(y); y)$, there exists a portfolio of bonds and stocks such that the allocation, together with the portfolio, also satisfies $\mathcal{B}^i(\mathbf{p}, r, q; y)$, for $i = k, c$. This proves that $\big((m_0^k(y), \mathbf{m}^k(y)), (m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y))\big)$ is an equilibrium allocation for $\mathcal{E}^{cm}(y)$.

Step 4: *Every equilibrium allocation of $\mathcal{E}^{cm}(y)$ can be supported as an equilibrium of $\mathcal{E}^{im}(y)$.*

Let $\left((m_0^k(y), \mathbf{m}^k(y)), (m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y))\right)$ be an equilibrium allocation of $\mathcal{E}^{cm}(y)$ supported by state prices $\rho(y)$ and spot prices $\mathbf{p}(y)$. Define

$$r(y) := \int_0^1 \rho_s ds, \tag{38}$$

$$q(y) := \int_0^1 \rho_s \cdot p_s(y) \cdot y_s ds. \tag{39}$$

It is straightforward to show that every money (and consumption) allocation which, together with a portfolio of bonds and stocks, belongs to $\mathcal{B}^i(\mathbf{p}(y), r(y), q(y); y)$, is also an element of $\mathcal{B}^i(\rho(y), \mathbf{p}(y); y)$. Moreover, for every allocation that maximizes U^i on $\mathcal{B}^i(\rho(y), \mathbf{p}(y); y)$, there exists a portfolio of bonds and stocks such that the allocation, together with the portfolio, belongs to $\mathcal{B}^i(\mathbf{p}(y), r(y), q(y); y)$. This shows that $\left((m_0^k(y), \mathbf{m}^k(y)), (m_0^c(y), \mathbf{m}^c(y), \mathbf{c}(y))\right)$ can be supported as an equilibrium for $\mathcal{E}^{im}(y)$, with prices $r(y), q(y)$ as above. ■

A.1 Equilibrium with a monopolistic firm

Magill, Quinzii, and Rochet (2015) refer to the equilibrium defined in their paper as "competitive" and attribute the inefficiency of the equilibrium outcome to the "direct" externality that the firm exerts on its stakeholders by controlling the probabilities of the two states. However, they also recognize that suboptimality of the equilibrium allocation "comes from the fact that the firm is not negligible, since the spot prices depend on its outcome" but, they argue, "this cause of inefficiency is nevertheless different from the traditional inefficiency associated with a large firm which under-produces to generate a higher price for its product." I show here that their equilibrium is, in fact, equivalent to a monopolistic equilibrium in the sunspot, or exogenous-uncertainty formulation of the model and therefore the cause of equilibrium outcome inefficiency is the traditional one: the firm underproduces (lower π means lower expected output) to generate higher spot prices with a higher probability, and thus higher date-0 price for its output.

This is summarized by the following straightforward result.

Proposition A.2 *At a monopolistic equilibrium, the firm chooses π^M such that $\gamma'(\pi^M) = \delta(u'(y_G) \cdot y_G - u'(y_B) \cdot y_B)$.*

Proof. A monopolistic firm anticipates that, by choosing a production plan $y \in Y$, the consumption spot prices will be $p_s(y) := \frac{u'(y_s)}{v'(m_1^c(y))}$ and the price of its equity will be $q(y) = \int_0^1 \rho_s \cdot p_s(y) \cdot y_s ds$. Following a reasoning similar to that of Section 2 it can be shown that m_1^c is constant in y and thus $m_1^c(y) = \bar{m}_1^c$, for every $s \in (0, 1]$. Moreover, the first order condition for consumer's maximization problem implies that $\rho_s(y) = v'(\bar{m}_1^c)$ and therefore, value maximization leads to solving

$$\max_{\pi \in [0,1]} \{\delta \left(\pi u'(y_G) y_G + (1 - \pi) u'(y_B) y_B\right) - \gamma(\pi)\},$$

and therefore a choice π^M such that

$$\gamma'(\pi^M) = \delta\big(u'(y_G) \cdot y_G - u'(y_B) \cdot y_B\big).$$

■

Although the firm's choice dictates the aggregate risk in the economy, Proposition A.1 shows that markets are effectively complete and thus, even if consumers had the opportunity to fully insure against *any* risk, they would choose not to do it because of prices. Therefore, the externality exerted on consumers does not come from the absence of insurance markets, but prices in the existing markets. It is those prices, and not the absence of markets, that forces them to bear the risk. This shows that the firm affects its stakeholders *only* through the (inter-temporal) commodity prices/total quantity supplied, which is the typical monopoly effect. Therefore, the direct externality in the endogenous state space formulation of the model is equivalent to the indirect externality a monopolistic firm exerts on its customers, via its effect on prices.

The original Magill, Quinzii, and Rochet's (2015) model also includes labor, and the assumption there is that the firm behaves competitively in the *spot* consumption and labor markets. The firm has two instruments through which it may control the consumption spot prices. One is through hiring labor at suboptimal levels (in the spot market) to reduce production and increase the spot price. The other is through under-investment in the better technology at date 0. The underlying assumption in Magill, Quinzii, and Rochet's (2015) model is that, once a state is realized, the firm behaves competitively and does not attempt to manipulate spot prices. However, it does manipulate *inter-temporal* prices through its investment at date 0, thus behaving as a large (monopolistic) firm at date 0 and as an infinitesimal (competitive) one in every spot market at date 1.[14] It can be shown that a fully competitive equilibrium (in which the firm also takes date-0 state prices as given) does not exist in this model.

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[14]Such behavior can be rationalized by the existence of a large number of other firms producing an identical good, which are active in each spot market. None of these firms, however, is active at date 0. Although this argument is not made explicitly in Magill, Quinzii, and Rochet's (2015) paper, in the supplemental material the authors discuss the possibility of adding firms with deterministic technologies that operate in each of the spot markets at date 1, thus alluding to the possibility of this interpretation.

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