The Unintended Consequences of Divestment [1]

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August 19, 2015

Abstract

Large divestment campaigns are undertaken in part to depress share prices of firms that investors see as engaged in harmful activities. We show that, if successful, investors who divest earn lower and riskier returns than those that do not, leading them to control a decreasing share of wealth over time. Divestment therefore has only a temporary price impact. Further, we show that, for standard managerial compensation schemes, divestment campaigns actually provide an incentive for executives to increase, not reduce, the harm that they create. Therefore, divestment is both counter-productive in the short run, and self-defeating in the long run.

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1 Introduction

On May 6, 2014, Stanford University announced that it would no longer invest funds in coal mining firms and would divest its existing holdings. According to university President John Hennessy:

> "Stanford has a responsibility as a global citizen to promote sustainability for our planet...The university's review has concluded that coal is one of the most carbon-intensive methods of energy generation and that other sources can be readily substituted for it. Moving away from coal in the investment context is a small, but constructive, step while work continues, at Stanford and elsewhere, to develop broadly viable sustainable energy solutions for the future."

In part, divestment campaigns like Stanford's allow groups to credibly signal their displeasure with a company, industry, or country's actions, but larger divestment campaigns also aspire to affect the prices and profitability of offending firms. Most campaigns are too small to have much effect but, in this paper, we ask what would happen if a divestment campaign were large enough to have a meaningful effect on share prices. Would this yield the benefits that divestment proponents seek?

We show that large-scale divestment campaigns feature two serious flaws. If divestment is effective in reducing prices, then the investors willing to purchase the lower-priced shares will earn higher returns. Over time, these amoral investors will see their share of the economy's assets grow, relative to the share held by moral investors. This means that the price discount due to divestment will shrink over time. Divestment campaigns are *inherently self-defeating*, in the sense that, even if they are successful at first, this very success will cause them to fail in the long run.

As noted by Keynes (1923), in the long run, we are all dead. What is the effect of a large-scale divestment campaign in the short run? Some targets of divestment campaigns, like fossil fuel firms, cannot mitigate the harm that campaigners dislike. For these firms, the short-run effect of divestment will be just as lousy as the long-run effect. Other targets, like firms employing sweatshop labor, can mitigate the harm, and we ask whether a low share price will cause them to do so. We show that the answer depends upon how the firm's manager is compensated. If she is rewarded for high near-term share prices, then a divestment campaign could incent her to satisfy campaigners. If she has mostly long-term incentives, however, or if the divestment campaign is small, she will not adjust her behavior. Further, if she is rewarded for high stock *returns*, then the incentives are precisely backward: shares in firms subject to a divestment campaign earn higher returns, so managers of those firms are rewarded for what campaigners see as bad behavior. To determine the short-run effects of large divestment campaigns, then, we need to know how executives are compensated. Do standard compensation plans reward high prices, mostly near-term?

Standard compensation practices do not specifically target price multiples, like the price-earnings ratio, market-to-book ratio, or price-to-sales ratio. Instead, there are two major classes of compensation. First are performance incentives that are tied to measures of firm performance unrelated to the stock price, like return-on-equity or return-on-assets. If mitigating a harm is costly, then any incentives tied to firm performance will cause the CEO to prefer not to mitigate.

Second are stock and option grants. Those grants typically award the CEO either a set dollar value of shares, or a set number of options whose strike price is the firm's share price on the grant date. In each case, a higher share price does not directly affect the value of the grant. But a higher return, post grant, clearly increases the value of either type of grant, so executives would prefer the high returns that being subject to a divestment campaign would provide.

These facts suggest that it is stock returns, not stock prices, that drive executive pay, meaning that it is in executives' financial interests to ignore divestment campaigns, at least until they want to sell their shares. Indeed, if it were possible, it would be optimal for managers at firms to adopt practices that are likely to attract divestment campaigns! This means that divestment campaigns are *counter-productive*, in the sense that they incent precisely the opposite behavior of what campaigners intend.

Although divestment is both counter-productive in the short run, and self-defeating in the long run, alternative compensation practices can solve the problem. Tying pay directly to mitigation of the harm can obviously induce better CEO behavior. Because this may be difficult to implement, as harms are often unverifiable, compensation tied to share prices themselves, not their changes over time, can also incent the CEO to mitigate the harm. The difficulty is that pay must depend significantly on imminent prices, and less so on more distant prices. This prescription runs directly counter to the increasingly common practice of long-vesting share grants, which are designed to improve management behavior in a variety of ways unrelated to the issues in this manuscript. Compensation that allows divestment to improve firm behavior in one area will likely induce bad behavior elsewhere.

Importantly, the theory that we provide focuses upon two unintended consequences of divestment, but it is not meant to be comprehensive. We leave aside two positive outcomes that divestment campaigns can produce. First, as mentioned above, divestment campaigns can be a credible signal that an important group of people believe that something is wrong. Managers of firms that are the subject of divestment campaigns are stigmatized, and social pressure can be as effective as financial pressure. Second, we ignore the fact that firms with lower expected returns also have lower costs of capital, and can therefore grow more quickly and achieve higher profitability. These benefits of divestment must be weighed against the costs we identify in this manuscript.

2 Literature

It is debatable whether or not divestment campaigns produce any real effect in financial markets. Teoh, Welch, and Wazzan (1999) provide empirical evidence that the South African boycott to end apartheid, the most prominent divestment campaign to date, had neither a discernible effect on the valuation of companies with ties to South Africa, nor any effect on the South African financial markets.[1] However, socially responsible investing (SRI) – an analogue to divestment – does appear to affect stock prices.[2] SRI strategies are typically exclusionary, meaning that socially irresponsible investments are screened out. Divestment and exclusionary investment are different sides of the same coin: divestment is reactive and pertains to the intentional liquidation of offending assets. Conversely, exclusionary investment is preemptive and avoids the offending assets altogether. Hong and Kacperczyk (2009) show that those stocks that are not SRI acceptable, i.e., "sin stocks," have lower price-to-book ratios, less institutional ownership, and less analyst coverage. Geczy, Stambaugh, and Levin (2005) provide similar evidence.

We are not the first paper to explore the equilibrium asset pricing implications of exclusionary investing. Heinkel, Kraus, and Zechner (2001) provide a model related to ours. They show that exclusionary investing limits risk sharing and that offending firms have lower stock prices in equilibrium. While our paper produces a similar insight, we depart from their work in several ways. First, we consider the long-run implications of exclusionary investing and show that, over time, socially responsible investors will hold less and less of the wealth in the economy. Second, Heinkel, Kraus, and Zechner (2001) presuppose that a firm's objective is to maximize share price. Although that assumption makes sense for firms that rely on equity offerings for financing, it ignores potential agency conflicts that are tied to price levels. Namely, under typical compensation schemes, managers desire to maximize stock *return*, not stock *price*, which is subtle but, as we show, important.

[1]Welch (2014) also argues that Stanford's divestment from coal stocks is ineffective at impacting stock prices.
[2]For a survey of the SRI literature see Renneboog, Ter Horst, and Zhang (2008).

3 Baseline Model

We begin by constructing a simple model with two types of investor and two assets. Investors have constant absolute risk aversion (CARA), which allows us to generate simple and intuitive formulae for asset prices, holdings, and expected returns. These results are highly suggestive of the idea that divestment strategies are self-defeating. Unfortunately, the simplicity comes at a cost: with CARA utility, investors' holdings of risky assets are unrelated to wealth, so the dynamic evolution of risky holdings will be unrealistic. To that end, we follow the baseline model with an extension in which we assume constant relative risk aversion (CRRA). This extension lacks analytical results, but we show numerically that the qualitative results of the baseline model hold, and that the evolution of the holdings of risky securities is as we expect.

3.1 Constant absolute risk aversion

Consider an economy in which a unit continuum of investors trade the stocks of two firms. The subscripts x and y identify each of the firms hereafter. Each firm has a unit length measure of publicly traded shares and the game takes place over two periods. In the first period, $t = 1$, shares of firm $j \in \{x, y\}$ trade at an endogenously determined price P_j. In the second period, $t = 2$, each firm j produces a stochastic dividend D_j that is distributed normally with mean μ and variance σ^2. The correlation between the firms' dividends is $\rho \in [-1, 1]$. In addition to the firms' securities, there exists a risk-less asset in perfectly elastic supply that generates a gross rate of return normalized to one. For simplicity, we do not allow the short-selling of shares.

In addition to producing a dividend, firm x produces a negative externality, which is valued by society at $-\overline{\chi} < 0$. The externality is relevant to the financial market because each investor is one of two types: amoral or moral. The amoral investors constitute a fraction α of all investors and the subscript a is used to characterize these investors hereafter. The amoral investors do not internalize (i.e., care about) the negative externality generated by firm x in their investment decisions. The remaining $1-\alpha$ investors are moral and the subscript m is used to characterize them. The moral investors are socially conscious and loathe the externality. To protest the externality, moral investors coordinate a divestment campaign for firm x. The divestment campaign is credible and moral investors do not invest in firm x.

All investors are risk averse and have exponential utility with risk aversion coefficient γ. We assume that each investor i is initially endowed with wealth W_i and that he consumes his entire terminal wealth at the conclusion of $t = 2$.[3] Consequently, investors maximize their expected terminal utility by choosing how many shares of each firm to purchase. Denote investor i's shares in firm j as

$$s_{i,\tau,j} \geq 0, \tag{1}$$

with $\tau \in \{a, m\}$. Then investor i's terminal wealth is given by $W_{i,\tau}^T = s_{i,\tau,x}(D_x - P_x) + s_{i,\tau,y}(D_y - P_y) + W_{i,\tau}$ and her utility is given by $u_{i,\tau} = 1 - e^{-\gamma W_{i,\tau}^T} = 1 - e^{-\gamma(s_{i,\tau,x}(D_x - P_x) + s_{i,\tau,y}(D_y - P_y) + W_{i,\tau})}$.

Share prices are determined endogenously through the market clearing conditions; each firm's share price is set so that aggregate investor demand equals the firm's supply of shares. Before proceeding to the base model equilibrium, we provide two assumptions for tractability.

Assumption 1. *The expected dividend is sufficient large,*

$$\mu \geq \gamma\sigma^2(1 + \rho). \tag{2}$$

Assumption 2. *The fraction of amoral investors is sufficiently large,*

$$\alpha \geq \frac{\gamma(1 - \rho^2)\sigma^2}{\mu - \gamma\rho(1 + \rho)\sigma^2} \tag{3}$$

Assumptions 1 and 2 are fairly mild and guarantee that the equilibrium stock prices studied hereafter are positive valued. The following lemma provides the equilibrium share prices and each investor's holdings.

Lemma 1. *The equilibrium stock prices are,*

$$P_x = \mu - \rho\gamma\sigma^2 (1 + \rho) - \frac{\gamma\sigma^2(1 - \rho^2)}{\alpha}, \tag{4}$$

$$P_y = \mu - \gamma\sigma^2 (1 + \rho). \tag{5}$$

The equilibrium share holdings for each type of individual investor are,

$$s_{m,x}^* = 0, \tag{6}$$

$$s_{m,y}^* = (1 + \rho), \tag{7}$$

$$s_{a,x}^* = \frac{1}{\alpha}, \tag{8}$$

$$s_{a,y}^* = (1 + \rho) - \frac{\rho}{\alpha}. \tag{9}$$

[3] While investor i's optimal investment strategy is independent of W_i with CARA utility, we explore a similar setup with CRRA utility in the subsequent section. The qualitative implications are unchanged.

The comparative statics of P_x and P_y are natural: both prices are increasing in the expected dividend μ, decreasing in the level of risk-aversion γ, the stock volatility σ, and the correlation of dividends ρ. Prices are lower when investors face more risk or are more averse to risk, but are higher when payouts are higher. The price P_y is independent of α because both investor types are willing to hold the asset. The price P_x however is increasing in the fraction of investors that are amoral, α, because risk sharing by a greater fraction of investors leads to a lower discount. That is, as the share of amoral investors increases, more investors are willing to invest in stock x, increasing its price. This implies the following proposition:

Proposition 1. *The portfolios of amoral investors outperform those of the moral investors with respect to expected returns and expected profit.*

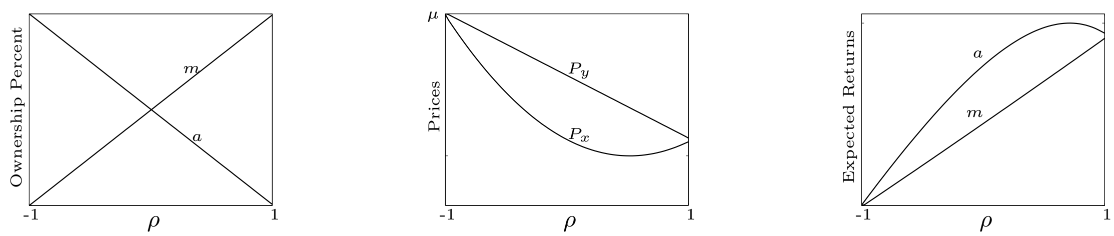
Corollary 1. *The stock of firm x has a higher expected return than the stock of firm y. The difference in expected returns is increasing with the proportion of moral investors.*

According to Proposition 1, the amoral portfolio dominates the moral portfolio. This is due to two factors. First, as Corollary 1 makes explicit, the stock of firm x trades at a discount despite having the same underlying fundamental characteristics as firm y.[4] This implies that amoral investors are able to augment their returns by investing in the cheaper stock. Second, because the stock of firm x provides a diversification benefit, amoral investors are willing to be more exposed to the risky assets. This too augments their portfolios returns.

Although we model this game with only a single period of trade, the implications in a dynamic setting are obvious: amoral investors' portfolio values will grow more quickly and the share of moral wealth in the economy will shrink. This implies that a successful divestment campaign is inherently self-defeating.

Ideally, we would model the dynamics of share prices and investor wealth shares with our current assumptions. With CARA utility, however, the quantity of wealth invested in risky assets by an investor is independent of that investor's total wealth. Therefore, under the assumption of CARA utility, while amoral investors will become relatively more wealthy over time, they will not acquire an increasing share of risky assets. In practice, it is unlikely that an investor's optimal risk exposure is independent of his level of wealth, so we turn to an assumption on investor utility that allows for more realistic dynamics, but at the cost of analytical tractability.

[4] This result is consistent with Hong and Kacperczyk (2009) who show that sin stocks trade at lower price-to-book ratios.



(a) Ownership split for firm y. (b) Prices P_x and P_y. (c) Investor expected portfolio returns.

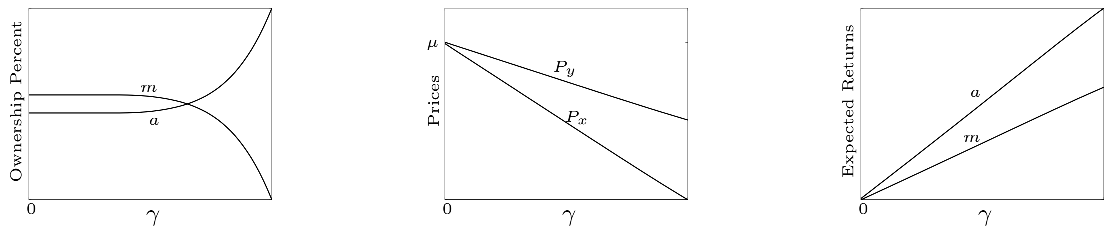
Figure 1: The effect of ρ. The default parameters are $\mu = 1$, $\sigma = 0.25$, $\gamma = 2$, $\alpha = 0.5$, and $W = 10$.

3.2 Constant relative risk aversion

Suppose that investors have power utility over terminal wealth, $u_{i,\tau}(s_{i,a,x}, s_{i,\tau,y}, \gamma) = \frac{1}{1-\gamma}\left(W_{i,\tau}^{T}\right)^{1-\gamma}$. For consistency with the base model, we label each investor's coefficient of relative risk aversion as γ. With power utility, closed-form solutions for prices and share holdings are not tractable. Instead, we rely on numerical analysis methods to generate the relevant comparative statics and insights. Outside of changing the functional form of investor utility, we maintain all assumption from the base model.

First, consider the comparative statics with respect to ρ which are depicted in Figure 1. Amoral investors hold all shares of firm x. In the first panel, the ownership split for firm y is shown. If the dividends of firm x and y are negatively correlated, the amoral investors are willing to hold greater ownership in firm y than moral investors because the negative correlation provides a diversification hedge. In the limiting case of perfect negative correlation, amoral investors hold all of firm y, as this forms a perfect hedge against their holdings of firm x. At a correlation of zero, the two groups of investors split the ownership in firm y based on their relative population proportions. If the two dividends are positively correlated, the amoral investors' willingness to hold the stock of firm y diminishes because they must hold all of firm x as well. In the limiting case, when the two stocks are perfectly correlated, each group specializes in one of the two stocks; amoral investors hold all of firm x and moral investors hold all of firm y.

The second panel in Figure 1 depicts the prices of stock x and y. If the two stocks are perfectly negatively correlated, all shares are held by amoral investors and the two stocks have the same price because they are fundamentally identical. As the correlation coefficient moves from negative one, the price of x declines to compensate amoral investors for holding the stock. The price of firm y's stock also declines to incent both groups of investors to hold the risky asset. As the correlation coefficient approaches one, the prices converge because each group of investors specializes in only



(a) Ownership split for firm y.

(b) Prices P_x and P_y.

(c) Investor expected portfolio returns.

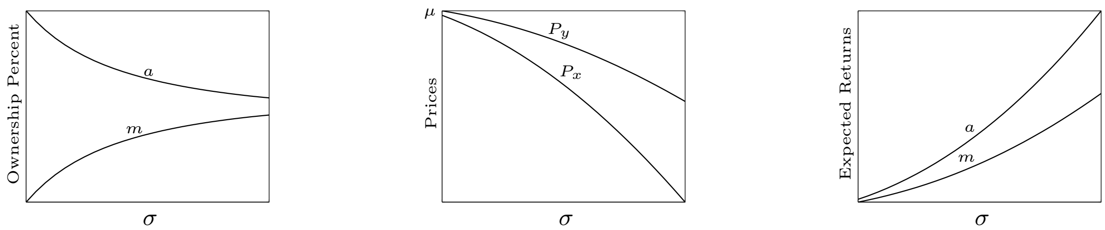
Figure 2: The effect of γ.

one of the stocks and the two populations are equal in size. The third panel in the figure depicts the expected returns of an amoral investor's portfolio and a moral investor's portfolio. Expected returns are increasing across both portfolios because the stock prices are declining. Importantly, the expected returns for amoral investors are greater.

The comparative statics with respect to γ are depicted in Figure 2. In the first panel, the ownership split in firm y is depicted. If γ is small, the ownership split is approximately equal. As γ increases and all investors become more risk averse, moral investors are willing to hold less of the asset because they do not possess the diversification opportunity via the stock of firm x. If investors are sufficiently risk averse, amoral investors hold both stocks. The second two panels show the stock prices of firm x and y and the portfolio returns respectively. Naturally, the prices of both stocks are declining with γ and expected returns are increasing - greater risk aversion necessitates a greater price discount for markets to clear.

In Figure 3, the comparative statics with respect to σ are depicted. In the first panel, the ownership share of firm y converges as σ gets larger. Intuitively, as both stock's dividends get increasingly volatile, the benefit of diversification becomes less important to the risk averse amoral investors. In fact, as σ approaches infinity, amoral investors and moral investors split ownership based on their relative population proportions. In the second panel, both prices are depicted and are shown to be decreasing as σ increases. This is due to the investors' risk aversion. The third panel shows that both portfolios experience higher expected returns as σ increases, however, the amoral investor portfolio again dominates.

The comparative statics depicted in Figures 1-3 show that the intuition from the base model does not materially change as we move from CARA to CRRA utility: amoral investors still have access to a relatively cheap asset, which allows them to earn a higher and less risky portfolio return than moral investors. Improved diversification then allows them to invest more in high-



(a) Ownership split for firm y.

(b) Prices P_x and P_y.

(c) Investor expected portfolio returns.

Figure 3: The effect of σ. The default parameter settings are $\mu = 1$, $\rho = 0$, $\gamma = 2$, $\alpha = 0.5$, and $W = 10$.

earning risky assets for any given wealth level, further increasing their returns. Finally, as with CARA utility, these facts imply that amoral investors' wealth increases over time, relative to that of moral investors. Unlike with CARA utility, higher wealth translates to larger investments in risky securities. Therefore, amoral money will crowd out moral money.

To illustrate the previous point explicitly, consider a simple extension of the model in which investors trade over a series of T dates. In this dynamic setup, we assume that each investor's objective is to maximize his terminal utility and that he forgoes interim consumption. Figure 4 depicts the evolution of aggregate wealth held by both moral and amoral investors in expectation. In the illustrated example, we assume that the proportion of amoral investors equals that of the moral and that all investors are endowed with same initial wealth. For an arbitrarily large number of dates, the amoral wealth share approaches 100% of the economy in expectation as t approaches T. Thus, in the long-run, the wealth of moral investors is expected to be subsumed by the amoral.

4 Divestment and Executive Compensation

We have shown that divestment campaigns are inherently self-defeating, in that their very success drives the share of moral investors in the economy to zero, thus making them ineffective in the long run. However, this need not be a serious problem: if a divestment campaign can change firm behavior quickly, then campaigners only earn lower returns briefly and their share of total wealth is little affected. Short-term effects depend upon executives responding to campaigners' behavior and, to that end, we therefore turn to the question of how executives will respond to divestment campaigns. One might expect that, because managers prefer higher stock prices, a divestment campaign would obviously generate positive managerial responses. We show that this is not so.

Suppose that a manager has a choice of whether to mitigate the externality at some cost to

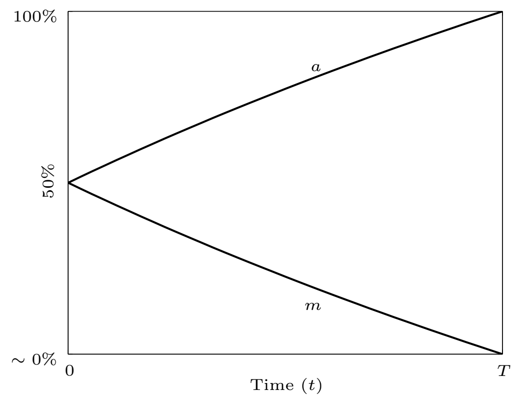


Figure 4: The expected evolution of investors' wealth share over time. The parameter set is $W_a^0 = W_m^0 = 10$, $\alpha = 0.5$, $\gamma = 2$, $\rho = 0$, $\mu = 1$, $\sigma = 0.25$.

the firm, $m \in [0, \overline{\chi})$. Recall that $\overline{\chi} > 0$ is the harm that society assigns to the externality, so we are assuming that mitigation is socially efficient, though weakly costly for the firm. Under what conditions will the manager mitigate the externality? We tackle this question by building a highly stylized model and applying it to standard compensation schemes. We allow the executive to choose a level of effort, which is personally costly, and also to choose whether to mitigate the externality, which can be done at some positive cost to the firm.[5]

We do not attempt to derive an "optimal" compensation function, for several reasons. First, it is not clear whose objectives should enter into the optimization. Is it society or shareholders and, if the latter, which shareholders? Different people would choose to hold shares if mitigation does and does not take place. Second, the problem of optimal compensation is probably moot: if moral investors were able to impose their will regarding compensation, then they would probably have the power to directly demand mitigation. Instead, we will observe what properties of a compensation function will allow divestment campaigns to achieve their goals, and under what circumstances.

4.1 The model with executive actions

The analysis is clearest if we ignore the direct impact of pay on profit. Therefore, suppose that managerial compensation is small relative to gross profit. In practice, this is approximately true: in 2014, for example, total earnings for Standard and Poor's (S&P) 500 firms were over \$2 trillion, while total CEO pay was a little over \$10 billion (Mullaney 2015). Let the dividend that

[5]We require effort because otherwise a flat wage would make the manager indifferent between mitigating and not mitigating the externality. For the problem to be interesting, we need pay to depend upon performance, and this is most easily done with an effort problem.

shareholders receive be $\widetilde{D}_x = D_x + e - m\chi$, where D_x is the same random dividend as in the last section, $e \in \{0,1\}$ is the manager's effort, m is the mitigation cost, and $\chi \in \{0,1\}$ is an indicator for whether mitigation has taken place. The terminal dividend $\widetilde{D}$ is also the stock's terminal price. The manager has utility function $U = E(w) - ce$, where w is her wage and $c \in (0,1)$ is her cost of effort. Effort is therefore personally costly, but socially efficient. The manager is risk-neutral for simplicity.

The time-line is as follows. First, the manager decides whether to mitigate the externality, and chooses an effort level $e \in \{0,1\}$. Mitigation is observable but non-contractible, and effort is hidden. Second, there is trading, with moral investors only willing to invest in stock x if the externality was mitigated. Stock y is also traded, and has the same properties as in the last section. Third, dividends are realized and there is an additional round of trading. Fourth, the manager is paid and investors receive the balance.

There are three contractible variables that we allow: (i) the initial price, P_x, which will depend upon the mitigation choice and the expected payout; (ii) gross profit, $\pi = D_x + e - m\chi$; and (iii) the stock return, which is the proportionate increase in price, $\frac{\widetilde{D}_x - P_x}{P_x}$. These three variables are ultimately defined by only two fundamental variables: if one knows the initial price and gross profit, as well as how the wage depends upon them, then one can calculate the final price and the return. We therefore write the wage as $w = w(P_x, \pi) \geq 0$.

It will be convenient to define notation to help with clarity throughout the remainder of the paper. Let the firm's price after the initial rounds of trading be denoted $P_{i,e,\chi}$, where i is the type of firm, e is the manager's effort, and χ is the mitigation decision. Naturally, e is unobservable, so $P_{i,e,\chi}$ is the price that results when investors expect the manager to take effort e. Let $\pi_{i,e,\chi}$ be gross profit for firm i, managerial effort e, and mitigation decision χ. Finally, let $w_{e,\chi} \equiv E[w|e,\chi]$ be firm x's manager's expected wage, given effort e and mitigation decision χ.

4.1.1 Prices and profits with and without mitigation and effort

In order to determine the effect of any given contract we must find asset prices in four scenarios. The manager can either exert effort or not, and can either mitigate or not. The case of no mitigation will largely follow the lines of our earlier work, with the exception that the mean of $\widetilde{D}_x$, the net dividend that investors receive, will equal $\mu + e$ if there is no mitigation. If there is mitigation, then moral investors are free to invest in both firms x and y, so we must re-solve for prices in this case.

choice	e	
χ	0	1
0	$P_{x,0,0} = \mu - \gamma\left(\rho\sigma^2(1+\rho) - \frac{\sigma^2(1-\rho^2)}{\alpha}\right)$	$P_{x,1,0} = \mu + 1 - \gamma\left(\rho\sigma^2(1+\rho) - \frac{\sigma^2(1-\rho^2)}{\alpha}\right)$
	$\pi_{0,0} = D_x$	$\pi_{1,0} = D_x + 1$
1	$P_{x,0,1} = \mu - m - \gamma\sigma^2\left(1+\rho\right)$	$P_{x,1,1} = \mu + 1 - m - \gamma\sigma^2\left(1+\rho\right)$
	$\pi_{0,1} = D_x - m$	$\pi_{1,1} = D_x + 1 - m$

Table 1: Summary of stock prices and gross profit for firm x as a function of managerial effort and mitigation choice.

Lemma 2. *If the externality is mitigated, then the equilibrium prices for the firms' stocks are,*

$$P_x = \mu + e_x - \gamma\sigma^2\left(1+\rho\right) - m, \tag{10}$$

$$P_y = \mu + e_y - \gamma\sigma^2\left(1+\rho\right) \tag{11}$$

The equilibrium share holdings for each type of individual investor are,

$$s^*_{m,x} = s^*_{m,y} = s^*_{a,x} = s^*_{a,y} = 1. \tag{12}$$

Not surprisingly, moral and amoral investors have identical holdings and the two stocks have the similar prices. We display the possible prices and gross profits for firm x in Table 1.

4.1.2 Incentive compatibility conditions for effort and mitigation

In this section, we begin by establishing several general principles for when compensation will incent the manager to mitigate the externality, and when it will fail to do so. Recall that we are interested in the effects of compensation functions $w = w(P_x, \pi)$ on the decision to mitigate the externality. In principle, compensation functions can relate in complex ways to prices and profitability. In practice, they are nearly always monotonic when it comes to profits: higher profit means higher pay. Because we are interested in how real-world compensation interacts with divestment to affect CEO behavior, we restrict attention to compensation plans that are monotonic in profit.

The difference in initial prices when mitigation is undertaken versus not is:

$$P_{x,1,1} - P_{x,1,0} = \gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) - m. \tag{13}$$

The price difference can be decomposed into two components. The first component,

$$\gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) \geq 0,$$

represents an indirect benefit of mitigation – the price is higher if moral investors are willing to invest, all else equal. The second component,

$$-m < 0,$$

is the direct cost of mitigation, and incurring it leads to a lower stock price. Without further assumptions, the expression in (13) cannot be signed. Nevertheless, the expression is useful in considering the cases in which standard compensation practices will aid or hinder the mitigation of the externality.

Lemma 3. *Any compensation plan that induces effort will induce mitigation only if one of the following holds:*

(i) w is increasing in the initial price P_x, and $P_{x,1,1} - P_{x,1,0} > 0$, or

(ii) w is decreasing in the initial price P_x, and $P_{x,1,1} - P_{x,1,0} < 0$.

Essentially, once we determine how the CEO's wealth depends on near-term prices, and how near-term prices depend upon the mitigation decision, Lemma 3 tells us whether divestment has some chance of inducing the CEO to mitigate the externality.

There are two cases to consider. First, if $\gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) \geq m$, then the initial price is higher with mitigation than without. The addition of moral investor demand has a greater effect on the price than the mitigation cost. This is likely to be the case when $\frac{1-\alpha}{\alpha}$ is large, i.e., there are many moral investors. As such, the wage must be increasing in the initial price in order to induce mitigation. Note that this is a necessary, not sufficient, condition for mitigation. Because gross profit is lower with mitigation than without, compensation is also lower with mitigation unless (i) it depends strongly on initial prices, or (ii) initial prices are significantly higher with mitigation. To see this, suppose for simplicity that $\frac{\partial w}{\partial P_x} = \delta_1$ and $\frac{\partial w}{\partial \pi} = \delta_2$, so compensation is linear in the initial and final prices. Then mitigation is only optimal for the CEO if

$$\left(\gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) - m\right)\delta_1 \geq m\delta_2, \tag{14}$$

which can be written

$$\frac{\delta_2}{\delta_1} \leq \left(\frac{1}{m}\gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) - 1\right). \tag{15}$$

This can be read that the effect of final prices on pay cannot be too large relative to initial prices if mitigation is to occur.

Second, if $\gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) \leq m$, then the addition of moral investor demand affects prices less than the direct cost of mitigation. In this case, the initial price is lower when mitigation is undertaken. As such, the wage must be decreasing in the initial price in order to induce mitigation. As before, this is a necessary, not sufficient, condition. If pay only depends weakly on the interim price, or if interim prices are not much lower when mitigation occurs, then even in this case, mitigation will not be optimal for the CEO.

To the extent that compensation is not small relative to profitability, the precise bounds on parameters adjust somewhat, but the general comparative statics will be identical.

These cases highlight an important initial result regarding compensation and mitigation. Many forms of managerial compensation reward high prices. Clearly, a high price at the time the manager sells is important, but there is also evidence that high prices around vesting dates are important (See Edmans et al 2015). This means that this second result is a problem for moral investors. If $\gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) \leq m$, then any compensation plan that rewards high interim prices will make mitigation unappealing. Further, since the terminal dividend is lower when there is mitigation, any compensation plan that rewards high final prices will also disincent mitigation.

We conclude this section with a recap of our results thus far.

(i) The externality will be mitigated by the CEO only if:

  (a) $\gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) \leq m$, and the CEO is rewarded for low interim prices, or

  (b) $\gamma\sigma^2\left(1-\rho^2\right)\left(\frac{1-\alpha}{\alpha}\right) \geq m$, and the CEO is rewarded for high interim prices.

(ii) In each case, the looser the inequality, the less heavily weighted that interim prices must be when determining compensation.

(iii) If there are many moral investors, so that $\frac{1-\alpha}{\alpha}$ is high, then mitigation is induced only if the CEO has sufficient incentives for high interim prices.

(iv) If there are few moral investors, then mitigation is induced only if the CEO has sufficient incentives for low interim prices.

(v) In either case, if the CEO faces strong long-term incentives, then no conditions exist that incent mitigation.

We are now in a position to analyze the effects of various compensation functions on managerial behavior. Moral investors are unlikely to gain the clout necessary to directly affect managerial compensation. That is, if they lack the power to directly reward managers for mitigation, then they probably also lack the power to change her compensation structure in other non-obvious ways that do not conform to standard compensation practices.[6] Therefore, we consider several common ways to reward managers and analyze what effects each will have under various parameter values.

4.2 Elements of compensation and the effect on CEO mitigation decisions

Managers are typically paid with a mixture of salary, cash bonuses that depend upon firm performance (e.g., return-on-assets or return-on-equity), stock, and options. Salary, which is independent of stock performance and profitability, cannot incent any behavior. Therefore, in the next three sections, we will analyze how each of the remaining three contract elements interacts with divestment to drive CEO behavior. We consider them individually, both for simplicity and to highlight their individual effects.

4.2.1 Performance bonuses

Cash or equity bonuses that depend upon profitability measures like return-on-assets, return-on-equity, or profit will incent managers not to mitigate the externality. Mitigation is costly, and profits are therefore lower with mitigation. Indeed, the natural incentive to avoid mitigation is precisely what divestment campaigns fight against. Compensation plans can only incent mitigation if they depend positively upon *near-term prices.* The more that they depend upon profitability or final prices, the harder it will be to convince a manager to mitigate externalities.

Lemma 4. *A manager whose pay is increasing in profit will not mitigate the externality.*

4.2.2 Stock grants

Many managers are paid largely in stock. Importantly, at the time of a stock grant, the value of the granted equity is divided by the share price to determine the number of shares granted. For equity grants, therefore, a lower share price has a positive effect on the number of shares granted – for any dollar value of a grant, a lower share price translates to more shares. This means that an executive paid in stock would prefer a low price at the time of the grant, all else equal.

In case this seems implausible, we offer three pieces of evidence in favor. First, consider a thought experiment. A CEO is in charge of a $1 billion company and the compensation committee is considering how many shares to grant her. Suppose it settles on one million shares which, priced

[6] See Baron (2008) for a model in which socially responsible investors induce pro-social preferences through corporate governance.

at \$10 per share, translates to a \$10 million grant. Now suppose that the company had recently split, and shares were only worth \$5 per share. Would the compensation committee be more likely to settle on pay worth \$5 million, or would it double the number of shares granted?

Second, consider the data. Murphy (1999) documents that, as of 1998, 40% of large companies grant shares and options on a fixed value basis in executive compensation contracts. Since then, that fraction has increased: in a 2013 study of 190 *Fortune 500* companies, Towers Watson's Wakefield and Sandler (2014) found that 90% of sample firms had equity grant guidelines. Of these, 75% issued equity grants using a fixed value rule.[7] That is, the contract specifies the dollar value of future grants. The future share price determines the number of shares actually granted.

Third, consider the previously common practice of option back-dating (Heron and Lie, 2007). While back-dating may now be infeasible, its frequent use before its academic discovery supports the claim that managers prefer low prices around equity grants, and suggests that less obvious forms of depressing share prices could still be commonly undertaken.

Managers receiving large equity grants therefore may prefer low interim prices. This means that, if there are many moral investors (α is low), so that prices are higher if the externality is mitigated, then an executive would prefer not to mitigate until after her grant is official. In this case, *the presence of moral investors actually induces amoral behavior on the part of the CEO*, and moral investing is therefore counter-productive.

We now show this formally. Let the initial number of shares of granted stock be $\frac{M}{P_{x,e,\chi}}$ where M is the dollar value of the grant. Then the payoff for the manager is her share allotment, multiplied by the final payout per share:

$$\frac{M}{P_{x,e,\chi}}\widetilde{D}_{x,e,\chi}, \tag{16}$$

where the final payout $\widetilde{D}_{x,e,\chi}$ equals $D_x + e - m\chi$. The payoff for the manager is therefore $\frac{M}{P_{x,e\chi}}\widetilde{D}_{x,e\chi} = \frac{M}{P_x}\left(D_x + e - m\chi\right)$. If the manager mitigates the externality, then the interim share price is

$$P_{x,e,1} = \mu + e - m - \gamma\sigma^2\left(1+\rho\right), \tag{17}$$

[7] "Almost 90% of companies granting LTI [long term incentives] have annual grant guidelines. Of these companies, approximately 75% grant on a fixed-value basis, while 25% grant a fixed number of shares. One in 10 companies with grant guidelines recently changed from a fixed-share to fixed-value basis. In our experience, fixed-share guidelines are typically implemented by development-stage and smaller commercial biopharmas that are still experiencing significant stock price volatility. As companies become more mature and their business cycles stabilize, it's more common to adopt fixed-value LTI grant guidelines."

In a related study of board of director compensation, Towers Watson's Michael Bowie (2013) found that "regardless of the type of equity awarded, companies continue to shift toward granting equity based on a fixed-value rather than a fixed-share approach. Eighty-five percent of companies issued equity grants using a fixed value, up from 82% last year."

and her expected payout is

$$E\left(\frac{M}{P_x}\widetilde{D}_x\right)=E\left(\frac{M}{P_x}\left(D_x+e-m\right)\right) \tag{18}$$

$$=\frac{M\left(\mu+e-m\right)}{\mu+e-m-\gamma\sigma^2\left(1+\rho\right)}. \tag{19}$$

If the manager does not mitigate the externality, then the interim price is

$$P_{x,\chi=0}=\mu+e-\rho\gamma\sigma^2\left(1+\rho\right)-\frac{\gamma\sigma^2(1-\rho^2)}{\alpha}, \tag{20}$$

and her expected payout is

$$E\left(\frac{M}{P_x}\widetilde{D}_x\right)=\frac{M\left(\mu+e\right)}{\mu+e-\left(\rho+\frac{1}{\alpha}(1-\rho)\right)\gamma\sigma^2\left(1+\rho\right)}. \tag{21}$$

Proposition 2. *The manager will mitigate the externality only if her expected payout is weakly higher if she mitigates, which occurs if and only if*

$$\alpha\leq 1-\frac{m}{\left(\mu+e-M\right)\left(1-(1-m)\rho\right)}. \tag{22}$$

Some intuition is in order. The difficulty in paying people based upon returns is that you reward high final prices, which is good, but also reward low early prices, which is bad. The cost of mitigation hits both prices equally, decreasing them by m. The effect on returns is ambiguous, because returns are proportionate, not absolute. A high mitigation cost lowers both the initial and the final prices by the same amount, so the proportionate increase from initial price to final price is increasing in the mitigation cost.

This benefit of mitigation for the CEO seem implausible. Essentially, Proposition 2 states that a CEO would like to burn money because it decreases interim and final prices equally, producing a higher return on any initial value of holdings. To see how this works, suppose that the company currently trades at a value of \$10 million and has an expected final payoff of \$12 million. Suppose that the CEO is to be granted equity worth \$1 million. Then her expected return is 20%, and she can expect to have \$1.2 million upon the realization of the dividend. Now suppose that she can destroy value. What should she do? She should borrow \$9 million and burn it, reducing the current value of the company to \$1 million. Because she is paid \$1 million, she owns the entire company. Ignoring interest, the expected dividend becomes \$3 million, which is \$9 million less than the prior expected dividend. The CEO therefore earns \$3 million, in expectation, rather than \$1.2 million.

This motivation for mitigation is silly and implausible. The sole reason to mitigate, for an executive paid with a fixed value share grant, is to burn cash. If we were to assume that some forces outside the model prevent the CEO from profiting from burning cash, then we are left with the result that mitigation can never be optimal when the CEO is paid with stock.

The more interesting parameter in Proposition 2 is the share of moral investors, $1-\alpha$. The greater the number of moral investors, the less the initial price declines with mitigation. If there are many of them, then the initial price increases with mitigation – indeed, the premise of divestment is that it hurts interim share prices. Specifically, the price is higher with mitigation if and only if

$$\frac{1-\alpha}{\alpha}(1-\rho)\gamma\sigma^2\,(1+\rho) \geq m.$$

But if mitigation makes the initial price higher, it still makes the final price lower by m. Therefore, if there are many moral investors, then when executives are paid with shares, they are disincentivised both at the time of grant and the time of sale from mitigating the externality! Equity pay exacerbates the incentives against mitigation, especially if there are many moral investors in the market. Divestment is counter-productive.

Corollary 2. *If the divestment campaign is sufficiently large to hurt interim share prices, then the manager will not mitigate the externality.*

4.2.3 Stock options

We now turn to stock options which, though less frequently granted than in the past, are not uncommon. Stock options are typically granted at par (Murphy 1999), and are most often offered either in fixed-value or fixed-number plans. We will show that, in either case, CEOs prefer low interim share prices.

If executives receive a fixed number of options, then the only relevant parameter is the expected return on shares. Clearly, mitigation reduces this, as the final price decreases by more than the interim price.

If executives receive a fixed value of options, then it is clear from the preceding analysis that they prefer not to mitigate. The harm from mitigation is even greater than under a fixed number plan: not only does the value of each option fall with mitigation, but the number granted falls as well. We therefore have the following intuition:

Claim: *An executive paid with stock options will not mitigate the externality.*

5 Conclusion

Our results are largely negative. Divestment plans are self-defeating, in the sense that their initial success *causes* their long-run failure. They are also often counter-productive, in that managers paid with standard compensation methods have incentives to, at a minimum, not mitigate the harms they cause and, worse, even generate harms to become targets of these campaigns.

The only compensation plans that align the interests of managers and campaigners are those that heavily emphasize interim/current stock prices, relative to future prices, profitability, stock returns, or any other measure of performance. This sort of plan is not common – indeed, practice is moving the other direction, with more restricted and long-vesting equity grants. A short-term focus on current prices is often viewed as myopic and contrary to long-run success. This is bad news for proponents of divestment.

We do not include in our analysis two clear benefits of divestment campaigns for their proponents: bad press for perceived offenders, and lower capital costs for compliers. Our results should therefore be taken as important elements in the discussion of divestment's effectiveness, but not the final word.

References

Baron, David P. 2008. Managerial contracting and corporate social responsibility. *Journal of Public Economics* 92:268—288.

Bowie, Michael. 2013. A Preliminary Review of 2013 Board of Director Pay. *Executive Pay Matters* Towers Watson.

Edmans, Alex, Vivian W. Fang, and Katharina Lewelllen. 2015. Equity Vesting and Managerial Myopia. Working Paper, European Corporate Governance Institute (ECGI), Brussels, Belgium.

Geczy, Christopher C., Robert F. Stambaugh, and David Levin. 2005. Investing in socially responsible mutual funds. Working Paper, University of Pennsylvania, Wharton.

Heinkel, Robert, Alan Kraus, and Josef Zechner. 2001. The Effect of Green Investment on Corporate Behavior. *Journal of Financial and Quantitative Analysis* 36:431—449.

Heron, Randall A., and Erik Lie. 2007. Does backdating explain the stock price pattern around executive stock option grants? *Journal of Financial Economics* 83:271—295.

Hong, Harrison, and Marcin Kacperczyk. 2009. The price of sin: The effects of social norms on markets. *Journal of Financial Economics* 93:15—36.

Keynes, J. M. 1923. Tract on monetary reform. Chicago.

Mullaney, Tim. 2015. Why corporate CEO pay is so high, and going higher. *CNBC.com* May 18, 2015. *http://www.cnbc.com/2015/05/18/why-corporate-ceo-pay-is-so-high-and-going-higher.html*

Murphy, Kevin J. 1999. Executive Compensation. *Handbook of Labor Economics* 3b:2485—2563 North Holland , Amsterdam O. Ashenfelter, D. Card (Eds.)

Renneboog, Luc, Jenke Ter Horst, and Chendi Zhang. 2008. Socially responsible investments: Institutional aspects, performance, and investor behavior. *Journal of Banking & Finance* 32:1723—1742.

Stanford Report. 2014. Stanford to divest from coal companies. *Stanford Report* May 6, 2014.

Teoh, Siew Hong, Ivo Welch, and C. Paul Wazzan. 1999. The Effect of Socially Activist Investment Policies on the Financial Markets: Evidence from the South African Boycott. *Journal of Business* 72:35—89.

Wakefield, Olivia, and Matt Sandler. 2014. Survey Finds Biopharma Companies Adapting Their Talent and Pay Strategies to Navigate a Difficult Environment. *Executive Compensation Bulletin* Towers Watson.

Welch, Ivo. 2014. Why Divestment Fails. *The New York Times* May 9, 2014.

Lemma A1. *Each moral investor's optimal portfolio is given by* $\{0, s^*_{m,y}\}$, *where*

$$s^*_{m,y} = \frac{\mu - P_y}{\gamma\sigma^2}. \tag{1}$$

Proof of Lemma A1:

The utility for investor i with type $\tau \in \{a, m\}$ is given by,

$$u_{i,\tau}(s_{i,a,x}, s_{i,\tau,y}, \gamma) = 1 - e^{-\gamma(s_{i,\tau,x}(D_x - P_x) + s_{i,\tau,y}(D_y - P_y) + W_{i,\tau})}, \tag{2}$$

where $s_{i,\tau,j}$ is the number of shares that investor i purchases in firm j and P_j is the price of firm j's shares. Although both stock prices are determined endogenously, they are equilibrium outcomes and may be treated as parameters. Consequently, the expected utility for investor i is,

$$1 - e^{-\gamma\left(s_{i,\tau,x}(\mu - P_x) - \frac{\gamma\sigma^2}{2} s^2_{i,,\tau,x} + s_{i,\tau,y}(\mu - P_y) - \frac{\gamma\sigma^2}{2} s^2_{i,\tau,y} - \gamma\rho\sigma^2 s_{i,\tau,x} s_{i,\tau,y} + W_{i,\tau}\right)}. \tag{3}$$

Each moral investor i chooses $s_{i,m,x} = 0$ and solves the problem,

$$\max_{s_{i,m,y} \in \mathbb{R}^+} s_{i,m,y}\left(\mu - P_y\right) - \frac{\gamma\sigma^2}{2} s^2_{i,m,y} + W_{i,m} \tag{4}$$

Consequently, each moral investor's optimal portfolio is given by $\{0, s^*_{m,y}\}$, where

$$s^*_{m,y} = \frac{\mu - P_y}{\gamma\sigma^2}. \tag{5}$$

■

Lemma A2. *Each amoral investor's optimal portfolio is given by* $\{s^*_{a,x}, s^*_{a,y}\}$, *where* $s^*_{a,j}$ $j \in \{x, y\}$ *is given by,*

$$s^*_{a,j} = \frac{(\mu - P_j) - \rho(\mu - P_{\not j})}{\gamma\sigma^2(1 - \rho^2)}. \tag{6}$$

Proof of Lemma A2:

Similar to the proof of Lemma A1, each amoral investor i solves the problem,

$$\max_{s_{i,a,x}, s_{i,a,y} \in \mathbb{R}^+} s_{i,a,x}\left(\mu - P_x\right) - \frac{\gamma\sigma^2}{2} s^2_{i,a,x} + s_{i,a,y}\left(\mu - P_y\right) - \frac{\gamma\sigma^2}{2} s^2_{i,ay} - \gamma\rho\sigma^2 s_{i,ax} s_{i,ay} + W_{i,a} \tag{7}$$

The optimal portfolio for an amoral investor is given by $\{s^*_{a,x}, s^*_{a,y}\}$, where $s^*_{a,j}$ $j \in \{x, y\}$ is given by,

$$s^*_{a,j} = \frac{(\mu - P_j) - \rho(\mu - P_{\not j})}{\gamma\sigma^2(1 - \rho^2)}. \tag{8}$$

■

Proof of Lemma 1:

Using Lemmas A1 and A2, the aggregate demand for each stock can be determined as a function of its price. First, consider the aggregate demand for the stock in firm x,

$$\int_0^\alpha \frac{(\mu - P_x) - \rho(\mu - P_y)}{\gamma\sigma^2(1-\rho^2)}\,\mathrm{d}x = \frac{\alpha\left((\mu - P_x) - \rho(\mu - P_y)\right)}{\gamma\sigma^2(1-\rho^2)}. \tag{9}$$

For the market to clear, the price necessarily satisfies,

$$1 = \frac{\alpha\left((\mu - P_x) - \rho(\mu - P_y)\right)}{\gamma\sigma^2(1-\rho^2)}. \tag{10}$$

Next, consider the aggregate demand for the stock in firm y is,

$$\int_0^\alpha \frac{(\mu - P_y) - \rho(\mu - P_x)}{\gamma\sigma^2(1-\rho^2)}\,\mathrm{d}x + \int_\alpha^1 \frac{\mu - P_y}{\gamma\sigma^2}\,\mathrm{d}x = \frac{\alpha\left((\mu - P_y) - \rho(\mu - P_x)\right)}{\gamma\sigma^2(1-\rho^2)} + \frac{(1-\alpha)(\mu - P_y)}{\gamma\sigma^2}. \tag{11}$$

For the market in firm y's stock to clear, the price necessarily satisfies,

$$1 = \frac{\alpha\left((\mu - P_y) - \rho(\mu - P_x)\right)}{\gamma\sigma^2(1-\rho^2)} + \frac{(1-\alpha)(\mu - P_y)}{\gamma\sigma^2}. \tag{12}$$

Equations (10) and (12) provide a system of two equations with two unknowns, P_x and P_y. First consider (10),

$$1 = \frac{\alpha\left((\mu - P_x) - \rho(\mu - P_y)\right)}{\gamma\sigma^2(1-\rho^2)}, \tag{13}$$

A rearrangement of (13) yields,

$$(\mu - P_x) = \frac{\gamma\sigma^2(1-\rho^2)}{\alpha} + \rho(\mu - P_y), \tag{14}$$

and a substitution of the preceding equation into (12) yields,

$$1 = \frac{\alpha\left((\mu - P_y) - \rho\left(\frac{\gamma\sigma^2(1-\rho^2)}{\alpha} + \rho(\mu - P_y)\right)\right)}{\gamma\sigma^2(1-\rho^2)} + \frac{(1-\alpha)(\mu - P_y)}{\gamma\sigma^2}, \tag{15}$$

which simplifies to,

$$P_y = \mu - \gamma\sigma^2(1+\rho). \tag{16}$$

Now, the explicit form of P_y in (16) is substituted into (13),

$$1 = \frac{\alpha\left((\mu - P_x) - \rho(\mu - (\mu - \gamma\sigma^2(1+\rho)))\right)}{\gamma\sigma^2(1-\rho^2)}, \tag{17}$$

which simplifies to,

$$P_x = \mu - \rho\gamma\sigma^2 (1+\rho) - \frac{\gamma\sigma^2(1-\rho^2)}{\alpha}. \tag{18}$$

The equilibrium share quantities are given by,

$$\begin{aligned}
s^*_{m,x} &= 0. && (19)\\
s^*_{m,y} &= \left(\frac{\mu - P_y}{\gamma\sigma^2}\right) && (20)\\
&= \left(\frac{\mu - \left(\mu - \gamma\sigma^2 (1+\rho)\right)}{\gamma\sigma^2}\right) && (21)\\
&= \left(\frac{\gamma\sigma^2 (1+\rho)}{\gamma\sigma^2}\right) && (22)\\
&= (1+\rho). && (23)\\
s^*_{a,x} &= \left(\frac{(\mu - P_x) - \rho(\mu - P_y)}{\gamma\sigma^2(1-\rho^2)}\right) && (24)\\
&= \frac{\rho\gamma\sigma^2 (1+\rho) + \frac{\gamma\sigma^2(1-\rho^2)}{\alpha} - \rho\gamma\sigma^2 (1+\rho)}{\gamma\sigma^2(1-\rho^2)} && (25)\\
&= \left(\frac{1}{\alpha}\right). && (26)\\
s^*_{a,y} &= \left(\frac{(\mu - P_y) - \rho(\mu - P_x)}{\gamma\sigma^2(1-\rho^2)}\right) && (27)\\
&= \frac{\gamma\sigma^2 (1+\rho) - \rho\left(\rho\gamma\sigma^2 (1+\rho) + \frac{\gamma\sigma^2(1-\rho^2)}{\alpha}\right)}{\gamma\sigma^2(1-\rho^2)} && (28)\\
&= \left((1+\rho) - \frac{\rho}{\alpha}\right). && (29)
\end{aligned}$$

■

Proof of Proposition 1:

Amoral investors purchase a non-zero number of shares in firm x and they purchases more shares in firm y,

$$\begin{aligned}
s^*_{a,x}P_x + s^*_{a,y}P_y - s^*_{m,y}P_y &= s^*_{a,x}P_x + P_y\left(s^*_{a,y} - s^*_{m,y}\right) && (30)\\
&= \frac{1}{\alpha}\left(\mu - \rho\gamma\sigma^2 (1+\rho) - \frac{\gamma\sigma^2(1-\rho^2)}{\alpha}\right) - \frac{\rho}{\alpha}\left(\mu - \gamma\sigma^2 (1+\rho)\right) && (31)\\
&= \frac{1}{\alpha}\left(\mu - \frac{\gamma\sigma^2(1-\rho^2)}{\alpha}\right) - \frac{\rho}{\alpha}\mu, && (32)
\end{aligned}$$

which is positive if,

$$0 \leq \left(\mu - \frac{\gamma\sigma^2(1-\rho^2)}{\alpha}\right) - \rho\mu \tag{33}$$

$$= (1-\rho)\mu - \frac{\gamma\sigma^2(1-\rho^2)}{\alpha}. \tag{34}$$

■

Proof of Corollary 1:

The expected dividend for both firms is μ. Consequently, if the price of firm x's stock is lower than the price of firm y's stock then the expected return is greater for firm x.

$$P_y - P_x = \left(\mu - \gamma\sigma^2 (1+\rho)\right) - \left(\mu - \rho\gamma\sigma^2 (1+\rho) - \frac{\gamma\sigma^2(1-\rho^2)}{\alpha}\right) \tag{35}$$

$$= -\gamma\sigma^2 (1+\rho) + \rho\gamma\sigma^2 (1+\rho) + \frac{\gamma\sigma^2(1-\rho^2)}{\alpha} \tag{36}$$

$$= -(1-\rho)\gamma\sigma^2 (1+\rho) + \frac{\gamma\sigma^2(1-\rho^2)}{\alpha} \tag{37}$$

$$= -\gamma\sigma^2 \left(1-\rho^2\right) + \frac{\gamma\sigma^2(1-\rho^2)}{\alpha} \tag{38}$$

$$= \gamma\sigma^2 \left(1-\rho^2\right)\left(\frac{1}{\alpha} - 1\right) \tag{39}$$

$$\geq 0 \tag{40}$$

The difference in expected returns is decreasing in α, or conversely, increasing with the proportion of moral investors (i.e., $(1-\alpha)$).

■

Discussion of remarks in Section 3.2: The numerical examples with constant relative risk aversion are provided via the following setup. With power utility, each investor's utility is

$$u_{i,\tau}(s_{i,a,x}, s_{i,\tau,y}, \gamma) = \frac{(s_{i,\tau,x}(D_x - P_x) + s_{i,\tau,y}(D_y - P_y) + W_{i,\tau})^{1-\gamma}}{1-\gamma}, \tag{41}$$

and expected utility is given by,

$$\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \frac{(s_{i,\tau,x}(D_x - P_x) + s_{i,\tau,y}(D_y - P_y) + W_{i,\tau})^{1-\gamma}}{1-\gamma} g(D_x, D_y|\rho, \mu, \sigma)\, \mathrm{d}D_y\, \mathrm{d}D_x, \tag{42}$$

where $g(D_x, D_y|\rho, \mu, \sigma)$ is the bivariate normal distribution. Each moral investor's optimal portfolio is given by $\{0, s^*_{m,y}\}$, where $s^*_{m,y}$ is implicitly defined by,

$$0 = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} (D_y - P_y)\left(s_{i,a,y}(D_y - P_y) + W_{i,\tau}\right)^{-\gamma} g(D_x, D_y|\rho, \mu, \sigma)\, \mathrm{d}D_y\, \mathrm{d}D_x. \tag{43}$$

Each amoral investor's optimal portfolio is given by $\{s^*_{a,x}, s^*_{m,x}\}$ where the shares are implicitly defined by the following system of equations,

$$0 = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} (D_x - P_x)\left(s_{i,\tau,x}(D_x - P_x) + s_{i,\tau,y}(D_y - P_y) + W_{i,\tau}\right)^{-\gamma} g(D_x, D_y|\rho, \mu, \sigma)\, \mathrm{d}D_y\, \mathrm{d}D_x, \tag{44}$$

$$0 = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} (D_y - P_y)\left(s_{i,\tau,x}(D_x - P_x) + s_{i,\tau,y}(D_y - P_y) + W_{i,\tau}\right)^{-\gamma} g(D_x, D_y|\rho, \mu, \sigma)\, \mathrm{d}D_y\, \mathrm{d}D_x. \tag{45}$$

The implicitly defined shares from both moral and amoral investors imply that share prices are also implicitly defined. The prices P_x, P_y are implicitly defined by the following system of equations,

$$1 = \alpha s^*_{a,x}(P_x, P_y), \tag{46}$$

$$1 = \alpha s^*_{a,y}(P_x, P_y) + (1-\alpha) s^*_{m,y}(P_x, P_y). \tag{47}$$

Comparative statics of ownership stakes in firm y, stock prices and investor expected portfolio returns with respect to ρ, γ, and σ are visually depicted in Figures 1, 2, and 3.

The dynamic version of the model is straightforward.

■

Proof of Lemma 2: Firm y does not produce an externality, so there is no mitigation cost. The manager is employed with a wage w_y and, if that wage elicits managerial effort e_y in equilibrium, investors expect the firm to produce a dividend D_y that is normally distributed with mean $\mu+e_y-w$ and variance σ^2. Firm x does produce a negative externality, and if the manager's wage elicits an effort choice e_x and externality mitigation, investors expect the firm to produce a dividend D_x that is normally distributed with mean $\mu + e_x - w - m$ and variance σ^2. Moral investors are no longer compelled to choose $s_{m,x} = 0$ because the externality is mitigated. Therefore, all investors face the same optimization,[8]

$$\begin{aligned} \max_{s_x, s_y \in \mathbb{R}^+} & s_x\left(\mu + e_x - E[w_x] - m - P_x\right) - s_x^2 \frac{\gamma}{2}\left(\sigma^2 + var(w_x) - 2cov(D_x, w_x)\right) \\ & + s_y\left(\mu + e_y - E[w_y] - P_y\right) - s_y^2 \frac{\gamma}{2}\left(\sigma^2 + var(w_y) - 2cov(D_y, w_y)\right) \\ & - s_x s_y \gamma\left(\rho\sigma^2 - cov(D_x, w_y) - cov(D_y, w_x) + cov(w_x, w_y)\right) \end{aligned} \tag{48}$$

[8]We exclude W_i from the optimization since it has no effect with CARA utility.

The solution to each investor's problem is,

$$s_x = \frac{\hat{\sigma}_y^2 \left(\mu + e_x - E[w_x] - m - P_x\right) - \hat{\rho}(\mu + e_y - E[w_y] - P_y)}{\gamma \left(\hat{\sigma}_y^2 \hat{\sigma}_x^2 - \hat{\rho}^2\right)}, \tag{49}$$

$$s_y = \frac{\hat{\sigma}_x^2 \left(\mu + e_y - E[w_y] - P_y\right) - \hat{\rho}(\mu + e_x - E[w_x] - m - P_x)}{\gamma \left(\hat{\sigma}_y^2 \hat{\sigma}_x^2 - \hat{\rho}^2\right)}, \tag{50}$$

where,

$$\hat{\sigma}_x^2 \equiv (\sigma^2 + var(w_x) - 2cov(D_x, w_x)), \tag{51}$$

$$\hat{\sigma}_y^2 \equiv (\sigma^2 + var(w_y) - 2cov(D_y, w_y)), \tag{52}$$

$$\hat{\rho} \equiv (\rho\sigma^2 + cov(w_x, w_y) - cov(D_y, w_x) - cov(D_x, w_y)). \tag{53}$$

For the markets to clear, the prices must satisfy,

$$1 = \frac{\hat{\sigma}_y^2 \left(\mu + e_x - E[w_x] - m - P_x\right) - \hat{\rho}(\mu + e_y - E[w_y] - P_y)}{\gamma \left(\hat{\sigma}_y^2 \hat{\sigma}_x^2 - \hat{\rho}^2\right)}, \tag{54}$$

$$1 = \frac{\hat{\sigma}_x^2 \left(\mu + e_y - E[w_y] - P_y\right) - \hat{\rho}(\mu + e_x - E[w_x] - m - P_x)}{\gamma \left(\hat{\sigma}_y^2 \hat{\sigma}_x^2 - \hat{\rho}^2\right)}. \tag{55}$$

The solution to the preceding system of equations is,

$$P_x = \mu + e_x - E[w_x] - m - \gamma \left(\hat{\sigma}_x^2 + \hat{\rho}\right), \tag{56}$$

$$P_y = \mu + e_y - E[w_y] - \gamma \left(\hat{\sigma}_y^2 + \hat{\rho}\right). \tag{57}$$

If the wages are sufficiently small, the preceding prices approximate to,

$$P_x = \mu + e_x - m - \gamma\sigma^2(1 + \rho), \tag{58}$$

$$P_y = \mu + e_y - \gamma\sigma^2(1 + \rho). \tag{59}$$

If x does not mitigate the externality, the prices are similar to those derived in Section 3,

$$P_x = \mu + e_x - E[w_x] - \gamma \left(\frac{\hat{\sigma}_x^2}{\alpha} + \hat{\rho} - \frac{(1-\alpha)\hat{\rho}^2}{\alpha\hat{\sigma}_y^2}\right), \tag{60}$$

$$P_y = \mu + e_y - E[w_y] - \gamma \left(\hat{\sigma}_y^2 + \hat{\rho}\right). \tag{61}$$

and, again, if the wages are sufficiently small, the prices approximate to,

$$P_x = \mu + e_x - \gamma \left(\rho\sigma^2(1 + \rho) - \frac{\sigma^2(1-\rho^2)}{\alpha}\right), \tag{62}$$

$$P_y = \mu + e_y - \gamma\sigma^2(1 + \rho). \tag{63}$$

■

Proof of Lemma 3 Because effort is hidden, and therefore cannot affect initial prices, and because $\pi = D_x + e - m\chi$ is increasing in effort, the wage must be increasing in π if the contract is to induce effort. In order to induce mitigation, the expected wage must simply be higher with mitigation than without: $w_{e,1} \geq w_{e,0}$. Because mitigation costs m and does not bring any direct benefit to the firm, gross profit π is lower with mitigation. If wages must be increasing in π to induce effort, the only way for wages to be at least as high with mitigation is for them to either (i) be increasing in the initial price, and for the initial price to be higher with mitigation, or (ii) be decreasing in the initial price, and for the initial price to be lower with mitigation.

Proof of Proposition 2: The inequality comes from setting her expected payout from mitigating greater than her expected payout from not mitigating:

$$\frac{M\left(\mu+e-m\right)}{\mu+e-m-\gamma\sigma^{2}\left(1+\rho\right)} \geq \frac{M\left(\mu+e\right)}{\mu+e-\left(\rho+\frac{1}{\alpha}(1-\rho)\right)\gamma\sigma^{2}\left(1+\rho\right)}, \tag{64}$$

and rearranging. The comparative statics are as follows. Clearly, the inequality is looser if m is greater, M is greater, and μ is lower. For α, we take a derivative of the right hand side with respect to α to get

$$\frac{d}{d\alpha}\frac{\left(\mu+e\right)\left(1-\alpha\right)\left(1-\rho\right)}{1-\left(1-\alpha\right)\rho} = -\frac{\left(\mu+e\right)\left(1-\rho\right)}{\left(1-\left(1-\alpha\right)\rho\right)^{2}}. \tag{65}$$

As both numerator and denominator are positive, and the ratio is negated, the derivative is negative. ■

Proof of Lemma 4: Trivially, gross profit π is lower by m when the externality is mitigated, so if pay is increasing in π, then the CEO will not mitigate.