ENABLING TRIPLE BOTTOM LINE COMPLIANCE VIA PRINCIPAL-AGENT INCENTIVE MECHANISMS

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ABSTRACT

A corporation that wants to fully embrace sustainability must address all three pillars of the triple bottom line. Among profit, planet, and people, it is this last category that is hardest to measure directly. When a company has remote locations and cannot directly observe effort, the compliance must be inferred from other metrics. We introduce a game-theoretic model to influence plant compliance to corporate goals.

JEL: C02, C61, M10, O21

KEYWORDS: Sustainability, Triple-Bottom-Line, Principal-Agent

INTRODUCTION

Of the triple bottom line areas (people, profit, planet), profit is the easiest to determine for all branch locations of a company. However, environmental (planet) performance is less easily monitored, but possible with pollution measurements for example. The third area, social performance (people), is a difficult one to measure and thus requires offering incentives to managers at remote location to take positive actions towards improving the social performance (or people aspect) of business.

Our model shows various incentive schemes that a Principal (Corporate) can offer to remote Branches/Plants (Agents) to have those locations invest high effort in providing good people health and wellbeing options. A branch may offer healthier choices in vending machines, provide speakers and fliers on healthy eating and exercise, offer smoking cessation assistance, and other efforts to improve overall wellbeing. Because Corporate cannot monitor the efforts each branch puts forward in providing health guidance, opportunities, and environments for its workforce, the number of sick days and health insurance claims can be used as a proxy for what effort the branch is exerting towards creating healthy and happy employees. Clearly, individual employee motivation is a confounding factor, but a baseline of claims and sick days can be compared to those data at time intervals after the supposed commencement of a new program to improve the triple bottom line. Non-trivial sized (n>30) employee workforce levels at a plant reduce the effect of outliers, e.g. a single individual that is extremely gung ho to improve, or conversely, an employee that is passive aggressive against any and all efforts to change their lifestyle.

Sustainability is a new, but important area being investigated by companies. Ho and Taylor (2007) reported on disclosures of 50 of the largest US and Japanese corporations based on the GRI (The Global Reporting Initiative) Reporting Guidelines. Firms with poor financial performance, in the manufacturing industry, were more likely to disclose social (people) performance, perhaps to offset profitability concerns. However, on average they reported only half of the people indices. There is not yet reporting standards for all aspects of the triple bottom line, other than voluntary disclosure. In addition, it is hard to quantify financial benefits to shareholders for environmental compliance and employee treatment beyond legal standards. Since compliance in all three pillars of the triple bottom line is not widely publicized, we are justified in assuming that improvement may be made in many companies worldwide. We next

cover literature in this area, then introduce our model and its notation. We provide numerical examples to clarify the differences in incentive schemes, and conclude with managerial implications.

LITERATURE REVIEW

The first well-known definition of sustainable development appeared in *Our Common Future* (World Commission on Economic Development, 1987, p. 8)—sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Later, authors such as Elkington (1994, 1998) expanded the definition of sustainability to include the triple bottom line of economic, environmental, and social performance. Economic and environmental performance are relatively easy to measure directly (e.g., net profits, mass of landfill waste, PPM in solution, emission composition). For example, Verfaillie and Bidwell (2000) tested a framework of eco-efficiency measures with 22 companies from around the world to create a guide for companies to report their economic and environmental performance. The third measure of the triple bottom line, social performance, is more difficult to assess. Norman and MacDonald (2004) questioned whether social performance indicators (e.g., diversity, union relations, health and safety, child labor, and community relations) could be measured in objective ways and whether those measures could be aggregated into a net social profit or loss score.

Maccarrone (2009) proposed that the triple bottom line is one scheme for defining corporate social responsibility. Another scheme proposed by the European Union (cited in Maccarrone, 2009) defined corporate social responsibility as a concept for companies to integrate their social and environmental concerns. This scheme includes two categories: an internal dimension (human resources, health and safety, environmental management) and an external dimension (local communities, partners, suppliers, customer, human rights, and global environmental management). Cartwright and Craig (2006) argued that corporate social responsibility must shift to ethical stances that recognize the rights of stakeholders, encourage cooperation between corporations and their stakeholders, and ensure the accurate and timely disclosure of all material issues.

Implementation of corporate social responsibility requires hiring socially responsible managers with well-developed ideals for social responsibility to avoid dilemmas created by the errant actions of staff (Svensson & Wood, 2008). These ideals could include ethics and social responsibility, which should be manifest in a social contract between employer and employees (Karnes, 2009). Giacalone and Promislo (2010) postulated that unethical behavior could result in decreases in well-being from the stress of being victimized by, witnessing, or being associated with those involved in that behavior. Ethics forms a necessary, but not sufficient, condition for implementation of corporate social responsibility and at the same time can affect a company's social performance regarding employee well-being. A secondary challenge is how to ensure social performance at remote locations in the company. This problem can be modeled as a principal-agent problem as described in the next section.

The principal-agent is a special-case game-theoretic model in which one party (the agent) agrees to perform some actions on behalf of another party (the principal), and this agreement is normally formalized in a contract. The agent will exert some level of effort that is not directly observable by the principal and costly to the agent. The principal can observe only the outcomes of the agent. After observing the outcomes, the principal pays the agent a fee or seeks to impose a penalty (Elitzur & Wensley, 1997). One potential problem is that agents have an incentive to shirk on their effort; therefore, a contractual agreement with appropriate incentive schemes that mitigate shirking is required (Gachter & Konigstein, 2009). In the next section, we present a model of various incentive schemes that a Principal (Corporate) can offer an Agent (Branch) to induce higher effort in achieve triple bottom line results.

MODEL

The model involves a Principal (Corporate) and Agent (Branch) that both wish to maximize their respective expected profit. The probabilities of achieving good, medium, and bad results are related to the effort exerted by the Agent. We investigate different scenarios to demonstrate under what conditions the Agent prefers to exert high effort, and the best incentive scheme for the Principal to use. Table 1 shows the variables used in our model.

Table 1: Variables used in Model

p_g^H	**the probability of achieving good results if the Agent exerts high effort**
p_m^H	the probability of achieving medium results if the Agent exerts high effort
p_b^H	the probability of achieving bad results if the Agent exerts high effort
p_g^L	the probability of achieving good results if the Agent exerts low effort
p_m^L	the probability of achieving medium results if the Agent exerts low effort
p_b^L	the probability of achieving bad results if the Agent exerts low effort
b_g	benefit to Principal from good results
b_m	benefit to Principal from medium results
b_b	benefit to Principal from bad results
w_g	wage paid to Agent by Principal if good results are observed
w_m	wage paid to Agent by Principal if medium results are observed
w_b	wage paid to Agent by Principal if bad results are observed
d_H	disutility to Agent for exerting high effort
d_L	disutility to Agent for exerting low effort
$u(w_g)$	utility to Agent from wage paid by Principal for good results
$u(w_m)$	utility to Agent from wage paid by Principal for medium results
$u(w_b)$	utility to Agent from wage paid by Principal for bad results
$u(w_H)$	utility to Agent from wage paid by Principal who observes high effort
$u(w_L)$	utility to Agent from wage paid by Principal who observes low effort
f	franchise fee (if applicable) paid by Agent to Principal regardless of results
i_g	bonus incentive from Corporate to Branch for good results
i_m	bonus incentive from Corporate to Branch for medium results

subject to the following assumptions:

$p_g^H > p_g^L$, the probability of achieving a high result is strictly greater when the Agent exerts high effort

$p_b^H < p_b^L$, the probability of achieving a bad result is strictly lower when the Agent exerts high effort

$p_g^H + p_m^H + p_b^H = 1$, the probabilities of outcomes sum to 100%

$p_g^L + p_m^L + p_b^L = 1$, the probabilities of outcomes sum to 100%

$u(w_g) > u(w_m) > u(w_b)$, the Agent receives positive increase in utility for better results

$b_g > b_m > b_b$, Corporate benefits more from good Branch results than medium results, which is greater than the benefit from bad results.

The sequence of decisions is; 1) Principal determine incentive scheme, 2) Principal communicates incentive scheme to Agent, 3) Agent decided on either high or low effort, 4) Agent exerts effort, 5) Principal and Agent observe results, and 6) Principal provides Agent with wages and/or bonus based on observed results. We now will outline four incentive schemes that may be offered by Corporate (Principal) to the Agent, starting first with a scheme that would require the ability to directly observe Agent effort. We follow this with three feasible schemes for comparisons.

Infeasible Scheme: Effort Based Wage

To establish a baseline solution, we will first examine the wages required to induce the desired behavior in the Agent (Branch) if their effort could be directly observed.

$$u(w_H) - d_H \geq u(w_L) - d_L \quad (1)$$

If effort was directly observable, the Principal could perfectly predict Agent behavior and induce accordingly using (1). However, in the scenario addressed in this paper, effort cannot be directly observed, but rather must be inferred from the observable results that are stochastically distributed for each Agent effort level. Equation (1) is intuitive in that only the difference in disutility to the Agent by exerting more effort needs to be overcome with extra utility provided by wage given for high effort contrasted with that offered for low effort.

A Pure Wage Scheme: Principal Incurs All Risk

Often companies reward employees at a preset compensation level. This pure wage is independent of the results demonstrated by the employees or branch. Hence: $w_g = w_m = w_b = w$ is the wage paid by Corporate to the Branch. The Agent's utility is therefore constant at *u(w)*. The disutility for the Agent differs based upon his effort level. The expected total utility to the Agent is:

For high effort: $u(w) - d_H$ (2)

For low effort: $u(w) - d_L$ (3)

From our assumption that higher effort produces more disutility to the Agent, $d_H > d_L$, the Agent will always choose to exert low effort, achieving the payoff in (3).

If $p_g^L b_g + p_m^L b_m + p_b^L b_b - w < p_g^H b_g + p_m^H b_m + p_b^H b_b - w$, then Corporate (Principal) would not logically chose this pure wage scheme.

This result makes intuitive sense, if an employee will not get any additional benefit for exerting high effort, they will not make the extra effort. In simpler terms, if your branch management is paid strictly via salary, they are unlikely to exert high effort. They can achieve the same wage utility from low or high effort, but clearly obtain more disutility from having to work harder. This does not preclude the rare possibility of a branch or individual workers who may be self motivated through pride or for other reasons to always exert high effort. However, the long term compliance of wishing your locations and employees will exert extra effort out of pride is tenuous at best.

A Pure Franchise Scheme: Agent Incurs All Risk

If each branch is a profit center, rather than a cost center, a franchise fee *f* might be required of the branch (Agent) to be paid to Corporate (Principal). The Branch receives the *g, m* or *b* rather than Corporate.
The utility for the Agent is necessarily lowered by the franchise fee *f* regardless of effort or results achieved. The Agent will exert high effort if the inequality in (4) holds.

$$[p_g^H - p_g^L]u(w_g - f) + [p_m^H - p_m^L]u(w_m - f) + [p_b^H - p_b^L]u(w_b - f) > d_H - d_L \qquad (4)$$

The branch incurs the franchise fee *f* regardless of outcome, and with high or low effort probabilistically has their efforts result in a good, medium, or bad result. The difference in high versus low probability of achieving each of the three results multiplied by the utility received per outcome must exceed the Agent's effort disutility difference in order to induce the branch to exert high effort. One often thinks of a common franchise such as McDonald's, where each store pays a fee to corporate regardless of how well they do. Therefore, it is incumbent on the individual location to achieve good results to more than cover the fixed fee arrangement. In bad economic times, or other reasons not inherently related to the effort at the location, the store (Agent) loses, and corporate does not share in this risk.

Shared Risk Scheme: Wage Plus Bonus

Sharing the risk of the uncertainty of results between Corporate and the Branch is an intuitively equitable solution. The Agent is given a base wage, w_B, regardless of output plus a bonus if either medium or high results are observed. Table 2 shows that incremental bonus incentives may be used to induce effort such that the branch is rewarded for non-bad results. From our assumptions, Corporate benefits from better Branch results as well. In this way, the risks and rewards are shared by both Corporate (Principal) and Branch (Agent).

Table 2: Bonus and Benefit per Result

Results Observed	Bonus Paid to Branch	Gross Benefit to Corporate
Good	i_g	b_g
Medium	i_m	b_m
Bad	0	b_b

The Branch (Agent) incurs risk because the bonus may be zero, but is potentially non-zero. Corporate (Principal) incurs risk due to the different benefits, given that $b_g > b_m > b_b$.
The Branch's expected profit from exerting high effort is

$$p_g^H u(w_g + i_g) + p_m^H u(w_m + i_m) + p_b^H u(w_b) - d_H \qquad (5)$$

The Branch's expected profit from exerting low effort is

$$p_g^L u(w_g + i_g) + p_m^L u(w_m + i_m) + p_b^L u(w_b) - d_L \quad (6)$$

If the following inequality holds, the Branch will exert high effort in order to maximize its expected utility.

$$[p_g^H - p_g^L]u(w_g + i_g) + [p_m^H - p_m^L]u(w_m + i_m) + [p_b^H - p_b^L]u(w_b) \geq d_H - d_L \quad (7)$$

Corporate can select i_g and i_m in order to make (7) hold, thus providing incentive to the Branch to exert high effort. Clearly, for the Principal, the incremental bonuses i_g and i_m must be less than the expected increase in benefits to Corporate from b_g and b_m. Having a single incentive for either good or medium results, if it is sufficiently large, will induce high effort from the Branch.

If the Branch exerts high effort, Corporate can expect profits of

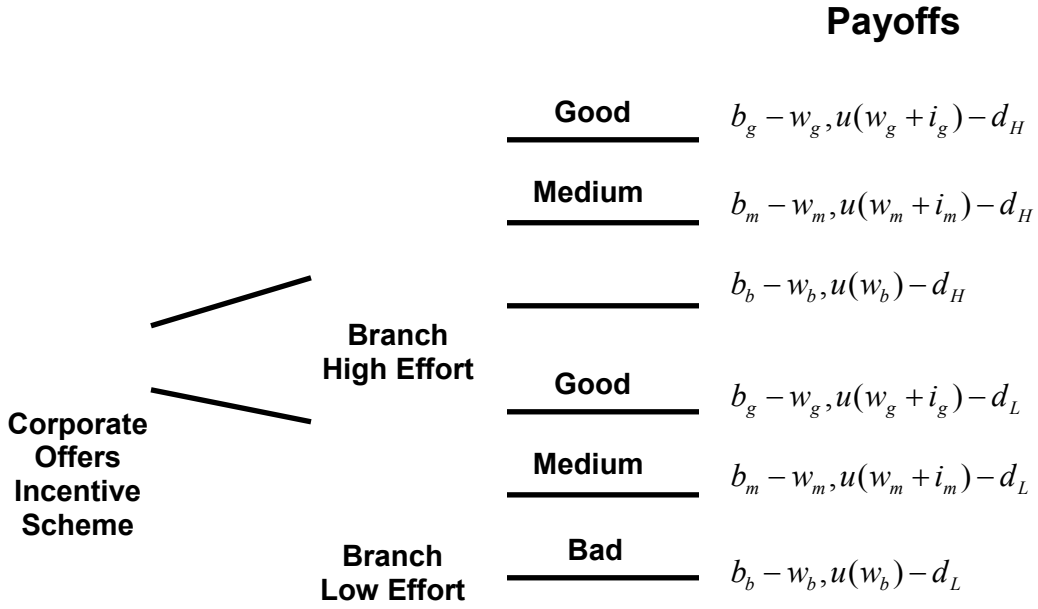
$$p_g^H (b_g - w_g - i_g) + p_m^H (b_m - w_m - i_m) + p_b^H (b_b - w_b) \quad (8)$$

If the Branch exerts high effort, Corporate can expect profits of

$$p_g^L (b_g - w_g - i_g) + p_m^L (b_m - w_m - i_m) + p_b^L (b_b - w_b) \quad (9)$$

Figure 1 shows the sequence of decisions taken by both Corporate and the Branch. Given each branch of this decision tree, the payoffs to Corporate and Branch can be viewed on the right hand side of the figure. Again, the effort by the Branch (middle decision in the figure) is not directly observable by Corporate.

Figure 1: Sequence of Decisions and Payoffs to Both Corporate and Branch After Good, Medium and Bad Results according to Branch High and Low effort.



We will demonstrate the three incentive mechanisms for non-directly observable effort in the next section via numerical examples.

NUMERICAL EXAMPLES

We now demonstrate the three feasible incentive schemes via numerical examples. Table 3 below shows the values for our variables.

Table 3: Variable Values for the Numerical Examples

p_g^H	60%	the probability of achieving good results if the Agent exerts high effort
p_m^H	30%	the probability of achieving medium results if the Agent exerts high effort
p_b^H	10%	the probability of achieving bad results if the Agent exerts high effort
p_g^L	15%	the probability of achieving good results if the Agent exerts low effort
p_m^L	35%	the probability of achieving medium results if the Agent exerts low effort
p_b^L	50%	the probability of achieving bad results if the Agent exerts low effort
b_g	2000	benefit to Principal from good results
b_m	1200	benefit to Principal from medium results
b_b	1000	benefit to Principal from bad results
w_g	2000	wage paid to Agent by Principal if good results are observed
w_m	800	wage paid to Agent by Principal if medium results are observed
w_b	500	wage paid to Agent by Principal if bad results are observed
w	600	wage paid to Agent without regard to results
d_H	500	disutility to Agent for exerting high effort
d_L	100	disutility to Agent for exerting low effort
$u(w_g)$	1000	utility to Agent from wage paid by Principal for good results
$u(w_m)$	800	utility to Agent from wage paid by Principal for medium results
$u(w_b)$	500	utility to Agent from wage paid by Principal for bad results
f	400	franchise fee (if applicable) paid by Agent to Principal regardless of results

A Pure Wage Scheme: Principal Incurs All Risk

The wage, w, is the same (600), therefore the utility is the same, and the difference in payoffs for the Agent comes from the difference in the disutility of effort.

$$u(w) - d_H = 600 - 500 = 100$$
$$u(w) - d_L = 600 - 100 = 500$$

Clearly, the Agent achieves a higher payoff by having low disutility (d_L) and thus will not exert high effort towards the Corporate sustainability goals. The Corporate inequality $p_g^L b_g + p_m^L b_m + p_b^L b_b - w < p_g^H b_g + p_m^H b_m + p_b^H b_b - w$ (570 < 1050) holds, indicating that this

scheme should not be chosen by Corporate because the Agent will exert low effort and the benefit to Corporate will thus be reduced.

A Pure Franchise Scheme: Agent Incurs All Risk

Regardless of outcome, the Branch must pay the fixed franchise fee ($f = 400$) to Corporate.
Equation (4), $[p_g^H - p_g^L]u(w_g - f) + [p_m^H - p_m^L]u(w_m - f) + [p_b^H - p_b^L]u(w_b - f) > d_H - d_L$, becomes 210 > 400, which does not hold. Since the left hand side does not exceed the effort utility difference on the right hand side, the Branch will chose to exert low effort.

Shared Risk Scheme: Wage Plus Bonus

For the Branch's expected profit for high effort from equation (5) we get 690. For the Branch's expected profit for low effort from equation (6) we get 710. Therefore, with this incentive scheme, the Branch would choose low effort. However, Corporate would see a benefit of 460 from (8) versus 360 from (9) so would expect to benefit more if the Branch exerted high effort. Therefore, Corporate needs to change the incremental bonus such that the Branch also is motivated to high effort.

At approximately, 445.45 for the incremental incentive for good outcomes (i_g), the Branch would be neutral between high and low effort. For values above 445.45, the Branch will rationally choose to exert high effort in order to maximize its expected payoff. Assume that the incentive for good results at the branch was increased from 400 to 450, then the Branch would exert high effort because equation (5) yields an expected profit of 720, and (6) gives 717.50. Similarly, Corporate sees its benefit rise from 353.50 if the Branch had exerted low effort, to 430 from equation (8) given that the Branch will exert high effort.

MANGERIAL IMPLICATIONS AND CONCLUSIONS

Sustainability is of growing concernt to customers and therefore, companies. Businesses may implement sustainability through the triple bottom line (people, profit, and planet). Profit is repoted by remote locations of a company, and compliance to environmental and pollution may be ascertained through monitoring. However, ensuring employees are in non-bullying environments, with opportunities for healthy food, breaks, and/or exercise time is more difficult to assess at a distance.

We have shown that the problem of encouraging remote branches to engage in desired behavior can be modeled as a Principal-Agent, game theoretic model. In order for Corporate to achieve the desired results when the actions cannot be directly observed, the risks and rewards need to be shared with the branches. We have shown via the Princpal-Agent model that this sharing of risk produces the best possible outcome for scenarios where effort cannot be observed directly.

The people aspect of the triple bottom line is difficult to measure directly, so often has to be inffered by outcomes. Compliance from all locations is esential to meet company wide triple bottom line goals. The incentive for all locations, acting as agents to the corporate principal, can be driven by the shared risk bonus schedule that was shown in Table 1. The entire enterprise can benefit from compliance induced by the shared incentive system outlined in this paper.

A limitation of this approach, and this paper, is that we must assume that there are observable outcomes that serve as a proxy for effort. There does not need to be a direct correlation, but rather probabilities

should decrease for these measures as effort increases. Possible observable outcomes are calls to a stress hotline, sick days taken, employee turnover, medical claims, etc.

Future research with emprical results demonstrating exactly which measures (e.g. sick days) are best predictors, for different industries and geographies, would allow application of our model to real business scenarios where the results could be tabulated.

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