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Three Essays on the Conveyance of Economic Information: Firm, Public, and Educational

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Paul Andrew Tomolonis, PhD

University of Connecticut, 2017

The use of economic information drives economic agents' actions in their pursuit of optimal outcomes; specifically, it helps individuals achieve the highest aggregate welfare possible given available resources. Firms face a tradeoff between earnings management (manipulation of reported profits) and corporate governance that results in an optimal firm value (profits over time); this determines the information provided to external parties and might lower aggregate welfare. Generally, investment in corporate governance is beneficial since accurate information is provided to the firm's investors and other counterparties; however, in cases of high information opacity (e.g. complex firms) the higher cost of corporate governance might make earnings management a better societal outcome even though it reduces welfare. Public regulation might help in these most opaque cases, but at the higher cost of blanket regulation over firms that are capable of self-regulation through corporate governance. In the public (government) realm, the reported funding status of public employee pension funds faces similar manipulation issues as it provides information to members regarding their future benefits and to the public regarding potential future taxes. The variation in funding status across states suggests differences in the way states approach this obligation and in the transparency of the information they provide. Conveying this information affects individual action regarding public employment and migration across state lines, which would deteriorate the future tax base of poorly funded states, exacerbating their funding issue; therefore, states have reason to be opaque in reporting their myopic budgetary decisions similar to the earnings management of firms. Information provision from both the firm and the

government relies on the ability of the individual to ingest and utilize it; this starts with discussions in the classroom. Application of economic reasoning to decision making is achieved by discussing economic concepts in an applied setting, both formally and informally. Social media is often seen as benefit in engaging students and all economic agents, but it can also serve to distract from critical thinking due to its informal nature. The lessons learned suggest firms and governments use social media to convey short, summary measures that can be interpreted by economic agents.

Three Essays on the Conveyance of Economic Information: Firm, Public, and Educational

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A Principal-Agent Model of Earnings Management with Corporate Governance

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ABSTRACT

The effect of earnings management and corporate governance on firm profits is explored using a principal agent model with the possibility of managerial discretion over earnings reports and a firm choice regarding the level of corporate governance. The model results in four cases of firm profits varying with the level of corporate governance. Two cases result in no earnings management, one case has allowing earnings management as a profit maximizing strategy, and one case is indeterminate. The parameters of the model dictate the case, resulting in firms with high information opacity (e.g. conglomerates) being the type of firm where earnings management might be profit maximizing. Even in this case, earnings management is constrained by the opportunity to use it and performance based pay that makes higher levels of corporate governance relatively more beneficial to the firm.

Keywords: Earnings management, Executive compensation, Optimal contracts, Corporate governance.

1. Introduction

Improving aggregate welfare and living standards depends on an efficient allocation of resources within an economy and to firms specifically. The allocation of capital across firms is significantly affected by firm performance as judged by the profits reported in their financial statements (earnings reports). These reports rely on managerial discretion in accounting choices. While there are rules regarding reporting choices (e.g. US GAAP or IFRS) enough discretion remains¹ to have a material effect on earnings reports and thus the allocation of resources (capital) to firms. To address these poor choices or self-interested managerial discretion, another level of control is developed through corporate governance. This study employs a model of managerial discretion over earnings reports that include corporate governance in order to discuss how the choice of corporate governance affects the incentives of managers and the reported performance of the firm. By considering firm characteristics through the parameters of the model along with varying levels of corporate governance, scenarios where earnings management might be either eliminated or profit maximizing can be isolated and discussed by firm type.

Earnings management (EM) is the practice of firms making choices that affect the appearance of their financial reports, especially published profits (earnings) reports. These choices could be economic decisions that affect sales and expenses (real earnings management) or accounting choices (e.g. assumptions, methods) that affect estimates or the timing of revenue and expense recognition (accrual earnings management). The methods and difficulty in detecting earnings management empirically have been well documented, including numerous survey papers that summarize and set the context of the issue. Dechow, Ge, and Schard (2010) review the earnings quality literature of which earnings management is a subset (i.e. all earnings management

¹ Part of this discretion is found in estimations that rely on managerial judgment regarding the likelihood of future events. Estimations are necessary in accounting to make the information provided to decision makers timely and therefore more relevant, but this trades off with the reliability of the information.

reduces earnings quality, but earnings quality can be low for other reasons, such as difficult or poor estimations). Lo (2008) discusses earnings management research from the perspective of a crime scene investigation to suggest new techniques and approaches to the vexing issue of finding evidence that others do not want to be found. Healy and Whalen (1999) provide a detailed overview of the academic evidence on earnings management specifically targeting standard setters as an audience, which keeps this work relevant for researchers in this area even today. What can be gleaned from this literature is a belief that earnings management is prevalent and has an effect on economic decisions. In support of this, Dichev, Graham, Harvey, and Rajgopal (2013) performed an earnings quality survey of 169 CFOs in public companies finding that 20% of them were willing to admit that they used or planned to use earnings management in a recent quarter and that the average effect of earnings management when used was a 10% change in earnings per share (EPS). Despite what might seem like an obvious impediment to the efficient allocation of resources, some argue that earnings management allows for more efficient transmission of internal information from the manager to the owner and the markets (Arya Glover, and Sunder, 2003), or that earnings management is a low cost alternative to aligning incentives to induce managerial effort (Sun 2013).

The ethics of earnings management ranges from seemingly innocent "window dressing" to outright fraud (e.g. Enron, or any of the other accounting scandals of the early 2000's); from the "everyone is doing it" mentality to excessive avarice driven deception. So, where is the line between the "acceptable" and the ridiculous? Ultimately, the purpose of earnings management is to alter the perception of firm performance, which will affect the decisions of those that transact with the firm. If this is done for personal gain, the requirements of fraud have been met: a knowingly made false statement in which another(s) takes reliance resulting in a gain to the perpetrator at the expense of the victim; so there is no acceptable level, only a question of magnitude to justify pursuing the issue. Since the victim(s) are often a disparate group (e.g.

shareholders) with smaller individual losses, enforcement and prosecution are often foregone with the losses taken to be a cost of the "system". Motivations behind earnings management generally arise from the personal (self-interested) incentives of senior management (e.g. performance pay - Healy (1985), Bergstresser and Philippon (2006), reputation in the job market - Francis, Huang, Rajgopal, and Zang (2008), ego, etc.); however, incentives to the firm and its current owners should not be forgotten as well (e.g. lower borrowing costs - Shen and Huang (2013), attracting more capital - DuCharme, Malatesta, and Sefcik (2004), meeting a bond covenant - Franz (2014), increased stock price for collateral or sale, etc.). This paper will focus on accrual earnings management as motivated by the manager's performance pay through a principal agent model framework, but the results are extensible to other earnings management settings also.

While the accounting literature focuses on the detection and local (firm level) effect of earnings management there is evidence in the financial economics literature that supports the notion that earnings management is detrimental to the macro-economy since sub-optimal investment and operational decisions are made based on "managed" financial reports which leads to the misallocation of economic resources, especially capital. Kedia and Philippon (2009) develop a model that shows earnings management firms over hire and over invest when they manage earnings. Durnev and Mangen (2009) extend this connection using financial restatements to show that competitors in an industry will make sub-optimal investment decisions due to distorted signals about investment profitability they obtain from the misreported statements of other firms in the industry that manage earnings. Sadka (2006) develops a model of the earnings management effects on product markets that results in lower social welfare due to low productivity firms over producing relative to high productivity firms. The mechanism at work here is that the lower productivity firms would not invest in as much capacity nor would they hire as much since they do not have the same profit opportunity as high productivity firms. High productivity implies more output with fewer inputs, thus more revenue (assuming it can be sold) at a lower cost of inputs,

which translates into more profits if production is increased. Since low productivity firms realize they do not have as much of a profit opportunity as high productivity firms, but they have access to low cost financing, they over invest in capital yet hire less labor (a variable input) than a high productivity firm; which results in less labor demand, slower wage growth, less spending and investment from households, and thus, less economic growth than if the high productivity firms had invested, hired more, and not been crowded out by low productivity, earnings managing firms.

In order to reduce earnings management, the natural check to the agent's (manager's) discretion in misreporting financial results to the principal (owners, directors) is corporate governance. Corporate governance is enacted by management through the policies and procedures that are mandated via the board of directors or directly by owners. Often in academic research, corporate governance is only thought of at the senior level (e.g. independent directors – Xie, Davidson, and DaDalt, 2003, is the CEO the chair of the board of directors - Morck, 2008, etc.); however, corporate governance extends throughout the organization through personnel policies and internal controls (e.g. background checks, disbursement approval authority, separation of duties, etc.). It is promulgated by senior management and directly affected by the way the governance (or control) environment is set by management or the strategic plan from the board of directors. Thus, while good corporate governance comes at a cost through both implementation and compliance; it brings a benefit to the operations in the form of information driven productivity and security (Shleifer and Vishny 1997). Taken in this context, the owners have a trade-off to make between the costs and benefits of corporate governance. The level of corporate governance chosen, which influences the expected cost to the agent of engaging in earnings management, will ultimately determine if earnings management is feasible or if truthful reporting will prevail.

Incorporating a choice over the level of corporate governance into a principal-agent framework with an earnings management feature is a main contribution of this paper. The results of this

exercise suggests that earnings management can be part of an equilibrium profit maximizing strategy *for some types of firms* where the information quality of earnings reports is already low, such as start-up firms, growth firms, firms with high market power, or complex highly diverse firms as might form through mergers and acquisitions (M&A) since these firms must meld different business, accounting, IT, and governance systems. Even in these environments, as the prevalence of earnings management increases so does the managerial contract cost to the principal, making higher levels of corporate governance relatively more profitable and earnings management decrease. Further, pay for performance compensation packages that incentivize high effort from the agent (manager) reduce the likelihood of earnings management being profit maximizing to the firm by adding costs that are proportionate to profits, thereby cut firm profitability more under earnings management, thus increasing the costs of forgoing good corporate governance. Moreover, there are many firms (most?) that do not see an increase in profits under earnings management when the costs and benefits of corporate governance are considered in addition to the cost corporate governance places on managers practicing earnings management. These results suggest that allowing or ignoring earnings management is rarely a prudent financial choice for firms and that the cost of good corporate governance is often worth it. Most importantly, by incentivizing truthful reporting through profit maximizing levels of corporate governance, the allocation of capital among firms is made more efficient to the betterment of all economic agents, especially households.

The remainder of the paper is organized as follows: Section 2 presents the model framework and operation. Section 3 analyzes the model implications and separates the results into cases. Section 4 discusses the various cases including entry and implications. Section 5 provides concluding remarks.

2. The Model

The model examined in this study is built upon a simple principal-agent framework which includes earnings management as found in Sun (2009, 2012, 2013). This study adds an endogenous choice variable over the level of corporate governance including it as a benefit as well as cost. The level of corporate governance provides both a cost and a benefit to the firm since corporate governance and internal controls help ensure the provision of good information for strategic and operational decision making while also protecting the investment of owners from misappropriation. The provision of quality information extends beyond internal decision makers to external users, especially capital markets. In any decision situation, better quality information is costly, but it results in more productive operations, the security of productive assets, and a more efficient allocation of capital. In this model, the level of corporate governance acts as an impediment to earnings management (as in Sun), with the addition of having its own costs and benefits.

Consider a risk-neutral principal (the owner(s) of a firm) who hires a risk-averse agent (the manager) for a one period contract. The firm's output (or earnings, abstracting away from most costs) is stochastic and influenced by the manager's effort as well as the owner's choice of corporate governance. Formally, the firm's output (y) is given by:

$$y = f(\psi, z), \tag{1}$$

where $\psi \geq 0$ is a measure of corporate governance, and z is a random variable. There are two possible values of z , denoted by $\{z_L, z_H\}$, with $z_L < z_H$. The probability distribution of z is

determined by the manager's effort level e . Similar to most principal-agent models, we assume that there are only two possible values of e , denoted by $\{l, h\}$, with $l < h$. Let $p_e \in (0,1)$ be the probability of having $z = z_H$ when the manager's effort is $e \in \{l, h\}$. We assume that $p_h > p_l$ implying that there is an expected positive return to managerial effort.

For any given value of ψ , we can rewrite (1) as $y_H(\psi) \equiv f(\psi, z_H)$ and $y_L(\psi) \equiv f(\psi, z_L)$. Both $y_H(\psi)$ and $y_L(\psi)$ are assumed to be twice continuously differentiable, strictly increasing, and strictly concave, which captures the idea that better corporate governance will lead to higher earnings (with diminishing returns) as supported empirically by Joh (2003). Both the owner and the manager are assumed to know the form of the functions $y_H(\psi)$ and $y_L(\psi)$ before they make their choices. Of course, good corporate governance is not free; the cost of the controls (ψ) is denoted by $\kappa(\psi)$, where $\kappa(\cdot)$ is a twice continuously differentiable, strictly increasing, and strictly convex function. This represents the idea that corporate governance is not only costly, but those costs increase at an increasing rate due to both the implementation and compliance (monitoring) costs of the controls and the reduction in business process efficiency when operating under increasingly strict controls.

The timing of events are as follows: At the beginning of the period, the owner chooses a level of corporate governance, ψ in order to maximize the firm's expected profits, taking into account the expected compensation contract for the manager. After observing ψ , the manager enters into a negotiation with the owner to form the terms of the compensation contract. The contract will have to specify the manager's effort level e , the compensation for the manager under both $\{y_H, y_L\}$, and a recommended reporting strategy, $R(y)$. The details of these contract elements will become clear momentarily. After exerting effort (e) at a cost to the agent of $a(e)$ (assume that $a(l) = 0$ and $a(h) = c$), the manager (agent) receives two pieces of private information. First, she privately observes the realized value of z . This, together with the information on $\{\psi, y_H(\cdot), y_L(\cdot)\}$, means

that the manager has private information on earnings (y). Second, the manager also privately learns about the possibility (x) of misreporting the realized value of y . Within the model (as in business), earnings management cannot be completely expected, or the owners (investors) would be able to unravel the true level of earnings and adjust their interpretation of the earnings report accordingly (using the Revelation principle). By making earnings management occur only with some probability (x), the principal must rely on the agent's report of earnings and cannot use backwards induction to deduce the agent's actions since both the principal and the agent face uncertainty over the opportunity to manage earnings even though they both know the distribution and functional form of earnings outcomes at a given level of managerial effort (e) and corporate governance (ψ). Once the outcome of this opportunity to manage earnings is known to the agent, she can decide to employ earnings management or not, if she has the opportunity. The principal will not be able to see if the earnings management opportunity is available to the agent and thus is uncertain over the decision set of the agent rendering backwards induction futile. As in Sun's model, we assume that there are two possible states of the world. In the first scenario, which happens with probability $x \in (0,1)$, the manager has the opportunity to misreport earnings, y (earnings management). In the second scenario, there is no such opportunity for earnings management. Let $R(y)$ be the reported earnings when the true value of earnings is y . In the first scenario, the manager can choose a value of $R(y)$ that is different from y . In the second scenario, the manager has no choice but to report truthfully, i.e., $R(y) = y$. Note that the manager is compensated based on reported earnings since the owner cannot distinguish between a truthful report and earnings management. Further, a strong level of corporate governance provides a check on the manager's discretion in misreporting financial results to the owner. To wit, a higher level of corporate governance (ψ) means that it is more costly² for the manager to manipulate

² Note that these are expected costs to the agent, including expected punishment if caught and the disutility from the uncertainty over being caught as well as any direct costs of managing earnings.

earnings reports when the opportunity is given (with probability x). In particular, if the manager chooses to report higher earnings than its actual value, then she will incur a cost ψ ; however, if there is no earnings management, there is no cost.³ This is expressed in the general manipulation cost function for the earnings report: $\phi(R(y) - y)$; since there are only two states of earnings in the model (and no downward earnings management) this becomes a constant: $\psi = \phi(y_H - y_L)$ under earnings management, but is zero under truthful reporting: $\psi = \phi(0) = 0$.

Due to the uncertainty over earnings and the opportunity to manage them, the principal is unable to deduce the validity of the agent's reported earnings (two dimensions of uncertainty within a single information signal). The principal (owner) has to consider the cost of inducing truthful reporting when making the contract offer. The owner's problem is to choose a level of corporate governance, ψ and an optimal compensation contract so as to maximize the firm's expected profits. This problem can be divided into two steps: First, with the knowledge of the agent's contract offer, incentives, and range of outcomes in mind, the principal has a choice to make over the level of corporate governance (ψ). This choice will be made before the contract is offered to the agent, with the principal using backwards induction to arrive at the agent's choices (but without the knowledge of the realized earnings management opportunity, x). This level of corporate governance will manifest as a cost to the agent for earnings management, but will also be both a cost and benefit to the principal as previously discussed. The principal considers the direct cost ($\kappa(\psi)$) and benefit ($y(\psi)$) of good corporate governance along with the indirect costs that will be passed back from the agent to the principal as part of the compensation contract cost. The agent

³ Only upwards earnings management is considered here (i.e. $R(y) > y$) so there is no cost associated with truthful reporting ($R(y) = y$) or downwards earnings management ($R(y) < y$). In a one period model, there would be no reason for downward earnings management and in actuality; the reason to manage earnings downward would be in anticipation of reversing this in future periods for upwards earnings management or as an adjustment for previous periods' upward earnings management. Note that in regulated industries, downward earnings management might be used to avoid regulatory scrutiny, but this is also part of a multi-period strategy to maximize profits.

realizes that the principal will try to induce high effort and truthful reporting by increasing the costs of earnings management, but the agent views earnings management as an insurance policy that can be exercised if low earnings come to pass (due to chance or shirking), and thus, if earnings management is limited by the principal, the agent will require higher pay to compensate for a greater likelihood that low pay might result despite high effort. Therefore, the choice of ψ has two trade-offs built into it: direct cost and benefit to the firm overall, and the increase in compensation contract costs with the benefit of more probable truthful reporting. The second step in the owner's problem is, conditional on the choice ψ , the owner chooses the optimal compensation contract so as to minimize the wages (i.e., contract cost to the owner) of inducing high effort ($e = h$) from the manager, subject to the manager's incentive compatibility and participation constraints. These wages result in some utility to the agent (manager), where her utility function, $U(\cdot)$, is strictly concave and strictly increasing; the utility promises are assumed to be invertible [$V(\cdot) = U^{-1}(\cdot)$] which yields the cost to the principal ("contract costs") of this compensation to the manager. Specifically, we will use the notation $V(u_{R(H)})$ to represent the contract costs to the principal of compensating the agent (in utility terms $u_{R(H)}$) for an earnings report when the results were high, and similar notation for an earnings report when earnings were low, $V(u_{R(L)})$. Since the principal cannot discern whether the agent engages in earnings management, this report of earnings is no different (in terms of compensation) than the actual earnings compensation when results are high or low $\{V(u_H), V(u_L)\}$ but reported earnings are at the discretion of the manager (agent). For a fixed level of ψ , the principal's objective is to minimize the contract costs of inducing high effort ($e = h$) in all states of nature (high and low earnings reports $\{R(H), R(L)\}$, and the ability to manipulate earnings, with probability x or not):

$$\min_{u_H, u_L, R(H), R(L)} E[V(u)|h] = x[p_h V(u_{R(H)}) + (1 - p_h)V(u_{R(L)})] + (1 - x)[p_h V(u_H) + (1 - p_h)V(u_L)]$$

The constraints of the minimization include the usual incentive compatibility constraint which requires utility promises from the principal that are sufficient enough to induce high effort from the agent after taking into account the cost to the agent of the effort put forth. The participation constraint ensures the manager's interest in working for the principal by keeping the utility gained by this work greater than the agent's outside options. The manager's incentive compatibility constraint (2) and participation constraint (3) are given by:

$$h = \arg \max_{e \in \{l, h\}} \{xE[u_{R(y)} - \phi(R(y) - y) - a(e)] + (1 - x)E[u_y - a(e)]\}, \quad (2)$$

$$xE[u_{R(y)} - \phi(R(y) - y) - a(h)|h] + (1 - x)E[u_y - a(h)|h] \geq \bar{U}, \quad (3)$$

where $\bar{U} > 0$ represents the payoff to an outside option for the manager.

Since the model has two information asymmetries built into it between the principal and the agent, one regarding the level of effort (as usual and addressed by the constraints above) AND a second one over the earnings (y) of the firm, the principal has a profit maximizing suggested reporting strategy (EM or truth) that requires another constraint for it to hold over the agent. Note that the reporting strategy is part of the optimization and might not be truthful reporting, as chosen by the principal.

$$R(y) = \arg \max_{r \in \{L, H\}} \{u_r - \phi(r - y)\} \quad \forall y \in \{L, H\} \quad (4)$$

Since there is no incentive to report low earnings when they are, in fact, high, the only options are to report truthfully ($R(H) = H$ and $R(L) = L$) or to report high earnings when they are, in fact, low (earnings management: $R(H) = H$ and $R(L) = L$). Truthful reporting involves no cost to the agent, so the agent's choice of reporting, when given the opportunity to manage earnings, reduces to a comparison between the utility differences of the reports (agents are compensated based on the only observable, reported earnings) less the cost of effort to the manager (assuming high effort, at cost (c)) and less the costs to the agent of earnings management (ψ), when available and exercised. When actual earnings are low ($z = z_L$) and the agent has the opportunity to manage earnings, if $u_{R(H)} - u_{R(L)} - c > \psi$ then earnings management is expected; if $u_{R(H)} - u_{R(L)} - c < \psi$ then truthful reporting is expected. Thus, the principal sets the utility promises in such a way to minimize the cost of inducing high effort and as a consequence sets a recommended reporting strategy that might include earnings management.

3. Analysis

The analytical results that stem from the model solution set up conditions for when earnings management is possible as a function of the model parameters. In particular, if $\psi < c/(p_h - p_l)$ then earnings management is cost effective to the agent since the expected cost of earnings management to the agent is less than the expected cost of exerting effort. To induce truthful reporting in this situation, the utility "wedge" ($u_H - u_L$) promised to the agent between high and low reported earnings must be small since the costs of earnings management is relatively small.

Why exert uncertain effort, to perhaps get u_H , if it costs less to manage the earnings and report high results instead ($\psi < c/(p_h - p_l)$)? On the other hand, to induce high effort in this case, the utility wedge has to be sufficiently large to overcome the uncertainty of the earnings outcome and compensate the manager for the cost of high effort (c). This "balancing" of the utility wedge might lead the principal to forgo truthful reporting to induce high effort at minimal costs, depending on the net benefits of corporate governance apart from compensation contract costs. Similarly, when $\psi \geq c/(p_h - p_l)$ the cost of earnings management is sufficiently large compared to the expected cost of effort to make it cost ineffective for the manager to engage in earnings management at any compensation level. When considering compensation contract costs in terms of the utility wedge ($u_H - u_L$) at a given level of corporate governance (ψ), the optimal compensation contract will involve⁴:

$$u_H = \bar{U} + \frac{c(1-p_l)}{(p_h-p_l)} \quad \text{and} \quad u_L = \bar{U} + \frac{c(1-p_l)}{(p_h-p_l)} - \frac{c-x(p_h-p_l)\psi}{(1-x)(p_h-p_l)}, \quad \text{when } \psi < \frac{c}{(p_h-p_l)}, \quad (5)$$

$$u_H = \bar{U} + c + \frac{c(1-p_l)}{(p_h-p_l)} \quad \text{and} \quad u_L = \bar{U} + c - \frac{c(p_l)}{(p_h-p_l)}, \quad \text{when } \psi \geq \frac{c}{(p_h-p_l)}. \quad (6)$$

When only considering the compensation contract costs and not the direct costs and benefits of corporate governance, Sun concludes that the optimal contract should increase performance pay use when earnings management is more likely since the principal has to overcome the temptation of the agent to manage earnings instead of exerting high effort. The logic is that a higher utility

⁴ See Sun 2009 for a proof of these results.

wedge (i.e. more performance based pay) will induce high effort even when earnings management is possible since the utility wedge, $(u_H - u_L)$, provides higher expected pay for high effort ($\Delta_{pay} = p_H(u_H - u_L)$) while the earnings management option comes with an expected cost $(u_H - \psi)$. Thus, if earnings management is an option and ψ is set high exogenously by regulation, the firm (owner) only controls pay for performance (PfP), so increasing it is the only way to ensure high effort.

While Sun's conclusions are thought provoking, the idea that the cost of earnings management is an exogenous parameter which has no direct effect on the firm's earnings (y) leaves a critical choice that the principal makes outside of the model. The choice the principal has over this cost (ψ) to the agent is the choice of corporate governance at the firm and this choice engenders both a cost and benefit to the firm in addition to its effect on earnings management. Good corporate governance fosters a culture of honesty and productivity within the firm as employees at all levels make a stronger association between their efforts and the rewards that result. Moreover, good corporate governance protects assets (investment) from misappropriation, and ensures the integrity of information for decisions on business process changes that, if made with accurate, quality information, are more likely to lead to productivity gains at the firm.

Considering the expected compensation contract costs when earnings management is cost effective to the agent ($\psi < \frac{c}{(p_h - p_l)}$), and is possible with probability x , under the assumption of high effort, results in expected compensation contract costs to the principal of:

$$x[p_h V(u_H) + (1 - p_h)V(u_H)] + (1 - x)[p_h V(u_H) + (1 - p_h)V(u_L)]. \quad (7)$$

Here the agent will report (and be paid on that report) high earnings when earnings management is possible and truthfully when earnings management is not possible.

From (5), when $\psi < \frac{c}{(p_h - p_l)}$:

$$u_H = \bar{U} + \frac{c(1 - p_l)}{(p_h - p_l)}, \quad (8)$$

$$u_L = \bar{U} + \frac{c(1 - p_l)}{(p_h - p_l)} - \frac{c - x(p_h - p_l)\psi}{(1 - x)(p_h - p_l)}. \quad (9)$$

Using (8) and (9) to make the substitutions for u_H and u_L in (7) yields contract costs of:

$$xV \left[\bar{U} + \frac{c(1 - p_l)}{(p_h - p_l)} \right] + (1 - x)p_h V \left[\bar{U} + \frac{c(1 - p_l)}{(p_h - p_l)} \right] + (1 - x)(1 - p_h)V \left[\bar{U} + \frac{c(1 - p_l)}{(p_h - p_l)} - \frac{c - x(p_h - p_l)\psi}{(1 - x)(p_h - p_l)} \right]$$

Making the simplifying assumption, without loss of generality, that the transformation from agent's utility to the principal's contract costs ($V = U^{-1}$) is linear allows for the simplification of contract costs to:

$$\bar{U} + x\psi(1 - p_h) + c, \quad \text{when } \psi < \frac{c}{(p_h - p_l)}. \quad (10)$$

Similarly, the expected contract costs to the principal when earnings management is NOT cost effective to the agent $\left(\psi \geq \frac{c}{(p_h - p_l)}\right)$, (which makes the fact that earnings management is possible, with probability x , moot) will be (assuming high effort):

$$[p_h V(u_H) + (1 - p_h)V(u_L)]. \quad (11)$$

Here the agent will always report truthfully (and be paid on that report) since it provides higher "take home" utility (after considering the expected costs of earnings management to the agent).

From (6), when $\psi \geq \frac{c}{(p_h - p_l)}$:

$$u_H = \bar{U} + c + \frac{c(1 - p_l)}{(p_h - p_l)}, \quad (12)$$

$$u_L = \bar{U} + c - \frac{c(p_l)}{(p_h - p_l)}. \quad (13)$$

Using (12) and (13) to make the substitutions for u_H and u_L in (11) yields contract costs of:

$$p_h V\left[\bar{U} + c + \frac{c(1 - p_l)}{(p_h - p_l)}\right] + (1 - p_h)V\left[\bar{U} + c - \frac{c(p_l)}{(p_h - p_l)}\right], \quad \text{if } \psi \geq \frac{c}{(p_h - p_l)}.$$

Making the simplifying assumption, without loss of generality that the transformation from the utility of the agent to the contract costs of the principal ($V = U^{-1}$) is linear allows the simplification of contract costs to:

$$\bar{U} + 2c, \quad \text{when } \psi \geq \frac{c}{(p_h - p_l)}. \quad (14)$$

Collecting these results, the firm's expected profits are determined by:

If $\psi < \frac{c}{(p_h - p_l)}$, then

$$\Pi(\psi) = p_h y_H(\psi) + (1 - p_h) y_L(\psi) - \kappa(\psi) - \bar{U} - x\psi(1 - p_h) - c. \quad (15)$$

If $\psi \geq \frac{c}{(p_h - p_l)}$, then

$$\Pi(\psi) = p_h y_H(\psi) + (1 - p_h) y_L(\psi) - \kappa(\psi) - \bar{U} - 2c. \quad (16)$$

Assuming that the principal wants to induce high effort, then the maximum profit that she can obtain is given by considering (15) and (16) under the choice of the level of corporate governance (ψ):

$$\Pi^* = \max_{\psi} \{\Pi(\psi) : \psi \geq 0\}.$$

Let ψ_{max} be the value of ψ that maximizes profits without considering contract costs:

$$\psi_{max} = \max_{\psi} \{p_h y_H(\psi) + (1 - p_h) y_L(\psi) - \kappa(\psi)\} \quad (17)$$

and define $\bar{\psi}$ as the breakpoint between cost effective earnings management and cost ineffective earnings management to the agent:

$$\bar{\psi} \equiv \frac{c}{(p_h - p_l)} \quad (18)$$

At $\bar{\psi}$ the contract costs to the principal switch from earnings management possible (contract cost given by (10)), to truthful reporting with certainty (contract costs given by (14))⁵, altering the expected profits as in (15) and (16). Which of these costs is higher than the other can be determined by the parameters of the model along with ψ . Note that at $\bar{\psi}$ the contract costs of earnings management is greater than truthful reporting if and only if $x(1 - p_h) > p_h - p_l$ which

⁵ Recall that the contract costs to the principal change under the different reporting regimes available to the agent since the agent considers earnings management as a hedge against a low earnings outcome that would result in lower pay. This hedge trades off with high effort being a better strategy even when earnings management is cost effective to the agent since the ability to manage earnings is not certain.

is independent of c . This is expected since $\bar{\psi}$ is an indifference point for the agent and thus her cost of effort is irrelevant.

This results in four possible scenarios or cases (see associated diagrams that follow):

Case 1: $\psi_{max} \leq \bar{\psi}$ and $x\psi(1 - p_h) > c$, where effective corporate governance is relatively expensive and contract costs under earnings management are **greater** than under truthful reporting (Figure 1).

Case 2: $\psi_{max} \leq \bar{\psi}$ and $x\psi(1 - p_h) \leq c$, where effective corporate governance is relatively expensive and contract costs under earnings management are **less** than under truthful reporting (Figure 2).

Case 3: $\psi_{max} > \bar{\psi}$ and $x\psi(1 - p_h) > c$, where effective corporate governance is relatively inexpensive and contract costs under earnings management are **greater** than under truthful reporting (Figure 3).

Case 4: $\psi_{max} > \bar{\psi}$ and $x\psi(1 - p_h) \leq c$, where effective corporate governance is relatively inexpensive and contract costs under earnings management are **less** than under truthful reporting (Figure 4).

For Case 2 and Case 3, it is easy to see that the optimal value of ψ is ψ_{max} , since the profit curve shift inside of itself at the contract cost breakpoint, leaving π_{max} as the only possible profit maximizing point (see Figures 2 and 3). This implies that earnings management is possible in Case 2, and not possible in Case 3 due to the location of $\bar{\psi}$ (the point at which earnings management becomes no longer cost effective to the agent) relative to the profit maximizing value of ψ . For Case 4, earnings management will NOT be possible since regardless of the profit maximizing point ($\bar{\psi}$ or ψ_{max}) both will be at or beyond $\bar{\psi}$, the point where earnings management is no longer cost effective to the manager (see Figure 4). For Case 1, it is uncertain where the profit maximizing point will be: before $\bar{\psi}$ (EM possible) or at $\bar{\psi}$ (EM no longer cost effective to the manager) since the profit maximizing level of ψ could occur at either level depending on the parameters of the model (see figure 1).

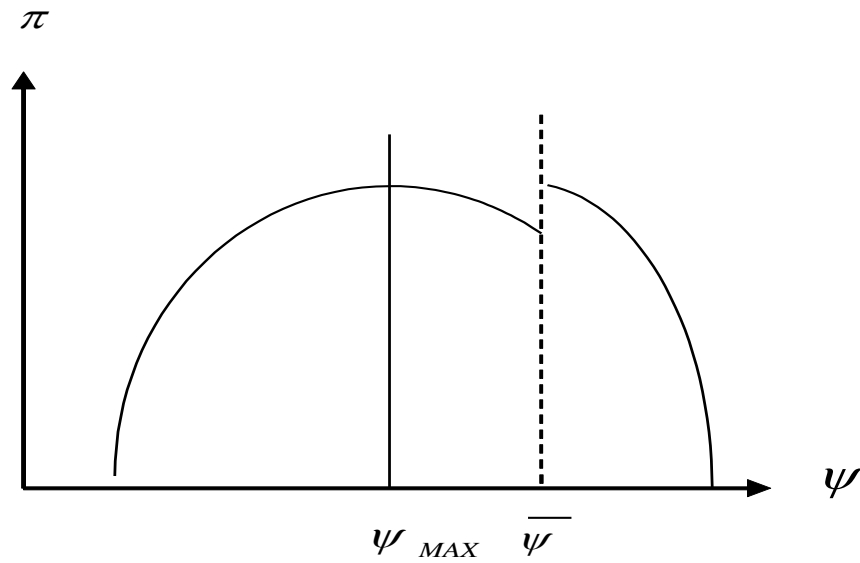


Figure 1: Case 1 ($\psi_{max} \leq \bar{\psi}$ and $x\psi(1 - p_h) > c$)

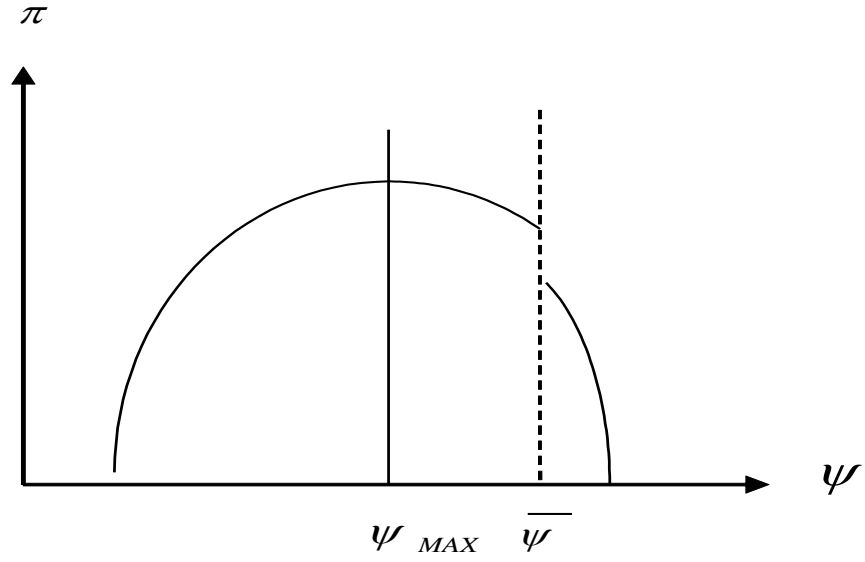


Figure 2: Case 2 ($\psi_{max} \leq \bar{\psi}$ and $x\psi(1 - p_h) \leq c$)

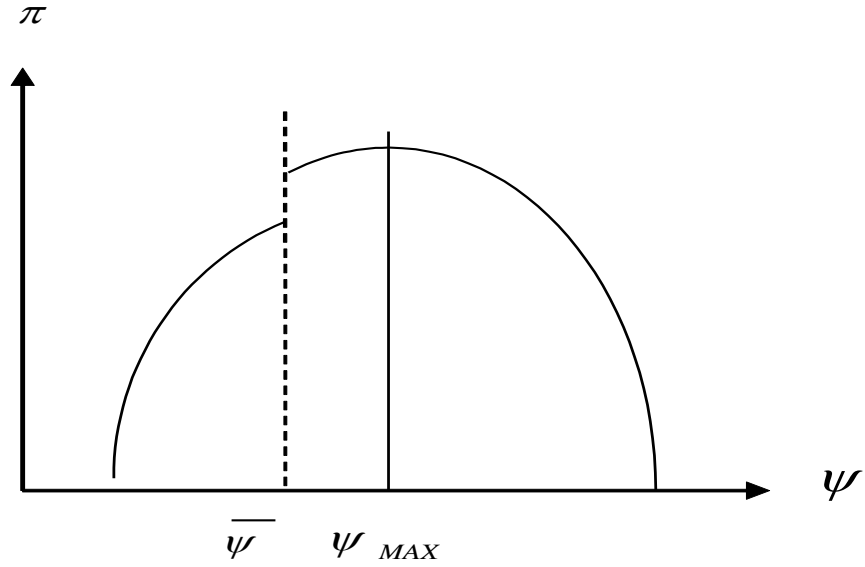


Figure 3: Case 3 ($\psi_{max} > \bar{\psi}$ and $x\psi(1 - p_h) > c$)

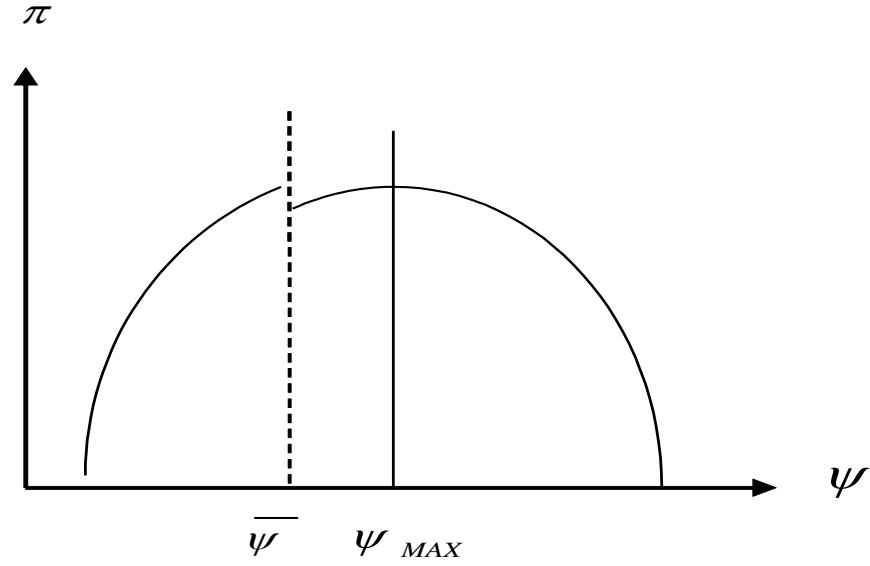


Figure 4: Case 4 ($\psi_{max} > \bar{\psi}$ and $x\psi(1 - p_h) \leq c$)

4. Discussion

To summarize the various profit cases from the preceding section:

Case #	Optimal level of ψ	Earnings Management state
Case 1	$\max_{\{\bar{\psi}, \psi_{max}\}} \pi$	Uncertain
Case 2	ψ_{max}	Present (profit maximizing to the firm) since $\bar{\psi} > \psi_{max}$
Case 3	ψ_{max}	NOT cost effective to the agent since $\bar{\psi} < \psi_{max}$
Case 4	$\max_{\{\bar{\psi}, \psi_{max}\}} \pi$	NOT cost effective to the agent since $\bar{\psi} < \psi_{max}$

Case 4: regardless of whether the profit maximum is at $\bar{\psi}$ or ψ_{max} , earnings management is not cost effective to the agent since $\bar{\psi} < \psi_{max}$ (see Figure 4); thus we will see **no earnings management**.

Case 3: The profit maximum will always be at ψ_{max} and since $\bar{\psi} < \psi_{max}$ (see Figure 3); earnings management is never cost effective for the agent; thus we will see **no earnings management**.

Case 2: The profit maximum will always be at ψ_{max} and since $\bar{\psi} > \psi_{max}$ (see Figure 2); earnings management is always cost effective for the agent. Earnings management **will occur whenever possible (with probability x)**, but note that as x rises, it becomes more likely to move to Case 1 which sees less earnings management as x increases.

Case 1: The profit maximum could be at ψ_{max} or $\bar{\psi}$ depending on parameters. If at ψ_{max} , earnings management is possible since $\bar{\psi} > \psi_{max}$, but if at $\bar{\psi}$, earnings management will NOT be cost effective to the agent. The parameters of interest in this case are $y'(\psi)$, $\kappa'(\psi)$ (how fast profits fall off after ψ_{max}), p_l, p_h (how close $\bar{\psi}$ is to ψ_{max}) and x (along with p_h determines how much of a shift there is between earnings management contract costs, and truthful reporting contract costs), see Figure 1. The parameter c would also influence how close ψ_{max} is to $\bar{\psi}$ and the shift between earnings management and truthful reporting contract costs, but there is a trade off on its value to keep it in Case 1. If c is too low $\bar{\psi}$ will shift to left of ψ_{max} (into Case 3, recall that $\bar{\psi} \equiv \frac{c}{(p_h - p_l)}$), too high and truthful reporting contract costs (given by (14)) would rise above earnings management contract costs (given by (10)) and into Case 2. To limit earnings management (make the profit maximizing point at $\bar{\psi}$), profits should fall off slowly after ψ_{max} ($y'(\psi)$ high, $\kappa'(\psi)$ low; which is contrary to Case 1 criteria since Case 1 has the earnings management profit curve (to

the left) inside of the truthful reporting profit curve and a slow fall off of profits increases the likelihood of shifting the earnings management profit curve above the truthful reporting profit curve into Case 2. Additionally, $\bar{\psi}$ should be close to ψ_{max} (c low, p_h high, p_l low) to increase the likelihood that the profit maximum will occur at $\bar{\psi}$; this is also contrary to Case 1 criteria since Case 1 is partially defined by $\psi > \psi_{max}$. Lastly, to limit earnings management, the shift from the earnings management profit curve to the truthful reporting profit curve should be large (c low, x high, p_h low) which is consistent with Case 1 criteria but with rising x , more earnings management is likely, also, p_h is at odds with the preceding discussion regarding the relative proximity of $\bar{\psi}$ and ψ_{max} so it must be "balanced", and c must be "balanced" as previously discussed to stay in Case 1. Out of all of these parameters that must be "balanced", only x has some free range; as x rises, earnings management has a greater likelihood of being an opportunity, but this also decreases profits (increases contract costs) on the left side of the profit curve where earnings management is cost effective to the agent ($\psi < \bar{\psi}$), naturally limiting earnings management by shifting down the earnings management profit curve (left) making the profit maximizing level of $\psi \geq \bar{\psi}$ more likely. Thus, firms that fall into Case 1 are **indeterminate regarding whether earnings management is a viable strategy** for the principal that would lead to profit maximization; however, the more likely the earnings management opportunity is, the more likely the firm is in Case 1 and the less likely that earnings management is a profit maximizing strategy, naturally limiting earnings management in this case.

In both Cases 3 and 4, $\bar{\psi}$ is less than ψ_{max} , which implies that truthful reporting is incentivized since the firm will want to pursue the profit maximizing level of corporate governance, ψ . Since ψ_{max} is greater than $\bar{\psi}$, the firm has reason to increase the level of ψ past $\bar{\psi}$ and thus beyond the level of ψ where earnings management ceases to be cost effective to the agent. In these cases, the critical parameters are the agent's cost of effort (c), the probability of high earnings given high

effort (p_h), and the probability of high earnings given low effort (p_l) since they define the level of $\bar{\psi} \equiv \frac{c}{(p_h - p_l)}$. The level of ψ_{max} is dependent on of the curvature of output ($y'(\psi)$) with respect to ψ and the curvature of corporate governance costs ($\kappa'(\psi)$) with respect to ψ since $\pi(\psi) = y(\psi) - \kappa(\psi)$. To keep the firm in Cases 3 or 4 ($\psi_{max} > \bar{\psi}$) and thus limit earnings management by providing incentive to increase ψ beyond the level of $\bar{\psi}$, the following parameters would behave thusly:

Low values: c , p_l [both to keep $\bar{\psi}$ low], $\kappa'(\psi)$ [for ψ_{max} to be high]

High values: p_h [to keep $\bar{\psi}$ low], $y'(\psi)$ [for ψ_{max} to be high]

A low cost of effort to the agent (c), is consistent with a low opportunity cost of the agent's time, suggesting the agent (manager) might lack experience or have a low skill set. This is also consistent with a manager that has fewer outside options being less likely to take the risk of earnings management. Rajgopal, Shevlin, and Zamora (2006) argue that the CEO's outside opportunities depend on her talent, which they proxy by the CEO's financial press visibility and her firm's industry-adjusted ROA (return on assets). They find that the CEOs' outside employment opportunities (talents) are positively correlated with a greater difference in firm profitability compared to industry profitability (their measure of relative performance evaluation, but could also be an indicator of earnings management ala Burgstahler and Dichev, 1997). This is consistent with what is expected from the model (cases 3 & 4) where a lower cost of effort (less CEO talent or opportunities) is associated with less earnings management (as evidenced in their empirical

work by less divergence between firm and industry profits). Further, Francis, et al. (2008) find a **negative** association between CEO reputation and earnings quality (earnings management lowers earnings quality). This also supports the modeled connection between a higher cost of effort to the manager (stronger reputation, more skill, therefore a higher opportunity cost (c)) and earnings management, since a higher c (reputation) implies more earnings management based on their empirical results, and this higher c also makes the model outcome less likely to be in cases 3 & 4 and therefore more likely to engage in earnings management.

In order to stay in cases 3 and 4, which limits earnings management, consider p_h and p_l together. The difference should be high (p_h high and p_l low), implying that effort is necessary to achieve high earnings and that given high effort, high earnings are more likely. This suggests firms that operate in a single line of business (or are relatively undiversified) and have experienced little merger and acquisition (M&A) activity in their past; thus keeping their operations relatively simple and easier to manage while still requiring effort, but that effort is rewarded more directly. Being undiversified would require more effort to achieve high earnings (on average) because the success or failure of the business hinges on one product which is subject to both idiosyncratic risks (e.g. preference changes, close substitutes) as well as the full effect of systemic risks (e.g. slowing consumer spending or investing). A more diversified firm would hedge away part of the systemic risk and spread the idiosyncratic risk across more lines with less likelihood of being negatively affected simultaneously, thus requiring less effort to obtain high earnings. The benefit firms derive from corporate governance should increase quickly relative to the cost of corporate governance ($y'(\psi) > \kappa'(\psi)$) since good information and control will lead to a more robust business process around the single product (e.g. easier to form a consistent strategy) while operations are relatively simple to manage and control (i.e. low cost of corporate governance). This keeps ψ_{max} high and more likely to be greater than $\bar{\psi}$, which keeps the model outcomes in Cases 3 & 4 (no earnings management). High values of $y'(\psi)$ and low values of $\kappa'(\psi)$ indicate

that corporate governance and controls are effective even at a low level ($\psi_{max} > \bar{\psi}$) and that the profit maximum occurs relatively late as the level of corporate governance increases. Doyle, Ge, and McVay (2007) find greater material weaknesses (i.e. weaker internal controls and corporate governance) correlated with increasing organizational complexity, so firms with more M&A and more diverse operations are more likely to have weaker corporate governance and greater likelihood to be in the earnings management cases (1 & 2), consistent with our argument that simpler firms (where, $p_h \gg p_l$ pushes $\bar{\psi}$ lower and $y'(\psi) \kappa'(\psi)$ keep ψ_{max} high) are more likely in Case 3 or 4 with less (or no) earnings management.

As we move away from cases 3 and 4, we would expect the cost of effort to the agent (c) to increase and the differential between p_h and p_l to decrease. This makes earnings management more likely, so the question of whether it is cost effective to try to eliminate or reduce earnings management arises. Considering the expected profit profiles for Cases 1 & 2, we see that $\bar{\psi}$ is now greater than ψ_{max} , suggesting that it will be profit reducing to increase corporate governance enough to make earnings management cost ineffective to the agent (manager); however, we must take in to account the change in compensation contract cost as we reach $\bar{\psi}$. In Case 2 this contract cost change is an increase in costs (a shift down in profits to the right of $\bar{\psi}$), ensuring the profit maximizing point occurs at ψ_{max} (before or left of $\bar{\psi}$), thus allowing for earnings management as an equilibrium profit maximizing strategy for both the principal and the agent. Under Case 1 this contract cost change results in lower costs or a shift up in profits to the right of $\bar{\psi}$, so whether earnings management is profit maximizing depends on the cost change itself ($x\psi(1 - p_h) \rightarrow c$), $\bar{\psi}$, the proximity of $\bar{\psi}$ to ψ_{max} , and the form (curvature) of the profit function ($y'(\psi), \kappa'(\psi)$), see profit diagrams, Figures 1 and 2.

To separate Cases 1 and 2, we compare the contract cost parameters on either side of $\bar{\psi}$. When the compensation contract costs under earnings management (10) are less than the costs under

truthful reporting (14) or $(x\psi(1 - p_h) < c)$, we have earnings management as the viable profit maximizing strategy of Case 2 (profit curve shifts down after $\bar{\psi}$). Note that this depends on high values of $\{c, p_h\}$ and a low value for the likelihood of the earnings management opportunity, $\{x\}$. While the higher value of p_h is contrary to moving away from Cases 3 and 4 (truthful reporting) since it lowers $\bar{\psi}$, it is dominated by the value of c since p_h is a probability and thus limited to the range (0,1) suggesting that p_h is closer to p_l to stay out of Cases 3 & 4. The limiting aspect of this case is that the model requires lower values for the opportunity to manage earnings (x) which reduces the overall prevalence of earnings management. Still, to fall into this scenario requires a high cost of effort to the agent (c) and a "balanced" probability of high earnings given high effort (p_h). This description suggests a firm with an experienced CEO (high opportunity costs, c), that is profitable if well managed, but is more likely to be profitable regardless of effort (p_h close to p_l). This type of firm might be a large conglomerate or a complex firm cobbled together through mergers and acquisitions (M&A) which would take an experienced CEO (high opportunity cost) to manage and would have more persistent profits through revenue diversity and reducing costs via economies of scale as well as scope; however this would also make their financial reporting more opaque, rendering controls less effective, following Doyle et al. (2007) as previously discussed. In this complex environment, earnings management might be acceptable to both the manager and the owner(s) since if the earnings reports are hard to comprehend anyway, further fouling them with earnings management might not harm the principal who must now put more trust in the agent (Case 2). This allows for lower compensation costs and possible earnings management that benefits both the manager as well as current owners (e.g. lower borrowing costs, higher stock price). Alternately, firms in need of a skilled CEO that have greater profitability given high effort, might also include start-up or growth firms which Doyle et al. (2007) also find as associated with increased opportunity for earnings management. Here, earnings management might afford more financing to the firm or enhance equity based compensation allowing the firm

to grow despite the inherent risks. This is consistent with the idea that the manager has private information to convey about the firm's prospects and earnings management allows for a more efficient allocation of capital as the manager passes this information to the market via earnings managed reports (Arya et al. 2003). Of course, the issue is that the capital markets cannot discern between "helpful" lies and deceitful ones, which would cause the misallocation of capital.

For Case 1, entry to it is limited by the by narrowness of the band formed by the cost of effort to the agent (c): on the low side out of Cases 3 and 4 as $\bar{\psi}$ shifts right (18) and on the high side into Case 2 as truthful reporting contract costs (14) increase relative to earnings management contract cost (10); entry to Case 1 is further limited by the effect of the p_h parameter on either side of this band. Entry is augmented by the opportunity to engage in earnings management (x), so the ultimate effect on profits must be considered since the profit curve shifts up after $\bar{\psi}$, ($x\psi(1 - p_h) \rightarrow c$). Note that ψ must be greater than c to enter this case since both x and p_h are probabilities confined to $(0,1)$. $\bar{\psi}$ is also greater than c by definition ($\bar{\psi} \equiv \frac{c}{(p_h - p_l)}$), so the questions become how close is ψ_{max} to $\bar{\psi}$, how fast do profits drop after ψ_{max} ($y'(\psi), \kappa'(\psi)$) and how large is the contract cost savings after $\bar{\psi}$ ($\Delta_{cost} = x\psi(1 - p_h) - c$)? For small decreases in profit ($y'(\psi)$ high, $\kappa'(\psi)$ low) and relatively large contract cost savings (x high, p_h low, c low), the principal will still be better off with a higher level of ψ that makes earnings management cost ineffective for managers. Of course, this contract cost savings is less likely to materialize in this case since the agent will be aware of this situation (rising ψ) and will pass on to the principal (through contract costs) the additional expected cost of effort created by greater uncertainty of pay since higher levels of ψ imply greater cost of earnings management; thus, not allowing c to go too low. Also, to move away from Cases 3 and 4 requires lower $y'(\psi)$ and higher $\kappa'(\psi)$ the opposite of what would make earnings management in Case 1 less likely thereby limiting or "balancing" the parameter levels. Similarly, too low a value for c will push the model back into

Cases 3 & 4; therefore, the parameters with some free range are p_h (low) and x (high) making entry to the indeterminate earnings management Case 1 limited.

As the difference in the probabilities of high earnings at given effort levels ($p_h - p_l$) come closer together the level of $\bar{\psi} \equiv \frac{c}{(p_h - p_l)}$ grows. As $\bar{\psi}$ rises, preventing earnings management is less profitable to the principal since the level of corporate governance (ψ) must also rise to surpass $\bar{\psi}$, so earnings management becomes more likely. This reduction in ($p_h - p_l$) can be thought of as an increase in the likelihood of high earnings regardless of effort, which might occur in high margin businesses that likely have more pricing power in the output market (or be more complex, diversified firms as argued previously), both consistent with higher likelihood of earnings management opportunities (x) as well since financial reports will be more difficult to understand. These types of firms include utilities, health care, and business services. Leone and Van Horn (2005) find that non-profit hospitals use a significant amount of earnings management, consistent with our case 1 conjectures. Also, Hughes, Johnston, Omonuk, and Dugan (2012) find that utilities use downward earnings management to justify rate increases, but if rates are regulated it reduces the level of earnings management practices; further they use upward earnings management for reporting to a parent company. Note that since the actual use of downward earnings management is predicated on multi-period results, the increase in the absolute amount of earnings management is consistent with the results of the model. Similarly, Key (1997) finds that cable companies use downward earnings management to get rate increases and avoid Congressional scrutiny, also in a multi-period effort. Additionally, close values of p_h and p_l imply greater likelihood of high earnings regardless of effort, so the earnings trend over time is naturally smoother. Investors perceive this as less risk and overvalue the firm, which leads to earnings management in order to delay the valuation correction as found empirically by Chi and Gupta (2009). Thus, firms where earnings management might be a profit maximizing equilibrium strategy and where

the information opacity (of reports) is hard to overcome are complex, diverse firms, monopolies, growth or start-up firms, or heavily regulated firms. This is consistent with managers having private information to convey that cannot be simply reported, but the issue of whether the lies are altruistic (to overcome the opacity) or self-interested remains impossible to disentangle; for most other firms, truthful reporting will increase profits.

Lastly, Sun discusses pay for performance (PfP) as a counterbalance to an increase in the likelihood or prevalence of earnings management since earnings management allows the agent to "masquerade" as a high earnings producer even when low earnings or low effort have been achieved; this acts like an insurance policy to the agent in cases of uncertain earnings outcomes despite high effort. Pay for performance incentivizes effort since actual high earnings are certain to get high pay, while relying on earnings management to report high earnings is more uncertain due to the expected cost of being caught (ψ) and uncertain opportunity to use earnings management (w/p: x) (see the earlier "utility wedge" discussion). By extending Sun's model to include some definite benefit to increasing corporate governance (which is also the cost of earnings management to the agent) beyond just reducing earnings management, the pay for performance discussion is limited to those cases (1 and 2) where earnings management is cost effective to the agent; yet as the incidence of the earnings management opportunity rises (x), Case 1 is more likely than Case 2, naturally limiting earnings management by confining it to an indeterminate profit case. Additionally, pay for performance actually reduces the likelihood of earnings management in Case 1 since it proportionately lowers profits by introducing an additional cost (a percent of profits paid to the agent) as profits rise. This means that the profit at ψ_{max} is lower, increasing the likelihood (or decreasing the difficulty) of having the profit at $\bar{\psi}$ be higher than at ψ_{max} which would make earnings management cost ineffective to the agent (see Figure 1).

Thus, the effect of performance based pay on increasing profitability and earnings management is limited to those cases when earnings management is an option. This option is not only limited by the probability of the earnings management opportunity (x), but also by the choice of corporate governance on the part of the principal. This choice has been shown here to be part of a profit maximizing strategy. There are scenarios within this model that allow for earnings management as part of an equilibrium profit maximizing strategy such as large complex firms, start-ups, or growth firms, high margin firms, and monopolies, all of which have more limited information and opaque financial reports suggesting that principals must rely on agents to do the right thing. However, increases in earnings management opportunities limit this option to an indeterminate case (Case 1), where higher performance pay actually makes the earnings management strategy less profitable, thereby incentivizing the principal to increase corporate governance enough to limit it.

5. Conclusion

After consideration of the various profit scenarios a firm faces involving the choice of the level of corporate governance and management compensation contract costs, there are a limited set of firm types where earnings management might be beneficial to the firm as a whole. When information opacity is significant (e.g. start-ups, complex or diverse firms, firms cobbled together through repeated M&A) earnings management might be profit maximizing for the firm despite the intuition that it misallocates resources to less productive firms. Even in these cases, earnings management might be constrained by opportunities to use it since the likelihood of use increases the benefit to good corporate governance as management compensation costs to the firm rises (agents paid for high or low effort leading to shirking) without the offsetting expected benefit of high effort from the manager. Further, performance based compensation for management, which is sometimes seen as exacerbating the earnings management problem by providing increased

incentives to misreport earnings, could also help alleviate it by introducing additional compensation costs that lower firm profits proportionately across all levels of corporate governance making the choice of higher corporate governance at a higher cost relatively less detrimental to profits overall while aligning the incentives of the agents and principals. Additionally, increases in regulation (or exogenous choice of the level of corporate governance) has the unintended consequence of lowering profits due to the mismatch between "one size fits all" rules and the optimal level (and type) of corporate governance for a particular firm or industry. This mismatch would lower the profit maximum across all levels of corporate governance (ψ_{max}) but would not change the earnings management outcomes in situations where its use is cost ineffective for the agent (model Cases 3 and 4). It would only reduce earnings management in other situations (model Cases 1 and 2) by increasing the level of corporate governance to the point where it would be cost ineffective for a manager to engage in earnings management ($\bar{\psi} \equiv \frac{c}{(p_h - p_l)}$); however, it would also increase this breakpoint since managers have to bear this extra cost (c) but it only has an indirect (if any) effect on the probability of high returns with high effort (p_h). Thus, this attempt at broad regulation works against itself in preventing earnings management by raising the level of corporate governance where earnings management is still feasible to the manager. This can be thought of as mismatched blanket regulatory requirements that intend to increase transparency of reported firm information (at a cost to the firm and the manager), but often decrease it due to standardize reporting of firm specific information that is more difficult to interpret as part of the economic picture of the specific firm while also contributing to information overload.

The research presented herein adds to the discussion of earnings management, its use, and its effect on firms by taking into account firm characteristics, the level of corporate governance, and the ultimate effect on firm profits. The next steps in this line of research would be a more well

specified empirical investigation of earnings management over the firm characteristics developed in this model as well as using the implications of this model to test existing or new empirical specifications employed to detect earnings management at the firm or industry level. Ultimately, a model specification that could estimate the effect of earnings management on the allocation of resources and consumer welfare is needed to put the cases where the use of earnings management is profit maximizing in the proper economic context.

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Variations in Unfunded Public Pension Obligations Across States

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ABSTRACT

There is a lack of evidence on a state's ability to pay as a driver of unfunded pension liabilities (Gross state product or tax revenues. Further, there is evidence that service levels (state employees per capita) and promises made to state retirees (total liability per member) are potential drivers of unfunded public pension liabilities. Given these results, we might conclude that state governments are their own worst enemy in the generation of these unfunded pension liabilities. This is especially true in light of the evidence suggesting that these deals were crafted for political expedience such as delaying the inevitable facing of fiscal imbalance (debt and deficits correlated with unfunded pension liabilities). Further complicating this issue is the possible flight of the tax base of a given state as the residents (taxpayers) discover the truth about the looming fiscal issues and conclude that they would be better served by a more prudent state government. This trend is exacerbated by those state pensioners who are currently collecting migrating to a more fully funded (pensions) state with lower expected tax rates.

1. Introduction

In 2013, US states reported a total unfunded pension costs for state employees of \$968 billion or 6.9% of aggregate state income (Pew 2017). Pension liabilities arise from state promises to its current and former employees (state workers) to fund their retirement, often including healthcare coverage or other postemployment benefits (OPEB). Unfunded pension liabilities represent the estimated portion of this future cost (liability) that is not set aside (invested) today based on estimated future payouts and investment returns over the relevant time-period. To be clear, the \$968B in unfunded pension obligations cited here excludes OPEB. If included, it is estimated to add an additional 28% to this amount at the state level (Munell, Aubry & Crawford 2016). To estimate unfunded pension liabilities, actuaries consider several uncertain aspects of a given pension plan's members; such as their current ages and expected lifespans as well as those of their spouses, because pension payments often continue until death of both household members. These pension characteristics can vary by plan (across and within states) and are accounted for by actuaries that deal with statistical predictions from demographic trends.

The generosity of survivor benefits (percent of payment that continues after the death of the primary beneficiary) is where the promises of politicians first start to affect actuarial distributions of these defined benefit programs. A common theme among the politicians that seek election (and re-election) from their constituents is to make the present seem better or improved at a low cost. This can be achieved by a slight of hand regarding the future since people tend to discount future costs more heavily than future benefits, especially when the cost is borne by society while the benefit accrues to individuals. Further, by shifting costs to future periods, balancing the state budget (required in several states) is made easier.

Survivor benefits are just the tip of the iceberg in state pensions since current negotiations with state employee unions include retirement age, years of service calculations, average wage calculations (e.g. weighting more recent pay higher), cost of living adjustments, and various other “credits” that improve the future payout of pensions, often in return for lower wages today. These future benefit promises are easier to ignore since their cost can be shifted to future periods and further obfuscated by over-estimation of pension plan return on investment. Of course, states must invest in order to expect any return, and this is where unfunded pension liabilities create the trade-off between future benefits and current costs. State governments often make optimistic assumptions about investment returns and actuarial estimations compensate with conservative assumptions in their predictions about the future costs of administering state pension plans. Actuarial reports regarding the “health” of a given pension plan are commissioned by the states on a regular basis, although not required or consistently formed (estimated). A “healthy” plan is often regarded as one that is at least 90% funded. However, the true health of a pension plan can be difficult to judge accurately because of a combination of a lack of consistent standards of measurement and a lack of actuarial independence.

The funding status of a state’s pension fund is considered fully funded when, based on actuarially estimated returns and payouts, the fund has enough current investments to pay the future anticipated costs (note that current contributions to the fund should be invested and not used to pay current retirees). Ideally, any pension fund would set aside the anticipated costs when the employee performs the work and thus earns the right to the future cash flow (retirement benefit) but, as with all budgets, current costs appear more significant than distant future payments. Add to this time-horizon issue the overly optimistic estimates of low payouts along with equal or greater optimism for high investment returns and the results are low current costs (pension investments set aside) with rising future obligations that are unfunded, even in the actuarial sense. While this appears to a significant issue for the states, a state by state comparison reveals that the health

of state pension plans varies dramatically from fully funded (actuarially) to substantial looming costs to keep up with future (and current) expectations of pension members (Barkley 2012). So what causes is disparity across the states?

Funding Disparity

As with any budget, an imbalance can be analyzed from the flow of resources available to finance spending, from the flow of resources spent (promised), or both. Since the financial crisis of 2008, states have recovered at different rates impacting their ability to collect tax revenue (Pew 2017). Tax revenue and the source of that revenue (state income or gross state product) are simple enough to measure with Census data. On the spending side, promises made to fund pension plans can arise from the level of state services provided or from the promises made to the state employees (or both). These spending side levels can be approximated with the number of state employees per capita (as a level of state services) and total pension liability per member of the pension plan or per capita. Since both low inflows and high outflows could be happening simultaneously, it is natural to begin with the association between state resources and total pension liability.

If total pension liability is positively correlated with state resources (ability to pay) then perhaps the “rich” states are over-promising to their employees because they feel rich. If total pension liability is negatively correlated with a state’s ability to pay then perhaps the state is making pension promises in lieu of an ability to compensate state employees in the current period and that might lead to greater underfunding of the pension obligation (liability). If there is no correlation, then the question of underfunding remains open to ability to pay and or promises made. These posited relationships are summarized in Chart 1.

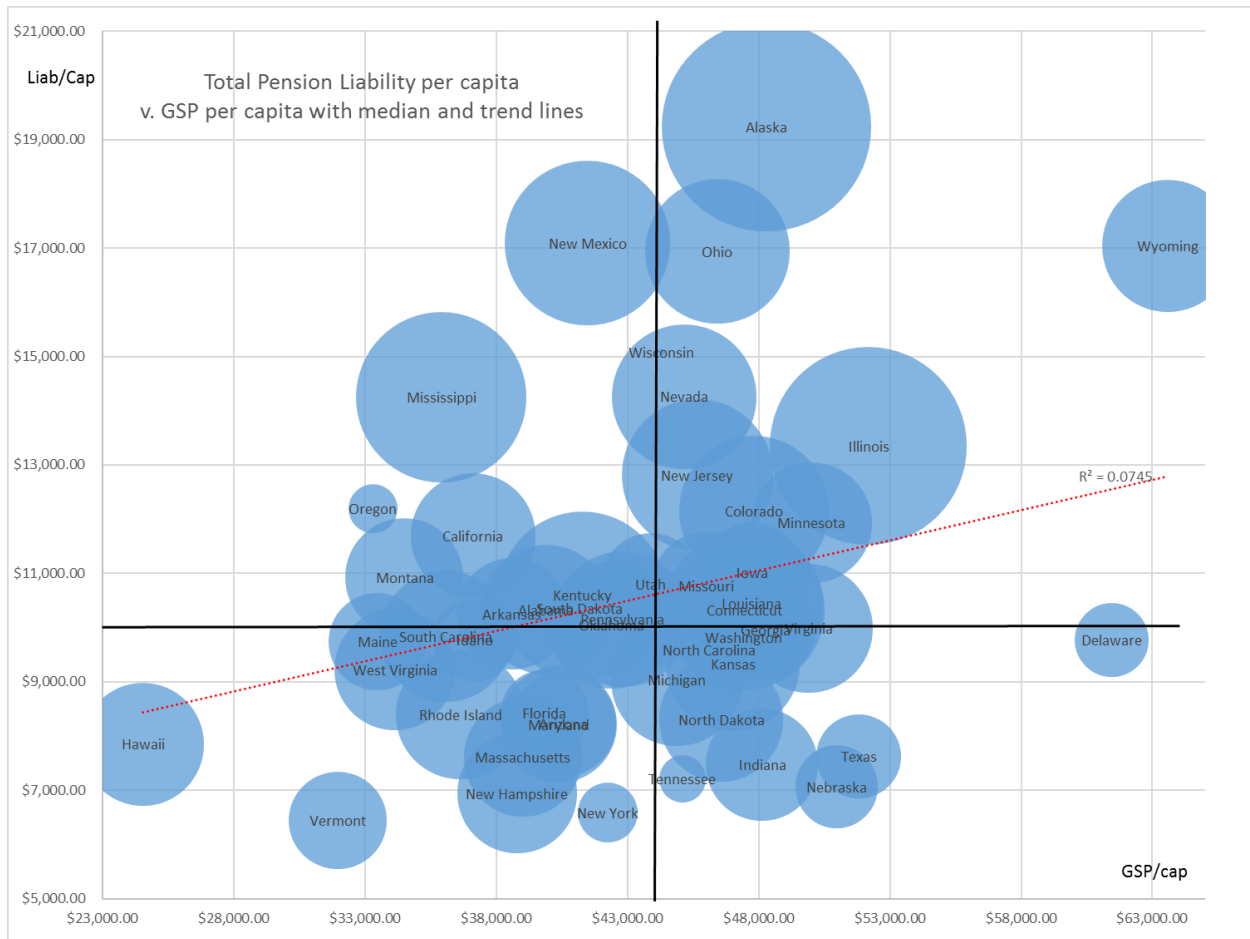
CHART 1

Positive Correlation: Ability to Pay (GSP) & Total Pension Liability	Rich states remunerating state employees from state largesse
Negative Correlation: Ability to Pay (GSP) & Total Pension Liability	Poor states using pension promises to forestall current budget issues
No Correlation: Ability to Pay (GSP) & Total Pension Liability	Open question as to ability to pay effect on pension funding status

Using 2013 data adjusted for cost of living differences among the states, there appears to be no correlation (or ever so slight positive correlation) between a state's ability to pay and its total pension liabilities (as shown in Figures 1-4, discussed next)

Figures 1 and 2 show a scatter plot of a state's total pension liability per capita versus gross state product (income) per capita by state with the size of the bubbles representing the size of the UNFUNDED portion of the total pension liabilities.

FIGURE 1



The first graph shows all states with a median GSP of about \$44,000 and total pension liability per capita of about \$10,000 (bold vertical and horizontal lines) dividing states into high and low ability to pay (above or below median GSP) and high and low promises of state services (above or below median pension liability per capita). Adding a trend line to this graph results in a R^2 of about 7.45% or very little correlation between a state's ability to pay and its pension liability per capita.

FIGURE 2



Figure 2 removes the outliers of Alaska, Hawaii, Vermont, Delaware, and Wyoming reduces the R^2 to less than 0.1% and allows a clearer picture of the remaining states Figure 2 appears to show no correlation between pension liabilities and a state's ability to pay for them in a per capita sense. There does appear to be larger UNFUNDED liabilities (size of the bubbles) as the total liability per capita grows, but this should come as no surprise since there are fewer taxpayers to foot the bill.

Figures 3 and 4 show the relationship between total liabilities per *pension plan member* and gross state product with similar results (i.e. little correlation). Here the interpretation on ability to pay is the same, but now considering the total pension liability per member of the plan is used as a proxy for the level of promises made to the plan members for future benefits. Separating across the median value leads to high and low promise states. The full panel of states in Figure 3 has an R^2 of 1.4%, with a median total pension liability per member of over \$127,000.

FIGURE 3

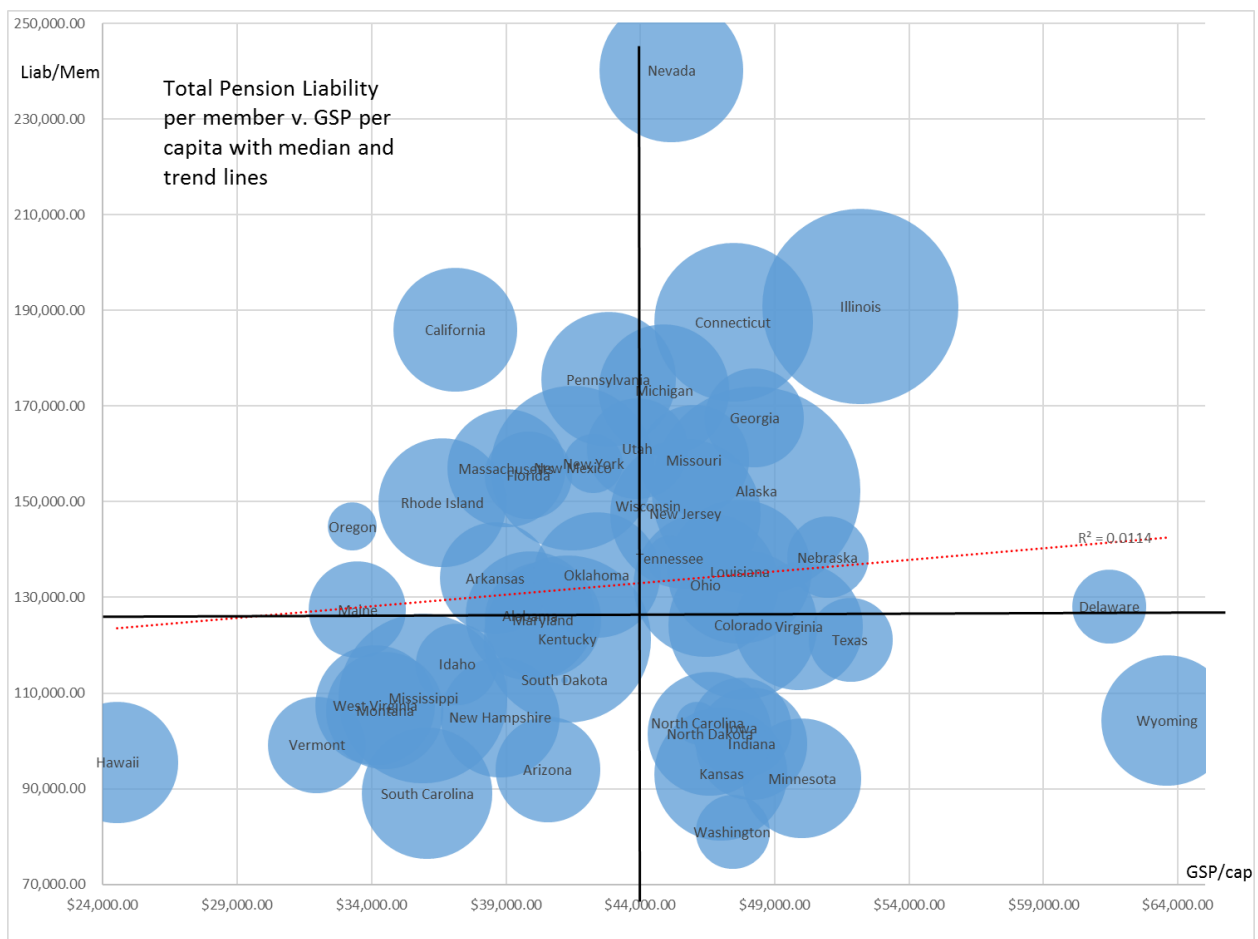
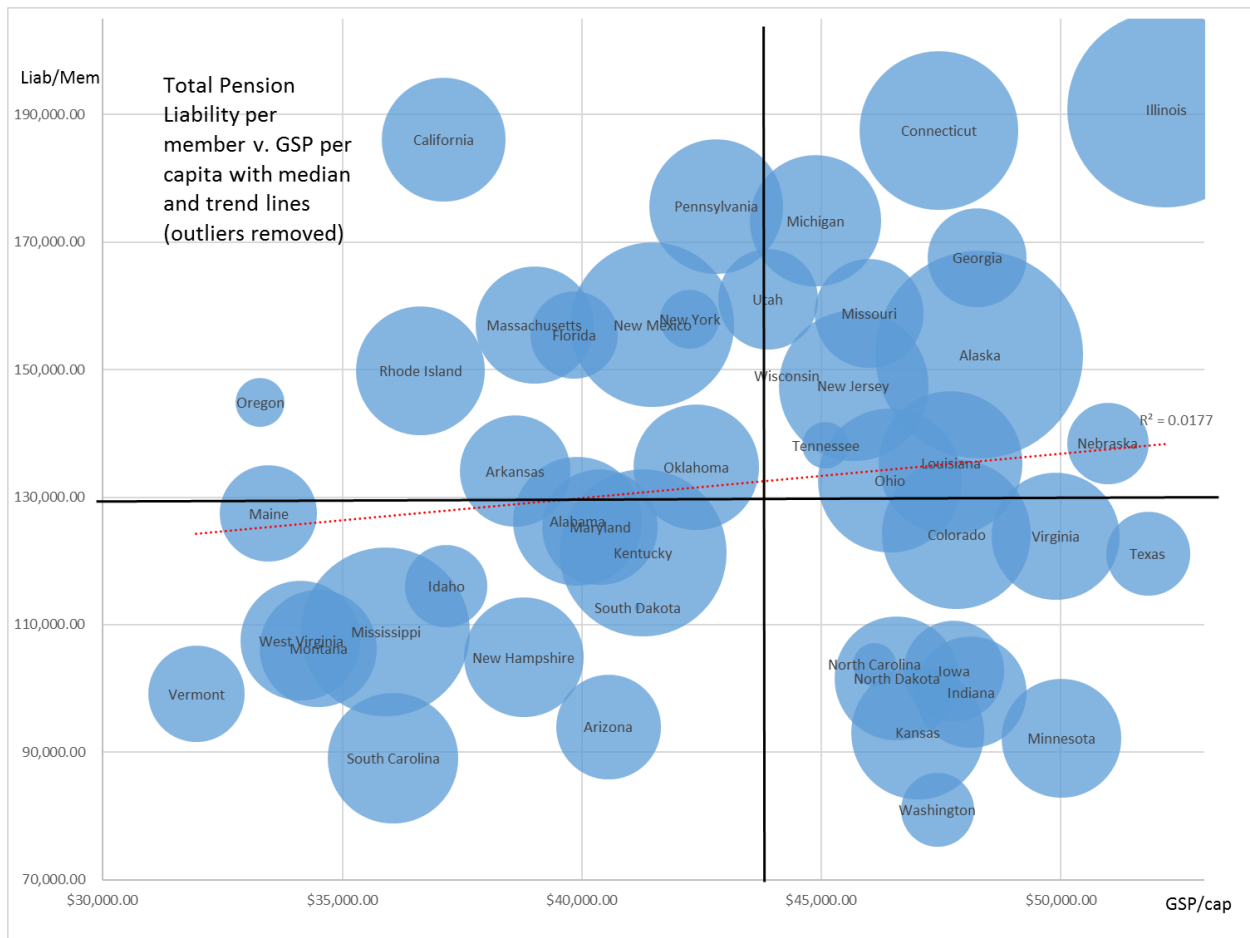


Figure 4, removing the outliers of Nevada, Delaware, Hawaii, and Alaska raises the median promise level to \$130,000 and slightly increases the R^2 to 1.7% confirming what can be seen in both graphs: no correlation between a state's ability to pay and its promises per member of the state work force. Interestingly, some of the largest unfunded pension liabilities (biggest bubbles) are in the high ability to pay, high promises made to state workers quadrant.

FIGURE 4



These preliminary results leave open the question of how state resources (ability to pay) affect the funding status of the state pensions. It could be that states with lower ability to pay cannot afford to meet similar obligations for pension plans as other states with more resources leading to hypothesis 1:

Hypothesis 1: States with a lower ability to pay will face higher unfunded pension liabilities.

It is also possible that state governments make promises of higher levels of state service for the broader electorate to curry favor at re-election time or to ameliorate some real or perceived social inequity.

Hypothesis 2: States with a higher percentage of state employees will face higher unfunded pension liabilities.

It might be the case that state governments make more significant pension promises to state employees as a form of deferred compensation or to appease a particularly vocal constituency (state employees).

Hypothesis 3: States with higher level of total pension liabilities will face higher unfunded pension liabilities.

This last hypothesis has an obvious mechanical nature to it since higher levels of pensions promises are likely to lead higher unfunded pension liabilities, but controlling for ability to pay and taking a longer-term perspective allows for some additional insight.

As a corollary to Hypothesis 3, states might provide additional pension (deferred) compensation in exchange for lower current period costs if the state is in a fiscal bind, especially if the state budget is required to be balanced by state law.

Hypothesis 4: States with more significant budget issues (deficits and debt) will face higher unfunded pension liabilities.

As preliminary results, the level of state resources (income or tax revenue) reveals no correlation between the source of funding and *unfunded* pension liabilities despite the wide variance in unfunded liabilities across states. The results from level of state services (state employees per capita) shows weak correlation with unfunded pension liabilities; whereas data on promises made to state employees (total pension liability per plan member) reveals stronger correlations despite the confounding issues of time members are in the state pension plan and the total level of membership. Results on the level of debt per capita and deficits both indicate a strong correlation with unfunded pension liabilities, which should come as no surprise since robbing the future is a common way to pay for the present.

After a brief overview of the literature in this area, this paper will discuss the methodology used to address the potential causes of variation in funding status across the states, offer a summary of the results, and provide some concluding remarks regarding the causes and possible avenues to address these issues. The hope is that states that are in funding trouble might be able to learn from the states that are funded, unless there are significant differences that preclude the application of these results.

2. Literature Review

The Pew reports (2017, 2014) are good at quantifying and comparing the state pension funding issues, but are only a part of the problem. Lutz & Sheiner (2014) estimate that unfunded OPEB might be as much as an additional half the size of unfunded pensions (despite being about a quarter of the overall cost) and demonstrate a similar variation across the states. OPEB unfunded obligations are often easier to “hide” since there are more estimations and therefore more opacity to the situation as a whole. Just on the pension side, even the actuarial estimates forecast an increase in ARC (annual required contribution) to keep the pension system current (Brainard & Brown 2015). These actuaries are paid by the state running the fund and thus, even their favorable estimations are based on statistical analysis of past trends that do not fully incorporate current financial market expectations as used by the financial professionals that manage the pension funds’ investments. In fact, Rauh & Novy-Marx (2010) estimate that even with zero cost of living adjustment and a move to the Social Security retirement age (many pensions allow for early retirement after 20 or 30 years of service) using Treasury Bill discount rates would put the pension deficit at \$1.5 Trillion rather than the actuarially estimated \$968 Billion. Liu, Lu & Zheng (2010) perform a similar ranking of pension status with qualitatively similar results to Pew and while actuarial discounting might understate the problem, it does not appear to change the relative ranking of pension funds.

While we can all agree that a problem exists and that it clearly varies by state, there is more of a paucity of research on the choices as well as the causes. Gale & Krupkin (2016) argue that options are limited since these pension (and collective bargaining) agreements are binding as well as being a political hot button. Abrogation of the contracts through bankruptcy is the threat point to engender renegotiation of the contracts but the lack of political will to upset the system that the politicians rely on to deliver services to their constituents as well as the state employee

constituency itself does not favor reform. Yet reform such as concessions, increases in taxes, or cuts in state service levels is necessary to meet the obligations in a way that is fair to all. Even as far back as Porterba (1996) we see evidence of short term budgeting at the state fiscal level that favors current constituents by passing the costs on to future generations. Porterba noted that many states have a balanced budget amendment in their state constitutions and a popular way to get around that restriction is through pension promises for tomorrow to get lower wage increases today. Compounding this issues are the lower bias actuarial estimates of the unfunded pension obligation by using upwardly biased estimations of long run returns to the pension assets. Johnson (1997) finds that states are using these mis-estimations to fund current period lower taxes and allow for generous pension promises that are unfunded today. Cheney et al (2003) provide further empirical evidence of states underfunding and or mis-estimating due to budget constraints in taxes or spending. Those mis-estimations in actuarial assumptions are associated with states that have most fiscal difficulty according to Eaton and Nofsinger (2004) and this extends into private pensions (as would be expected) according to Comprix and Muller (2006).

Missing from this stream of literature is additional research on the fundamental causes of the pension problem. Is it just political expedience that creates this issue, or are more basic economics such as the ability to pay or the level of services at the root of these funding problems. Exposing these issues more clearly provides insight so that we can learn from past mistakes and not fall prey to the same issues as we try to repair the current system. Isolating the economic cause allows those that will face this issue (future generations of citizens) to make wiser choices in the politicians they elect and the places they choose to live.

3. Methodology

With so many states facing unfunded pension obligations, it raises the question: whence do these issues arise? We can think of it in two ways: either the state wishes to provide services for its residence on par with other states but cannot afford it (ability to pay) or states that have the ability to pay are making promises of higher pensions to their state employees. The latter could be either a case of pension promises that are consistent with a higher level of state services to residents (e.g. more state employees per capita). A more nefarious motivation such as to defer current pay (or pay increases) in order to balance a fiscal budget today or even a political side payment for election support, is a possible future area of research. In order to attempt separating and testing these possibilities we can think of states as either high or low ability to pay states (HA, LA) as well as either high or low promise of future pay states (HP, LP). Since these conditions are not mutually exclusive we have a two by two categorization of states, represented in Chart 2 below.

CHART 2

Low Ability (LA), High Promise (HP)	High Ability (HA), High Promise (HP)
Low Ability (LA), Low Promise (LP)	High Ability (HA), Low Promise (LP)

To discern a state's ability to pay both Gross State Product (GSP) and Tax Revenues (TR) are considered (Census Bureau data). Gross State Product is, of course, a measure of the total income of a state and should be highly correlated with ability to pay for state worker pensions. The confounding factors include states with porous borders (small states or states with significant

portions of the population at a border) especially those with high tax rates relative to the bordering states. To account for this, Tax revenues collected by the states is tested with qualitatively similar results in all cases. Tax revenues are clearly dependent on the tax rate(s) in each state, but tax arbitrage (competition) among the states (especially those with porous borders) limits the amount of variance to some degree; so, the similar results should not be surprising.

The ability to pay results indicate that the level of unfunded pension obligations (Pew Report) in a state is, at best, unrelated to both measures of ability to pay (when adjusting for the cost of living between states). Further, unfunded pension liabilities are actually positively correlated with ability pay when using unadjusted (CoL) levels (GSP: 0.1 $p=0.011$, TR: 0.6, $p=0.031$) which is counter to the expectation (Pew Report). Thus, it can be concluded that relatively poor states with less ability to pay for state services provided by state employees are not a significant driver of unfunded pension liabilities.

So then, what is driving some states further into an unfunded status while others are able to fully (actuarially speaking) fund future pensions obligations. One possible explanation is that states make “promises” to state employees for either a higher level of state services (i.e. lower pay today, but more generous pensions) or for political expedience such as delaying compensation in order to balance the current fiscal period’s budget. Regardless of the reason, let us consider how to measure these promises made and then attempt to disentangle the potential causes.

In this study, the level of promises made to state employees is proxied by the total pension liability per capita (LpC) and total pension liability per member of the pension plan (LpM), which includes past and present employees. Total pension liability means that this is the total pension cost for future payments based on past employment (as actuarially determined), not just the unfunded portion of that liability. Higher pension liability per capita suggest that state employees are paid

and or promised more future pay, which could result from higher state services being provided or a higher cost of living. To compensate for the cost of living differences the Census Bureau regional price deflators by state are used to adjust the data. Higher total liability per capita is also consistent with higher deferred compensation in exchange for pay concessions today (reduce current fiscal pressures) which is more likely to correlate with higher unfunded portions of this liability. The data show that total liabilities per capita (LpC) has significant ($p=0.000$) correlation with unfunded pension liabilities (point estimates from 0.41 to 0.35) when using both cost of living adjusted data and unadjusted data and whether or not including GSP as a control for ability to pay. This suggests that the level of promises made to state employees is a driver of unfunded pension liabilities regardless of the relative cost of living or state's ability to pay (overall or per capita).

It could also be the case that there are more state pension members (consistent with a higher service level) so total pension liability per plan member is also considered. Pension liability per plan member rises as the level of promises to each member increases, which is a more direct measurement of the promises, but with less connection to state services levels provided to the state's citizens. However, this measure also suffers from diffusion over a longer time frame: it includes as members those just hired all the way out to those who might have been retired for 20 or more years. The level of promises is likely to have varied greatly over that time frame and more recent hires are in the divisor (denominator) despite not contributing much to the dividend (numerator). Despite this bias, the LpM still produces weakly significant point estimates (within the 10% range: $p=0.003$ for uncontrolled, unadjusted data to $p=0.076$ for GSP controlled and cost of living adjusted data with point estimates from 0.01 to 0.02) indicating correlation to unfunded pension liabilities. This suggests that these unfunded liabilities are, at least, partially caused by promise made to state employees.

To further explore the relation between these promises made to state employees and their causes, the level of services provided is estimated by the number of current state employees per capita and the total state retirement plan membership per current capita. The number of current (EE/capita) or current and former (Member/capita) state employees per capita is suggestive of the level of services provided but could be confounded with low productivity of employees (to the extent that varies by state) or by excessive hiring as a concession to state unions for lower current fiscal period pay increases to existing members. Of course, we would expect higher levels of members per capita to be associated with higher total pension cost and higher unfunded pension liabilities as these higher costs are spread among few residents, and the results are significant ($p=0.000$, point=77,713). However, to the extent that prior state employment levels are correlated with current state employees (consistent with the level of service argument for higher pension costs), we would expect higher current employment levels to also be associated with higher pension costs and greater unfunded pension liabilities. This is a reasonable assumption barring any significance difference in longevity or retirement age (an open question relating back to promises made for political expedience). The results indicate a break between current and former plan members since the liability per capita is not correlated with current state employees per capita ($p=0.27$). This break suggests that the level of service argument is not supported as a reason for a state to have excessive unfunded pension liabilities.

To compare with prior research on political and fiscal motivations for unfunded pension liabilities (Chaney et. al, 2003; Eaton & Nofsinger 2004) the fiscal stress of a state is considered as a driver of unfunded pension liabilities. When the level of unfunded pension liability per capita is compared with the level of state debt or current year deficits per capita (and controlling for income as well as using cost-adjusted data) higher debt or deficits are significant drivers of unfunded liabilities ($p=0.026$ and $p=0.049$, respectively).

4. Results

Estimating the link between ability to pay and unfunded liabilities suggests a simple correlation model:

$$(1) \text{ Unfunded level} = \alpha + \beta(\text{ability to pay}) + \epsilon$$

With the unfunded level and ability to pay measures normalized by population (per capita); additionally, cost of living adjustments by state are made using Census deflators.

RESULTS 1

<i>Dep. Var. = unfunded pension liabilities per capita</i>	Intercept	β	CoL adjusted β
GSP per capita (p value)	-1162.57 (0.50) 1924.43 (0.257)	0.098 (0.012)	0.026 (0.494)
Tax Revenue per capita (p value)	1720.84 (0.032) 2379.08 (0.002)	0.0005 (0.041)	0.0003 (0.306)

Thus, no association between ability to pay (state resources) and *unfunded* pension liabilities appears, similar to the earlier results regarding total pension liabilities and a state's ability to pay measures; Hypothesis 1 fails. That re-opens the question as to what does cause some state's to run into pension funding trouble while others seem to be able to fully fund their state pensions.

Estimating the link between the level of state services to the public and unfunded liabilities is accomplished with state employees per capita and state pensions members per capita (past level of services) while controlling for ability to pay:

$$(2) \text{ Unfunded level} = \alpha + \beta(\text{level of service to public}) + \gamma (\text{ability to pay control}) + \varepsilon$$

RESULTS 2

<i>Dep. Var. = unfunded pension liabilities per capita</i>	Intercept	β	γ
State Emp per capita (p value)	-2,480 (0.1498)	119,939 (0.0128)	0.08 (0.0280)
Plan members per capita (p value)	-2,888 (0.1319)	22,500 (0.0578)	0.09 (0.0133)
State Emp per capita - CoL adjusted (p value)	115 (0.95417)	82,368 (0.0641)	0.04 (0.3480)
Plan members per capita-CoL adjusted (p value)	425 (0.8024)	27,170 (0.0127)	0.01 (0.8319)

It appears that there is at least a weak association between the level of state services provided and the unfunded pension liabilities. So, appeasing state voters by providing a higher level of services and then delaying the payment for these services is at least mildly suggested. The level of state services as measured by total pension plan members (retired and active) per capita is more strongly associated (at the 5% level) with unfunded pension liabilities, suggesting that at

least part of the unfunded liability is a result of the state governments provision of services. This provides some support for Hypothesis 2 but using total plan members per capita as a measure of state services suffers from the possibility of changes in the denominator (population) driving the results. For example, as states make increasing high promises to state workers in the future (pension promises) it drives up the expected cost and hence likely future burden on taxpayers. To the extent that these taxpayers are mobile, they might move to states with a lower expected future burden on taxpayers (e.g. migration from the northeast to the southeast that has been witnessed over recent decades).

So then, if a state's ability to pay is unrelated to unfunded pension liabilities and the level of services provided is only weakly associated with them, it might be that states are promising their employees too much in the future, possibly to defer that cost. Using the total level of pension liabilities (funded and unfunded) as a measure of these promises (both per capita and per plan member) provides some insight into the relationship between pension promises and unfunded pension liabilities:

$$(3) \text{ Unfunded level} = \alpha + \beta(\text{pension promises}) + \gamma (\text{ability to pay control}) + \varepsilon$$

RESULTS 3

<i>Dep. Var. = unfunded pension liabilities per capita</i>	Intercept	β	Γ
Total liability per capita (p value)	-1,986 (0.1644)	0.3867 (0.0000)	0.021 (0.5267)
Total liability per plan member (p value)	-1,290 (0.4395)	0.015 (0.0453)	0.054 (0.2020)
Total liability per capita - CoL adjusted (p value)	132 (0.9306)	0.3611 (0.0000)	-0.014 (0.6814)
Total liability per plan member -CoL adjusted (p value)	260 (0.8902)	<i>0.015 (0.0764)</i>	0.019 (0.6141)

The results of the pension promises show strong correlation on a per capita basis, but the natural bias there is towards correlation since higher total liability per capita is more likely to drive higher unfunded liability per capita, even when controlling for a state's ability to pay. The weaker statistical significance (at the 10% level) with total pension liability per plan member also biased, but away from results since the higher promises are likely to be the more current agreements whereas the older agreements (with current retirees) are the ones that would drive higher unfunded pension liabilities given the longer time horizon of accumulation and the shorter time horizon for investment returns. When taken together, these results suggest that the level of promises made to state workers is weakly associated with higher unfunded pension liabilities under Hypothesis 3.

The question of why state governments would make these pension promises to state employees is still unanswered. One possibility is the deferral of compensation for state employees to make

the state budget easier to balance (especially if it is required to balance by law). Some light may be shed on this by considering the association between state debt (or deficit) levels and unfunded pension liabilities.

Estimating the connection between budget shortfalls and unfunded pension liabilities can be done with state debt per capita and state deficits controlling for a state's ability to pay since debt might be substituted for a state's ability to pay:

$$(4) \text{ Unfunded level} = \alpha + \beta(\text{debt or deficit}) + \gamma (\text{ability to pay control}) + \varepsilon$$

RESULTS 4

<i>Dep. Var. = unfunded pension liabilities per capita</i>	Intercept	β	Γ
State debt per capita (p value)	162 (0.9252)	0.365 (0.0184)	0.037 (0.391)
State deficit (p value)	-2,887,624 (0.1318)	22,500 (0.0578)	94.07 (0.0133)
State debt per capita CoL adjusted (p value)	488 (0.7782)	0.370 (0.0260)	0.0298 (0.4199)
State deficit CoL adjusted (p value)	1,434,401 (0.3871)	18,970 (0.0492)	1.13 (0.9769)

From these results there appears to be strong support for the association between state debt (or deficit) and unfunded pension liabilities as hypothesized (Hypothesis 4). It should be noted that while debt per capita produces significant results, deficit per capita was not even close ($p=0.756$), yet deficit level versus unfunded pension liability per capita was significant (see tabulated results). This could be the result of high deficit states looking to balance the budget with an extraordinary move like slowing funding payments to pensions whereas low deficit states turn to other measures. That result is obfuscated by dispersing the current deficit over more citizens. Also, the recency of deficits versus debt could be a factor as well: a deficit this year might not change the contribution made to the pension plan very much whereas a series of deficits resulting in higher debt levels (per capita) likely has a higher cumulative effect on unfunded pension liabilities and states with a higher current deficit (in total) are more likely to have higher debt levels (long term deficits). In other words, there are high and low spending states but some of the high spending states have a higher population and so get shifted into the middle on a per capita basis and these high spending states are the one having trouble funding their pensions.

Given the results (summarized in Chart 3) from the tests of association between unfunded pension liabilities by state and the possible causes, it seems that funding is within the control of the state governments.

CHART 3 RESULTS SUMMARIZED

Unfunded pension liabilities are associated with:	Measure:	Significance:	Result:
H1: a state's ability to pay	Income (GSP) pC Tax revenue pC	None None	Fail
H2: a state's level of service provided	State employees per capita (pC) Plan members pC	10% level 5% level	Weak pass
H3: a state's promises to its pension plan	Total pension liability per capita Total liability per member	1% level 10% level	Weak pass
H4: a state's budget balance	State debt per capita State deficit	5% level 5% level	Strong pass

So what does the future hold for these various pension plans with such wide differences in funding status across states?

Obviously, states that are fully funded must keep up with the future retirees but states that are behind in funding today must catch up or face the possible migration of their tax base away from the future. These states might catch a break if the number of state employees retired slows or reverses (this would also make funded states have an even brighter future); however, if the upcoming number of retirees is rising then states that are behind in funding will face even more difficulty in funding, exacerbating the demographic migration threat. You can only raise state taxes so much before your tax base moves to another state (tax arbitrage) given the relative ease of moving. In fact, once this trend starts, it builds on itself as the best and brightest seek opportunities and congregate in new areas, bringing tax dollars, productivity, and output with them. This leaves

the unfunded and worsening states in a terrible predicament that might necessitate the re-negotiation of state pension agreements or concessions from state workers unions. Even those fully funded states might be subject to these same market (the market for state services are a reasonable cost) forces as their future pension liabilities rise. At least those states have choices in their future, but the states with the issue today must solve the Laffer curve trade-off between tax rates and growth quickly or risk losing their tax-paying base.

To visualize this issue, consider states along two dimensions: the funding status of the current pension liabilities and the present level of state retirees per capita. This suggests a two by two matrix of possibilities (Chart 4) in to which we can map the various states by their current status.

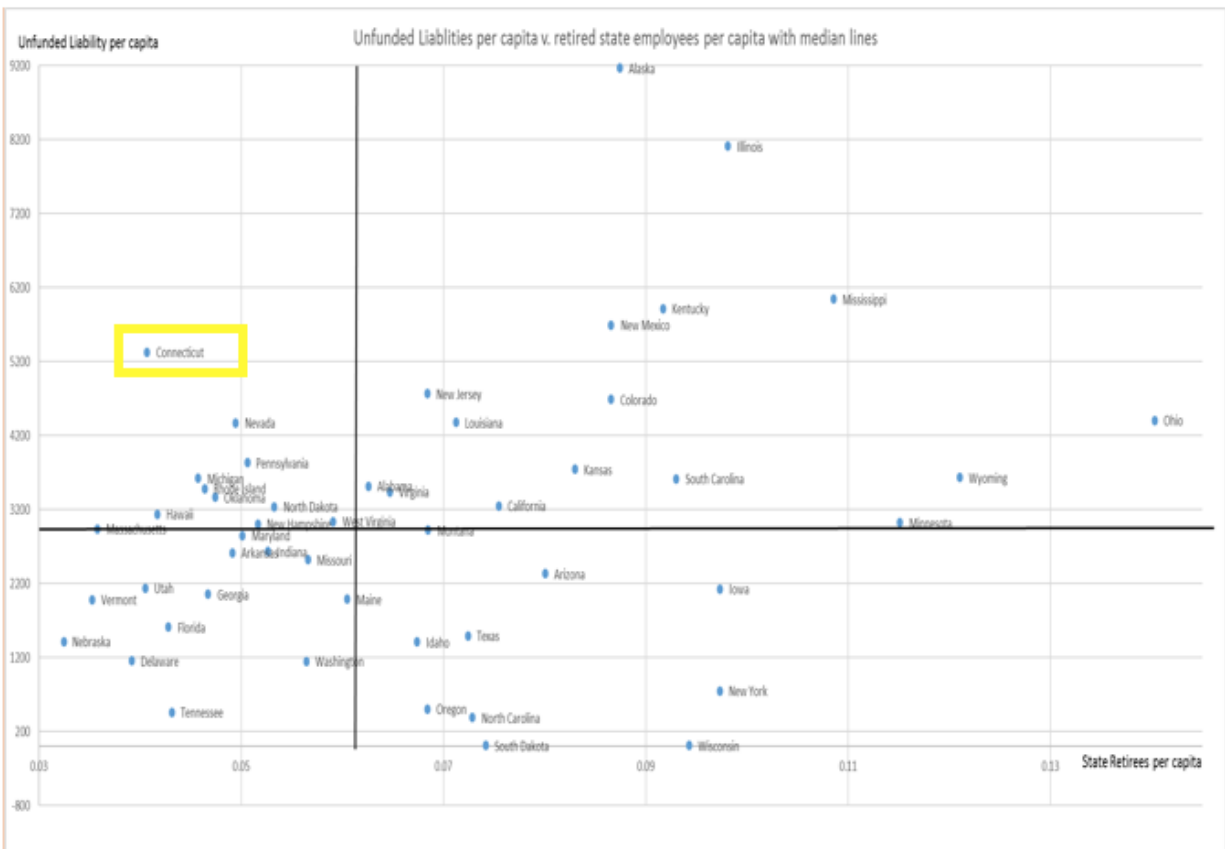
CHART 4

Low Funding, Low Retirees	Low Funding, High Retirees
High Funding, Low Retirees	High Funding, High Retirees

Subtracting the current state employees per capita from the total state pension membership per capita, an estimate of the number of retired state workers per capita is found. Observing (see graph) a clustering of states by unfunded liabilities and the estimate of state pensioners per capita we can see four groupings (quadrants), with low unfunded status and many retirees (lower right, e.g. Wisconsin) as being the least risky group since they are paid up for those that are retired now (little uncertainty about the bill). Next, funded states that have few current retirees (lower left, e.g. Tennessee) are current and have the flexibility to stay out of trouble by not over-promising today.

The upper right quadrant (e.g. Mississippi) have a high number of current retirees and a low funding status, so they are in current trouble but working through it; if they can pay now and avoid making promises for the future they can head in the correct direction. The upper left quadrant (e.g. Connecticut) has a low funded status and few retirees, so their problems lie ahead, especially if they continue to make promises they cannot keep.

FIGURE 5



The funding status of state pensions is clearly a choice of the state government, but so is the number of current state employees that will become future retirees. Assuming a normal trend

across states with reversion to the mean, those states with a high level of current retirees are likely to see lower levels in the future, and those with lower levels are likely to see a rise, unless the state government of the given state is entrenched in its ways which might cause the trend to continue or worsen. Factors such as these are what lead to the tax arbitrage migration discussed in the preceding analysis.

So what drives states to make these promises? Political expedience in balancing the state's budget has been proffered as a reason. The test of this relationship suggests that states that are in fiscal trouble have higher unfunded liabilities. This is not surprising since if the state cannot balance its budget it is likely to have difficulty in setting aside money for long-term obligations. Yet, the compounding of the fiscal problems by under-funding the promises made to state employees is, in part, masking the fiscal problems of the state, especially if the worst days (most retirees) lie ahead.

5. Conclusion

When taken together, the lack of evidence on a state's ability to pay as a driver of unfunded pension liabilities, along with the evidence that service levels and promises made to state retirees are a potential driver, we might conclude that state governments are their own worst enemy in the generation of these unfunded pension liabilities. This is especially true in light of the evidence suggesting that these deals were crafted for political expedience such as delaying the inevitable facing of fiscal imbalance. Further complicating this issue is the possible flight of the tax base of a given state as the residents (taxpayers) discover the truth about the looming fiscal issues and conclude that they would be better served by a more prudent state government. This slight of fiscal hand is leaving those taxed by the state and its future pensioners potentially holding the bag; unfortunately, that bag might not be as full as promised or envisioned.

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Social Media as an Online Course Discussion Forum – Engagement and Results

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ABSTRACT

This paper makes a comparison between the use of social media and traditional Course Management System (CMS) discussion groups in fully online (Microeconomic Principles) courses. Students within the same sections of the classes were randomly assigned to a discussion forum in either Facebook or in the CMS (Blackboard) to discern a difference in the level of engagement (as measured by frequency and length of posts as well as rated post content) and learning outcomes (measured by overall course average). The popular hypothesis is that students using social media (Facebook discussion group here) have greater engagement with the class and higher learning outcomes relative to students not using that platform for coursework (the CMS control group here) because of the ease of use and student familiarity with social media which allows them to make more connections and gain a deeper understanding of the course material through discussions with others. The results of this study suggest membership in the treatment group (Facebook) is associated with both declining student engagement measures and lower learning outcomes.

1. Introduction

Online only classes are growing in popularity and enrollment (now up to 32% online as percent of total enrollment, Allen & Seaman 2013) due to their asynchronous and anywhere characteristics that allow both students and instructors maximum flexibility and because of their effect toward reducing the delivery cost of courses (Deming et. al 2015). Along with these advantages comes some disadvantages such as the lack of connection between the instructor and the students and among the students themselves, reducing learning outcomes (Alpert et al. 2016), and lowering retention rates (Allione and Stein 2016; Hart 2012). As an attempt to replace the classroom dynamic and increase learner engagement, online delivery tools (Course Management Systems or CMS) have incorporated discussion boards and messaging capabilities but their familiarity and accessibility pale in comparison to that of social media such as Facebook that have been used longer and more often by students, as well as being more accessible on mobile platforms. Consequentially, social media have an advantage of not forcing students into an additional unfamiliar electronic portal such as a CMS.

While CMS portals do have an advantage in assigning groups and managing student submissions, most of these advantages accrue to the instructor rather than the student who only sees an additional portal that must be managed and attended. Of course, social media is not a secure nor a complete platform for managing online course delivery so grades and other FERPA regulated content must remain in the CMS; thus, the online student would still be required to use multiple portals. Despite this additional requirement, the hope has been that students with easier and more consistent access to social media would be more engaged in discussion forums that are hosted on social media and that this would translate into better learning outcomes for them as a group.

Social media as a discussion forum presents no learning curve for students, most of who have a social media accounts as well as apps on their mobile devices; so, there is no uncertainty or delay in accessing the discussions. This will be the case for more and more instructors as well, but even for others not yet immersed in social media it is no more difficult to learn than a CMS interface. This tie to social media means that messages are read and often responded to more quickly as social media accounts are checked more frequently, often with push notifications or alerts. This is not what is associated with the standard CMS. See Bosch (2009) for a thorough discussion of the advantages of Facebook as an instructional tool.

As a tradeoff to ease of access, privacy concerns must be considered when interacting with students via social media. Built in privacy protections should be set with care and students should be informed of the recommended privacy settings, since they might not consider these settings. This study created a secret Facebook group, which added a protective layer by allowing access only to those invited into the group, while others on the social media platform could not see the group or its posts. Students were added to the group as “members”, not as “friends” so that student privacy settings restrict the instructor to the student profile to the more restrictive “public” instead of the less restrictive “friend” level. This approach addresses the “creepy tree house” downside of using social media in an instructional setting described by McBride (2008).

Studies of the use of Facebook in an educational setting report mixed results and often suffer from access to weak data sets with uncertain generalizability due to poor proxy measures or confounding effects. Kirschner & Karpinski (2010) and Junco (2012) report that increased time spent on Facebook is associated with reduced learning outcomes; of course, in both of these studies (surveys about time use) Facebook is supplanting time or focus that might be spent on studying. On the other hand, Pellizzari (2012) reports a positive association between Facebook usage as an instructional aid and learning outcomes. Further Junco, et al. (2012) found a

significantly greater increase in engagement and learning outcomes when using Twitter as a discussion forum.

To minimize selection bias and generate consistent controls, a randomized controlled trial (RCT) type experiment should be used. The randomizations reduce confounding bias in the allocation of covariates apart from the one specifically controlled and thus affords greater reliability and generalizability. The RCT methodology has yet to be applied widely in this setting (social media engagement and outcome effects) but Figlio et al. (2010) conducted a randomized experiment comparing live and internet based classroom learning outcomes for a microeconomics class finding that live lectures benefited student outcomes. At the primary and secondary education level there have been many RCT type experiments regarding engagement including those sponsored by the Department of Education⁶ and Rimm-Kaufman (2014). This study employs such a randomized controlled trial design to the use of Facebook as a discussion forum, with students randomly assigned to Facebook (treatment) or a traditional CMS (control) discussion groups. Discussion threads are weekly graded assignments for students in both groups (the same assignment, at the same time, with the same rules, just the location of the group is varied). The grade (6% of the course grade) was predicated on the student's contribution to the discussion (e.g. posing a course related question, responding to a posted question, posting and describing a link to relevant material, or commenting on the linked material). This study addresses the differential effect social media tools used in instruction have on student engagement (as measured by the length, frequency, and quality of student posts in both groups) and learning outcomes (measured by the course grade with appropriate controls). The results suggest a different approach by students using social media based discussions, with shorter more frequent

⁶ <http://www.ies.ed.gov/ncee/wwc/references/registries/RCTSearch/RCTDetail.aspx?studyId=355>

posts but lower engagement and lower learning outcomes; this is in contrast to most studies about the benefits of social media as an instructional tool.

2. Literature Review

As was just illustrated, the use of social media in education is receiving increased attention as “digital natives” or those that grew up with internet and now social media, enter institutions of higher learning. The ubiquity of social media (90% of college students enrolled with 97% of those on Facebook daily: Smith & Caruso, 2010) and its acceptance by instructors is driving new uses of social media in the classroom to attract, engage, and reach students where they live, in the cyber-world. Academics in psychology, education, and computer science are studying the role of this “connectivism” (Siemens, 2005) in higher education, which is the idea that learning is fostered by diversity of viewpoints, and that learning is continual, being aided by others as well as kept current by sharing the work garnered from multiple sources for both diversity and completeness. In other words, by being connected we can have a greater, more current conceptualization of the issues and attempts to solve them. A prime example is the DIY videos on YouTube; at a glance many different solutions to common problems can be found by watching what others have done. This is forcing faster changes to our educational approach, from knowledge to process, as more knowledge is at our fingertips via the internet. In the spirit of this connectivism, and as a lifelong learning tool, social media can help us foster these connections to each other and to the repository of knowledge and experience available from others. The use of social media for class discussions seems to fit into these efforts at connectivism while leveraging an existing tool already in the hands of students. This new methodology comes at a cost of shorter attention spans and more of a “gatherer” mentality than an understanding of the overall solution process and how it is connected across disciplines (another aspect of connectivism). The weighing of the costs and

benefits is unfolding in the literature including the current study that helps frame and address this tradeoff.

This approach to learning and connectivism reflects a different learning style among digital natives (Selwyn, 2012) who are those that have grown up with social media and digital networking for all of their lives; thus, the effect of the use of social media in higher education has taken on greater significance (Baird & Fisher, 2006). Due to the relatively recent emergence of these digital natives (or net-geners) into higher education along with the nascent use of social media in this area, there are only a handful of studies regarding the link between the use of social media and student performance or engagement.

In contrast to these time-use association studies of Kirschner & Karpinski (2010) and Junco (2012) from above, others have investigated the use of social media (Facebook) as part of the pedagogy of a particular class to student outcomes in that class. Bosch (2009) considers the case of undergraduates in Cape Town whose lecturers used Facebook (FB) as means to communicate with the class. Bosch uses interviews of the students to conclude that FB was well accepted by both students (for access) and lecturers (for communication and eliciting questions). Kaliban, Ahmad, & Abidin (2010) uses a similar methodology with a survey (in the context of learning English) to find that over 60% of students felt that the specific use of FB helped with the ease of communication, interaction, and networking within the class. Survey based studies have their limitations since instrument or researcher bias might be present encouraging students to think that the desired outcome is for Facebook to have a positive impact; or simply familiarity might be a default response, skewing the favorable results for Facebook higher.

Pellizzari (2012) in math for economics classes used Facebook specifically to engage students more readily and thus attempts to leverage the familiarity and time spent on social media to affect

student learning outcomes as measured by the course grade. Pellizzari (2012) also surveys students regarding their use of Facebook in the class but further relates course outcomes (grades) to the amount of individual student use of the Facebook “classroom”, finding a positive association between FB use and outcome. Despite this association between outcomes and the specific use of Facebook, Pellizzari (2012) hesitates to assign this effect to Facebook since other course software is widely available in the learning environment (e.g. Blackboard or other CMS). Note also that Pellizzari’s work along with many others, employs Facebook as an additional tool giving differential access to those that chose to use it (opening the possibility of selection bias as well: more engaged students choose to use FB), as opposed to considering the difference between Facebook and traditional CMS portals across all students in the sample. The current study works to fill in that gap by assessing student outcomes and perceptions through grades and surveys while utilizing a randomized controlled trial type experiment with randomly assigned students to either use Facebook or the institution’s CMS (a derivation of Blackboard), similar to Harmon, et al. (2014) . This allows direct comparisons of similar students across the two software platforms at the same time (i.e. within the same section of the course, with the same resources and at the same point in time) in terms of both learning outcomes and student engagement measures.

Student engagement is often defined by time and effort spent on material (Kuh, et al., 2007) and includes active and collaborative learning (Coates, 2007); thus, this study uses frequency and length of discussion posts to demonstrate active and collaborative learn as well as an association to time and effort spent on the material. This effort is further measured by the quality of the posting as independently rated. Student engagement is associated with improved learning outcomes (measured by grades), but research on the connection between engagement and the use of social media is sparse despite what seems to be popularly accepted as a good avenue to foster that engagement. Broad time use surveys like Junco (2012) relate the overall use of social media (Facebook) to survey measures of student engagement (using the National Survey of Student

Engagement) which, of course, result in negative associations between social media usage and engagement as students reduce engagement in academics to spend more time in non-academic social settings. Earlier studies have found that educational information technology (e.g. CMS) enhances student engagement (Laird & Kuh, 2005) as we would expect from the connectivism arguments previously made. Further along that same reasoning, specific use of social media within a class improves networking among students as well as the overall perception of the educational experience (Rutherford, 2010), both of which are part of student engagement foundations (Coates 2007). The current work extends this literature by making comparisons across IT platforms used for engagement; thus, allowing measurement of student engagement and outcome levels between social media (FB) and an ordinary CMS (Blackboard) in a randomized controlled trial design that enhances data reliability and generalizability of the results by removing common sources of bias such as selection or perception.

3. Data and Methodology

The data on student characteristics, engagement, and learning outcomes was collected from six sections of Principles of Microeconomics taught in a Winter/Summer Intersessions in 2013 and 2014. Students were randomly assigned to discussion groups either in Facebook (treatment), or in the CMS (control) at the start of the courses. There were four Facebook and four CMS groups over the various terms when this course ran (Winter 13 to Winter 14); with each group consisting of approximately 15 students. Table 1 presents the demographic characteristics of interest across the different discussion forums along with a comparison of the means. Since there was no significant difference across the means of the two forum types, the randomization of the students appears to be successful (i.e. no significant differences in the allocation of demographic and potential significant covariates) for this implementation.

Table 1 Student Characteristics by Discussion Forum

	FB=0 N	FB=0 Mean	FB=1 N	FB=1 Mean	Diff in Means	t	Pr(T > t)
Grade Point Average	56	6.43	50	6.89	-0.46	-0.13	0.90
Total Credits	57	54.72	51	51.31	3.41	0.52	0.60
Math SAT Score	48	627.08	45	641.33	-14.25	-0.93	0.36
Verbal SAT Score	48	576.25	45	599.33	-23.08	-1.40	0.17
Written SAT Score	35	577.43	34	592.35	-14.92	-0.76	0.45
Female=1	58	0.62	53	0.49	0.13	1.38	0.17
Observations	112						

Note: ***p<0.01 **p<0.05 *p<0.10; differences in N reflect availability of demographic data

Part of the course grade (6%) depended on participation in an online discussion forum for each learning module that is usually comprised of one textbook chapter with 11 total modules in the course.⁷ The learning modules are scheduled to be worked on during a set period of days (a

⁷ The weights for the overall average grade for the course are: (final exam: 30%, 3 hourly exams: 10% each, homework: 19%, graphing exercises: 10%, quizzes: 5%, and discussions: 6%).

session) and each session contained an assignment to participate in an online classroom discussion about the session topics with the discussion forum open for the entire length of the session, but then closed at the end of the session. Students were encouraged to discuss the work and the material with each other, echoing or answering concerns of other students in hopes of arriving at an improved understanding of the course material. The course average for the discussion participation was calculated by dropping the two lowest scores to allow for unanticipated scheduling conflicts that might have arisen for a student. Students were given the following directions for the discussion:

- Post a question about the subject content in this session. It should be a question to clarify confusion about the material in the session. (~25% of posts)
- Post an answer to a posted question. (~25% of posts)
- Post a typo you found in the material for this session. (~5% of posts)
- Post a link to an article or a video or a news event that has a helpful explanation or illustration of some aspect of the material in this session. With the link, post a few sentences explaining how the content of the video/article relates to the session and how it helped improve your understanding of the session. Think of these sentences as an explanation to the class as to how or why the linked material will be of interest to them. (~45% of posts of which approximate 1 in 9 were links without explanation)

(Note that the only significant difference in the average number of type of posts between FB and CMS is 4 times as many “bare” link postings on FB, but “bare” links were a small proportion of all the postings. This is consistent with findings the students in the FB group were less engaged compared with traditional CMS groups.)

The data collected for discussion activity: the number of posts to the discussion forum, the average length of the discussion post (not including URL's), the total words posted (average

length times number of posts), and the average rating of discussion posts are summarized by discussion group type (FB v CMS) in Table 2.

Table 2 Discussion Activity by Discussion Forum

	CMS N	CMS Mean	FB N	FB Mean	Diff in Means	t	Pr(T > t)
Average Length of Posts	59	251.54	53	164.76	-86.78	-4.35	0.00
Average Number of Posts	59	28.69	53	30.81	2.12	0.74	0.46
Average Rating of Posts	59	2.94	53	2.96	0.02	0.21	0.83
Total Words Posted (Ave Len x Ave #)	59	6765.09	53	5162.1	-1602.92	-2.12	0.04
Observations	112						

The average rating of the discussion post is a measure of the engagement of the students based on the type of post (typo, question, link with explanation, answer) and the quality of that post (1 to 6 scale with 6 being an outstanding answer to another student's question) as judged by a graduate economics student and independently by a graduate student in chemistry. There was no qualitative or statistical differences on the rating of the posts but note that these were ratings of engagement rather than grades for the quality of the post relative to course material. There was no statistical difference between the average number of posts across the treatment

(Facebook) or control (CMS) discussion groups, despite some expectation that students using social media based discussions would post more frequently. There was a significant difference (at the 1% level) across treatment and control groups for the average length of the post (a quantitative measure of engagement), the total words by student (at the 5% level), and in the overall course grade (at the 1% level). These results suggest that there was no discernable difference in the way (type and frequency of posts) students interacted with the discussion boards across treatment and control, but there was a difference in the time and effort spent on the posts resulting in longer posts for the CMS group. This suggests more engagement for the CMS group and this is also associated with higher learning outcomes as measured by the overall course grade.

MEASURING THE EFFECT ON ENGAGEMENT AND LEARNING OUTCOMES

This study is interested in whether participation in the online discussion board affected student engagement and learning outcomes. Engagement was measured by participation in the discussion forums as separated by Facebook (treatment) and CMS (control); three dimensions of engagement are considered: the number of posts, the average length of the posts by student, and the total words (length) of postings by student. As indicated previously, this study did not find any difference across treatment and control for the number of posts or the average rating of the posts, but engagement as assessed by the average length of posts and the total length of posting appear to be significant; therefore, the following empirical model is estimated:

The OLS model (Model 1):

$$y_i = \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \varepsilon_{1i}, \text{ where } i = 1, 2, \dots, N.$$

with N as the total number of students, the dependent variable, y_i , measure of engagement, is alternatively: number of posts, average length of posts (AveLen) or total length of posting (TotalWords), where i is the i^{th} student. Variable x_{1i} is an indicator of whether the discussion group is Facebook (1) or CMS (0), x_{2i} is an academic input (GPA) control for within group differences in engagement, x_{3i} is a vector of student characteristics, and ε_{1i} is the idiosyncratic error term.

The list of independent variables and their definitions are:

FB	1 if student is in a Facebook discussion group; 0 otherwise
GPA	At beginning of course
Total Credits	At beginning of course
SAT Math	High School
SAT Verbal	High School
SAT Written	High School
Female	1 if student is female; 0 otherwise ⁸

The hypothesis is students in the Facebook (treatment) group will be more engaged than those in the CMS (control) group since they have easier and more frequent access to the discussion forum. Thus, the coefficient on the Facebook indicator variable (β_1) is expected to be positive and significant based on this expectation and some previous empirical studies in this area (see the Literature Review). The coefficients for the academic control variables are expected to be positive, as better performing students are assumed to be more engaged.

⁸ Several other demographic variables were collected such as Major and previous online course experience, but since this was an introductory course students were predominately lower level (i.e. second or third semester) and so had not had the opportunity to take many other online courses or much experience in their declared major.

Learning outcome is measured by the student's overall semester grade separated by Facebook (treatment) and CMS (control) discussion group membership. This study is concerned with differential learning outcomes as driven by student engagement in discussion forums; therefore, the following empirical model is estimated:

The OLS model (Model 2):

$$z_i = \beta_1 x_{1i} + \beta_4 x_{4i} + \beta_3 x_{3i} + \varepsilon_{2i}, \text{ where } i = 1, 2, \dots, N.$$

with N as the total number of students, the dependent variable, z_i is student's overall course average, where i is the i^{th} student. Variable x_{1i} is an indicator of whether the discussion group is Facebook (1) or CMS (0), x_{4i} is an engagement input (number of posts since it is not mean different across groups) control for within group differences in engagement, x_{3i} is a vector of student characteristics, and ε_{2i} is the idiosyncratic error term⁹.

The list of independent variables and their definitions are:

FB	1 if student is in a Facebook discussion group; 0 otherwise
GPA	At beginning of course
Total Credits	At beginning of course

SAT Math	High School
SAT Verbal	High School
SAT Written	High School
Gender	1 if student is female; 0 otherwise

The hypothesis is that students in the Facebook (treatment) group will experience higher learning outcomes predicated on the first hypothesis where they were expected to be more engaged than those in the CMS (control) group since they have easier and more frequent access to the discussion forum. Thus, the coefficient on the Facebook indicator variable (β_1) is expected to be positive and significant based on this expectation and some previous empirical studies in this area (see the Literature Review). The coefficients for academic control variables are expected to be positive since better prepared and performing students are more likely to have higher learning outcomes.

4. Results and Discussion

Student Engagement

The regression results from the student engagement model are reported in Table 3, along with the control variables and intercept. Student engagement in this model is assessed via the number of posts, the average length of the posts, and total length of postings made to the discussion forum over the course of the term. Longer posts suggest more thought and preparation was put

into the post and more effort was expended as a whole. Additional effort of this nature indicates a student who is spending more time with the material and is therefore, internalizing it more than other students lacking this type of engagement.

Table 3 OLS Regression Engagement (Model 1)

	(1)	(2)	(3)
Dependent Variable (y_i):	Average	Average	Total Words
	Length of	Number of	Posted (Ave Len x
	Posts	Posts	Ave #)
β_1 :FB Group=1; CMS Group=0	-76.90*** (4.31)	1.947 (0.69)	-1629.1* (2.07)
β_2 :Grade Point Average	3.648 (0.23)	6.563* (2.63)	1599.4* (2.31)
Female=1	12.62 (0.67)	1.837 (0.61)	315.0 (0.38)
Total Credits	0.569+ (1.94)	-0.0179 (0.38)	-4.113 (0.32)
Math SAT Score	-0.207 (1.61)	-0.0271 (1.33)	-13.12* (2.32)
Verbal SAT Score	-0.110 (0.92)	0.0162 (0.85)	4.791 (0.91)

Average Rating of Posts	126.3*** (6.89)	-4.351 (1.49)	2105.3* (2.61)
Constant	21.24 (0.19)	29.63+ (1.69)	1299.6 (0.27)
Observations	92	92	92
R^2	0.507	0.137	0.216
Adjusted R^2	0.466	0.065	0.150
Wald Chi2			
Prob > chi2	0.000	0.080	0.004
F	12.344	1.900	3.297
Log lik.	-533.931	-364.727	-882.160

Absolute t statistics in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Membership in the treatment group (Facebook) has a large and strongly significant impact on the average length of post (1% level) and the total length of postings (5% level) made by discussion posters. For the engagement measure “number of posts” membership did not matter. These results suggests a lower level of engagement on the part of these students at least along the dimensions of time spent and effort put forth to craft the discussion post. This result is counter to the original hypothesis that Facebook discussion forums would see more engaged students due to ease of use and access; however, the results might be explained by considering the venue. Social media, by design, is more casual and often social posts are quick and unedited. In an academic course setting this might be compensated by more frequent postings, but the data in this study does not suggest that is the case since the results for the number of postings is not

significantly different between the control group and the treatment group. It is also interesting to note that when the individual control for engagement was changed to average number of posts by a student, it has a significant positive influence on the overall course grade (0.22, $p < 0.001$) despite not differing in mean across treatment (Facebook) and control (CMS) groups, or showing significance as a control in the engagement regression). This suggests that the number of posts is an indicator of engagement that influences learning outcomes; yet the lack of difference between treatment and control is still consistent with lower engagement in the Facebook (treatment) group since the thought is that environment would produce shorter (as seen in the data) but more frequent postings, thus compensating for the shorter focus and delivery expected. In other words, the number of posts matter, and the treatment (Facebook) group did not deliver as expected in this regard¹⁰.

Learning Outcomes

The regression results from the learning outcomes model are reported in Table 4, along with the control variables and intercept. Learning outcomes were assessed by considering the final course grade, and the final exam score in light of controls such as GPA and credits at the outset (proxies for better preparation and additional knowledge). Both specifications used the same control variables.

¹⁰ The results when measures of engagement that varied significantly between groups are used are qualitatively the same as these results.

Table 4 OLS Regression Semester Grade (Model 2)

	(1)	(2)
Dependent Variable (z):	Semester Grade	Final Exam Score
β_1 :FB Group=1; CMS Group=0	-3.693*	-0.973
	(2.18)	(0.53)
β_4 :Average Rating of Posts	0.526	1.570
	(0.30)	(0.83)
Female=1	-1.538	-3.275+
	(0.86)	(1.67)
Grade Point Average	3.501*	4.220*
	(2.35)	(2.59)
Total Credits	0.00480	0.0187
	(0.17)	(0.61)
Math SAT Score	0.0340**	0.0474***
	(2.78)	(3.55)
Verbal SAT Score	-0.00600	-0.00628
	(0.53)	(0.51)
Constant	59.07***	34.70**
	(5.64)	(3.03)
Observations	92	92
R^2	0.199	0.266
Adjusted R^2	0.132	0.205

Wald Chi2		
Prob > chi2	0.008	0.000
F	2.972	4.343
Log lik.	-317.293	-325.366

Absolute *t* statistics in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For the semester grade specification membership in the treatment (Facebook) group has large and significant negative effects on the overall learning outcome measure (course grade). The final exam grade (all multiple choice exam) is also used to assess learning outcomes, but it showed no significance which was interpreted as a result of the final exam being the culmination of the work of the term (where every students puts in extra effort) whereas the course grade is influenced by engagement over the entire term.

In both specifications, previous and what might be considered innate, preparation at the secondary and primary levels (as evidenced by Math SAT scores) figured prominently in course grade outcomes; yet post-secondary experience (GPA) seemed to matter less. This might be the result of the course in the study often being taken early in the post-secondary academic career.

The results regarding the treatment (Facebook) group's performance in terms of outcome stands contrary to the expected results predicated on previous empirical work in this area. It does tie into the results found in the regression results for the student engagement model with a similar story.

Social media is meant to be a more casual and cursory forum where the relaxed and familiar atmosphere encourages participation, but not necessarily engagement, as defined academically. This comes as little surprise when considered in the light of conversations instructors have with student compared to short answers or essays where the student understands the expectation of increased engagement and performance. Social media is a form of informal chat despite being conducted in entered text (e.g. is it more like a word processor or a text message?). It is certainly more like informal speech than like formal prose since abbreviations and colloquialisms are commonly used. Participants are online more frequently, and the time between questions and responses is often shorter on average than in a non-social media forum, but are they more engaged in what they are saying or is the ephemeral nature of a social forum undermining that engagement. Since social media is conversational it is more conducive to sharing information, expressing opinions, and asking questions than a more formal discussion format like the standard CMS forum; but, the empirical results are consistent with this ease of access trading off with a more casual and less engaged approach to the discussion. Further, the approach is seen as having a deleterious effect on learning outcomes overall.

5. Conclusion

The use of online courses is burgeoning, and in this milieu educational institutions widely use CMS systems that have built in tools for email and discussion boards. These tools have the advantages for the instructor of ease of assigning students to groups, and tools for tracking and grading student posts. The disadvantages of CMS discussion tools are on the student side: the time to access the board is slowed by logon verification procedures and students spend much less time checking into the discussion boards than to social media. An alternative that is seeing increasing use is to develop discussion forums in social media such as Facebook. Social media

has several advantages including ease of use and time spent in the application; hence use in an online classroom does not force students into an additional electronic portal that they would not naturally use. This means that messages once sent are fairly quickly read, and responded to in a timely manner; which is not typically the case for the standard CMS. The disadvantages of social media include that students, while spending more time in social media, are more relaxed and less engaged in them; thus, they can become distracted and not focused on the instructional material.

This study empirically tests which effect of social media is more dominate: ease and frequency of use or casual and distracted as applied to the differential effects of using social media compared to a course management system for hosting class discussion in an online Principles of Microeconomics class. The differential effects were measured by student engagement proxies and learning outcomes through a randomized controlled trial experimental design that randomly assigned students to either Facebook or the CMS discussion tool for classroom discussion. Engagement was assessed by length and frequency of posts; whereas, learning outcomes were compared using overall course grade averages, and the multiple choice final exam. The empirical results show that for students taking an online class the use of social media discussions resulted in lower engagement (shorter average and total postings with no significant difference in the frequency of posting to atone for the loss of length) and lower learning outcomes (overall course average). This result is based on a sample of 112 students across 4 sections of the course; future work with larger sample sizes is needed.

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