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# Rob Peter to Pay Paul?
# The Role of Board Reforms in Workplace Safety

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**ABSTRACT**

Do board reform laws influence workplace safety? Using a cross-national sample of 8,812 firm-year observations from 1,804 firms in 60 countries (2006–2018), this study examines whether major board reform laws—designed to enhance board independence and protect shareholder interests—unintentionally increase employee accidents and lost workdays. Drawing on the theory of political decision-making, the analysis suggests that increased shareholder power drives managers to adopt efficiency measures that may cut critical investments in employee safety. The results indicate that workplace safety deteriorates under board reform laws, particularly in environments with robust investor protections and weak labor regulations.

## INTRODUCTION

Corporate governance has become a focal point of global business practices, with board reforms emerging as a key mechanism to enhance transparency, accountability, and shareholder value. Over the past two decades, numerous countries have implemented board reform laws aimed at strengthening the oversight role of directors and mitigating agency conflicts. These reforms have garnered significant attention from scholars and policymakers, with research highlighting their positive impact on firm value, reduced information asymmetry, and improved investment efficiency (Chen et al., 2011; Chen et al., 2015). Yet while the benefits to shareholders have been well-documented, there remains a critical gap in our understanding of how these reforms affect other key stakeholders, particularly employees.

This study seeks to address this gap by examining the relationship between board reform laws and workplace safety. Specifically, we ask: Does the existence of board reforms influence workplace safety? To answer this question, we analyze the impact of country-level board reform laws on workplace safety between 2006 and 2018, using a cross-national dataset of employee accidents. Our sample encompasses 8,812 firm-year observations associated with employee accidents by 1,804 firms from 60 countries.

The implementation of board reforms has been a global trend, with over 42 countries adopting such laws in response to corporate governance scandals. These reforms typically mandate greater board

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independence, strengthen audit committee oversight, separate the roles of CEO and chairman, and impose stricter disclosure requirements (Ahmad et al., 2024; Black & Kim, 2012; Fauver et al., 2017). While these measures are intended to enhance transparency and accountability to shareholders, their impact on other stakeholders, particularly employees, remains understudied.

The importance of this inquiry cannot be overstated. Employees are increasingly viewing workplace safety as vital to their health and well-being (Guest, 2017). Moreover, employees and the knowledge they possess constitute a critical resource for firms, serving as a unique source of competitive advantage (Crook et al., 2008; Wang et al., 2009). The value of this human capital is intrinsically linked to employees' health and productivity, both of which can be severely compromised by work-related injuries or illnesses. The scale of this issue is staggering: the International Labor Organization (ILO) estimates that over 2.3 million workers worldwide succumb to work-related accidents or injuries annually, equating to nearly 6,000 deaths every day (*ILO*, 2017).

Our study is grounded in political decision-making theory, which posits that the power of stakeholders determines the prioritization of their demands by decision-makers (Mintzberg, 1983; Pettigrew, 1977; Salancik & Pfeffer, 1974). We argue that board reforms, while designed to protect shareholder interests, may inadvertently shift the board's focus towards satisfying shareholders' demands at the expense of employees. As board accountability increases, so too does shareholders' power to impose their agenda (Bebchuk, 2004; Denis & McConnell, 2003; Hermalin & Weisbach, 2001). This increased shareholder influence can lead to heightened pressure on managers to boost short-term financial performance and operational efficiency, potentially at the cost of employee safety.

Our findings reveal that the existence of board reform laws is associated with an increase in employee accidents and lost workdays. These results are robust to the use of country and industry fixed effects, suggesting a consistent pattern across different contexts. Furthermore, we explore how the influence of board reforms on workplace safety varies across countries with heterogeneous legal and regulatory protections for shareholders and employees. We find that the impact of board reforms on employee accidents is stronger in countries where investors have greater protections and employees have less legal protections.

This study makes two primary contributions to the existing literature. First, it extends research on global corporate governance reforms by illuminating the unintended consequences of board reforms on employees. While previous studies have focused on the benefits of these reforms for shareholders, our work highlights how they can potentially harm a crucial stakeholder group. Second, we contribute to the growing body of literature on workplace safety by examining the role of board reforms as a determinant of safety outcomes. This builds upon recent work exploring the influence of institutional factors on workplace safety, such as the study by Shi, Xia, and Meyer-Doyle (2021) on the impact of institutional investor activism.

Our study is particularly timely given the ongoing global trend towards strengthening board reform laws. As countries continue to adopt and refine these reforms, it is crucial to understand their full implications, not just for shareholders but for all stakeholders. By shedding light on the potential trade-offs between

shareholder interests and employee safety, we hope to inform more balanced approaches to corporate governance that consider the well-being of all stakeholders.

## THEORETICAL BACKGROUND

### Board Reform Laws

Over the past two decades, numerous high-profile corporate governance scandals have exposed top executives exploiting their positions and harming employees. Examples include the Deepwater Horizon disaster at BP (2010), Foxconn's exploitative labor conditions (2010), and the 1984 Bhopal gas leak in India, all of which contributed to increased employee accidents and lost workdays, thereby prompting various nations to strengthen corporate governance reforms (Aguilera & Jackson, 2003; Denis & McConnell, 2003). Often, boards of directors bore responsibility when they failed in their fiduciary duties to shareholders and moral responsibilities to broader stakeholders. Board-level wrongdoing can entail falsifying or neglecting financial statements, inadequate oversight of audit or managerial compensation committees, inconsistent disclosures, and failing to hold top executives accountable for operational decisions.

Most nations have adopted comprehensive board reform laws in response to major securities scandals. The United Kingdom led the way with the Cadbury Report (1992), introduced after questionable corporate acquisitions in the early 1990s. Serving as a template for other nations, it aimed to mitigate governance failures by enhancing board accountability. Following the Enron scandal in 2001, the United States also enacted substantial board reforms. In total, more than 42 nations have passed such laws over the last two decades, effectively deterring managerial misconduct and bolstering financial transparency and accountability. Still, the pace and scope of legislation differ across contexts, given divergent economic, political, and legal conditions.

Board reform laws primarily seek to strengthen shareholders' ability to oversee boards by increasing disclosure mandates and managerial liability. Many countries' statutes require greater board independence, robust audit and compensation committee supervision, and the separation of CEO and chair roles (Fauver et al., 2017). Certain jurisdictions also require shareholder authorization for equity compensation, revised ethical standards for management, certification of financial statements, or the creation of independent accounting oversight entities. However, the details vary. Some jurisdictions mandate establishing audit committees and appointing independent members, whereas others emphasize mandatory auditor rotations or restrictions on consulting fees for auditing firms (Fauver et al., 2017). Regulators adopt contrasting strategies: while some utilize a comply-or-explain model—letting firms deviate from rules by explaining their reasons (e.g., Australia, Brazil, U.K.)—others employ rule-based frameworks, making compliance compulsory (e.g., Canada, Denmark, Japan, U.S.). Notably, reforms emphasizing board and audit committee independence often enhance firm value and comply-or-explain mandates can yield higher valuation gains than purely rule-based regimes (Fauver et al., 2017).

Yet relatively few studies explore how board reform laws affect other stakeholders, particularly employees, and how they relate to workplace safety. Although prior work finds that these reforms can augment firm value and stimulate R&D (Ahmad & Kowalewski, 2021; Fauver et al., 2017), some research indicates they might increase debt costs (Lin et al., 2020) or compound agency challenges where ownership is heavily concentrated (Hertig, 2005). Here, the focus is on how these reforms may influence employee accidents, given that employee well-being is essential for sustaining competitive advantage. While previous scholarship examines industrial accidents' impact on corporate legitimacy or foreign direct investment decisions, it remains unclear whether and how board reforms—designed to make boards more accountable—could pressure managers to emphasize productivity at the cost of employee safety (Desai, 2011; Pek et al., 2018). In clarifying how greater board accountability might drive operational efficiency strategies that undermine workplace safety, this study deepens our understanding of corporate governance's unintended consequences.

**Workplace Safety**

Prior research consistently underscores employees' importance in organizational success, positing that injuries and lost workdays can severely diminish the value employees generate (Chen et al., 2021; Crook et al., 2011; Shi et al., 2021). When employees are injured or incapacitated, the firm's productivity often suffers (Danna & Griffin, 1999; Gubler et al., 2018). Direct expenses include medical fees, workers' compensation, and legal representation, while indirect costs may involve training replacements, investigating accidents, or adopting new safety measures (Gavious et al., 2009). Alarmingly, the International Labor Organization (ILO) reports an annual global total of over 340 million work-related accidents or injuries, 11,000 of which are fatal, with a collective cost exceeding $3 trillion in 2017 (*ILO*, 2017).

Scholars in psychology, organizational behavior, and occupational health have examined multiple firm or employee-level drivers of workplace safety (Christian et al., 2009; Hofmann et al., 2017). For instance, safety programs, robust human resource practices, and committed leadership can foster a safety climate, predictive of reduced accident rates (Clarke, 2006; Griffin & Neal, 2000). Research also shows that strong leadership and powerful CEOs can lower injuries and illnesses (Haga et al., 2021; Tucker et al., 2016; Zohar, 2002). Moreover, employee attitudes and personality traits correlate with workplace safety outcomes, partly through higher motivation and adherence to safety protocols (Clarke & Robertson, 2005). Balancing the competing demands of resource allocation, profitability, and long-term survival similarly affects safety considerations (Cohn & Wardlaw, 2016).

Beyond direct financial implications, a firm's safety record heavily influences its capacity to attract and retain talent (Fernández-Muñiz et al., 2009). Employees observe accident frequency and may perceive inadequate protection or potential retaliation if they report hazards. Elevated accident rates correlate with higher turnover and hindered recruitment of high-caliber personnel. By contrast, positive perceptions of workplace safety can bolster employee loyalty and foster a more stable workforce.

Although scholars have studied how private equity transactions (Cohn et al., 2021), funding constraints (Cohn & Wardlaw, 2016), safety climate (Beus et al., 2010; Chowdhury & Endres, 2010), organizational safety practices (Neal & Griffin, 2006), and employee satisfaction (Ayim Gyekye, 2005; Hayes et al., 1998) influence workplace safety (Grawitch et al., 2006), relatively little attention has been paid to whether board reforms, aimed at increasing director-level transparency, affect the frequency of accidents or lost workdays (Harter et al., 2002). Understanding how board reforms shape employee well-being is vital, as employees constitute the firm's primary value creators (Chatain & Meyer-Doyle, 2017; Crook et al., 2011). A rise in employee illnesses and injuries not only reduces productive labor hours but also degrades workplace relationships, motivating key personnel to leave and discouraging potential hires. This study therefore extends the analysis of global corporate governance reforms by investigating whether, and how, country-level board reform laws influence workplace safety decisions and outcomes.

**Hypotheses**

Political decision-making theory views organizations as open political systems where actors seek to influence decisions reflecting their preferences (Mintzberg, 1983; Pettigrew, 1973). Given finite resources, decision makers prioritize demands from those with the greatest power (Pettigrew, 1973). Worldwide, shareholders have become highly influential, especially in the United States and United Kingdom, where the shareholder-value paradigm dominates, emphasizing maximizing shareholder wealth (Davis, 2009; Fligstein, 2001). In emerging economies like India, Korea, and China, concentrated ownership triggers conflicts between controlling and minority shareholders, as weak protections compel managers to favor controlling interests (Young et al., 2008). Meanwhile, Continental models in France, Germany, and Japan strive to balance multiple stakeholders, yet controlling shareholders can still wield substantial influence (Aguilera et al., 2007).

As shareholder equity has grown, so have the tactics they employ, including proxy contests, director removals, lawsuits, and other mechanisms (Boyd, 1994; Pound, 1988; Walsh & Seward, 1990). Activism has risen worldwide (Hartmann et al., 2021), leading to demands such as dismantling poison pills, altering voting structures, and pursuing "proxy access" that lets significant shareholders nominate directors (Fox & Lorsch, 2012). In China and Korea, where proxy access is rare, activists may launch tender offers, delegate voting rights, or propose removing directors (Hill & Thomas, 2015). These strategies often target cost reductions, potentially cutting safety expenditures or intensifying workloads (Goetzel et al., 2014; Vinodkumar & Bhasi, 2010), which can raise accident rates and lost workdays (Goetzel et al., 2014; Vinodkumar & Bhasi, 2010).

Board reforms generally heighten shareholder influence by promoting accountability and transparency, making boards more likely to chase short-term gains (Sanders & Carpenter, 2003; Denes et al., 2017). Consequently, they may implement efficiency measures that undermine workplace safety, since cutting "nonessential" items often includes training or wellness programs. Where board reforms are absent or weak, boards can be less responsive to shareholder activism, thus allocating more resources to employees,

customers, and suppliers (Cronqvist et al., 2009). By prioritizing multiple stakeholders, such boards mitigate pressures for aggressive cost-cutting and preserve safer working conditions. However, under reforms that enhance shareholder power, investors may threaten lawsuits or proxy contests if performance falters, prompting managers to trim expenses in ways that affect employee safety (Shi et al., 2020).

In sum, political decision-making theory predicts that decision makers concentrate on the most powerful constituency, and in reform-intensive settings, shareholders usually hold that position. Thus, boards and managers, seeking to satisfy these influential actors, may emphasize short-term gains at the expense of workplace safety. Restructuring operations, lengthening work hours, or slashing safety programs can improve financial metrics yet raise accident risks, ultimately harming employees. Conversely, in settings without strict reforms, boards may heed wider stakeholder interests and devote resources to safer environments, reducing accidents and lost workdays. Ultimately, as shareholder activism grows and governance laws bolster accountability, firm leaders become more likely to enact efficiency measures that erode employee welfare, reinforcing the notion that those wielding greater power shape crucial outcomes. Hence, reforms may sacrifice employee safety for shareholder returns.

Based on these arguments, we propose our first hypothesis:

*Hypothesis 1: The presence of board reform laws is positively associated with the number of employee accidents.*

**The moderating role of investor protections**

The influence of board reforms on workplace safety is likely to vary across different institutional contexts. Specifically, we argue that the impact of board reforms on employee accidents and lost workdays is contingent on the level of investor and employee protections within a country.

In countries with stronger investor protections, shareholders have more legal tools and mechanisms to exert influence over corporate decision-making (La Porta et al., 1997, 2000, 2002). These protections can include rights related to voting, litigation, and information disclosure. When board reforms are implemented in such contexts, the already strong position of shareholders is further enhanced, potentially amplifying the pressure on managers to prioritize shareholder interests over other stakeholders.

With greater investor protections, shareholders can more effectively demand increased efficiency and performance from firms. This intensified pressure can lead managers to take more aggressive actions to meet shareholder expectations, potentially at the expense of workplace safety. Managers may be more inclined to push for cost-cutting measures or productivity enhancements that could compromise safety standards or increase employee workloads without adequate safeguards. Furthermore, in countries with strong investor protections, boards may be more focused on avoiding shareholder litigation or activist interventions, potentially diverting attention and resources away from other important issues such as workplace safety. This heightened concern for shareholder satisfaction could lead to a relative neglect of employee welfare considerations.

In contrast, boards in countries with weak shareholder protections might not prioritize shareholders' interests when making decisions. In such countries, powerful managers and controlling owners may divert assets for personal gain (Qian et al., 2017). Weak protections can lead to more tunneling, where resources are expropriated from minority shareholders (Johnson et al., 2000). This can reduce the impact of board reform laws. Interestingly, when investor protections are weak, employee power can increase, leading boards to recommend maintaining workplace safety or reducing employee workload.

Based on these arguments, we propose our second hypothesis:

*Hypothesis 2: The positive relationship between board reform laws and the number of employee accidents is stronger in countries with higher levels of investor protection.*

**The moderating role of employee protections**

The effect of board reform laws on employee safety also depends on employees' capacity to counter pressures for higher productivity. Political decision-making theory posits that, when nations enact legislation protecting workers, the balance of power in corporate governance can shift toward employees, granting them a stronger voice in allocating control rights (Pagano & Volpin, 2001, 2005). Emboldened by legal safeguards and transparency requirements, employees can participate more actively in firm governance, pressing boards to heed their interests. Labor market flexibility–the ease with which firms can alter wages, working hours, or headcount–captures the power dynamic between employees and shareholders (Botero et al., 2004).

Where employee protections are weak (i.e., high labor market flexibility), firms can more easily reduce workforce costs by firing or reassigning staff (Chacar et al., 2010). Such environments diminish employees' power and embolden boards to prioritize shareholder demands for cost-cutting or efficiency, potentially curtailing safety expenditures and intensifying workloads. As shareholders gain influence under board reform laws, managers may implement measures that overlook safety concerns, thereby increasing accidents and lost workdays.

Conversely, in countries with stronger labor laws (i.e., lower labor market flexibility), employees enjoy legal protections that impede dismissals and wage cuts. Regulations mandate higher minimum wages, constrain hiring and firing, and empower labor unions, enabling employees to demand safer conditions and greater training investments. Even if board reforms amplify shareholder activism, boards in these contexts cannot easily disregard employee welfare without risking litigation, union conflict, or reputational harm. Consequently, reforms in lower-flexibility settings yield fewer negative effects on workplace safety, as boards must balance shareholder pressures with employee demands.

Hence, the impact of board reforms on accidents and lost workdays depends on whether employees can effectively resist cost-cutting tactics. With low employee protections, reforms tend to reinforce short-term financial objectives at employees' expense. With high employee protections in place, employees possess sufficient bargaining power to mitigate safety trade-offs, motivating boards to safeguard working conditions. Overall, employee protections moderate the relationship between board reforms and employee

safety outcomes, such that reforms exacerbate accidents when employee protections are weak but attenuate this effect when employees hold more influence (Cunat & Melitz, 2012). This suggests that the structure of labor regulations shapes firm-level employment strategies and also interacts with governance reforms in determining workplace safety.

Based on these arguments, we propose our third hypothesis:

*Hypothesis 3: The positive relationship between board reform laws and the number of employee accidents is stronger in countries with lower levels of employee protections.*

**METHODS**

Figure 1 summarizes the study design. We treat major board reform laws as an exogenous, country-year treatment and examine their association with employee accidents and lost workdays measured at t+1 using Refinitiv ESG. We include a rich set of firm-year controls, and country, industry, and year fixed effects. We probe identification through three complementary strategies: (1) a Heckman selection correction to address reporting selection into accident disclosure, (2) extended regression models using political economy instruments tied to reform adoption, and (3) for robustness: Poisson and CEM-matched difference-in-differences regression specifications. We further test heterogeneous effects via investor protections and employee protections measured at the country-year level.

We employ a longitudinal dataset spanning 2006 to 2018 to test our hypotheses. The Refinitiv global ESG dataset provides information on employee accidents and lost workdays. Since 2002, Refinitiv has collected data and scored firms on multiple ESG dimensions (Ioannou & Serafeim, 2012; Rathert, 2016). Firm financial and R&D expenditure data come from Thomson Reuters Worldscope, institutional ownership data from FactSet, and firm-level governance data from BoardEx and Capital IQ. Firm valuation and stock return data are from Datastream, while country-level data are obtained from the World Bank. Observations from the financial services and utility industries are excluded due to their highly regulated nature. The sample begins in 2006 because employee accident data before this year are largely incomplete. After matching all variables, the final dataset consists of 1,482 firms from 60 countries, totaling 8,812 firm-year observations.

**Figure 1.** Research Design

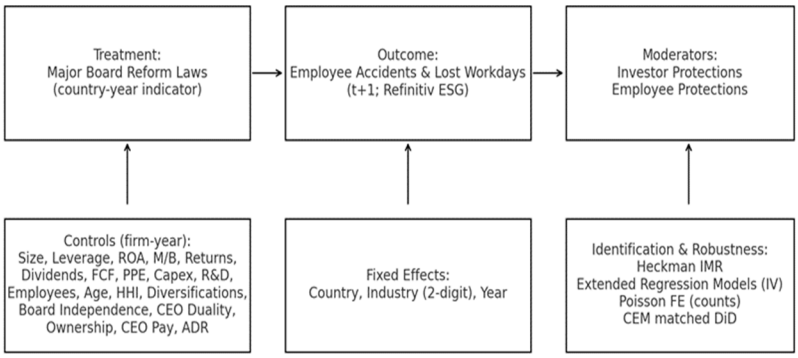


*Figure 1. Research design schematic. Treatment: country-year major board reform laws. Outcome: employee accidents & lost workdays (t+1). Moderators: investor protections and employee protections. Controls: firm-year financials, governance, competition & diversification, workforce, and macro factors. Fixed effects: country, industry, year. Identification & robustness: Heckman IMR, extended regression models, Poisson fixed effects, and CEM-matched DiD.*

The dependent variable is the natural logarithm of employee accidents. Refinitiv ESG defines employee accidents as the number of injuries and fatalities reported by employees while working for the company. Accidents are calculated using total working hours multiplied by the injury rate, divided by 1,000,000. Total working hours are estimated as the number of employees multiplied by 2,000. Employee injuries include all work-related deaths, illnesses, minor and major injuries, lost time and non-lost time accidents, medical treatment injuries, recordable incidents, and commuting accidents. The median number of accidents per firm-year is 80, while the highest recorded number is 7,187.

Accident measures derived from corporate reports may understate true incident counts and can vary with disclosure regimes and internal reporting cultures. We implement three mitigations and diagnostics. First, we measure outcomes at *t+1* and include country and year fixed effects to neutralize level differences in reporting standards and macro shifts. Second, we add firm-year observables correlated with exposure and reporting. Third, we implement a Heckman selection step that models the propensity to report accidents and include the inverse Mills ratio in outcome regressions. Robustness checks using Poisson fixed effects for count data and CEM-matched samples yield consistent inferences. We also (a) re-estimate excluding countries with lower coverage of ESG disclosure, (b) winsorize at 1% and confirm results to 2%, and (c) benchmark to lost workdays. Together, these steps improve comparability while acknowledging that non-random under-reporting could attenuate effects; our estimates may therefore be conservative.

Information on board reform laws was gathered following Fauver et al. (2017). The key explanatory variable, major reform law, captures whether a country implemented major board reform laws in a given

year. Rather than focusing on the first passage of a board reform law, this measure accounts for substantial legal revisions that significantly alter governance structures. If a country implemented a major reform law within the sample timeframe, the variable is coded as “1” from the reform’s implementation onward and “0” otherwise. Table 1 illustrates the breakdown of firms and major board reform law existence year by country. Refer to Appendix A for additional information on how board reforms are coded.

**Table 1.** Sample Distribution by Country

| Country | Number of obs. | Number of Firms | Law Year | Country | Number of obs. | Number of firms | Law Year |
|---|---|---|---|---|---|---|---|
| Argentina | 5 | 3 | 2001 | Malaysia | 87 | 23 | 2001 |
| Australia | 352 | 89 | 2004 | Marshall Islands | 9 | 1 | - |
| Austria | 39 | 8 | 2004 | Mauritius | 3 | 1 | - |
| Belgium | 75 | 16 | 2005 | Mexico | 83 | 19 | 2001 |
| Bermuda | 75 | 20 | - | Netherlands | 174 | 30 | 2004 |
| Brazil | 168 | 39 | 2002 | Nether Antilles | 5 | 1 | - |
| BVI | 8 | 2 | - | New Zealand | 26 | 9 | - |
| Canada | 426 | 84 | 2004 | Norway | 123 | 17 | 2005 |
| Cayman Is. | 126 | 43 | - | Panama | 4 | 2 | - |
| Chile | 37 | 10 | 2001 | Papua N Guinea | 9 | 1 | - |
| China | 133 | 48 | 2001 | Peru | 3 | 1 | - |
| Colombia | 41 | 9 | 2001 | Philippines | 26 | 8 | 2002 |
| Denmark | 68 | 12 | 2001 | Poland | 71 | 18 | 2002 |
| Finland | 94 | 19 | 2004 | Portugal | 37 | 7 | 2001 |
| France | 320 | 60 | 2001 | Qatar | 10 | 3 | - |
| Germany | 187 | 44 | 2002 | Russia | 123 | 22 | - |
| Greece | 36 | 7 | 2002 | Saudi Arabia | 10 | 3 | - |
| Hong Kong | 120 | 25 | 2005 | Singapore | 86 | 27 | 2003 |
| Hungary | 21 | 3 | 2003 | South Africa | 190 | 43 | - |
| India | 95 | 24 | 2002 | South Korea | 284 | 57 | 1999 |
| Indonesia | 57 | 17 | 2007 | Spain | 191 | 34 | 2006 |
| Ireland | 103 | 18 | 2001 | Sri Lanka | 5 | 1 | - |
| Isle of Man | 3 | 2 | - | Sweden | 171 | 30 | 2006 |
| Israel | 45 | 8 | 2000 | Switzerland | 156 | 31 | 2002 |
| Italy | 202 | 40 | 2006 | Taiwan | 231 | 57 | - |
| Japan | 834 | 150 | 2002 | Thailand | 144 | 30 | 2002 |
| Jersey | 34 | 7 | - | Turkey | 94 | 20 | 2002 |
| Jordan | 4 | 1 | - | UAE | 2 | 2 | - |
| Kuwait | 5 | 3 | - | United Kingdom | 700 | 122 | 1998 |
| Luxembourg | 31 | 10 | - | United States | 2,011 | 363 | 2003 |
| **Total:** | **8,812** | **1,804** | | | | | |

Our two moderator variables are investor protections and employee protections. Investor protection laws influence corporate governance by shaping shareholder-manager dynamics. The primary measure of investor protection is Guillén and Capron's (2016) index of minority shareholder protections by country-year. Stronger protections correlate with higher stock market development and greater pressure on managers to deliver short-term returns, while weaker protections grant insiders more discretion over corporate strategies (Surroca et al., 2020). Employee protections are constructed by first measuring labor market flexibility, using five sub-indices from the World Economic Forum (WEF) Global Competitiveness Index: labor-employer relations cooperation, hiring and firing practices, wage flexibility, taxation effects on work incentives, and redundancy costs (Bauer et al., 2018). Higher labor market flexibility scores indicate weaker employee protections, while lower scores reflect stronger protections. To improve interpretability, the labor market flexibility measure is reverse-coded to create the employee protections variable.

Several firm-level and macroeconomic characteristics that may influence workplace safety are controlled for in the regressions. Firm size is measured as the natural logarithm of assets in U.S. dollars. Leverage is defined as the ratio of long-term debt and debt in current liabilities to total assets. Firm performance is controlled using return on assets (ROA), calculated as net income divided by total assets, and the market-to-book ratio, representing a firm's valuation. Industry-adjusted stock returns are measured as the firm's performance relative to its industry peers in the same two-digit SIC code. Additional financial controls account for investment and liquidity constraints. Dividend payout is measured as total cash dividends to total assets, while free cash flow (FCF) is the ratio of free cash flow to assets. Property, plant, and equipment (PPE) is controlled as the ratio of net PPE to total assets, while capital expenditures are measured as capital spending relative to total sales. R&D intensity is measured as the firm's research and development expenditures divided by its net sales. The number of employees, log-transformed, is included since larger firms tend to report more accidents. Firm age is controlled, as more experienced firms may have more effective safety procedures.

Industry characteristics are captured using the Herfindahl-Hirschman Index (HHI), which measures market concentration and competition. Greater market competition may drive firms to prioritize efficiency over safety. Product diversification is measured using the Palepu (1985) entropy measure of sales across product segments, as firms with a broader product portfolio face more operational complexity, which may impact workplace safety. Geographic diversification is measured as the sum of squared revenue percentages from different regions (Fauver et al., 2004) capturing firms' global footprint.

Corporate governance controls include board independence and CEO duality, which influence management oversight and strategic decision-making. The proportion of independent directors on a firm's board is included as stronger board oversight may enhance workplace safety policies. CEO duality, a dummy variable coded as "1" if the CEO is also the board chairman and "0" otherwise, accounts for governance structures that may centralize decision-making. Institutional ownership, measured as the percentage of shares held by institutional investors, reflects shareholder influence on firm policies (Hartzell & Starks, 2003). Insider ownership, the percentage of closely held shares, captures the extent of managerial control (Musteen et al., 2009). Executive compensation is included as the log of total CEO pay in 2012 U.S. dollars, sourced from Capital IQ to account for managerial incentives. Since firms cross-listed on U.S. exchanges face heightened disclosure requirements, an ADR dummy variable is included, coded as "1" if the firm is cross-listed and "0" otherwise (Fernandes & Ferreira, 2008).

At the country level, product liability law is included, coded as "1" if a country enacted new product liability legislation during the sample period and "0" otherwise. World Trade Organization (WTO) membership is controlled for using a dummy variable indicating whether a country joined the WTO within the sample period. GDP growth rate is included, as firms in rapidly growing economies may prioritize safety investments to sustain expansion. Country and industry fixed effects are incorporated to control for unobserved heterogeneity. Year fixed effects capture macroeconomic fluctuations that may influence workplace safety. Standard errors are clustered at the country level to address potential correlations among

firms in the same regulatory environment. All continuous variables are winsorized at the 1% level to mitigate the impact of outliers. To reduce concerns over reverse causality, the dependent variable is measured at *t+1*; explanatory variables are measured at *t*.

Hypotheses are tested using ordinary least squares (OLS) regressions with country, industry, and year fixed effects. The primary equation is:

$$(Log)Employee\ Accidents_{\{it+1\}} = \alpha_t + \alpha_u + \alpha_i + \delta\big(Major\ Reform\ Existence_{\{it\}}\big) + \gamma X_{\{it\}} + \varepsilon_{\{it\}}$$

where *i* indexes firms and t indexes years. Employee accidents at time *t+1* is the dependent variable. The key explanatory variable, major reform, is a dummy variable equal to "1" if the firm is located in a country that implemented a major board reform law and "0" otherwise. *X* represents a vector of control variables. The coefficient of interest, δ, captures the effect of board reform laws on workplace safety. To account for potential multicollinearity, interactions with investor protections and employee protections are tested based on median-split values.

To address potential selection bias, a Heckman selection model is employed, and an inverse Mills ratio is computed to correct for firms' likelihood of reporting accidents. Robust standard errors clustered at the country level are used in all models. The inclusion of these econometric adjustments strengthens causal inference by controlling for omitted variable bias and sample selection effects. Table 2 presents the descriptive statistics of the variables used regression models.

[Insert Table 2 here]

**RESULTS**

Before conducting regression analyses, we perform multicollinearity diagnostics by calculating the variance inflation factor (VIF). Untabled results indicate that average VIF values are below 6, with none exceeding 10, the threshold for concern. Table 3 is used to test our hypotheses.

[Insert Table 3 here]

In Model 1, we examine the impact of control variables and firm performance measures on employee accidents. Model 2 tests Hypothesis 1, where the effect of major reform on (log) employee accidents is positive and significant (β = 0.593, $p < .01$), supporting the hypothesis. On average, 123 additional employee accidents occur when board reform laws are present, after controlling for financial and governance characteristics as well as country, industry, and year fixed effects.

Models 3 and 4 test Hypothesis 2, which proposes that the positive relationship between board reform laws and employee accidents is stronger in countries with higher investor protections. We conduct subgroup analyses based on the median investor protection value (6.85), dividing the sample into high and low investor protection groups. In Model 3 (high investor protection), the coefficient of major reform is positive and significant ($\beta = 0.307$, $p = .011$). In Model 4 (low investor protection), it is positive but not significant ($\beta$

= 0.161, $p$ = .683). A Wald test confirms that the coefficients differ significantly, $F(1, 59) = 4.96$, $p$ = .0297. In magnitude, employee accidents increase by 92 in high investor protection countries when reform laws exist, controlling for financial and governance characteristics.

Models 5 and 6 test Hypothesis 3, suggesting that the relationship between board reform laws and employee accidents is stronger in countries with low employee protections. We conduct subgroup analyses, categorizing firms based on employee protections. In Model 5 (low employee protections), the coefficient of major reform is positive (β = 0.450, $p$ = .015). In Model 6 (high employee protection), the coefficient is negative and significant (β = –0.692, $p$ < .01). A Wald test confirms that the coefficients significantly differ, $F(1, 59) = 18.62$, $p$ < .01. In magnitude, employee accidents increase by 107 in low employee protection countries when reform laws exist. In contrast, in high employee protection countries, accidents decrease by 34 under reform laws, after controlling for financial and governance factors.

Overall, our findings highlight the varying effects of board reform laws on workplace safety across institutional environments. The presence of major board reforms correlates with increased employee accidents, but this relationship is influenced by investor and employee protection levels. While board reforms may improve governance, they may also introduce operational disruptions that impact workplace safety, particularly in settings with weak labor protections.

**Robustness checks**

Country and industry fixed-effects regressions mitigate bias from time-invariant firm heterogeneity but do not fully account for firms influencing board reform laws or unobservable time-variant heterogeneity. Additionally, the adoption of major board reform laws may be non-random and correlated with variables affecting employee accidents, raising endogeneity concerns.

To address these concerns, we employ extended regression models (ERMs) using Stata 17. ERMs correct for endogenous covariates, sample selection bias, nonrandom treatment assignment, and within-panel correlation. We distribute major board reform laws quasi-randomly across countries with similar political and trade environments, using political variables as instruments. Prior research links political economy variables to regulatory changes (Kroszner & Strahan, 1999; Pagano & Volpin, 2001, 2005) and financial outcomes (Beck et al., 2001).

Following Correa and Lel (2016), we instrument the presence of major board reform laws using political orientation variables from the Inter-American Development Bank's Political Institutions Database (Beck et al., 2001). We code political orientation with an indicator for left/right economic policy stance and continuous variables for opposition voting share and margin of majority.

[Insert Table 4 here]

The extended linear probability regression (Table 4, Model 1) tests the effect of major board reform laws on employee accidents. The coefficient for major board reform law existence is positive and significant

($\beta$ = 0.442, $p$ < .01), supporting Hypothesis 1. The presence of such laws increases employee accidents by 106 on average.

Hypothesis 2 posits that the relationship between board reform laws and employee accidents is moderated by investor protections. Incorporating voting share of the largest opposition party as an additional instrument, Model 2 shows a positive and significant interaction effect ($\beta$ = 1.265, $p$ = .010). The marginal effect of board reform laws on employee accidents is 4.11 ($z$ = 8.94) for low investor protections (mean – 1 SD) and 4.50 ($z$ = 15.62) for high investor protection (mean + 1 SD), supporting Hypothesis 2.

Hypothesis 3 suggests that employee protection levels influence the effect of board reform laws on accidents. Subgroup analysis shows a significant positive coefficient in the low employee protection group ($\beta$ = 2.752, $p$ < .01; Model 3), while the effect is weaker but still significant in the high employee protection group ($\beta$ = 0.848, $p$ < 0.01; Model 4). These results support Hypothesis 3, suggesting that the nonrandom nature of board reform laws does not drive the findings.

To further validate results, we construct a matched sample using coarsened exact matching (CEM). CEM pairs treatment firms (subject to reform laws) with control firms (not subject to laws) based on firm characteristics: log sales (firm size), leverage, ROA, Tobin's Q, dividends, industry-adjusted stock returns, and institutional ownership. We also include two-digit SIC industry and year fixed effects. CEM reduces imbalance in covariates between groups, improving causal inference (Blackwell et al., 2009; Iacus et al., 2012).

Using this matched sample, we conduct a weighted fixed-effects linear probability model regression. Model 5 (Table 4) shows that the Post × treatment coefficient remains positive and significant ($\beta$ = 0.206, $p$ < 0.01), reinforcing Hypothesis 1. Subgroup analysis of the CEM sample reveals that in high investor protection countries, Post × treatment is positive and marginally significant ($\beta$ = 0.143, $p$ = .077), whereas in low investor protection countries, the effect is negative but not significant ($\beta$ = –0.031, $p$ = .803). Similarly, in low employee protection countries, Post × treatment is positive and significant ($\beta$ = 0.197, $p$ = .048), but in high employee protection countries, it is positive but not significant ($\beta$ = 0.023, $p$ = .811).

**Supplemental Analyses**

[Insert Table 5 here]

Table 5 presents results using alternative measures of investor and employee protections. Using the anti-director index as an alternate investor protection measure, board reform laws continue to exhibit a stronger positive effect in high investor protection countries ($\beta$ = 2.075, $p$ < .01) and a negative effect in low investor protection countries ($\beta$ = –0.287, $p$ = .019), reinforcing Hypothesis 2. Similarly, other employee protection indices confirm that board reforms significantly increase workplace accidents in weak employee protection countries ($\beta$ = 1.906, $p$ < .01) but show no significant effect in strong employee protection countries ($\beta$ = –0.161, $p$ = .295), further supporting Hypothesis 3. Table 5 (Model 5) also confirms that board

reform laws significantly increase lost workdays ($\beta = 0.962$, $p < 0.01$), with firms experiencing a 48% rise in lost workdays when these laws are enacted. These results remain robust after including additional controls for firm performance, governance characteristics, and macroeconomic factors.

Taken together, our cross-national evidence shows that major board reforms—while improving shareholder oversight—can elevate accident risk when enacted in settings with strong investor rights and weak employee protections. At the same time, our heterogeneity analyses and theory imply that institutional context matters: in stronger labor-protection regimes and when reform content bolsters risk governance, safety outcomes need not deteriorate and may improve. Policymakers and boards can therefore design reforms with safeguards (committee mandates, safety KPIs, disclosure harmonization) that preserve accountability without eroding employee welfare.

## DISCUSSION

The findings contribute to the corporate governance literature by highlighting an unintended consequence of board reform laws. Although such reforms are designed to enhance transparency and protect shareholder interests (Fauver et al., 2017), they may inadvertently lead to underinvestment in workplace safety, thereby compromising employee well-being (Shi et al., 2021). This trade-off challenges the assumption that enhanced governance uniformly benefits all stakeholders and underscores the need for more balanced approaches (Aguilera et al., 2007).

Our heterogeneity tests indicate that in strong employee-protection environments, the adverse association weakens and can even reverse when dismissal frictions, works councils, or union coverage constrain speed-to-efficiency moves. Reforms whose content strengthens committee independence and disclosure can complement established safety systems by elevating board attention to operational risk. Where shareholder power is high but countervailed by robust labor institutions, safety investments may be maintained or enhanced as part of broader risk-management mandates. These contingencies suggest that governance changes are not universally harmful for safety; their net effect turns on who holds countervailing power and the specific content of the reform.

We outline concrete safeguards that regulators, exchanges, and boards can adopt alongside reforms: (1) mandate or encourage a board-level safety and operations risk committee (or explicit charter for audit/risk committees) with authority over leading indicators; (2) require periodic board training on process safety and human-factors risk; (3) embed safety KPIs in CEO incentive plans; (4) strengthen incident disclosure comparability with common definitions and assurance; and (5) adopt comply-or-explain statements specifically addressing how safety will be preserved during cost-efficiency programs triggered by new governance constraints.

For regulators and board members, our results further suggest that governance reforms should incorporate safeguards for employee welfare. Potential measures include mandating employee representation on boards or establishing dedicated safety oversight committees to counterbalance cost-cutting pressures that erode safety investments (Cobb, 2016).

Although this study employs multiple methodologies to mitigate potential biases, limitations remain. Reliance on reported accident data may be affected by underreporting. Future research could complement these quantitative findings with qualitative approaches—such as interviews and case studies—to further explore internal decision-making processes. Additional studies might also examine industry-specific dynamics or the influence of corporate culture on these outcomes.

## CONCLUSION

This study provides robust evidence that board reform laws—despite their goal of enhancing corporate governance and protecting shareholder interests—can lead to unintended adverse effects on workplace safety. The findings demonstrate that these reforms are associated with increased employee accidents and lost workdays, particularly in environments characterized by robust investor protections and high labor market flexibility. By integrating insights from political decision-making, stakeholder, and resource dependency theories, the study underscores the need for balanced governance approaches that safeguard both financial performance and the firm's most valuable asset—its employees.

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**Table 2.** Descriptive Statistics

| | Variable | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | (Log) employee accidents | 4.25 | 2.08 | 1.00 | | | | | | | | | | | | | |
| 2 | Major reform | 0.91 | 0.29 | 0.03 | 1.00 | | | | | | | | | | | | |
| 3 | Investor protections | 6.61 | 0.88 | -0.02 | 0.03 | 1.00 | | | | | | | | | | | |
| 4 | Employee protections | -5.63 | 2.07 | 0.19 | -0.24 | 0.41 | 1.00 | | | | | | | | | | |
| 5 | (Log) total assets | 17.43 | 2.71 | -0.07 | -0.03 | 0.03 | -0.30 | 1.00 | | | | | | | | | |
| 6 | Leverage | 0.17 | 0.15 | 0.06 | -0.02 | 0.11 | 0.14 | -0.18 | 1.00 | | | | | | | | |
| 7 | Return on assets | 0.05 | 0.07 | 0.04 | -0.06 | 0.10 | 0.08 | -0.13 | 0.07 | 1.00 | | | | | | | |
| 8 | Market-to-book | 2.84 | 3.37 | 0.07 | 0.02 | -0.02 | 0.03 | -0.19 | 0.15 | 0.31 | 1.00 | | | | | | |
| 9 | Industry-adjusted stock returns | 0.03 | 0.29 | 0.00 | -0.02 | 0.02 | 0.04 | -0.04 | 0.01 | 0.10 | 0.10 | 1.00 | | | | | |
| 10 | Dividend | 0.03 | 0.03 | 0.00 | -0.05 | -0.11 | -0.06 | -0.19 | -0.02 | 0.40 | 0.44 | 0.01 | 1.00 | | | | |
| 11 | Free cash flow | 0.07 | 0.08 | -0.12 | -0.02 | 0.14 | 0.14 | -0.09 | 0.02 | 0.21 | 0.10 | 0.06 | 0.06 | 1.00 | | | |
| 12 | Property, plant & equipment | 0.27 | 0.26 | -0.19 | -0.07 | 0.17 | 0.06 | -0.08 | 0.39 | 0.12 | -0.08 | 0.02 | 0.01 | -0.03 | 1.00 | | |
| 13 | Capital expenditure | 0.10 | 0.21 | -0.28 | -0.03 | 0.05 | 0.03 | -0.10 | 0.25 | 0.02 | -0.09 | -0.01 | -0.05 | -0.05 | 0.61 | 1.00 | |
| 14 | R&D intensity | 0.01 | 0.08 | -0.05 | 0.03 | 0.02 | -0.02 | -0.01 | -0.01 | -0.04 | -0.02 | -0.01 | -0.03 | 0.00 | 0.01 | 0.07 | 1.00 |
| 15 | (Log) employees | 9.19 | 1.73 | 0.51 | -0.07 | 0.08 | 0.04 | 0.27 | 0.06 | 0.09 | 0.06 | 0.00 | -0.02 | 0.06 | -0.15 | -0.31 | -0.12 |
| 16 | Firm age | 62.47 | 46.44 | 0.03 | 0.09 | 0.00 | 0.03 | -0.08 | 0.02 | -0.01 | 0.01 | -0.01 | -0.05 | -0.05 | -0.01 | -0.01 | 0.03 |
| 17 | Product market rivalry (HHI) | 0.53 | 0.34 | 0.07 | -0.16 | -0.01 | -0.01 | -0.09 | 0.16 | 0.17 | 0.03 | 0.02 | 0.05 | 0.18 | 0.12 | -0.05 | -0.01 |
| 18 | Product diversification | 0.50 | 0.30 | -0.12 | -0.04 | 0.07 | -0.01 | -0.06 | 0.07 | 0.11 | 0.04 | 0.02 | 0.09 | 0.09 | 0.19 | 0.11 | 0.00 |
| 19 | Geographic diversification | 0.51 | 0.32 | -0.17 | -0.06 | 0.02 | -0.09 | 0.08 | 0.10 | 0.02 | 0.01 | -0.02 | 0.04 | -0.06 | 0.17 | 0.15 | 0.01 |
| 20 | Independent directors (%) | 0.57 | 0.28 | 0.18 | 0.06 | 0.19 | 0.25 | -0.35 | 0.22 | 0.12 | 0.16 | 0.03 | 0.08 | -0.03 | 0.07 | 0.04 | 0.02 |
| 21 | CEO duality | 0.39 | 0.49 | 0.16 | 0.06 | 0.21 | 0.20 | 0.02 | 0.08 | 0.08 | 0.12 | -0.01 | 0.00 | 0.08 | -0.01 | -0.04 | 0.00 |
| 22 | Institutional ownership (%) | 0.32 | 0.31 | 0.24 | 0.12 | 0.28 | 0.29 | -0.27 | 0.21 | 0.17 | 0.19 | 0.06 | 0.01 | 0.12 | 0.02 | -0.05 | -0.01 |
| 23 | Inside ownership (%) | 0.18 | 0.24 | -0.10 | -0.15 | -0.09 | -0.16 | 0.19 | 0.03 | 0.08 | -0.08 | 0.00 | -0.01 | 0.06 | 0.16 | 0.05 | -0.01 |
| 24 | (Log) Total CEO compensation | 14.58 | 1.14 | 0.27 | 0.11 | 0.27 | 0.30 | -0.10 | 0.18 | 0.11 | 0.16 | 0.02 | 0.00 | 0.03 | 0.00 | -0.01 | 0.02 |
| 25 | ADR dummy | 0.49 | 0.50 | 0.09 | -0.07 | -0.32 | -0.11 | 0.22 | -0.19 | -0.07 | -0.10 | 0.01 | 0.03 | -0.01 | -0.16 | -0.11 | -0.02 |
| 26 | Product liability law | 0.95 | 0.21 | 0.09 | 0.15 | -0.05 | -0.10 | -0.01 | 0.02 | -0.03 | 0.02 | 0.00 | -0.03 | -0.01 | -0.09 | -0.07 | -0.01 |
| 27 | World Trade Organization member | 0.01 | 0.10 | -0.02 | -0.34 | 0.15 | -0.07 | 0.13 | 0.01 | 0.05 | -0.02 | 0.03 | 0.05 | -0.03 | 0.06 | 0.01 | -0.02 |
| 28 | GDP growth (%) | 0.02 | 0.02 | -0.13 | -0.03 | -0.03 | -0.31 | 0.06 | -0.01 | 0.08 | 0.06 | -0.04 | 0.05 | -0.01 | 0.04 | 0.03 | 0.01 |

Note: Absolute value of correlations great than 0.01 significant at p<.05 levels.

**Table 2.** Descriptive Statistics (Continued)

| | Variable | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | (Log) employees | 1.00 | | | | | | | | | | | | | |
| 16 | Firm age | 0.04 | 1.00 | | | | | | | | | | | | |
| 17 | Product market rivalry (HHI) | 0.11 | 0.04 | 1.00 | | | | | | | | | | | |
| 18 | Product diversification | -0.04 | -0.06 | 0.05 | 1.00 | | | | | | | | | | |
| 19 | Geographic diversification | -0.08 | -0.04 | 0.02 | 0.30 | 1.00 | | | | | | | | | |
| 20 | Independent directors (%) | 0.01 | 0.02 | -0.01 | -0.01 | -0.08 | 1.00 | | | | | | | | |
| 21 | CEO duality | 0.15 | 0.02 | -0.03 | -0.01 | -0.06 | 0.11 | 1.00 | | | | | | | |
| 22 | Institutional ownership (%) | 0.17 | 0.05 | 0.03 | 0.10 | -0.05 | 0.48 | 0.26 | 1.00 | | | | | | |
| 23 | Inside ownership (%) | 0.08 | -0.08 | 0.20 | 0.08 | 0.16 | -0.35 | -0.08 | -0.34 | 1.00 | | | | | |
| 24 | (Log) Total CEO compensation | 0.15 | 0.06 | -0.09 | -0.02 | -0.06 | 0.37 | 0.25 | 0.45 | -0.28 | 1.00 | | | | |
| 25 | ADR dummy | 0.11 | 0.02 | 0.06 | 0.01 | -0.04 | -0.36 | -0.18 | -0.33 | 0.17 | -0.24 | 1.00 | | | |
| 26 | Product liability law | 0.04 | 0.02 | -0.05 | -0.03 | -0.08 | 0.02 | 0.03 | 0.09 | -0.12 | 0.10 | -0.04 | 1.00 | | |
| 27 | World Trade Organization member | 0.08 | -0.05 | 0.04 | 0.04 | 0.05 | -0.08 | -0.06 | -0.08 | 0.15 | -0.06 | 0.07 | -0.03 | 1.00 | |
| 28 | GDP growth (%) | 0.01 | -0.03 | 0.03 | 0.05 | 0.11 | 0.04 | -0.05 | -0.06 | 0.08 | -0.09 | -0.08 | -0.09 | -0.04 | 1.00 |

Note: Absolute value of correlations great than 0.01 significant at p<.05 levels.

**Table 1**. OLS Regressions
Impact of the Existence of Major Board Reform Laws on (Log) Number of Employee Accidents

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| | Employee Accidents | Employee Accidents | Employee Accidents | Employee Accidents | Employee Accidents | Employee Accidents |
| Dependent Variable | | | High I/P | Low I/P | Low E/P | High E/P |
| Major reform | | 0.593 | 0.307 | 0.161 | 0.450 | -0.692 |
| | | [0.000] | [0.011] | [0.683] | [0.015] | [0.000] |
| (Log) total assets | 0.145 | 0.147 | 0.049 | 0.218 | 0.235 | -0.031 |
| | [0.040] | [0.039] | [0.592] | [0.010] | [0.037] | [0.608] |
| Leverage | -0.570 | -0.570 | -0.929 | -0.061 | 0.048 | -1.405 |
| | [0.036] | [0.036] | [0.003] | [0.858] | [0.872] | [0.001] |
| Return on assets | -0.182 | -0.182 | -0.311 | -0.005 | 0.062 | -0.743 |
| | [0.712] | [0.712] | [0.488] | [0.994] | [0.928] | [0.348] |
| Market-to-book | -0.008 | -0.008 | -0.005 | -0.021 | -0.022 | -0.002 |
| | [0.234] | [0.245] | [0.572] | [0.052] | [0.031] | [0.792] |
| Industry-adjusted stock returns | 0.003 | 0.003 | -0.023 | -0.020 | -0.044 | 0.049 |
| | [0.961] | [0.956] | [0.798] | [0.754] | [0.584] | [0.391] |
| Dividend | -1.633 | -1.609 | -0.601 | -1.607 | -1.309 | -2.250 |
| | [0.258] | [0.265] | [0.760] | [0.432] | [0.536] | [0.121] |
| Free cash flow | -1.629 | -1.637 | -0.820 | -2.338 | -1.244 | -1.586 |
| | [0.002] | [0.002] | [0.086] | [0.023] | [0.195] | [0.000] |
| Property plant and equipment | -0.268 | -0.263 | -0.557 | -0.096 | -0.050 | -0.602 |
| | [0.148] | [0.154] | [0.009] | [0.686] | [0.840] | [0.049] |
| Capital expenditure | -0.825 | -0.826 | -0.560 | -0.942 | -0.939 | -0.530 |
| | [0.000] | [0.000] | [0.002] | [0.001] | [0.000] | [0.074] |
| R&D intensity | 0.353 | 0.352 | 0.251 | 0.713 | 0.536 | -0.088 |
| | [0.284] | [0.286] | [0.174] | [0.158] | [0.215] | [0.841] |
| (Log) employees | 0.378 | 0.378 | 0.494 | 0.280 | 0.259 | 0.580 |
| | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] |
| Firm age | -0.001 | -0.001 | 0.002 | -0.004 | -0.002 | 0.000 |
| | [0.350] | [0.349] | [0.043] | [0.001] | [0.065] | [0.926] |
| Product market rivalry (HHI) | 0.166 | 0.165 | 0.364 | 0.056 | -0.007 | 0.410 |
| | [0.204] | [0.207] | [0.012] | [0.779] | [0.967] | [0.025] |
| Product diversification | -0.380 | -0.379 | -0.399 | -0.266 | -0.627 | -0.048 |
| | [0.006] | [0.006] | [0.045] | [0.143] | [0.002] | [0.758] |
| Geographic diversification | -0.081 | -0.084 | 0.094 | -0.317 | -0.179 | 0.098 |
| | [0.625] | [0.611] | [0.691] | [0.126] | [0.369] | [0.695] |
| Independent director (%) | -0.154 | -0.151 | 0.266 | -0.701 | -0.596 | 0.056 |
| | [0.524] | [0.533] | [0.313] | [0.023] | [0.063] | [0.828] |
| CEO duality | 0.061 | 0.061 | 0.029 | 0.025 | 0.088 | -0.025 |
| | [0.405] | [0.408] | [0.722] | [0.865] | [0.530] | [0.718] |
| Institutional ownership (%) | -0.161 | -0.156 | -0.068 | -0.286 | -0.258 | -0.114 |
| | [0.258] | [0.272] | [0.715] | [0.313] | [0.339] | [0.565] |
| Inside ownership (%) | -0.172 | -0.174 | -0.386 | -0.014 | -0.141 | -0.306 |
| | [0.229] | [0.225] | [0.092] | [0.952] | [0.453] | [0.055] |
| Log (total CEO compensation) | -0.001 | 0.000 | -0.012 | 0.018 | 0.068 | -0.049 |
| | [0.991] | [1.000] | [0.833] | [0.768] | [0.308] | [0.222] |
| ADR dummy | 0.194 | 0.196 | -0.017 | 0.342 | 0.477 | -0.143 |
| | [0.139] | [0.138] | [0.905] | [0.133] | [0.018] | [0.192] |
| Product liability law | -0.382 | -0.375 | -0.583 | -0.247 | -0.320 | -0.710 |
| | [0.023] | [0.026] | [0.000] | [0.121] | [0.098] | [0.000] |
| World Trade Organization | 0.507 | 0.511 | 0.483 | | 0.585 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | [0.000] | [0.000] | [0.001] | | [0.004] | |
| GDP growth rate | 1.177 | 1.274 | 0.537 | 1.244 | 0.965 | 0.568 |
| | [0.318] | [0.274] | [0.618] | [0.595] | [0.462] | [0.824] |
| Inverse Mills ratio | -1.099 | -1.086 | -1.369 | -0.889 | -0.888 | -1.473 |
| | [0.000] | [0.000] | [0.000] | [0.035] | [0.057] | [0.001] |
| Constant | 3.250 | 2.645 | 2.881 | 2.790 | 2.044 | 4.187 |
| | [0.043] | [0.104] | [0.130] | [0.176] | [0.409] | [0.010] |
| Observations | 8,812 | 8,812 | 4,760 | 3,834 | 4,293 | 4,301 |
| R-squared | 0.627 | 0.627 | 0.699 | 0.650 | 0.635 | 0.697 |
| Country FE | YES | YES | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES | YES | YES |
| Firm FE | NO | NO | NO | NO | NO | NO |
| Year FE | YES | YES | YES | YES | YES | YES |
| Adjusted R-squared | 0.620 | 0.620 | 0.691 | 0.637 | 0.623 | 0.689 |

Note: Standard errors clustered at the country level. *p*-values are reported in brackets. Two-tailed tests.

**Table 2**. ERM and Matched Sample
Impact of the Existence of Major Board Reform Laws on (Log) Number of Employee Accidents

| Dependent Variable | Model 1<br>Employee Accidents | Model 2<br>Employee Accidents I/P | Model 3<br>Employee Accidents Low E/P | Model 4<br>Employee Accidents High E/P | Model 5<br>Employee Accidents (CEM) |
|---|---|---|---|---|---|
| Major reform | 0.442 | -5.157 | 2.752 | 0.848 | |
| | [0.001] | [0.220] | [0.000] | [0.000] | |
| Investor protections | | -1.042 | | | |
| | | [0.050] | | | |
| Major reform × investor protections | | 1.265 | | | |
| | | [0.010] | | | |
| Post × treatment | | | | | 0.206 |
| | | | | | [0.003] |
| (Log) total assets | 0.147 | 0.173 | 0.238 | -0.034 | -0.068 |
| | [0.033] | [0.020] | [0.018] | [0.536] | [0.007] |
| Leverage | -0.570 | -0.566 | 0.058 | -1.392 | -0.075 |
| | [0.031] | [0.037] | [0.846] | [0.000] | [0.819] |
| Return on assets | -0.184 | 0.037 | -0.050 | -0.607 | 0.490 |
| | [0.706] | [0.939] | [0.940] | [0.420] | [0.370] |
| Market-to-book | -0.008 | -0.009 | -0.017 | -0.000 | -0.026 |
| | [0.238] | [0.152] | [0.073] | [0.948] | [0.181] |
| Industry-adjusted stock returns | 0.003 | 0.016 | -0.017 | 0.051 | -0.162 |
| | [0.958] | [0.779] | [0.820] | [0.413] | [0.017] |
| Dividend | -1.609 | -1.872 | -1.350 | -2.293 | 2.202 |
| | [0.258] | [0.196] | [0.502] | [0.095] | [0.148] |
| Free cash flow | -1.638 | -1.744 | -1.203 | -1.632 | -3.324 |
| | [0.001] | [0.001] | [0.150] | [0.000] | [0.000] |
| Property plant and equipment | -0.262 | -0.275 | -0.132 | -0.595 | -0.596 |
| | [0.148] | [0.129] | [0.586] | [0.034] | [0.030] |
| Capital expenditure | -0.826 | -0.886 | -0.929 | -0.451 | 0.070 |
| | [0.000] | [0.000] | [0.000] | [0.060] | [0.720] |
| R&D intensity | 0.352 | 0.339 | 0.442 | -0.100 | 4.247 |
| | [0.279] | [0.305] | [0.289] | [0.763] | [0.007] |
| (Log) employees | 0.378 | 0.364 | 0.256 | 0.587 | 0.555 |
| | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] |
| Firm age | -0.001 | -0.001 | -0.002 | 0.000 | 0.001 |
| | [0.343] | [0.308] | [0.035] | [0.887] | [0.069] |
| Product market rivalry (HHI) | 0.164 | 0.149 | 0.019 | 0.376 | 0.167 |
| | [0.201] | [0.256] | [0.914] | [0.012] | [0.179] |
| Product diversification | -0.379 | -0.306 | -0.625 | -0.063 | -0.969 |
| | [0.004] | [0.026] | [0.001] | [0.680] | [0.000] |
| Geographic diversification | -0.085 | -0.099 | -0.188 | 0.105 | 0.462 |
| | [0.606] | [0.566] | [0.301] | [0.638] | [0.000] |
| Independent director (%) | -0.152 | -0.168 | -0.552 | 0.124 | 0.360 |
| | [0.526] | [0.509] | [0.061] | [0.619] | [0.007] |
| CEO duality | 0.061 | 0.044 | 0.083 | -0.032 | -0.300 |
| | [0.401] | [0.573] | [0.513] | [0.683] | [0.000] |
| Institutional ownership (%) | -0.155 | -0.125 | -0.149 | -0.161 | 1.995 |
| | [0.269] | [0.419] | [0.575] | [0.429] | [0.000] |
| Inside ownership (%) | -0.174 | -0.112 | -0.117 | -0.254 | 0.278 |
| | [0.218] | [0.453] | [0.522] | [0.081] | [0.058] |
| Log (total CEO compensation) | -0.000 | -0.018 | 0.056 | -0.046 | -0.056 |

| | | | | | |
|---|---|---|---|---|---|
| | [0.998] | [0.724] | [0.341] | [0.179] | [0.121] |
| ADR dummy | -0.376 | -0.228 | -0.387 | -0.777 | -0.053 |
| | [0.021] | [0.089] | [0.029] | [0.000] | [0.598] |
| Product liability law | 0.196 | 0.205 | 0.433 | -0.091 | 0.358 |
| | [0.130] | [0.150] | [0.014] | [0.312] | [0.000] |
| World Trade Organization member | 0.512 | 0.558 | 0.368 | | -0.184 |
| | [0.000] | [0.000] | [0.055] | | [0.209] |
| GDP growth rate | 1.294 | 0.992 | 1.362 | -0.017 | -1.381 |
| | [0.261] | [0.594] | [0.161] | [0.994] | [0.052] |
| Inverse Mills ratio | -1.086 | -1.052 | -0.864 | -1.453 | -0.415 |
| | [0.000] | [0.000] | [0.043] | [0.001] | [0.007] |
| Right | 0.711 | 0.836 | | 1.012 | |
| | [0.042] | [0.039] | | [0.049] | |
| Vote Share of Opposition Parties | | -0.022 | | | |
| | | [0.022] | | | |
| Left | | | 4.852 | | |
| | | | [0.000] | | |
| Constant | 3.436 | 6.874 | 0.036 | 3.079 | -0.586 |
| | [0.033] | [0.037] | [0.988] | [0.063] | [0.602] |
| Observations | 8,812 | 8,113 | 4,440 | 4,372 | 4,118 |
| Country FE | YES | YES | YES | YES | NO |
| Industry FE | YES | YES | YES | YES | NO |
| Firm FE | NO | NO | NO | NO | YES |
| Year FE | YES | YES | YES | YES | YES |
| Log-likelihood | -17251 | -22003 | -8701 | -7970 | |
| R-squared | | | | | 0.803 |
| Adjusted R-squared | | | | | 0.753 |

Note: Standard errors clustered at the country level. *p*-values are reported in brackets. Two-tailed tests

**Table 3**. Poisson FE Regressions
Impact of Major Board Reform Law Existence on (Count) Number of Employee Accidents

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Dependent Variable | Employee Accidents High I/P | Employee Accidents Low I/P | Employee Accidents Low E/P | Employee Accidents High E/P | Employee Lost Workdays |
| Major reform | 2.075 | -0.287 | 1.906 | -0.161 | 0.962 |
| | [0.000] | [0.019] | [0.000] | [0.295] | [0.000] |
| (Log) total assets | -0.075 | 0.334 | -0.076 | 0.497 | 0.308 |
| | [0.218] | [0.000] | [0.178] | [0.000] | [0.000] |
| Leverage | -0.517 | -0.287 | -0.563 | 0.091 | 0.024 |
| | [0.064] | [0.369] | [0.036] | [0.749] | [0.970] |
| Return on assets | -0.175 | -1.951 | -0.684 | 0.373 | -1.472 |
| | [0.544] | [0.005] | [0.051] | [0.248] | [0.164] |
| Market-to-book | -0.010 | -0.033 | -0.003 | 0.008 | -0.048 |
| | [0.006] | [0.027] | [0.494] | [0.610] | [0.002] |
| Industry-adjusted stock | 0.054 | 0.027 | 0.058 | -0.066 | 0.093 |
| | [0.226] | [0.749] | [0.358] | [0.206] | [0.283] |
| Dividend | -7.353 | 1.832 | -6.379 | 0.984 | 2.154 |
| | [0.001] | [0.580] | [0.011] | [0.219] | [0.330] |
| Free cash flow | -2.432 | -0.511 | -2.518 | -0.923 | -0.890 |
| | [0.000] | [0.482] | [0.000] | [0.004] | [0.289] |
| Property plant and | 0.842 | -0.208 | -0.116 | 0.131 | 0.082 |
| | [0.024] | [0.730] | [0.818] | [0.711] | [0.862] |
| Capital expenditure | -2.107 | -1.418 | -1.272 | -0.190 | -0.698 |
| | [0.001] | [0.087] | [0.043] | [0.522] | [0.155] |
| R&D intensity | -0.055 | 0.958 | 0.139 | 13.157 | -1.813 |
| | [0.895] | [0.397] | [0.823] | [0.077] | [0.039] |
| (Log) employees | 0.628 | 0.123 | 0.642 | -0.012 | 0.236 |
| | [0.000] | [0.050] | [0.000] | [0.791] | [0.001] |
| Firm age | -0.000 | -0.002 | 0.000 | -0.037 | 0.000 |
| | [0.806] | [0.036] | [0.758] | [0.130] | [0.947] |
| Product market rivalry (HHI) | -0.242 | -0.071 | -0.369 | -0.054 | 0.381 |
| | [0.099] | [0.618] | [0.006] | [0.657] | [0.115] |
| Product diversification | -0.371 | -0.248 | -0.316 | -0.114 | 0.132 |
| | [0.000] | [0.146] | [0.004] | [0.396] | [0.529] |
| Geographic diversification | 0.778 | -0.209 | 0.868 | -0.020 | -0.454 |
| | [0.000] | [0.283] | [0.000] | [0.745] | [0.006] |
| Independent director (%) | -0.080 | -0.125 | -0.057 | -0.022 | -0.092 |
| | [0.617] | [0.569] | [0.772] | [0.847] | [0.764] |
| CEO duality | 0.040 | 0.184 | 0.081 | -0.019 | -0.010 |
| | [0.397] | [0.124] | [0.127] | [0.617] | [0.919] |
| Institutional ownership (%) | -0.198 | -0.173 | -0.187 | -0.039 | -0.781 |
| | [0.337] | [0.677] | [0.509] | [0.785] | [0.170] |
| Inside ownership (%) | 0.061 | 0.049 | -0.074 | -0.115 | -0.607 |
| | [0.746] | [0.831] | [0.777] | [0.255] | [0.001] |
| Log (total CEO | -0.046 | 0.020 | -0.102 | -0.054 | 0.068 |
| | [0.573] | [0.724] | [0.074] | [0.252] | [0.239] |
| ADR dummy | -0.116 | -0.111 | -0.116 | -0.552 | 0.216 |
| | [0.667] | [0.723] | [0.715] | [0.012] | [0.336] |
| Product liability law | 0.306 | -0.428 | 0.448 | -0.157 | -0.198 |
| | [0.066] | [0.025] | [0.006] | [0.231] | [0.360] |

| | | | | | |
|---|---|---|---|---|---|
| World Trade Organization | | 0.049 | | 0.765 | -0.128 |
| | | [0.800] | | [0.000] | [0.656] |
| GDP growth rate | 1.528 | 3.021 | -0.661 | -0.892 | 5.338 |
| | [0.155] | [0.077] | [0.247] | [0.480] | [0.025] |
| Inverse Mills ratio | -1.089 | -0.106 | -1.029 | -0.212 | -0.277 |
| | [0.000] | [0.728] | [0.001] | [0.358] | [0.246] |
| Constant | 2.158 | 0.339 | 2.953 | 2.288 | 2.195 |
| | [0.070] | [0.895] | [0.033] | [0.399] | [0.051] |
| Observations | 4,596 | 4,425 | 4,361 | 4,267 | 5,775 |
| Country FE | YES | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES | YES |
| Firm FE | NO | NO | NO | NO | NO |
| Year FE | YES | YES | YES | YES | YES |
| Pseudo R-squared | 0.801 | 0.732 | 0.812 | 0.963 | 0.736 |

Note: Standard errors clustered at the country level. *p*-values are reported in brackets. Two-tailed tests.

## Appendix A. Coding of "major board reforms" and country-level timeline

A.1 Coding rule. We classify a reform as major if a statute, code, or binding exchange rule introduced substantive changes to the board's monitoring architecture, including one or more of: (i) board independence thresholds or definitions, (ii) audit/compensation committee independence or charter requirements, (iii) CEO–chair separation or lead independent director provisions, (iv) director/auditor liability, certification, or disclosure enhancements, or (v) comply-or-explain adoption with enforceable monitoring. We code a country-year as 1 from the last major effective fiscal year the reform materially applied to listed firms; otherwise 0. When multiple reforms occurred, the indicator switches to 1 at the last major effective year and remains 1 thereafter.

A.2 Timeline table. Appendix Table A1 reports country, number of firm-year observations, number of unique firms, and the first effective law year coded as major.

### Table A1 Major Board Reform Enactment

| Country | Obs | Firms | Law Year |
|---|---|---|---|
| Argentina | 5 | 3 | 2001 |
| Australia | 352 | 89 | 2004 |
| Austria | 39 | 8 | 2004 |
| Belgium | 75 | 16 | 2005 |
| Bermuda | 75 | 20 | |
| Brazil | 168 | 39 | 2002 |
| British Virgin Islands | 8 | 2 | |
| Canada | 426 | 84 | 2004 |
| Cayman Islands | 126 | 43 | |
| Chile | 37 | 10 | 2001 |
| China | 133 | 48 | 2001 |
| Colombia | 41 | 9 | 2001 |
| Denmark | 68 | 12 | 2001 |
| Finland | 94 | 19 | 2004 |

| | | | |
|---|---|---|---|
| France | 320 | 60 | 2001 |
| Germany | 187 | 44 | 2002 |
| Greece | 36 | 7 | 2002 |
| Hong Kong | 120 | 25 | 2005 |
| Hungary | 21 | 3 | 2003 |
| India | 95 | 24 | 2002 |
| Indonesia | 57 | 17 | 2007 |
| Ireland | 103 | 18 | 2001 |
| Isle of Man | 3 | 2 | |
| Israel | 45 | 8 | 2000 |
| Italy | 202 | 40 | 2006 |
| Japan | 834 | 150 | 2002 |
| Jersey | 34 | 7 | |
| Jordan | 4 | 1 | |
| Kuwait | 5 | 3 | |
| Luxembourg | 31 | 10 | |
| Malaysia | 87 | 23 | 2001 |
| Marshall Islands | 9 | 1 | |
| Mexico | 83 | 19 | 2001 |
| Netherlands | 174 | 30 | 2004 |
| Netherlands Antilles | 5 | 1 | |
| New Zealand | 26 | 9 | |
| Norway | 123 | 17 | 2005 |
| Panama | 4 | 2 | |
| Papua New Guinea | 9 | 1 | |
| Peru | 3 | 1 | |
| Philippines | 26 | 8 | 2002 |
| Poland | 71 | 18 | 2002 |
| Portugal | 37 | 7 | 2001 |
| Qatar | 10 | 3 | |
| Russia | 123 | 22 | |
| Saudi Arabia | 10 | 3 | |
| Singapore | 86 | 27 | 2003 |
| South Africa | 190 | 43 | |
| South Korea | 284 | 57 | 1999 |
| Spain | 191 | 34 | 2006 |
| Sri Lanka | 5 | 1 | |
| Sweden | 171 | 30 | 2006 |
| Switzerland | 156 | 31 | 2002 |
| Taiwan | 231 | 57 | |
| Thailand | 144 | 30 | 2002 |
| Turkey | 94 | 20 | 2002 |

| | | | |
|---|---|---|---|
| United Arab Emirates | 2 | 2 | |
| United Kingdom | 700 | 122 | 1998 |
| United States | 2011 | 363 | 2003 |

A.3 Sensitivity to coding. We re-estimated models using a two-year wash-in and a stricter content filter (requiring at least two content categories). Results are stable in sign and significance for core tests, and heterogeneous effects by investor and employee protections remain.

# Indexed Universal Life Insurance as an Investment Vehicle and a Retirement Saving Account

**Valentina Colon*, Sabrina D'Aulisa*, Chunhui Yu***

**ABSTRACT**

In this paper, we analyze the cash flow, return and risk, protection value, and tax advantages of index universal life insurance. We examine it both as a life insurance policy and as an investment vehicle. While most of the literature and business reviews focus solely on historical index data analysis, our approach goes beyond that. We conduct a case study by comparing the S&P 500 investment fund to indexed universal life insurance, based on both historical data and a dynamic stochastic prediction model. To evaluate potential outcomes, we employ a classical Monte Carlo simulation method. Through this analysis, we aim to uncover the advantages and disadvantages of investing in Indexed Universal Life Insurance policies.

## INTRODUCTION

Life insurance has traditionally been viewed as a tool for providing financial protection to beneficiaries upon the policyholder's death. However, its role in investment and retirement planning has gained increased attention over the past decades (Katt, 2015; Pfau, 2015; Bayraktar and Young, 2016; Bednarczyk et al., 2023). Life insurance products, especially whole life and universal life policies, offer features that can be leveraged for an investment vehicle and a retirement income tool, providing both protection and financial flexibility.

Whole life insurance policies provide lifetime coverage with a cash value component that grows over time. The guaranteed growth of the cash value, coupled with the death benefit, makes whole life insurance a dual-purpose financial product. The cash value can be accessed through policy loans or withdrawals, providing a source of retirement income without the need to liquidate other assets. Universal life insurance offers flexible premiums and adjustable death benefits. Comparing to Whole life policy, universal life insurance has more flexibility and potential higher cash value growth linked to market performance. These policies allow policyholders to adjust contributions based on their financial situation, which can be particularly advantageous during retirement. On the other hand, the variability in returns and the complexity of these products require careful management and understanding. Within universal life insurance there exists two popular types, variable universal life insurance and indexed universal life insurance. Both variable

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and indexed life insurance have the same concept where the customer put money into the policy and part of the money goes into investing to obtain a cash value while the other part of the money goes into paying the insurance policy cost. The main difference between the two comes into play when speaking about the investment portion of the policy. Variable universal life insurance policies offer a range of subaccounts, similar to mutual funds, where policy holders can invest the cash value. These subaccounts typically include various asset classes like stocks, bonds, and money markets. The cash value growth depends on the performance of the chosen subaccounts. There is potential for high returns if the investment performs well, but there is also a risk of loss if the market declines. On the other hand, the indexed universal life insurance policies credit interest to the cash value based on the performance of a chosen stock market index such as S&P 500. The cash value is not directly invested in the market, but rather linked to index performance. The interest credited is usually subject to a participation rate and a cap. There is also a guaranteed minimum interest rate, floor rate, providing downside protection.

According to LIMRA (www.limra.com), in year 2023, the new premium of indexed universal life insurance products was 3.7 billion, which represented 24% of total U.S. life insurance premium sold. This work will focus on analyzing the investment performance of indexed universal life insurance products.

## LITERATURE REVIEW

Permanent life insurance, including whole life and universal life policies, has garnered attention for its dual purpose of providing death benefits and accumulating cash value that can be used during retirement. One of the primary benefits of using life insurance for retirement is its tax-advantaged status. A life insurance policy can offer tax-deferred cash accumulation, tax-free withdrawals (if properly structured), and a tax-free death benefit to beneficiaries. Ben Baldwin analyzed variable universal life as a retirement income strategy. Baldwin performed a Monte Carlo simulation to indicate that this strategy may not be reassuring for an investor looking to gain retirement funds. The tax-advantaged death benefits are what make life insurance policies unique; however, maintenance of the portfolio is necessary to reduce risk (Baldwin, 2007). DeLibero and Pfau also stated that regularly monitoring the variable life insurance policy is essential to optimize cash flow and that life insurance as an asset class should be a supplement to existing retirement portfolios. It may not be suitable for those in lower income brackets. Tax benefits allow for cash value to grow on a tax-deferred basis, providing an option similar to the Roth IRA but without income and fund limitations. Although life insurance is usable as a retirement tool when properly structured, it may not be suitable for every individual as they are illiquid, long-term contracts (DeLibero & Pfau, 2017).

Slaydon, El-Houbi, and Montano analyzed the performance of an Index Universal Life (IUL) policy against a traditional term policy, investing the premium difference into the S&P 500, based on a case study with historical data comparison (Slaydon, El-Houbi, Montano, 2010). Wu and Liang compared an Indexed Universal Life policy and a 529 plan to fund college education. Stochastic models suggested that 100% stock 529 portfolios outperformed the IUL policy; however, the IUL policy was less volatile, indicating a steadier rate of growth (Wu, Liang, 2019). Whether to surrender or hold the contract after four years of

education funding depends on the expectation of stock returns, interest rates, and mortality charges of an IUL policy. It becomes apparent that an IUL policy tends to mitigate market risk due to bounded rates while maintaining steady account growth (Wu, Liang, 2019). Dong, Halen, Moore, and Zeng contrasted numerous portfolios that include life insurance retirement plans with those that do not. The findings show portfolios including a life insurance retirement policy decrease income risk and increase legacy potential. Their study focused on limited pay whole life product model outcomes; however, more complex products such as universal life plans are more common when used as investment tools (Dong, Halen, Moore, Zeng, 2019).

As stated by Dong, Halen, Moore, and Zeng (2019), complex products such as universal life plans are more common when used as an investment tool. In this paper, we will compare the accumulation performance of an Index Universal Life policy against buying a traditional term policy and investing the premium difference into the S&P 500, also through a tax advantage retirement account like ROTH IRA. Similar to Slaydon, El-Houbi, and Montano (2010), we will analyze the case study results based on historical data. Moreover, we will also compare the results through Monte Carlo simulations based on a stochastic model.

**CASE STUDY**

This case study assumes a 30-year-old healthy (insurance health rating: preferred) male, non-smoker, was exploring the options of two investment plans, with annually deposit of $6,000.

1. Buy a 30-year term life insurance policy with death benefit of $500,000 paying level premiums and invest the rest of $6,000 to a S&P index fund through a tax advantage account like Roth IRA.
2. Buy an IUL policy with a death benefit of $500,000 and pay a level premium of $6,000 annually for 30 years. Assume this IUL is an option B policy in the first 30 years, which offers a death benefit that increases as the policy's cash value increases.

The annual cost of the 30-year term life insurance policy was quoted as $560. The annual cost of the IUL policy for the first 30 years was illustrated as in the following table 1. The name of the insurance company that provided the illustrations is withheld for confidentiality.

**Table 1.** Annual cost summary for an IUL policy illustration

| Yr | Age | Premium Outlay | Premium Charge | Per Policy Expense | Per 1000 (Base) | Base COI Charges | Total Annual Cost |
|---|---|---|---|---|---|---|---|
| 1 | 31 | $6,000 | $480 | $120 | $699 | $106 | $1,405 |
| 2 | 32 | $6,000 | $360 | $120 | $699 | $117 | $1,296 |
| 3 | 33 | $6,000 | $360 | $120 | $699 | $143 | $1,322 |
| 4 | 34 | $6,000 | $360 | $120 | $699 | $155 | $1,334 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | 35 | $6,000 | $360 | $120 | $699 | $165 | $1,344 |
| 6 | 36 | $6,000 | $360 | $120 | $699 | $175 | $1,354 |
| 7 | 37 | $6,000 | $360 | $120 | $699 | $186 | $1,365 |
| 8 | 38 | $6,000 | $360 | $120 | $699 | $204 | $1,383 |
| 9 | 39 | $6,000 | $360 | $120 | $699 | $227 | $1,406 |
| 10 | 40 | $6,000 | $360 | $120 | $699 | $250 | $1,429 |
| 11 | 41 | $6,000 | $360 | $120 | $0 | $272 | $752 |
| 12 | 42 | $6,000 | $360 | $120 | $0 | $298 | $778 |
| 13 | 43 | $6,000 | $360 | $120 | $0 | $327 | $807 |
| 14 | 44 | $6,000 | $360 | $120 | $0 | $360 | $840 |
| 15 | 45 | $6,000 | $360 | $120 | $0 | $398 | $878 |
| 16 | 46 | $6,000 | $360 | $120 | $0 | $461 | $941 |
| 17 | 47 | $6,000 | $360 | $120 | $0 | $525 | $1,005 |
| 18 | 48 | $6,000 | $360 | $120 | $0 | $601 | $1,081 |
| 19 | 49 | $6,000 | $360 | $120 | $0 | $686 | $1,166 |
| 20 | 50 | $6,000 | $360 | $120 | $0 | $785 | $1,265 |
| 21 | 51 | $6,000 | $360 | $120 | $0 | $877 | $1,357 |
| 22 | 52 | $6,000 | $360 | $120 | $0 | $1,010 | $1,490 |
| 23 | 53 | $6,000 | $360 | $120 | $0 | $1,163 | $1,643 |
| 24 | 54 | $6,000 | $360 | $120 | $0 | $1,340 | $1,820 |
| 25 | 55 | $6,000 | $360 | $120 | $0 | $1,546 | $2,026 |
| 26 | 56 | $6,000 | $360 | $120 | $0 | $1,784 | $2,264 |
| 27 | 57 | $6,000 | $360 | $120 | $0 | $1,976 | $2,456 |
| 28 | 58 | $6,000 | $360 | $120 | $0 | $2,189 | $2,669 |
| 29 | 59 | $6,000 | $360 | $120 | $0 | $2,429 | $2,909 |
| 30 | 60 | $6,000 | $360 | $120 | $0 | $2,698 | $3,178 |

**HISTORICAL DATA ANALYSIS**

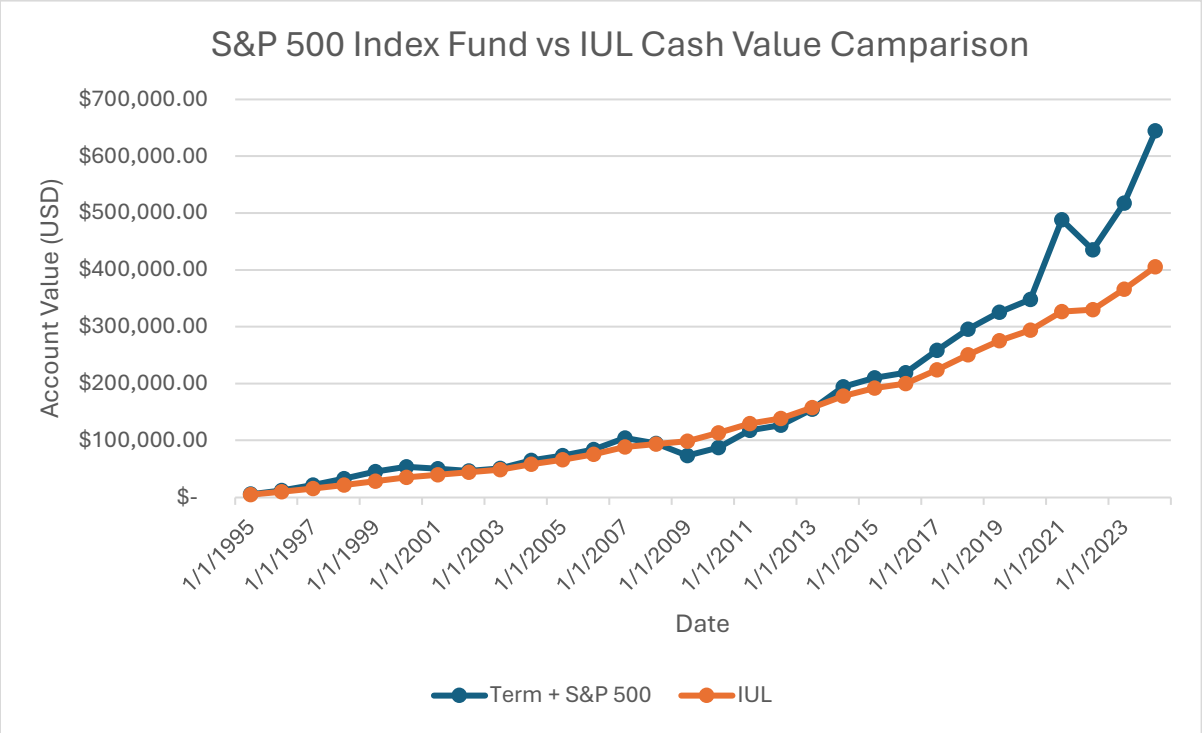
The S&P 500 index price was collected from June 1994 to June 2024. Assume the cash value of IUL policy is credited according to the popular 1-year point-to-point S&P 500 index strategy, with floor rate 0% and cap rate 10%. Here, for simplification, we ignore the index fund dividend, fee and charges.

Note: During these 30-year periods, the index fund account will receive $6,000-$560 (Term Insurance Cost) =$5,440 cash investment and the IUL cash value account will receive $6,000 subtracting ‘Total Annual Cost’ as shown in Table 1.

**Table 2.** Index Fund vs IUL Cash Value based on historical data comparison

| Date | S&P Index | Change % | Index Fund | Floor | Cap | Index Rate | IUL Cash Value |
|---|---|---|---|---|---|---|---|
| 6/1/1995 | 545 | 0.00% | $5,440 | 0% | 10% | 0.00% | $4,595 |
| 6/1/1996 | 671 | 23.09% | $12,136 | 0% | 10% | 10.00% | $9,759 |
| 6/1/1997 | 885 | 31.99% | $21,458 | 0% | 10% | 10.00% | $15,412 |
| 6/1/1998 | 1134 | 28.10% | $32,927 | 0% | 10% | 10.00% | $21,620 |
| 6/1/1999 | 1373 | 21.07% | $45,306 | 0% | 10% | 10.00% | $28,438 |
| 6/1/2000 | 1455 | 5.97% | $53,449 | 0% | 10% | 5.97% | $34,780 |
| 6/1/2001 | 1224 | -15.83% | $50,430 | 0% | 10% | 0.00% | $39,415 |
| 6/1/2002 | 990 | -19.16% | $46,207 | 0% | 10% | 0.00% | $44,032 |
| 6/1/2003 | 975 | -1.55% | $50,933 | 0% | 10% | 0.00% | $48,626 |
| 6/1/2004 | 1141 | 17.07% | $65,065 | 0% | 10% | 10.00% | $58,060 |
| 6/1/2005 | 1191 | 4.43% | $73,385 | 0% | 10% | 4.43% | $65,878 |
| 6/1/2006 | 1270 | 6.62% | $83,686 | 0% | 10% | 6.62% | $75,463 |
| 6/1/2007 | 1503 | 18.35% | $104,483 | 0% | 10% | 10.00% | $88,202 |
| 6/1/2008 | 1280 | -14.85% | $94,403 | 0% | 10% | 0.00% | $93,362 |
| 6/1/2009 | 919 | -28.18% | $73,241 | 0% | 10% | 0.00% | $98,484 |
| 6/1/2010 | 1031 | 12.12% | $87,556 | 0% | 10% | 10.00% | $113,392 |
| 6/1/2011 | 1321 | 28.13% | $117,622 | 0% | 10% | 10.00% | $129,726 |
| 6/1/2012 | 1362 | 3.15% | $126,767 | 0% | 10% | 3.15% | $138,732 |
| 6/1/2013 | 1606 | 17.92% | $154,924 | 0% | 10% | 10.00% | $157,439 |
| 6/1/2014 | 1960 | 22.03% | $194,496 | 0% | 10% | 10.00% | $177,918 |
| 6/1/2015 | 2063 | 5.25% | $210,146 | 0% | 10% | 5.25% | $191,900 |
| 6/1/2016 | 2099 | 1.74% | $219,233 | 0% | 10% | 1.74% | $199,740 |
| 6/1/2017 | 2423 | 15.46% | $258,567 | 0% | 10% | 10.00% | $224,071 |
| 6/1/2018 | 2718 | 12.17% | $295,483 | 0% | 10% | 10.00% | $250,658 |
| 6/1/2019 | 2942 | 8.22% | $325,206 | 0% | 10% | 8.22% | $275,232 |
| 6/1/2020 | 3100 | 5.39% | $348,167 | 0% | 10% | 5.39% | $293,797 |
| 6/1/2021 | 4298 | 38.62% | $488,054 | 0% | 10% | 10.00% | $326,720 |
| 6/1/2022 | 3785 | -11.92% | $435,337 | 0% | 10% | 0.00% | $330,051 |
| 6/1/2023 | 4450 | 17.57% | $517,255 | 0% | 10% | 10.00% | $366,148 |
| 6/1/2024 | 5498 | 23.54% | $644,453 | 0% | 10% | 10.00% | $405,584 |

**Figure 1.** Historical Comparison: S&P 500 Index Fund vs IUL Cash Value




Clearly, the S&P 500 index fund through a tax advantage ROTH account performs better in accumulation than an IUL cash value investment policy under this hypothetical 'back-testing' data assumption, even the IUL account has lower volatility.

**MONTE CARLO SIMULATION**

Following the historical 'backtesting' results, a simulation for thirty years into the future is performed using the Monte Carlo method. With the same base assumption as listed in the historical data analysis, we further assume that the S&P500 index follows a geometric Brownian motion process,

$$dS_t = \mu S_t dt + \sigma S_t dW_t$$

where $S_t$ is the index price; $W_t$ is standard Brownian motion process; $\mu$ is the percentage drift; $\sigma$ is the percentage volatility. (Interested readers may refer to Oksendal, 2013 for the properties of geometric Brownian motion.)

In this case study, we assume that $\mu = 8\%$, which is the average annual rate of return of S&P 500 index for the last 30 years, from 6/1/1995 to 6/1/2024; and $\sigma = 15.9\%$, which is the standard deviation correspondingly.

We have used Microsoft Excel to generate Monte Carlo trials, one trial comparison result is shown as in Figure 2.

**Figure 2.** One trial simulation: SP 500 Index Fund vs IUL Cash Value

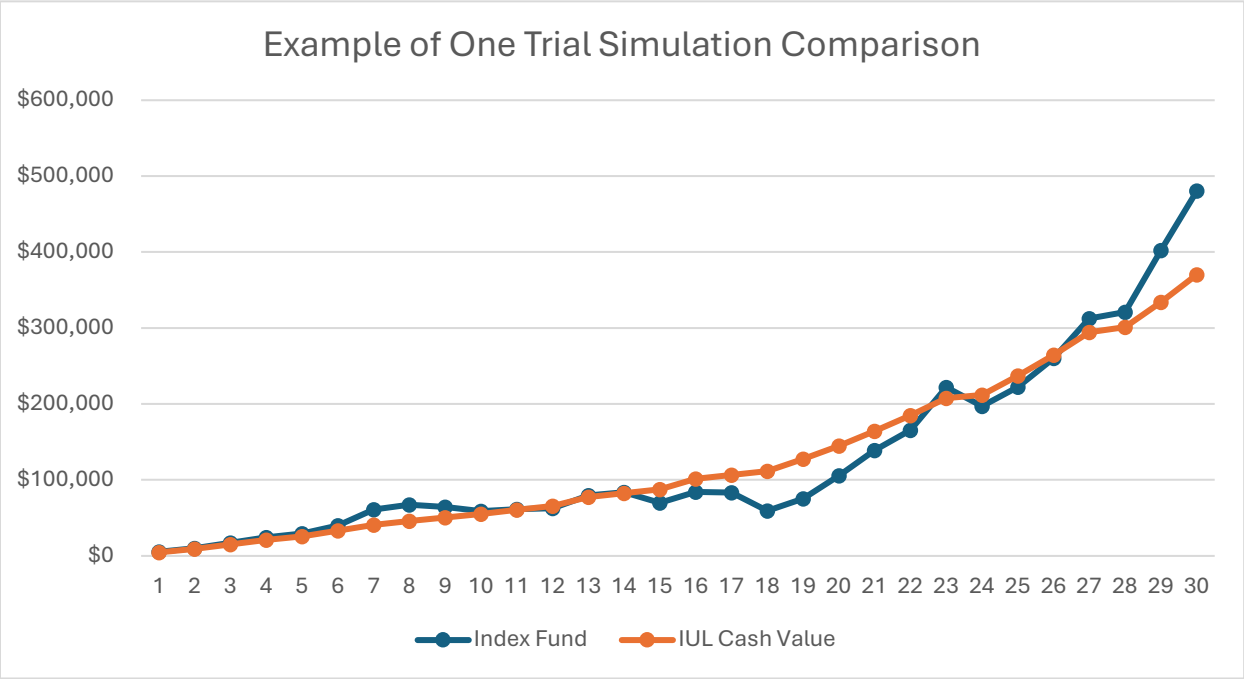
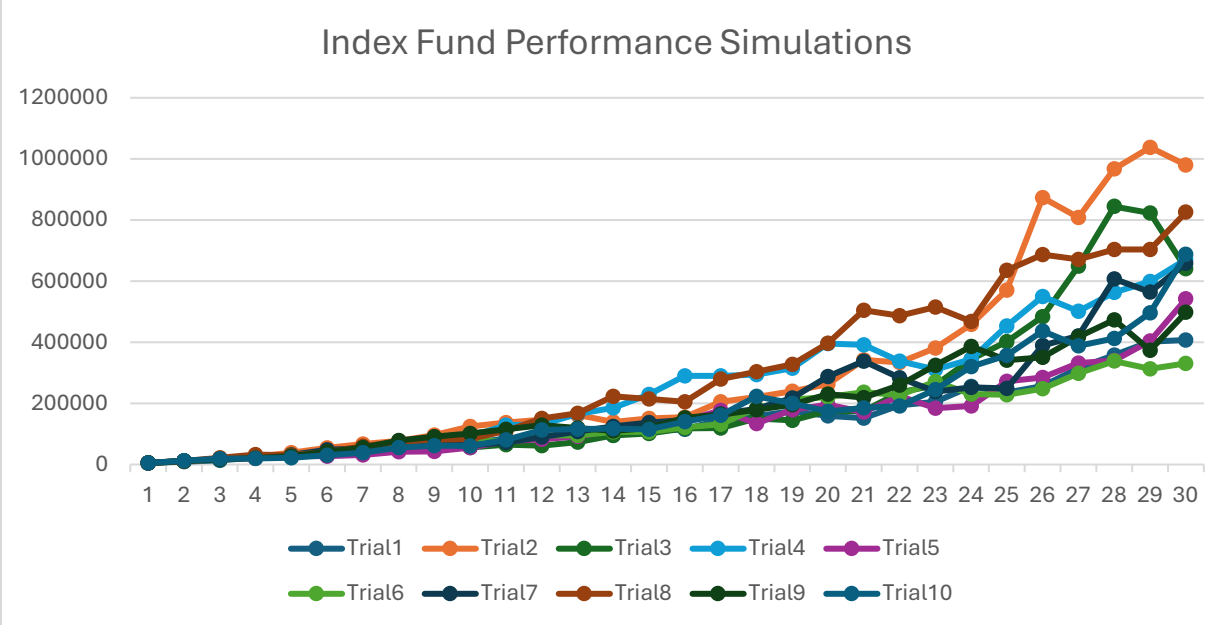



**Figure 3.** Ten trial simulation: SP 500 Index Fund Performance




We performed 500 Monte Carlo simulation iterations; compared the end accumulated value of these two types of investment after a 30-year period.

**Table 3.** Monte Carlo Camparison Results

| | S&P 500 Index Fund | IUL Cash Value |
|---|---|---|
| Win % | 72.20% | 27.80% |
| Mean | $625,172 | $353,995 |
| Median | $509,308 | $348,971 |
| Standard Deviation | 377,663 | 59,276 |

IUL exhibits lower mean, median, and standard deviation than S&P 500 Index fund. The lower average returns (mean and median) are an inherent trade-off for the guarantees and fees of the insurance policy. The cash value growth is capped during strong market years and is reduced by the internal costs of the policy, such as the cost of insurance (COI) and policy fees. A portion of the premium is used to hedge against market risk, which also dampens potential returns. The lower volatility (standard deviation) is a direct result of the built-in "floor" or guaranteed minimum interest rate, which protects the policy's cash value from negative market performance. This downside protection fundamentally alters the policy's return profile, making it less volatile than the underlying index. The ‘risk-averse’ policyholder accepts capped upside potential in exchange for eliminating market risk to their principal.

## CONCLUSIONS

Because of its tax advantages, an IUL policy can be considered a supplement to a Roth retirement plan. In this case study, we evaluated the performance of two types of tax advantage investments: an index fund within a Roth-type retirement account and an indexed universal life insurance (IUL) policy. Based on historical ‘back-testing’ data analysis and Monte Carlo simulation predictions, the S&P 500 Index fund outperformed the IUL in accumulation but with higher volatility. While our results do not suggest that an IUL is a direct substitute for a market-indexed retirement plan, for high-income earners who do not qualify for a Roth IRA, an IUL policy could provide a tax-advantaged alternative with no funding or income limits. Overall, IUL, as an insurance product providing market index growth, offers flexibility and tax advantages but comes with higher fees and complexity. People should take this into consideration when planning to use an IUL policy as a supplement of a retirement investment account.

## REMARKS

We acknowledge the limitation that our analysis is based on a single case study. However, we have chosen a plan that is highly representative of a common type of Indexed Universal Life (IUL) product in the market for two specific reasons.

1. Standard crediting method: The plan selected uses an industry-standard interest crediting method, specifically a capped S&P 500 annual point-to-point strategy with a guaranteed floor. This mechanism is one of the most widely used crediting designs, making our findings relevant to a significant portion of the IUL market.

2. Representative market segment: The plan's design—including its premium structure, fees, and crediting parameters—is typical for IUL products marketed to policyholders prioritizing long-term cash value accumulation. Therefore, our analysis provides valuable insight into the performance characteristics experienced by a large group of actual policyholders.

The insights and methodologies from this case study can also inform and guide future possible larger-scale research.

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# Did Public Pension Asset Allocations Respond to Government Accounting Rule Changes In 2014?

**Jason Hecht[*], Kathryn Yeaton[*], and Charles Steindel[**]**

**ABSTRACT**

Regulations implemented by the Governmental Accounting Standards Board (GASB) in 2014 required a reduction in the rate used to discount future benefit payments which increased the reported present value of public pension plan liabilities. Earlier research indicated that risk-taking behavior of pension fund managers is inversely associated with net actuarial balance, whereby poorly-funded plans took on more investment risk. Using a dynamic panel system of General Methods of Moments models that allow for allocation endogeneity, we find evidence for increased allocations to risky assets following the adoption of the GASB 67/68 standards in 2014.

## INTRODUCTION

Post-retirement obligations of states and municipalities to their employees have become a major concern to legislators, beneficiaries, taxpayers, and other stakeholders.[1] Thus, it is not surprising that the precise methods used for valuing public pension plan assets and liabilities, as well as the reporting and disclosure of fund balances have become the focus of politicians and economists alike. These matters have become particularly contentious in states with notably underfunded pension plans. In response to ongoing concerns about the transparency and usefulness of financial reports from state-sponsored pension funds, the Governmental Accounting Standards Board (GASB) implemented new reporting standards and regulations in 2014.[2]

The accounting standards set forth in GASB 67 provide guidelines for computing the financial position of pension plans that will satisfy GASB 68. These new rules modified the long-standing practice of discounting future benefits (i.e., liabilities) by the assumed rate of return on pension assets. In many cases, the GASB 67 procedure have resulted in a reduction in the rate of interest used to discount plan liabilities. Discounting future benefits by a lower rate increases their present value and thus reduces the reported funding ratio which is equal to the market value of assets divided by the discounted value of liabilities.

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This paper will analyze the impact of the GASB 67/68 changes on pension plan investment allocations. We employ a dynamic panel model that controls for the endogenous determination of asset allocations using a two-step dynamic panel system of General Method of Moments (GMM). Regressors include both plan and state-level factors and instrumental variables. Our main contributions to the literature are fourfold. First, no prior study has attempted to estimate dynamic panel models that control for the endogenous determination of asset allocations. Second, we model fund allocations for six different investment categories. Third, we apply new state-level control variables that have not been tested in models of pension asset allocations. Finally, our panel time dimension (2001-2018) exceeds that of prior studies. To that extent, we test for a structural break in 2014 due to the change in GASB discounting rules using data and variables from the *Pension Plan Database* (hereafter. PPD) maintained by the *Center for Retirement Research* at Boston College.

**SUMMARY OF GASB RULE CHANGES**

Sponsors of public defined-benefit pensions have arguably assumed optimistic rates of returns on pension assets. A plan that applies an optimistic earnings rate to discount future benefits may understate the employer's contribution needed to meet future vested pension payments. This practice has long been questioned by analysts who argue that since pension payments are highly certain, liabilities should be discounted at a low, risk-free rate (Kohn 2008; Munnell et. al., 2012; Haselmann, 2012; Mead, Van Wagner, and Boyd, 2015; Rauh 2009). For example, private pension plan sponsors typically assume relatively low rates of return (Andonov, Bauer, and Cremers, 2017). Alternatively, state pension plan managers argue that their higher discount rate reflects the much smaller probability that municipalities will fail to make pension payments, compared to private pension plan sponsors who are subject to greater solvency and liquidity risk.[3]

In 2012, GASB released two new accounting standards for public defined-benefit pension plans. The first, *GASB Statement No. 67, Financial Reporting for Pension Plans - an Amendment of GASB Statement No. 25* (GASB 2012a), became effective for plan fiscal years beginning after June 15, 2013. The second, *GASB Statement No. 68, Accounting and Financial Reporting for Pensions, an Amendment of GASB Statement No. 27* (GASB 2012b), became effective for employer fiscal years beginning after June 15, 2014. GASB 67 and GASB 68 substantially changed the accounting presentations and disclosures required under the previously promulgated standards in GASB 25, GASB 27 and GASB 50 (GASB, 1994a, 1994b, 2007).

The new GASB standards have had the effect of reducing the flexibility of plan managers in their choice of actuarial methods and assumptions used in consolidating reports to plan sponsors. Specifically, GASB 67 and GASB 68 limited discretion in the reporting of pension costs to improve comparability between different pension plans. By amending GASB 25 with 67/68, the Board established a reporting approach that separates accounting from funding-oriented measures for plans that fall within the scope of the new rules.

However, the Board also concluded that it is not within their purview to set a standard that either establish a specific method of financing pensions or regulate the compliance with the financing policy or method.

The second significant change required by the new standards affected the interest rate used to discount future benefit payments. Under the old GASB 25 standard, the actuarial value of pension liabilities was calculated by discounting anticipated benefit payments with the same rate used to project returns on invested plan assets. However, under GASB 67/68, this procedure can be used to consolidate the position of a plan with its sponsor only if a plan has assets assumed to be sufficient to pay all benefits in any future period. For plans that cannot make that assumption, liabilities must be discounted at a lower "blended" rate that reflects: 1) the long-term expected rate of return on pension plan assets for the years in which the plan will have sufficient funds to pay benefits; and 2) a tax-exempt borrowing rate for years after that period. Given that tax-exempt rates are generally lower than expected returns on plan assets, the impact of the blended discount rate would be to raise the present value of liabilities.

If the reported funding status of a pension plan affects their contributions, benefits, asset allocations, etc., then the adoption of the new GASB standards could materially impact fund balances even though they did not require any significant change in the benefit structure or other plan component (Munnell et. al., 2012). However, although the new GASB standards have resulted in changes in the presentations of financial reports, plans continue to show estimates of pension assets and liabilities consistent with the older (GASB 25) methodology.[4] These calculations are used to compute estimates of the "actuarial determined contribution" (ADC), or the amount of employer contributions needed to ultimately put a plan in a position to pay vested benefits without any further employer contributions. It is quite possible for a plan to present two measures of its funding position: one determined under the older GASB 25 rules, and one based on the new GASB 67/68 rules. Therefore, the new accounting standards could have a significant impact on a plan's calculated funding position.

To provide some comparisons of the impact of the recent accounting changes, figure 1 displays the average aggregate value of the funding ratio under the old (GASB 25) and new (GASB 67/68) rules; the time series are compiled from the *PPD* for 2013 through 2018.[5] As expected, the GASB 67/68 ratio is lower than the GASB 25 ratio for most of this period.

**Figure 1.** Ratio of Actuarial Assets to Actuarial Liabilities ("Funding Ratio")

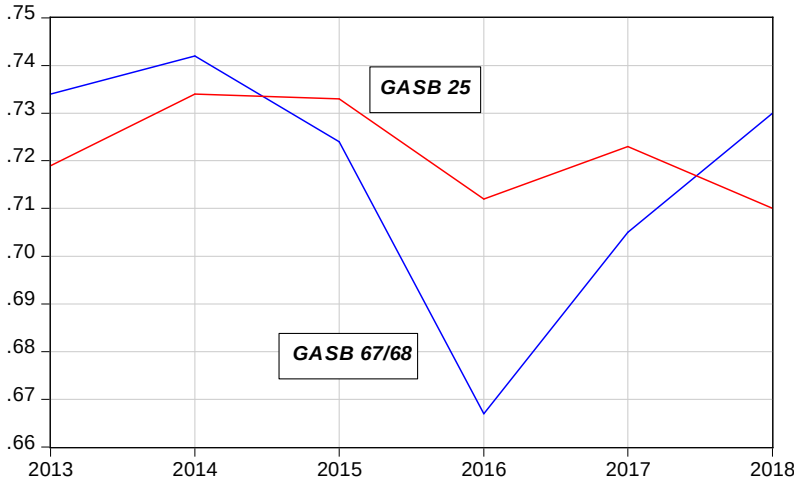
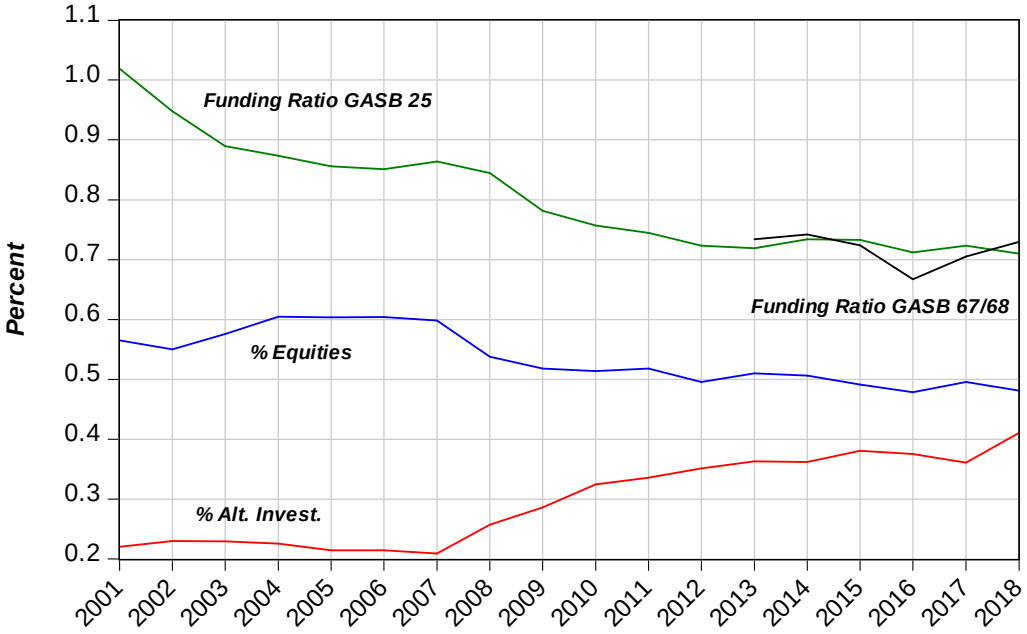



Figure 2 shows the movement in the older (GASB 25) funding ratio alongside the new (GASB 67/68) funding ratio. The lower portion of the graph also shows asset allocation to equities and "alternative" investments (i.e., private equity, hedge funds, commodities) in fund portfolios. Since 2007, while the percentage of assets allocated to equities has declined, alternative investment allocations have increased. Part of the explanation for the reallocation in pension plan assets presumably reflects a need to "reach for yield" as relatively safe long-term bond yields have fallen for several decades.[6]

**Figure 2**. Funding Ratios vs. % of Asset Allocations to Equities and Alternative Investments



**PREVIOUS LITERATURE**

This study aims to fill two gaps in the current literature extant on public pension plan asset allocations. The first is to measure the impact of the 2014 change in accounting and reporting standards governing the valuation of public pension liabilities on asset allocations over the longest available time series (2001-2018). Second, we seek to specify and estimate an econometric model that can account for the endogenous relationship between asset allocations and expected returns, while controlling for the impact of the 2014 accounting change.

The practice of discounting expected public pension benefits by a market-determined interest rate is assumed to reflect an accurate opportunity cost for valuing future benefit payments. Plan managers must ensure adequate short-term liquidity to pay benefits as they come due, while maintaining long-term solvency by investing in a diversified portfolio of assets with reasonable risk-return parameters. Financial economists developed the concept of the "required return" as defined by the Capital Asset Pricing Model (CAPM) to demonstrate that a discount rate applied to a future stream of expected payments must incorporate both the risk-free rate and covariance with market-priced risks (Markowitz, 1952; Sharpe, 1963; Lintner, 1965). Regulators, actuaries, auditors, pension, and investment managers typically employ some form of the CAPM including a multi-factor specification (Fama and French, 1993) while also recognizing imperfect/asymmetric information constraints within insurance and asset markets (Rothschild and Stiglitz, 1978; Stiglitz and Weiss, 1983) in their selection of an appropriate discount rate (Harrington, 1983).

Park (2009) and Rauh (2009) hypothesized that persistent actuarial imbalances have been associated with unrealistically high discount rates on plan liabilities, such that prospective underfunding would become evident when assets failed to realize expected high returns. Prior to the 2014 implementation of new accounting and reporting standards by the Government Accounting Standards Board (GASB) rules 67and 68, plan managers discounted pension payments at the same rate realized on plan assets. This approach understated the present value of future benefits and overstated the reported actuarial value of plan assets to liabilities which fostered managerial complacency regarding unrealistically low levels of contributions and long-term solvency. Brown and Pennacchi (2015) applied Merton's (1974) "structural credit risk" model to a defined-benefit pension fund to demonstrate why pension plan claim reserves should be discounted by yields on US Treasury debt, and not a short-term risk-free rate linked to tax-free municipal instruments.

Reducing the assumed rate of return on assets and discount rate on liabilities would reduce a plan's actuarial ratio of assets to liabilities. It is also possible that fund managers would subsequently work to offset the reduction by increasing the share of riskier, but expected higher-earning assets. In effect, the impact of the changes in the GASB rules have been comparable to the impact of losses in asset values. Previous work has not examined whether the GASB rule change had such an impact. However, prior to the 2014 accounting change, plan sponsors were concerned about the problem, which in many instances reduced the reported actuarial ratio of assets to liabilities and potentially increased pressure to raise contributions. Allen and Petacchi (2014) found that state governments with underfunded defined-benefit

pension plans, budget deficits, and high pension liability discount rates were opposed to the adoption of the new GASB standards. Moreover, states opposed to adopting the new standards were subject to more stringent balanced budget requirements, implying that increased employer contributions would put greater strains on government finance. Subsequent political pressure from public employee unions could arise if financial indicators signaled a persistent decline in plan solvency. Alternatively, support for the adoption of GASB 67/68 was found among external users of state pension plan financial statements (e.g., rating agencies, credit analysts), but the differences between support and opposition was tempered in states with constitutionally protected pension benefits.

The question of selecting an appropriate expected return on assets and discount rate for plan liabilities, was recently addressed in the May 2024 GASB publication "Post-Implementation Review Report GASB Statements No. 67, Financial Reporting for Pension Plans, and No. 68, Accounting and Financial Reporting for Pensions". The report commented that the academic literature suggesting the use of a “blended discount rate that incorporates the long-term expected rate of return is associated with investment choices. Specifically, investments with a higher investment return and, therefore, potentially higher risk, may be selected to reduce the newly recognized net pension liability, assuming investment policies allow these choices (Bonsall et al. 2019; Allen and Petacchi, 2022)”. The latter authors also “found that state governments most opposed to the original proposal to use a fully market-based rate, (rather than the ultimate blended rate in the final standard), are the ones least likely to reduce their discount rate in the post-implementation period. These are also the governments with more significant economic constraints (See also Naughton et. al. 2015).”

Our second contribution to the literature is to examine the impact of the changes in accounting reporting standards through a model of asset allocation that controls for endogeneity between asset allocations and expected returns. Funds with riskier portfolios may assume higher expected returns, but an assumption of higher expected returns may strive to achieve them with riskier portfolios. For example, Mohan and Zhang (2014) test the “accounting effect” hypothesis whereby asset allocations to equities are influenced by the assumed expected rate of return. However, their specification addressed endogeneity concerns via the use of plan fixed-effects and lagged regressors. Brown and Wilcox (2009) tested whether greater discretion by pension fund managers to set (high) discount rates was associated with lower contribution levels. However, these authors did not control for an endogenous relationship between discount rates and contributions. Other studies by Mortimer and Henderson (2014) and Andonov, Bauer, and Cremers (2017), while making important empirical contributions to the literature on pension fund adequacy, did not adequately control for the simultaneous determination between pension plan asset allocations and, for example, aggregate portfolio returns and actuarial funding decisions which are made with respect to investment returns, expected revenue flows and reserve adequacy. These and other empirical studies assume that endogeneity can be adequately captured by time and state dummy variables and fixed effects to control for all unobservable factors.

In contrast, our modeling methodology will explicitly address endogeneity issues by employing General Method of Moments (GMM) estimation techniques in a dynamic panel model using the Arellano-Bond estimator, developed in Arellano and Bond (1991) and refined in Arellano and Bover (1995) and Blundell and Bond (1998), which includes Hansen's (1982) GMM. Roodman (2009) provides rigorous proofs of the superiority of GMM estimators over both OLS and 2SLS, as well as specification advantages from the inclusion of instruments from outside and within the researcher's dataset (p. 105-110). Furthermore, we will employ Sargan (1958) and Hansen (1982) tests of over-identified instruments (or "joint validity of instruments") as well as testing for panel-specific serial correlation (separate from fixed effects), using the Arellano-Bond test of first-order serial correlation in the levels by analyzing the second-order correlation in differences.

**HYPOTHESES**

There are two competing hypotheses to explain the relationship between pension risk and actuarial funding ratios.

**H1**: There is a positive association between a pension plan's actuarial funding ratio and allocations to risky assets.

The "risk management" hypothesis predicts a positive association because a well-funded pension plan can tolerate greater investment risk and thus a higher allocation to risky assets (Rauh, 2009).

**H2**: There is a negative association between a pension plan's actuarial funding ratio and allocations to risky assets.

Alternatively, the "risk transfer" hypothesis predicts a negative association between the actuarial funding ratio and investment allocations, in order achieve a higher likelihood of funding balance by reducing allocations to risky assets. (Mohan and Zhang, 2014)

The implementation of GASB 67/68 resulted in reductions to actuarial funding ratio (especially for underfunded plans) which are reported alongside ratios calculated using the old GASB 25 standard. To test the impact from the implementation of GASB 67/68 on pension plan funding ratios, we interact the lagged actuarial funding ratio with a time dummy variable for 2014. The new variable tests the impact on asset allocations arising from a general effect from the lagged funding ratio (which is common to all funds) as well as its sensitivity to the GASB 67/68 accounting change in 2014. Since the new reporting standards impose a lower discount rate to discount future benefit payments, a significant reduction in the actuarial value of funding ratios occurred for many plans. This leads to the following hypothesis:

**H3**: The implementation of the GASB 67/68 standards is associated with an increase in plan allocations.

**DATA**

To test the above hypotheses, we use data from the *Pension Plan Database* (hereafter, "*PPD*") maintained by the *Center for Retirement Research* at Boston College. The dataset is comprised of 177 state and local government-sponsored plans, covering a range of employees including teachers, public safety, EMS, and other state workers from 2001 through 2018. The *PPD* is a comprehensive longitudinal database that has been widely used by researchers to test a variety of hypotheses about pension plan funding and reserve adequacy as well as other financial and public policy issues (see for example, Allen and Petacchi (2014); Anantharaman and Chuk (2019); Andonov, Bauer, and Cremers (2017); Mohan and Zhang (2014); Mortimer and Henderson (2014)). The *PPD* also includes a range of information drawn from actuarial, GASB and other financial and compliance reports.

The percentage distribution of our panel-year observations by sponsoring locality and covered employee are displayed in table 1; the distribution of observations is also shown for the top-10 states included in our sample:

**Table 1.** Distribution of Panel Observations by Employer and Leading States

**Covered Employees**

*(N = T X K = 3,178)*

| Employer | *State & Local Workers* | *Teachers* | *Public Safety* | *Only State Workers* | *Municipal Workers* | Σ |
|---|---|---|---|---|---|---|
| State | 24.9% | 18.0% | 8.5% | 6.1% | 6.8% | 64.3% |
| County | 0.0% | 0.0% | 0.0% | 0.0% | 6.8% | 6.8% |
| City | 0.0% | 1.1% | 9.1% | 0.0% | 15.3% | 25.5% |
| Schools | 0.0% | 3.4% | 0.0% | 0.0% | 0.0% | 3.4% |
| Σ | 24.9% | 22.5% | 17.6% | 6.1% | 28.9% | 100.0% |

**Panel-Year Observations By Top States**

*(N = T X K = 3,178)*

| | # Obs. | % of Total |
|---|---|---|
| California | 270 | 8.5% |
| Illinois | 144 | 4.5% |
| Texas | 144 | 4.5% |
| Louisiana | 126 | 4.0% |
| Missouri | 126 | 4.0% |
| New York | 126 | 4.0% |
| Arizona | 90 | 2.8% |
| Michigan | 90 | 2.8% |
| Minnesota | 90 | 2.8% |
| Ohio | 90 | 2.8% |
| Pennsylvania | 90 | 2.8% |
| West Virginia | 90 | 2.8% |
| Colorado | 82 | 2.6% |
| Σ | 1,558 | 49.0% |

Over half the pension plans in our sample are state-sponsored (64.3%), followed by city (25.5%), county (6.8%), and school districts (3.4%). Municipal worker plans represent 28.9% of our sample while plans covering both state and local (non-teaching) workers are next with 24.9%, followed by teachers (22.5%), public safety officers (17.6%), and plans exclusively covering state employees (6.1%). Thus, our dataset includes a balanced mix of workers who participate in defined-benefit pension plans that are sponsored by states and municipalities The bottom portion of table 1 shows that in our sample, 10 states accounted for just under half of our panel year observations.

**DEPENDENT VARIABLE: Panel-Year Means**

Table 2 displays the average annual distribution of asset allocations across six investment categories for 177 public pension funds.[7] These data show that while both equities and fixed income investments declined as a share of total pension assets, alternative investments more than doubled their allocation between 2001 and 2018.

**Table 2**. Average Annual Distribution of Public Pension Assets (%)

| | Equities | Fixed Income | Real Estate | Private Equity | Hedge Fund | Commod. | **MEMO:** Alternatives |
|---|---|---|---|---|---|---|---|
| 2001 | 0.565 | 0.333 | 0.063 | 0.058 | 0.043 | 0.019 | 0.120 |
| 2002 | 0.550 | 0.350 | 0.068 | 0.056 | 0.047 | 0.028 | 0.130 |
| 2003 | 0.576 | 0.319 | 0.061 | 0.056 | 0.048 | 0.036 | 0.140 |
| 2004 | 0.605 | 0.293 | 0.057 | 0.052 | 0.051 | 0.042 | 0.144 |
| 2005 | 0.604 | 0.295 | 0.057 | 0.052 | 0.054 | 0.032 | 0.138 |
| 2006 | 0.604 | 0.282 | 0.062 | 0.053 | 0.051 | 0.029 | 0.133 |
| 2007 | 0.598 | 0.274 | 0.066 | 0.055 | 0.052 | 0.021 | 0.128 |
| 2008 | 0.538 | 0.291 | 0.080 | 0.075 | 0.057 | 0.035 | 0.166 |
| 2009 | 0.518 | 0.294 | 0.071 | 0.078 | 0.069 | 0.041 | 0.188 |
| 2010 | 0.514 | 0.282 | 0.068 | 0.086 | 0.074 | 0.045 | 0.205 |
| 2011 | 0.518 | 0.259 | 0.073 | 0.086 | 0.081 | 0.046 | 0.212 |
| 2012 | 0.496 | 0.257 | 0.083 | 0.094 | 0.087 | 0.047 | 0.228 |
| 2013 | 0.510 | 0.238 | 0.082 | 0.088 | 0.095 | 0.050 | 0.232 |
| 2014 | 0.506 | 0.228 | 0.081 | 0.086 | 0.105 | 0.050 | 0.241 |
| 2015 | 0.491 | 0.230 | 0.089 | 0.086 | 0.106 | 0.051 | 0.244 |
| 2016 | 0.478 | 0.232 | 0.098 | 0.091 | 0.101 | 0.060 | 0.252 |
| 2017 | 0.495 | 0.225 | 0.094 | 0.092 | 0.093 | 0.058 | 0.243 |
| 2018 | 0.481 | 0.231 | 0.091 | 0.101 | 0.093 | 0.066 | 0.260 |

**EXPLANATORY VARIABLES**

To measure the impact of plan-specific factors, the GASB rule changes and state-level factors, we employ a mix of quantitative and qualitative variables to explain public pension fund investment allocations. Model mnemonics for each explanatory variable are shown before each definition as well as the expected sign (in parentheses). The dependent variable for each model (%ASSETS$_{it}$) is the percentage of total assets for the i$^{th}$ plan, in the t$^{th}$ year that is allocated to a specific investment category.

1. %ASSETS$_{it-n}$ (+): Each dynamic panel model includes the lagged value of the dependent variable as a right-hand side regressor; a positive sign is expected. In addition, Baltagi (2011, p. 157) observed that: “Arellano and Bond (1991) argued that additional instruments can be obtained in a dynamic panel model if one utilizes the orthogonality condition that exists between lagged values of $Y_{it}$ and the disturbances $v_{it}$.

2. $ACTURATIO_{it-n}$ (+/-): As described above, there are two major hypotheses to explain risk-taking behavior by public pension fund managers. The "risk management" hypothesis predicts a positive association between the actuarial funding ratio and risky assets because a well-funded pension plan can tolerate greater investment risk (Rauh, 2009). Alternatively, the “risk transfer” hypothesis predicts a negative association as current funding deficits are transferred to future taxpayers while pension managers reduce their investments in risky assets to make up for the decline in funding.
3. $ACTURATIO_{it-n} * DUM2014_t$ (+): We test for the impact of the GASB accounting change by interacting the lagged actuarial funding ratio variable with the time dummy variable for 2014. A positive coefficient implies that the GASB 67/68 change in 2014 - requiring a lower discount rate for valuing the liabilities of underfunded plans – spurred an increase in allocations to higher-yielding assets.
4. $INVESRET3YR_{it-n}$ (-): The three-year lagged investment return on a pension fund's total portfolio return. A negative coefficient is expected as higher returns in the previous year would allow for a reduction in portfolio risk.
5. $CALPERSHR_{it-n}$ (+): To capture the "herding" behavior of pension fund managers to emulate (or “mimic”) asset allocation percentages of the largest public pension fund, the California Public Employees Retirement System ("CalPers"); the lagged value of the share of their asset class is used. A positive coefficient is expected as pension fund managers try to emulate/mimic the CalPers’ asset allocation percentages (Mohan and Zhang 2014).[8]
6. $ARC_{it}$ (+/-): Under GASB 25, plan managers had to specify the percentage of the actuarially required contribution ($ARC_{it}$) paid by a sponsor. The ARC (renamed the "actuarially determined contribution (or “ADC" under GASB 67/68) is the amount employers need to cover incremental accrued benefits plus the amortization of any funding gap or actuarial losses. Mohan and Zhang (2014) found that the ARC was inversely associated with pension fund risk-taking. Alternatively, Anantharaman and Chuk (2019) found a positive association as plan sponsors who consistently met their required contributions would be expected to continue to do so.

The following are state-level control variables:

7. $LREALPCY_{it-n}$ (+): The lagged logarithm of real personal income is expected to be positively correlated with plan allocations. Higher income would increase a state's ability to make required contributions either directly through increased employee contributions or indirectly via increased state income and other taxes. Either way, plan managers would have greater latitude to increase risky asset allocations.
8. $(FUNDEDL/TAX)_{it-n}$ (+): The ratio of the funded portion of a pension plan to state tax collections. A higher ratio would imply better plan solvency and thus higher risk tolerance
9. $(UNFUNDEDL/TAX)_{it-n}$ (-): The ratio of the unfunded portion of a pension plan to state tax collections. A higher ratio would imply poorer plan solvency and less tolerance for risk.

10. BALBUDGET$_i$ (+): Indicator variable equal to one if a state has strong requirements for a balanced budget; this variable is derived from a table showing balanced budget requirements (i.e., "constitutional," "statutory," "cannot carry forward deficit") published by the National Conference of State Legislatures (2010).[9] Such a requirement would constrain state contributions to fund pensions and likely increase asset allocations to higher-yielding investments.
11. GUVELECT$_{it-n}$ (+/-): An indicator variable equal to one in the year prior to a gubernatorial election in the state where a pension plan is located. The expected sign for this variable will depend on whether low or high-risk asset classes are being modeled. For the low-risk asset allocation models, a positive coefficient is expected as managers increase their allocation to less volatile assets; for risky assets, a negative coefficient is expected as fund managers reduce their exposure in anticipation of increased state funding in years prior to a gubernatorial election.
12. UNIONPCT$_{it}$ (+/-): The percentage of unionized workers in a state. Both Mohan and Zhang (2014) and Anantharaman and Chuk (2019) test for a "union effect" whereby a higher percentage could be expected to increase funding and reduce portfolio risk. However, the precise impact is ambiguous because increased bargaining power by public sector unions could lead to higher employer contributions and thus lower the required return on plan assets. Alternatively, states with higher union density but poorly funded pensions could require higher expected returns from increased allocations to riskier assets.

**DYNAMIC PANEL MODELS**

To test the main hypotheses regarding pension plan investment allocations and the impact of the GASB 67/68 rule change, all models are estimated using Stata's dynamic panel system General Method of Moments (GMM) using the *xtabond2* program. The estimators are based upon Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998).[10] All specifications include the lagged dependent variable as a regressor to control for both short- and long-run managerial adjustments to asset allocations. Furthermore, Roodman (2009) explains how the *xtabond2* program is appropriate in dynamic panel models with: 1) fewer times series length (T) than the number of cross section (K); 2) a lagged dependent variable regressor; 3) explanatory variables that are not "strictly" exogenous, meaning that they are correlated with past and possibly current realizations of the residuals; 4) fixed effects; and 5) heteroscedasticity and autocorrelation within, but not across panels. The efficacy of this approach has also been underscored in Baltagi (2011, p. 159)

> For [a panel dataset of] fixed T and large N, the recommended estimator in this situation is GMM suggested by Arellano and Bond (1991), which basically differences the model to get rid of the individual fixed effects, and along with them, any time-invariant regressor.

This also gets rid of any endogeneity that may be due to the correlation of these individual effects and the right-side regressors.

Previous empirical work on public pension investment allocations have not employed this modeling strategy, preferring to simply assume that lagged explanatory variables address all endogeneity concerns (Mohan and Zhang, 2014). However, causality can run in both directions between plan allocations and, for example, actuarial required contributions. Panel system GMM can also account for "weak exogeneity" that could arise between investment allocations and reserve adequacy.[11] Another advantage of using the *xtanbond2* program is that time invariant characteristics (e.g., location) as well as unobservable influences (e.g., managerial acumen) may be correlated with explanatory variables. Panel system GMM addresses these issues by estimating a two-equation system in both levels and first-differences. We briefly illustrate how the methodology applies to our econometric models:

The panel system GMM approach, begins with a general model of pension asset allocations estimated in levels

$$\%ASSET_{it} = \beta_1 \%ASSET_{it-n} + \beta_2 PLANMEAS_{it-n} + \beta_3 STATEMEAS_{it-n} + u_{it} \quad \textbf{[1]}$$

where $\%ASSET_{it}$ is the allocation of assets invested in six different investment categories for the $i^{th}$ pension plan in the $t^{th}$ year; $\%ASSET_{it-n}$, the lagged dependent variable; PLANMEAS are plan-specific financial and actuarial measures; STATEMEAS are state-level pension and economic variables; and $u_{it}$ is the observation-specific error term. Plan fixed effects are contained in the error term, $u_{it}$ in equation [1] which consists of the unobserved plan-specific effects, $v_i$ and the observation-specific error term, $e_{it}$, which can be defined as:

$$u_{it} = v_i + e_{it} \quad \textbf{[2]}$$

To address the fixed effects problem, equation [1] is estimated in first-differences and defines the second GMM model [3] as:

$$\Delta\%ASSET_{it} = \beta_1 \Delta \%ASSET_{it-n} + \beta_2 \Delta PLANMEAS_{it-n} + \beta_3 \Delta STATEMEAS_{it-n} + \Delta u_{it} \quad \textbf{[3]}$$

Thus, model [3] removes the fixed (plan-specific) effect, and from equation [2], we derive the following differenced error term:

$$\Delta u_{it} = \Delta v_i + \Delta e_{it} \quad \textbf{[4]}$$

which is equivalent to:

$$u_{it} - u_{it-1} = (v_i - v_i) + (e_{it} - e_{it-1}) = (e_{it} - e_{it-1}) \quad \textbf{[5]}$$

This is the basic structure underlying the *xtabond2* models which uses Hansen's (1982) GMM. Subsequent augmentations from Arellano and Bover (1995) and Blundell and Bond (1998) allow for more instruments that improved efficiency by building a two-equation "system" based on levels (equation [1]) and first-differences (equation [3]). Roodman (2009) provides rigorous proofs of the generality of GMM estimators over both OLS and 2SLS, because GMM "do not assume that good instruments are available outside the immediate dataset" (p.100). Furthermore, the Sargan/Hansen tests of over-identified instruments (or the "joint validity of instruments") are also shown for each allocation model; accepting the null hypothesis for both test statistics is the desired outcome. To test for panel-specific serial correlation (separate from fixed effects), the Arellano-Bond estimator provides tests of first-order serial correlation in the levels by analyzing the second-order correlation in differences. This can be done by calculating the correlation between $v_{it-1}$ in $\Delta v_{it}$ and $v_{it-2}$ in $\Delta v_{it-2}$; accepting the null hypothesis on both AR terms, confirms the absence of panel serial correlation. Finally, we note how Arellano and Bond (1991) use a dynamic specification to capture, for example, short- and long-run adjustments, including, managerial decisions and actions regarding plan allocations and expected returns.

**ESTIMATED MODEL SPECIFICATION**

The following panel econometric equation [6] is estimated for each of six allocation categories, plus a seventh equation for the sum of allocations to private equity, hedge funds, and commodities:

$$\%ASSET_{it} = \beta_0 + \beta_1 \%ASSET_{it-n} + \beta_2 ACTURATIO_{it-n} + \beta_3 (ACTURATIO_{it-n} * DUM2014_{it}) + \beta_4 INVRET3YR_{it-n} + \beta_5 ARC_{it} + \beta_5 CALPERSHR_{it-n} + \beta_6 \log(REALPCY)_{it-n} + \beta_7 (FUNDED/TAX)_{it-n} + \beta_8 (UNFUND/TAX)_{it-n} + \beta_9 BALBUDGET_i + \beta_{10} GOVELECT_{it-n} + \beta_{11} UNIONPCT_{it} + \beta_{12} TIME_t + \varepsilon_{it} \quad \textbf{[6]}$$

where %ASSET is the percentage of assets invested in each investment category: equities, fixed income, real estate, private equity, hedge funds, or commodities for the $i^{th}$ pension fund in the $t^{th}$ year. The explanatory variables include: $ACTURATIO_{it-n}$, the lagged actuarial value of assets divided by liabilities (reported under GASB 25 rules); the interaction term, ($ACTURATIO_{it-n} * DUM2014_{it}$) tests for the change in the funding ratio due to the full-year implementation of GASB 67/68 in 2014; $INVRET3YR_{it-n,}$ is the he lagged composite 3-year overall return on a pension fund's investment portfolio; $ARC_{it}$, is the percentage of the annual required contribution paid by a sponsor; $CALPERSHR_{it-n}$ is the percentage of CalPERS' assets invested in the asset being modeled. State control variables include log($REALPCY_{it-n}$) which is the lagged

log of real personal income; $(FUNDED/TAX)_{it-n}$ and $(UNFUNDED/TAX)_{it-n}$ are the lagged ratios of funded and unfunded pension plan liabilities to total tax collections, respectively; $BALBUDGET_i$ is a dummy variable equal to one if a state has a strong requirement for an annual balanced budget; $GOVELECT_{it-n}$ takes a value of one in the year prior to gubernatorial election; $\%UNION_{it}$ is the percentage of unionized workers; $TIME_t$ are time dummy variables; and $\varepsilon_{it}$ is the random error term.

In each equation, there are endogenous regressors as well as lagged (or "predetermined") regressors and "exogenous" state-level instrumental variables. (Roodman, 2009, pp. 99-100). Robust standard errors are calculated and assume that errors are correlated within individual cross sections. For this reason, Roodman strongly suggests including time dummy variables "to remove *universal* time-related shocks from the errors. (italics added, Roodman, 2009, p. 110). Lag selections on appropriate regressors are based both on prior empirical research as well as each equation's results for the Sargan, Hansen and Arellano-Bond tests.

**ECONOMETRIC RESULTS**

Table 3 shows the panel descriptive statistics for each explanatory variable used in the regression models. The average actuarial funding ratio (reported under GASB 25 rules) is 80 percent; the average 3-year investment return on pension assets is 6.4 percent; the average CalPERS equity percentage is 53.6 percent; and the average percent of the annual required contribution paid by a plan sponsor averaged 9.5 percent.

For the state control variables, the lagged log of real personal income averaged 10.612 ($42,607); the ratios of funded and unfunded plan liabilities to state tax collections, respectively averaged 121 and 27 percent, respectively. The percentage of unionized workers across all states averaged about 11.8 percent.

**Table 3**: Descriptive Statistics for Independent Variables

| *Variable* | Mean | Std. | $N_{it} = K_i X T_t$ | Number of Funds | Avg. # of $T_t$ Per Panel |
|---|---|---|---|---|---|
| $ACTURATIO_{it-1}$ | 0.800 | 0.189 | 2,965 | 177 | 16.8 |
| $ACTURATIO_{it-1} * DUM2014_i$ | 0.043 | 0.175 | 2,965 | 177 | 16.8 |
| $ARC_{it}$ | 0.946 | 0.462 | 3,037 | 177 | 17.2 |
| $INVRET3YR_{it-1}$ | 0.064 | 0.055 | 2,371 | 159 | 14.9 |
| $CALPERSHR_{it-1}$ | 0.536 | 0.056 | 3,186 | 177 | 17.0 |
| $LREALPCYR_{it-1}$ | 10.612 | 0.223 | 3,178 | 177 | 17.0 |
| $(FUNDED/TAX)_{it-1}$ | 1.214 | 1.419 | 3,054 | 177 | 16.8 |
| $(UNFUND/TAX)_{it-1}$ | 0.268 | 0.420 | 3,054 | 177 | 16.8 |
| $BALBUDGET_{it}$ | 0.541 | 0.498 | 3,178 | 177 | 18.0 |
| $UNIONPCT_{it}$ | 0.118 | 0.057 | 3,142 | 175 | 18.0 |

Model (1) in table 4 (below) displays the results for the equity allocation equation using a two-year lag on relevant regressors. The negative and significant coefficient on $ACTURATIO_{it-2}$ is consistent with the "risk transfer" hypothesis, whereby managers seek greater actuarial funding balance by a reduction in investment risk. The coefficient on this variable implies that a one percentage point increase in the funding ratio, results in a decline of 22.5 basis points in equity investments. The significant and positive coefficient on the interaction between the funding ratio and the 2014 time-dummy variable ($ACTURATIO_{it-2}$ *$DUM2014_{it}$), indicates that pension plans increased their allocation to equities by 13.3 basis points following the implementation of the GASB 67/68 rules. Both results support the risk transfer hypothesis and GASB 67/68 rule-change hypothesis, respectively. The positive and significant coefficient of on the $CALPERSHR_{it-2}$ variable, implies that for each percentage point increase in the CalPERS equity allocation, the average plan manager increased allocations to equites by a little more than three-quarters of a percentage point. The coefficient on the indicator variable, $BALBUDGET_i$ indicates that states with a balanced budget requirement, will increase plan equity allocations by 5.4 basis points compared to states without this constraint; this result also supports the risk transfer hypothesis. Finally, the insignificant Sargan and Hansen statistics as well as the insignificant AR(1) and AR(2) terms indicate the validity of the instruments and the absence of panel autocorrelation, respectively. The lag selection in all specifications was based on both the lag between financial results and managerial actions as well as the Hansen-Sargan, and Arellano-Bond diagnostic results.

Model (2) displays the results for the fixed income equation, where the only significant regressor was the lagged dependent variable. A one-year lag was used on most regressors because it provided the best specification tests according to the Arrellano-Bond, Sargan and Hansen probability values. While there is no easy explanation for the model's poor explanatory performance, perhaps the lack of significant variation in fixed income allocations after 2014 may be a contributing factor.

Model (3) shows the results for the real estate allocation model. The negative coefficient on the $ACTURATIO_{it-1}$ supports the risk transfer hypothesis, whereby a percentage point increase in the actuarial funding ratio is associated with a 39.8 basis point decline in the allocations to real estate assets. Although the $ACTURATIO_{it-1}$*$DUM2014_{it-1}$ variable was not significant, it had the expected positive sign, suggesting that the GASB 67/68 rule change increased the demand for risky asset allocations. The expected negative coefficient on the actuarial required contribution ($ARC_{it}$), implied that for each percentage point increase in this ratio, real estate holdings would decline by 17.6 basis points. These results are consistent with Mohan and Zhang (2014) who found that the actuarial funding ratio and required contributions were inversely associated with pension fund risk-taking. The ratios of a plan's funded and unfunded pension obligations to state tax collections had a significant +2.0 and -12.0 basis point impact, respectively. This result provides support for the risk transfer hypothesis, whereby pension funding deficiencies are borne by both current and future taxpayers. Furthermore, in states with a balanced budget requirement, real estate allocations

are increased by about 2 basis points. The acceptance of the null hypotheses for both instrument validity and panel serial correlation, imply that the estimated model does not suffer from endogeneity and inefficiency problems.

**Table 4**. Dynamic Panel System GMM Models of Asset Allocations (%)

| | | *Model 1* | | *Model 2* | | *Model 3* | |
|---|---|---|---|---|---|---|---|
| ***Dependent Variable*** | | %EQUITIES$_{it}$ | | %FIXEDINC$_{it}$ | | %REALEST$_{it}$ | |
| *Lags* | | *(it-2)* | | *(it-1)* | | *(it-2)* | |
| *Explantory Variables:* | *E(Sign)* | $\beta$ | s.e.$^{\tau}$ | $\beta$ | s.e.$^{\tau}$ | $\beta$ | s.e.$^{\tau}$ |
| %DEPVAR$_{it-n}$ | + | 0.008 | 0.065 | 0.778 | 0.163 *** | -0.100 | 0.230 |
| ACTURATIO$_{it-n}$ | - | -0.225 | 0.090 *** | 0.025 | 0.150 | -0.398 | 0.238 * |
| ACTURATIO$_{it-n}$ * DUM2014$_i$ | + | 0.133 | 0.059 ** | -0.017 | 0.071 | 0.175 | 0.128 |
| INVRET3YR$_{it-n}$ | - | -0.167 | 0.210 | 0.136 | 0.143 | 0.053 | 0.269 |
| CALPERSHR$_{it-n}$ | + | 0.776 | 0.183 *** | 0.304 | 0.868 | 6.921 | 5.432 |
| ARC$_{it}$ | - | -0.063 | 0.048 | -0.023 | 0.038 | -0.176 | 0.094 * |
| LREALPCYR$_{it-n}$ | + | 0.001 | 0.040 | 0.005 | 0.011 | -0.019 | 0.044 |
| (FUNDEDL/TAX)$_{it-n}$ | + | 0.011 | 0.010 | -0.003 | 0.008 | 0.020 | 0.013 * |
| (UNFUNDL/TAX)$_{it-n}$ | - | -0.060 | 0.039 | 0.007 | 0.046 | -0.120 | 0.072 * |
| BALBUDGET$_i$ | +/- | 0.054 | 0.013 *** | 0.003 | 0.004 | 0.020 | 0.012 * |
| GUVELECT$_{it-n}$ | +/- | -0.006 | 0.006 | 0.002 | 0.003 | 0.003 | 0.004 |
| UNION%$_{it}$ | +/- | 0.001 | 0.001 | -0.001 | 0.001 | 0.002 | 0.001 ** |
| N=T X K | | | 2,021 | | 2,168 | | 1,524 |
| # of Plans (K) | | | 152 | | 153 | | 132 |
| Avg. T (Yrs.) | | | 13.3 | | 14.2 | | 11.6 |
| AR(1) Prob. | | | 0.211 | | 0.000 *** | | 0.123 |
| AR(2) Prob. | | | 0.430 | | 0.646 | | 0.719 |
| Sargan Test Prob. | | | 0.153 | | 0.770 | | 0.564 |
| Hansen Test Prob. | | | 0.641 | | 0.762 | | 0.589 |
| # of Instruments | | | 29 | | 29 | | 28 |

* Significant at <= 0.10 confidence level.
** Significant at <= 0.05 confidence level.
*** Significant at <= 0.01 confidence level.
$^{\tau}$ Heteroscedasticity-corrected standard errors.

Table 5 displays the panel model results for plan assets allocated to “alternative” investments including private equity (Model 4), hedge funds (Model 5), commodities (Model 6), and an aggregate of all three categories (Model 7). For private equity (Model 4), the significant lagged dependent variable supports the

dynamic panel specification. The negative sign on the three-year average investment rate of return, lagged two-years ($INVESRET3YR_{it-2}$), is consistent with higher ex-post returns reducing the allocation to riskier private equity allocations by 33.2 basis points. Evidence of "herding" behavior to follow CalPers allocations, is supported by the significant coefficient on the $CALPERSHR_{it-2}$ variable which suggests that for each percentage point increase in private equity holdings, the average state pension plan increased their allocations by 33 basis points. On the other hand, for each percentage point increase in the actuarial required contribution ($ARC_{it}$), private equity allocations were reduced by 19.6 basis points. Overall, the econometric evidence supports the risk transfer hypothesis, which may also point to the difficulty with monitoring actual returns on private equity investments (Mittal, 2024). Recent reports suggest that state pension funds have been reducing their holdings in private equity due to investment losses, poor returns, and illiquidity (Gillers, 2024). The Arellano-Bond, Sargan, and Hansan test probabilities all confirm the absence of panel serial correlation as well as the validity of the instrumental variables.

Unfortunately, neither the hedge fund (model 5) nor commodity (model 6) allocation equations provided any statistically significant regressors (other than the lagged dependent variables). The tests of serial correlation and appropriate instruments were all generally acceptable. The widespread insignificance of regressors across the alternative investment allocation models did not meaningfully change with different lag structures.

Model (7) aggregates the three alternative investment allocations into a single model. The results are better than that for either hedge funds or commodities, however, the sample only includes 57 pension plans. The negative sign on the actuarial funding ratio implies that a one percentage increase, leads to a 42.2-basis point decline in alternative investments. Furthermore, the implementation of GASB 67/68 in 2014 is associated with a 25.4-basis point increase in alternative allocations, supporting the risk transfer hypothesis and impact of the GASB 67/68 rule change. The ratios of a state's funded and unfunded -pension obligations (each divided by state tax revenues) had a significant +3.4 and -8.8 basis point impact on alternative investment allocations, respectively. This result supports the risk transfer hypothesis, whereby the funding burden will likely be borne by future and current taxpayers, respectively. Unfortunately, the unexpected positive and significant coefficients on the 3-year investment return ($INVRET3YR_{it-3}$) and actuarial required contribution ($ARC_{it}$), were counter to expectations. Finally, the small number of panel observations (252), number of included pension plans (57), and length of the average panel time series (4.4 years) undermines the robustness of the model, despite acceptable test results supporting the validity of the instruments and the regressor lag structure as evidenced by the absence of panel serial correlation.

**Table 5** – Dynamic Panel System GMM Models of Asset Allocations (%): Alternative Investments

| Dependent Variable | | Model 4 %PRIVEQUT$_{it}$ | | Model 5 %HEDGEFND$_{it}$ | | Model 6 %COMMOD$_{it}$ | | Model 7 % ∑ ALT | |
|---|---|---|---|---|---|---|---|---|---|
| Lags | | (it-3) | | (it-2) | | (it-2) | | (it-3) | |
| Explantory Variables: | E(Sign) | β | s.e.ᵀ | β | s.e.ᵀ | β | s.e.ᵀ | β | s.e.ᵀ |
| %DEPVAR$_{it-n}$ | + | 0.571 | 0.271 ** | 1.374 | 0.574 ** | 1.594 | 0.898 * | 1.351 | 0.296 *** |
| ACTURATIO$_{it-n}$ | - | -0.127 | 0.143 | 0.046 | 0.183 | 0.223 | 0.209 | -0.422 | 0.193 ** |
| ACTURATIO$_{it-1}$ * DUM2014$_i$ | + | 0.075 | 0.068 | 0.083 | 0.090 | -0.102 | 0.122 | 0.254 | 0.133 * |
| INVRET3YR$_{it-n}$ | - | 0.332 | 0.086 *** | 0.130 | 0.640 | -0.112 | 0.384 | 1.426 | 0.605 ** |
| CALPERSHR$_{it-n}$ | + | 0.330 | 0.197 * | -0.825 | 1.384 | N/A | N/A | N/A | N/A |
| ARC$_{it}$ | - | -0.196 | 0.097 ** | 0.133 | 0.128 | 0.041 | 0.144 | 0.185 | 0.089 ** |
| LREALPCYR$_{it-n}$ | + | -0.045 | 0.037 | 0.051 | 0.060 | 0.011 | 0.064 | 0.008 | 0.097 |
| (FUNDEDL/TAX)$_{it-n}$ | + | 0.009 | 0.008 | 0.000 | 0.012 | -0.008 | 0.013 | 0.034 | 0.019 * |
| (UNFUNDL/TAX)$_{it-n}$ | - | -0.055 | 0.051 | 0.025 | 0.058 | 0.057 | 0.057 | -0.088 | 0.052 * |
| BALBUDGET$_i$ | +/- | 0.005 | 0.011 | -0.011 | 0.011 | -0.008 | 0.010 | -0.018 | 0.020 |
| GUVELECT$_{it-n}$ | +/- | -0.008 | 0.005 * | 0.005 | 0.004 | -0.002 | 0.005 | -0.010 | 0.006 |
| UNION%$_{it}$ | +/- | 0.001 | 0.001 | 0.000 | 0.002 | 0.000 | 0.001 | 0.003 | 0.003 |
| N=T X K | | 1,254 | | 751 | | 482 | | 252 | |
| # of Plans (K) | | 122 | | 107 | | 84 | | 57 | |
| Avg. T (Yrs.) | | 10.3 | | 7.0 | | 5.7 | | 4.4 | |
| AR(1) Prob. | | 0.125 | | 0.380 | | 0.562 | | 0.581 | |
| AR(2) Prob. | | 0.849 | | 0.005 *** | | 0.073 * | | 0.419 | |
| Sargan Test Prob. | | 0.377 | | 0.966 | | 0.982 | | 0.073 * | |
| Hansen Test Prob. | | 0.144 | | 0.971 | | 0.986 | | 0.695 | |
| # of Instruments | | 23 | | 22 | | 27 | | 22 | |

* Significant at <= 0.10 confidence level.
** Significant at <= 0.05 confidence level.
*** Significant at <= 0.01 confidence level.
ᵀ Heteroscedasticity-corrected standard errors.

## CONCLUSIONS

GASB 67 and GASB 68 were designed to improve the transparency and consistency of pension reporting by state and local pension plans and their respective government employers. In particular, the pension standards required the recognition of the net pension liability in financial statements that are measured in a consistent manner. While the responsibility of government accounting authorities is to promulgate standards that meet the needs of users, it is also important to examine whether these modifications lead to changes in the economic decision-making of state and local governments. There appear to be unanticipated policy-related consequences resulting from these two standards. First, the reported accounting values on the funding position of state and local public pension plans have greatly improved over the last decade since the standards were implemented. The US Bureau of Economic Analysis (BEA) reports that the aggregate funding ratio of all plans rose from 47.2 percent at the end of 2016 to 65.9 percent at the end of 2023, reversing about two-thirds of the decline from the 2000 figure of 76.5 percent.[12] Much of the rebound reflects an increase in employer contributions to the plans, but the surge in market values of the assets held by the plans - especially equity holdings - also provided comparable support. Thus, the second policy-related consequence is a shift in plan holdings into riskier assets.

This study applies a novel econometric approach to modeling public pension asset allocations using Stata's *xtabond2* dynamic panel estimation with the two-step system of General Method of Moments. These techniques allow for endogeneity in asset allocation decisions as well as correcting panel-specific heteroscedasticity and serial correlation. A significant inverse correlation between the actuarial funding ratio and plan allocations to equities, real estate, and private equity (representing just over two-thirds of total assets) supporting the "risk transfer" hypothesis. The key result is that we find evidence that the

implementation of the GASB 67/68 standards in 2014, which lowered the discount rate on future claim payments, was associated with an increase in plan allocations across four of six investment classes. Evidence supporting mimicry of CalPers' allocations by the average plan manager, was consistently positive across four of six models. State-level control variables provided some significant, but not always consistent results.

In sum, actuarial funding gaps, the adoption of more stringent valuation standards for discounting pension reserves, and the secular decline in bond yields and assumed earnings rates, appear to account for the shift in public pension plan allocations toward riskier assets over the first two decades of this century. Such shifts to riskier assets, however, make plans more vulnerable to market declines which could, potentially, lead to declines in their funding status. An upshot is that analyses of other types of benefit plans (e.g., postretirement healthcare) may require more detailed reporting of assets and less emphasis on the reporting of aggregate balance sheet ratios.

## ENDNOTES

1. "New Jersey Bill Addresses State's' Indebted Pension System," *Wall Street Journal*, 5/31/2019, p. A-3. Although pension funding can be a major challenge for state government budgets, there is little evidence that underfunding has a negative impact on economic growth and employment. (Steindel, 2020)
2. The GASB establishes the rules and procedures used to prepare financial statements for government-sponsored pension plans.
3. Although a distressed private pension plan that cannot meet their obligations may obtain funding from the federally-chartered Pension Benefit Guaranty Corporation (PBGC), its revenues are constrained by statutory limits on the premiums it charges. Thus, the PBGC tries to monitor private pension plan investment risk and return assumptions in order to limit its overall exposure to bankruptcy risk.
4. Mortimer and Henderson (2014, p. 424) note that for "FY 2010 State of Wisconsin Department of Employee Trust Funds CAFR recognizes plan assets ($84.9 billion) and liabilities ($9.0)..." however, on "Page 121 of the same CAFR discloses the actuarial valuation for assets ($80.6 billion) and liabilities ($80.8 billion)."
5. Figure 1 shows a smoother pattern for funding ratios prepared under GASB 25 compared to those calculated using the GASB 67 standards, in part reflecting this smoothing of asset values.
6. Based on the PPD, we calculate that the average *assumed* investment return declined from about 8.0% in 2001 to 7.2% in 2018; the average assumed inflation rate also declined from 3.8% to 2.7% over the same period. The realized 10-year returns dropped from 10.5% in 2001 to 6.7% in 2018.

7. The panel observations are unbalanced such that in no year, for any asset category, do we observe 177 observations.

8. CalPERS did not invest in commodities and thus its share was excluded as an explanatory variable from the econometric model results shown in table 5.

9. A value of one is assigned to each pension year observation if the plan is located within a state where the constitution mandates that the governor and/or the legislature must submit a balanced and the state cannot carry over a deficit into a new fiscal year.

10. The Arellano-Bover/Blundell-Bond estimator augments the Arrellano-Bond version by incorporating the additional assumption that first differences of instrument variables are uncorrelated with the fixed effects. This allows the introduction of more instruments and can dramatically improve efficiency. It builds a system of two equations – the original and the transformed one – and is known as the "system GMM" (Roodman, 2009, p. 86-87).

11. "Our GMM estimator optimally exploits all the linear moment conditions that follow from the assumption of no serial correlation in the errors, in an equation that contains individual effects, lagged dependent variables and *no strictly exogenous variables* (italics added). (Arellano and Bond, 1991, p. 277).

12. BEA table "SAINC70", which can be found in the section Annual Personal Income by State. BEA's estimates apply a common discount rate to compute the present value of benefits and do not take into account potential effects of cost-of-living provisions. BEA's discount rate has changed over time, and a 2022 increase from 4 percent to 5 percent helped boost the ratio.

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# The Unintended Consequence of Shifting the Responsibility for Social Service Expenditures from State to Local Governments

**Julie Anna Golebiewski, George Palumbo & Mark Zaporowski***

**ABSTRACT**

This paper examines the effect of states shifting the fiscal responsibility of social services to county governments on the credit ratings of local governments. Using an ordered probit model, we identify the marginal impact of economic, demographic, fiscal and financial variables on the perceived creditworthiness of local governments as measured by Moody's credit ratings. We find that county governments with the fiscal responsibility for social services have higher probabilities of lower ratings than their counterparts in states that have not shifted this burden to local governments and therefore have higher borrowing costs.

## INTRODUCTION

Eleven states, including New York, assign some, or all, of the responsibility for social service expenditures to local governments. To varying degrees, the responsibility to raise revenues needed to pay the local government's share of these expenditures accompanies this mandate. While many reports, books and articles published over the last 60 years discuss the burden of unfunded or partially funded mandates (Campbell and Sacks, 1967; Bahl, 1984; Anders and Shook, 2003), relatively little (de Mello, 2001) has been said about the impact of this responsibility transfer on the general obligation (GO) credit ratings of these local governments.

Using an ordered probit model to analyze publicly available data[1] for individual governmental units, as well as for their overlying counties, we identify the relative impact of the economic, demographic, fiscal, financial, and governmental factors that affect Moody's GO ratings as presented in *US Local Government General Obligation Debt (Moody's 2014, revised 2016)*. In addition to the expected economic, fiscal, and financial impacts discussed in Moody's methodological reports and the existing literature, we find that the assignment of social service responsibility to local governments, government type and the underlying racial composition of the population affect ratings.

This paper shows that while county governments generally seem to receive preferential treatment when compared to city, village and town governments, those counties with social service responsibility have less favorable ratings, even when compared to cities, towns and villages within the same counties. We identify

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the direct negative marginal impact on ratings associated with social service expenditure and revenue responsibility, as well as the indirect negative impact related to the higher dependence on state aid that often accompanies it. The secondary effects of decentralization are important to understand, as lower credit ratings are likely to add to the burden of fiscal responsibility by adding to the cost of borrowing for these counties.

We also find that governments with higher proportions of black populations have lower credit ratings regardless of the assignment of the responsibility for social service expenditures by state governments to county or other local governments. Thus, we conclude that in the eleven states[2] that assign the responsibility for social services expenditures to counties, or county equivalents, those local governments incur increased revenue-raising burdens, face possible mandated tax or expenditure constraints, a greater dependence on intergovernmental transfers and therefore lower credit ratings. The implied higher interest costs on all outstanding county government GO debt is likely an unintended consequence of the imposition of social service responsibility on those local governments by their state government.

## LITERATURE REVIEW

Before Roy Bahl (1971) econometrically established the role that economic, demographic and fiscal factors play in the determination of credit quality, ratings analysis centered around accounting statements and financial analysis (see for example Carleton and Lerner, 1969). Following Bahl, numerous studies identified the crucial connection between economic base, the fiscal capacity of individual governments and their creditworthiness (Cluff and Farnham, 1985, Loviscek and Crowley, 1990, and Hildreth and Miller, 2002). Poterba and Rueben (2001) expanded the link between public policies and credit ratings, identifying the impact of fiscal capacity constraints imposed by state governments on their local governments. They concluded that tax limits for state governments increase the perception of risk and thus increase borrowing costs, while expenditure limits had the opposite effect. In contrast, Johnson and Kriz (2005) found no relationship between revenue limits and credit ratings, though they did conclude that revenue limits increase the cost of borrowing. They also found that expenditure limits and associated fiscal constraints led to higher credit ratings, and thus to lower borrowing costs. Mullins (2004) concluded that the impact of tax and expenditure limitations on credit ratings might be obscured by the asymmetric affect these limitations have on high- and low-income areas.

Johnson, Kioko and Hildreth (2012) modeled state government credit ratings as a function of a series of financial, fiscal, economic, and demographic characteristics. They found that financial factors and the existence of governmental enterprise revenue were important determinants of both Moody's and S&P state government credit ratings. In earlier work Golebiewski, Palumbo and Zaporowski (2020) and Palumbo and Zaporowski (2012) analyzed a similar set of factors and identified the marginal impact of each factor on the probability of falling into a specific rating category. They found that found that county governments seemed to have received differential treatment in the Moody's ratings process. Their results showed the dominant

role played by the diversity of the economic base and income on credit ratings, while also indicating that governmental and fiscal factors play a greater role for local governments than was reported by Johnson, Kioko and Hildreth for state governments.

Capeci (1991) examined the relationship between credit ratings and the cost of financing public borrowing. Cornaggia, Cornaggia, and Israelsen (2018) reported that yields dropped significantly when recalibration led to ratings upgrades (relative to non-upgraded bonds) by 12 to 18 basis points in the secondary market and those issuers received a reduction of 17 to 23 basis points on their new primary market issues[3]. Kriz and Xiao (2017) found that the yield spread of municipal bonds in the Aaa, Aa, and A rating categories increased over their risk-free comparison group by approximately 15 basis points, a finding that contradicted Moody's claim that recalibration was yield neutral.

Johnson, Abbas and LaFontant (2017) used the Johnson, Kioko and Hildreth model to identify a structural break in Moody's credit ratings of state governments following its 2010 recalibration. They concluded that, after the recalibration, a greater level of general revenue was associated with higher ratings and that there was a reduction in the negative impact of higher tax burdens. Benson and Marks (2022) found an inverse relationship between credit quality and interest cost broadening the impact of recalibration on interest cost to include the effects of split ratings between S&P and Moody's. Their findings also suggest that following recalibration, the rating systems of Moody's and S&P became more alike.

The literature relating financial information and credit ratings did not cease after Bahl's 1971 analysis. In a cross-country and cross-level analysis de Mello (2001) concluded "…that fiscal decentralization affects the average return lenders demand when financing local government budget imbalances." This article, however, focused on revenue-sharing initiatives and their impact on both the central government and local government recipients. Iacuzzi (2022) highlighted the importance of this in an extensive review of the literature related to the use of financial information for credit analysis. She also linked an increased emphasis on financial reporting to the transfer of fiscal responsibility to local governments (decentralization) and public sector reforms aimed at improving transparency, equity, and efficiency. The article also noted that the shifting of responsibility has increased local governments' need to access credit markets, concluding that while the literature on financial indicators has grown, scholars still mostly refer to financial indicators first developed in the 1980s.

A somewhat different approach to the non-economic factors in the credit rating process can be found in Park, Butler and Denison (2020). The authors examined the claim that rating agencies use governmental factors as a determinant of credit ratings. Using an ordered probit model on a sample of 644 municipalities with Standard and Poor's ratings, they found that sustained high-quality financial reporting, as determined by a certificate of achievement from the Government Finance Officers Association (GFOA), led to higher credit ratings. Additionally, they concluded that demographic characteristics like population and the racial composition of the population affected credit ratings. While Yinger (2010) reported that higher proportions of Black and Hispanic populations led to lower credit ratings, and higher proportions of Asians led to higher

credit quality, Park et al. found that higher proportions of both white and black populations led to lower ratings. In contrast, Maher, Deller, Stallmann, and Park (2016) found higher concentrations of white population were associated with higher credit ratings, while finding the expected effects of economic, demographic, fiscal and financial characteristics. Thus, Yinger, Maher et al., as well as Park et al. found that the racial composition of the population can affect credit ratings, though the impact as measured by the percent white, black, Hispanic or Asian is not consistent across the studies. As far back as Cluff and Farnham (1984) and Moon and Stotsky (1993), an unclear and unexpected relationship between race and credit ratings has appeared.

The goal of the credit rating process is to determine whether the revenue generating capacity of a local government is adequate to meet its debt service requirements. The amount and burdens of pre-existing debt play a pivotal role in determining credit quality. In addition to debt service requirements, other financial factors include pension and health insurance liabilities that have accrued for past and current employees, as well as those that will accrue for future employees over the life of the obligation. There are significant variations among the states concerning the extent to which local governments are responsible for the funding of future pension and health insurance liabilities[4]. State governments can and have returned the revenue raising responsibility for pensions to local governments in periods when state pension systems have failed to provide adequate revenues to meet liabilities.

Since state governments determine the expenditure and revenue-raising responsibilities, as well as any fiscal and debt limits, for local governments there can be substantial differences in per capita spending and tax revenue across states. Thus, local governments in different states with similar demand for public services may exhibit vastly different levels of expenditures, taxes, and intergovernmental revenues.

We have found that expenditure and revenue responsibility for social services affects the perceived creditworthiness of local governments. The model developed below separates the effects of recalibration from changes in the perception of relative creditworthiness by type and level of government, while examining the determinants of credit quality following Moody's quantitative ratings scale. Additionally, we examine the marginal effects of government type; the dependence on intergovernmental aid, the assignment of fiscal responsibility, and several demographic characteristics of the population not specifically identified in the new Moody's rating methodology.

## DATA

The source of the data used in this analysis is the 2012 Census of Governments and 2010 Census of Population from the U.S. Census Bureau and ratings data from Moody's Investors Service. Because we analyze a cross-section of local governments in all 50 states, we rely on Census definitions of local governments that standardize fiscal measurements. While cities and villages are generally classified as municipal governments, towns are not classified as municipalities in most states, but where they are, they

appear as towns in our data. The Census of Governments' standardization eliminates the differences in government definitions across states.

Between 2002 and 2016, Moody's released a series of methodological papers outlining the bond rating process. These sources identify the factors that guide the credit rating process at Moody's for governments that issue long-term debt. Accordingly, we use the following variables to explain the variation in Moody's ratings:

RECALIBRATION = 1 if the entire increase in rating occurred between 2006 and 2010, at the time of or before recalibration; 0 otherwise

BLACK RATIO - the ratio of black residents to the total population

MUNI = 1 if government is city or village; 0 otherwise

TOWN = 1 if government is town; 0 otherwise

AID TO EXPENDITURE RATIO - intergovernmental revenue as % of total expenditures(2012)

POPULATION CHANGE - ratio of 2010 population to 2000 Census population

STATE RATING 2013 - Moody's quantitative credit rating for state government in 2013

POPULATION - 2010 Census population in thousands

2006 RATING - quantitative Moody's 2006 credit rating in 2014 scale

GENERAL FUND BALANCE - general fund balance in millions of dollars (2010)

INTEREST PAYMENTS - interest payments in millions of dollars (2012)

PUBLIC DEBT - Total long term debt less public debt for private purposes in millions of dollars (2012)

MEDIAN HOUSE VALUE - ACS median housing value thousands of dollars (2010)

MEDIAN FAMILY INCOME - ACS median family income thousands of dollars (2010)

DIRECT EXPENDITURES - direct expenditures millions of dollars (2010)

TAX LIMITS = 1 if state imposed tax limits exist for local governments; 0 otherwise

EXPENDITURE LIMITS = 1 if state-imposed expenditures limits exist for local governments; 0 otherwise

CONCENTRATION RATIO - industry employment concentration ratio where higher values indicate more concentration

UNEMPLOYMENT RATE - BLS unemployment rate for overlying county (2013)

PROPORTION WITH INCOME OVER 250 - fraction of households with personal income > $250,000

LOCAL FISCAL RESP = 1 if government located in a state where social services expenditures are a county government responsibility; 0 otherwise

MUNI IN STATE WITH LOCAL FISCAL RESP = 1 if local government is city or village located in a state with local government social service responsibility; 0 otherwise

TOWN IN STATE WITH LOCAL FISCAL RESP = 1 if local government is a town located in a state with local government social service responsibility; 0 otherwise

2014 RATING - Moody's Quantitative Rating 2014

There were 1,663 local governments with both 2006 and 2014 Moody's ratings that were used in our analysis. The mean, minimum and maximum values of each variable used in this study appear in Table 1.

**Table 1.** Descriptive Statistics

| | MEAN | MINIMUM | MAXIMUM |
|---|---|---|---|
| 2014 RATING | 2.17 | 1 | 5.67 |
| RECALIBRATION | 0.89 | 0 | 1 |
| BLACK RATIO | 9.20 | 0 | 82 |
| MUNI | 0.58 | 0 | 1 |
| TOWN | 0.13 | 0 | 1 |
| AID TO EXPENDITURE RATIO | 20.90 | 0 | 140 |
| POPULATION CHANGE | 13.70 | -72 | 610 |
| STATE RATING 2013 | 1.71 | 1 | 3.34 |
| POPULATION | 110.24 | 0.21 | 8,175.13 |
| 2006 RATING | 2.73 | 1 | 4.67 |
| GENERAL FUND BALANCE | 19.23 | -130.49 | 707.19 |
| INTEREST PAYMENTS | 11.92 | 0 | 4,271.62 |
| PUBLIC DEBT | 232.88 | -2,300.75 | 95,657.96 |
| MEDIAN HOUSE VALUE | 227.38 | 47.1 | 1,000.0 |
| MEDIAN FAMILY INCOME | 71.59 | 25.69 | 250.001 |
| DIRECT EXPENDITURES | 277.81 | 0.02 | 97,004.26 |
| TAX LIMITS | 0.26 | 0 | 1 |
| EXPENDITURE LIMITS | 0.50 | 0 | 1 |
| CONCENTRATION RATIO | 11.40 | 4.50 | 34.90 |
| UNEMPLOYMENT RATE | 7.00 | 3.20 | 15.10 |
| PROPORTION WITH INCOME OVER 250 | 35.30 | 0 | 100 |
| LOCAL FISCAL RESP | 0.48 | 0 | 1 |
| MUNI IN STATE WITH LOCAL FISCAL RESP | 0.29 | 0 | 1 |
| TOWN IN STATE WITH LOCAL FISCAL RESP | 0.04 | 0 | 1 |

The major factors described in Moody's 2014 report (slightly revised in 2016) on ratings methodology for the general obligations of local governments fall into four broad categories: economic/demographic, fiscal/financial, governmental, and debt/pension. While there are a wide variety of sub-categories used to adjust the ratings generated by these factors, the broad groups provide some communality and transparency to the process.

Since the credit rating process attempts to determine whether the revenue generating capacity of a local government is adequate to meet its debt service requirements, the amount and burdens of debt play a pivotal role in determining credit quality. In addition to debt service requirements, other financial responsibilities include pension and health insurance liabilities that have accrued for past and current employees, as well as those that will accrue for future employees over the life of the obligation. There are significant variations among the states concerning the extent to which local governments are responsible for the funding of future pension and health insurance liabilities. Moreover, state governments can and have returned the revenue raising responsibility for pensions to local governments in periods when state pension systems have failed to provide adequate revenues to meet liabilities. For a discussion of the impacts of shared responsibility of pension funding, see Martell, Kioko, and Moldogaziev (2013).

Since state governments determine the expenditure and revenue-raising responsibilities, as well as any limits, for local governments, there can be substantial differences in per capita spending and tax revenue across states. Thus, local governments in different states with similar demand for public services may exhibit vastly different levels of expenditures, taxes, and dependency on intergovernmental revenues. These differences may affect the perceived creditworthiness of local governments[5].

We use the recalibration variable to account for changes that occurred as Moody's moved from a relative to a global scale (Moody's, 2010). In 2006, only 31.3% of Moody's GO ratings were Aa3 or above. By 2014, the proportion above Aa3 had increased to 71% (see Table 4 in the Appendix). Over the same period, the proportion of Moody's ratings that were A3 or below fell from 13.9% to 2.6%. Thus, over an eight-year period that included the financial markets crisis and then the most severe recession in the US since the Great Depression, the perception of the credit quality of local general-purpose governments, as represented by Moody's ratings, increased dramatically.

The model developed below separates the effects of recalibration from changes in the perception of relative creditworthiness by type and level of government, while examining the determinants of credit quality following Moody's quantitative ratings methodology. Additionally, we examine the impact of government type, the dependence on intergovernmental aid, the assignment of fiscal responsibility, and several demographic characteristics of the population not identified in the 2014 Moody's report.

**MODELING THE RATING PROCESS**

To model this process, we follow the procedure outlined in Palumbo and Zaporowski (2012). Due to the discrete nature of the dependent variable, we employ the ordered probit estimation technique. This allows estimation of the marginal impacts of various governmental characteristics on Moody's credit ratings for general obligation bonds.

To model this process, we assume there exists a latent index for each issuing government, $R_i^*$, that reflects the probability of default and consequently, the bond rating for government i's GO debt. $R_i^*$ is related to a vector of economic, demographic, fiscal, governmental, and financial explanatory variables (X) via the following:

(1) $R_i^* = \beta' X + \varepsilon,$

where $\varepsilon$ is assumed to be an independently and identically distributed normal random variable. Although $R_i^*$ is unobservable, we observe the underlying rating ($R_i$) assigned to government i's GO bonds. The observed credit rating on issue i, $R_i$, is determined from $R_i^*$ as follows:

$$(2)\quad R_i = \begin{cases} 1.00 \text{ if } R_i^* \le \mu_1 \\ 1.67 \text{ if } \mu_1 < R_i^* \le \mu_2 \\ 2.00 \text{ if } \mu_2 < R_i^* \le \mu_3 \\ \quad . \\ \quad . \\ \quad . \\ 5.67 \text{ if } R_i^* > \mu_{13} \end{cases}$$

The cutoff points for each rating are represented by the μ parameters. As $\mu_i$ increases, the creditworthiness of the issuer decreases, the risk of default increases, and the credit rating agency assigns a lower rating to the government. The conditional probability of observing each value of R is given by:

$P(R_i = 1.00 \mid X, \beta, \mu) = \Phi(\mu_1 - \beta'X)$

$P(R_i = 1.67 \mid X, \beta, \mu) = \Phi(\mu_2 - \beta'X) - \Phi(\mu_1 - \beta'X)$

(3) .

.

$P(R_i = 5.67 \mid X, \beta, \mu) = 1 - \Phi(\mu_{13} - \beta'X),$

where Φ is the cumulative normal distribution function. The β and μ parameters are estimated by maximizing the following log likelihood function[6],

(4) $L(\beta, \mu) = \sum_{i=1}^{n} \sum_{j=1}^{14} \log\left(P(R_i = j \mid X, \beta, \mu)\right) \lambda(R_i = j),$

where $\lambda(R_i = j)$ is a logical function that takes on the value 1 if $R_i = j$ and the value 0 if $R_i \neq j$.

The ratings assigned to bond issues by Moody's in this analysis range from highest quality (Aaa) with the lowest probability of default to a lower quality (B1) with the highest probability of default, in our sample. Consistent with Moody's quantitative models, smaller values of the dependent variable imply higher creditworthiness and a lower probability of default. A negative value for an estimated coefficient would therefore indicate a direct relationship between the explanatory variable and credit quality, while a positive coefficient indicates an inverse relationship between the explanatory variable and credit quality.

While Aaa rated issues can be perceived to have lower levels of default risk than Aa1, and Baa3 issues have lower risk than those rated Ba1, the rating categories should not be treated as equally spaced discrete intervals since credit ratings are measured on an ordinal rather than an interval scale. Probit analysis allows for the estimation of cutoff points associated with various levels of credit quality. The explanatory variables that are used to explain variation in 2014 RATING appear in Table 1 and are similar to those employed in the existing literature. Since the objectives of this paper are to identify the impact of fiscal responsibility for social services on counties and to estimate differences in creditworthiness by government type, we create dummy variables for cities, towns and for local governments in states that have assigned fiscal responsibility for social services to counties.

The ability of debt issuing governments to meet their future obligations is directly related to their expenditure commitments and their fiscal capacity. Own source revenues are predominantly comprised of taxes, user fees and charges. At the local level, the principal tax bases are consumption and property values, though when local income taxes exist they are generally very important.

The economic, demographic, fiscal and financial data are publicly available from the Bureau of Economic Analysis (BEA), Bureau of Labor Statistics (BLS), the Census of Governments (COG) for 2012, and the decennial Census of Population and Housing (COP) for 2010. These reflect the most recent

information that was available to Moody's analysts in 2014. The economic and demographic information was taken from the American Community Survey (ACS) in 2010, which provided the most recent socio-economic data relevant to the 2014 rating.

**ESTIMATING EQUATION**

The population regression function to be estimated is:

$$\begin{aligned}\text{2014 RATING}_i = {} & \beta_0 + \beta_1 \text{RECALIBRATION}_i + \beta_2 \text{ BLACK RATIO}_i + \beta_3 \text{MUNI}_i + \beta_4 \text{ TOWN}_i \\ & + \beta_5 \text{ AID TO EXPENDITURE RATIO}_i + \beta_6 \text{ POPULATION CHANGE}_i \\ & + \beta_7 \text{ STATE RATING 2013}_i + \beta_8 \text{ POPULATION}_i + \beta_9 \text{ 2006 RATING}_i \\ & + \beta_{10} \text{ GENERAL FUND BALANCE}_i + \beta_{11} \text{ INTEREST PAYMENTS}_i + \beta_{12} \text{ PUBLIC DEBT}_i \\ & + \beta_{13} \text{ MEDIAN HOUSE VALUE}_i + \beta_{14} \text{ MEDIAN FAMILY INCOME}_i \\ & + \beta_{15} \text{ DIRECT EXPENDITURES}_i + \beta_{16} \text{ TAX LIMITS}_i + \beta_{17} \text{ EXPENDITURE LIMITS}_i \\ & + \beta_{18} \text{ CONCENTRATION RATIO}_i + \beta_{19} \text{ UNEMPLOYMENT RATE}_i \\ & + \beta_{20} \text{ PROPORTION WITH INCOME>250}_i + \beta_{21} \text{ LOCAL FISCAL RESP}_i \\ & + \beta_{22} \text{ MUNI IN STATE WITH LOCAL FISCAL RESP}_i \\ & + \beta_{23} \text{ TOWN IN STATE WITH LOCAL FISCAL RESP}_i + \beta_{24} \text{ 2006 RATING}_i + \varepsilon_i\end{aligned}$$

The estimated coefficients of the model appear in Table 2[7]. A positive estimated coefficient on an explanatory variable results in a reduction in the probability of falling into the highest ratings category (Aaa) and an increase in the probability of falling into the lowest ratings category (B1). The effect of a one unit change in an explanatory variable on the ratings categories between the highest and lowest is not readily apparent without additional calculations estimating marginal impacts of each explanatory variable on inclusion in each rating category.

**Table 2.** Ordered Probit Estimates

| VARIABLE | COEFFICIENT | Z-STATISTIC | P-Value |
|---|---|---|---|
| RECALIBRATION | -1.4250 | -15.27 | 0.000 |
| BLACK RATIO | 0.0042 | 1.73 | 0.084 |
| MUNI | 0.3082 | 2.80 | 0.005 |
| TOWN | 0.6728 | 4.47 | 0.000 |
| AID TO EXPENDITURE RATIO | 0.0013 | 0.57 | 0.567 |
| POPULATION CHANGE | -0.0019 | -1.89 | 0.058 |
| STATE RATING 2013 | 0.1800 | 3.02 | 0.003 |
| POPULATION | 0.0009 | 5.94 | 0.000 |
| 2006 RATING | 2.6294 | 33.49 | 0.000 |
| GENERAL FUND BALANCE | -0.0144 | -10.76 | 0.000 |
| INTEREST PAYMENTS | 0.0030 | 2.27 | 0.023 |
| PUBLIC DEBT | 0.0001 | 1.40 | 0.016 |
| MEDIAN HOUSE VALUE | 0.0004 | 0.72 | 0.470 |
| MEDIAN FAMILY INCOME | -0.0145 | -6.19 | 0.000 |
| DIRECT EXPENDITURES | -0.0003 | -3.63 | 0.000 |

| | | | |
|---|---|---|---|
| TAX LIMITS | 0.1825 | 2.20 | 0.028 |
| EXPENDITURE LIMITS | 0.0040 | 0.06 | 0.137 |
| CONCENTRATION RATIO | 0.0258 | 3.32 | 0.001 |
| UNEMPLOYMENT RATE | 0.0307 | 1.48 | 0.138 |
| PROPORTION WITH INCOME OVER 250 | -0.0002 | -0.09 | 0.502 |
| LOCAL FISCAL RESP | 0.1901 | 1.65 | 0.035 |
| MUNI IN STATE WITH LOCAL FISCAL RESP | -0.0935 | -0.69 | 0.361 |
| TOWN IN STATE WITH LOCAL FISCAL RESP | -0.4437 | -2.07 | 0.863 |
| Limit Points | | | |
| μ1 = 2.50, μ2 = 4.05, μ3 = 6.32, μ4= 7.69, μ5 =9.49, μ6 = 10.37, μ7= 10.64, μ8 = 11.02, μ9 = 11.17, μ10 = 11.40, μ11 = 11.57, μ12 = 11.66, μ13 = 11.80, Log Likelihood = -1593.27 | | | |

To identify the marginal impacts of a change in the explanatory variables, it is necessary to first substitute the estimated coefficients from Table 2 into (3). The marginal impacts on probabilities of inclusion in each rating category are presented in Table 3[8]. Missing ratings categories in these tables indicate a near zero marginal impact (zero to four decimal places).

Negative values in the columns labeled Aaa, Aa1 and Aa2 in Table 3 indicate that an increase in the independent variable decreases the probability of falling into the highest rating categories (Aaa – Aa2), ceteris paribus, while increasing the probability of falling into the lowest rating categories (Aa3 and below). For example, a one percentage point increase in the black ratio decreases the probabilities of receiving a Aa1 rating by 0.02 percentage points and a Aa2 rating by 0.14 percentage points, while simultaneously increasing the probabilities of being given a Aa3 rating by 0.12 percentage points, and an A1 rating by 0.04 percentage points.

**Table 3.** Marginal Impact of Changes in Explanatory Variables on Probability of Inclusion in Rating

| **VARIABLE** | **Aaa** | **Aa1** | **Aa2** | **Aa3** | **A1** | **A2** |
|---|---|---|---|---|---|---|
| BLACK RATIO | -.0000 | -.0002 | -.0014 | .0012 | .0004 | .0000 |
| AID TO EXPENDITURE RATIO | -.0000 | -.0001 | -.0004 | .0004 | .0001 | .0000 |
| STATE RATING 2013 | -0.0002 | -0.0105 | -0.0574 | 0.0509 | 0.0170 | 0.0002 |
| POPULATION | -0.0000 | -0.0001 | -0.0003 | 0.0003 | 0.0001 | 0.0000 |
| 2006 RATING | -0.0023 | -0.1537 | -0.8382 | 0.7437 | 0.2482 | 0.0023 |
| INTEREST PAYMENTS | -0.0000 | -0.0002 | -0.0010 | 0.0009 | 0.0003 | 0.0000 |
| PUBLIC DEBT | -0.0000 | -0.00001 | -0.00003 | 0.00003 | 0.00001 | 0.0000 |
| MEDIAN HOUSE VALUE | -0.0000 | -0.00002 | -0.0001 | 0.0001 | 0.00004 | 0.0000 |
| CONCENTRATION RATIO | -0.0000 | -0.0015 | -0.0082 | 0.0073 | 0.0024 | 0.0000 |
| UNEMPLOYMENT RATE | -0.0000 | -0.0018 | -0.0098 | 0.0087 | 0.0029 | 0.0000 |
| EXPENDITURE LIMITS | -0.0000 | -0.0003 | -0.0012 | 0.0011 | 0.0003 | 0.0000 |
| TAX LIMITS | -0.0002 | -0.0117 | -0.0560 | 0.0517 | 0.0160 | 0.0001 |
| TOWN | -0.0003 | -0.0253 | -0.2371 | 0.1661 | 0.0949 | 0.0016 |
| MUNI | -0.0003 | -0.0191 | -0.0957 | 0.0868 | 0.0281 | 0.0003 |
| POPULATION CHANGE | 0.0000 | 0.0001 | 0.0006 | -0.0006 | -0.0002 | -0.0000 |
| GENERAL FUND BALANCE | 0.0000 | 0.0008 | 0.0046 | -0.0041 | -0.0014 | -0.0000 |
| MEDIAN FAMILY INCOME | 0.0000 | 0.0008 | 0.0046 | -0.0041 | -0.0014 | -0.0000 |
| RECALIBRATION | 0.0004 | 0.0353 | 0.4769 | -0.2093 | -0.2905 | -0.0120 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PROPORTION WITH INCOME>250 | 0.0000 | 0.00001 | 0.00007 | -0.00006 | -0.00002 | -0.0000 |
| DIRECT EXPENDITURES | 0.0000 | 0.00001 | 0.00008 | -0.00007 | -0.00002 | -0.0000 |
| LOCAL FISCAL RESP | -0.0002 | -0.0111 | -0.0606 | 0.0536 | 0.0181 | 0.0002 |
| MUNI IN STATE WITH LOCAL FISCAL RESP | 0.0001 | 0.0057 | 0.0293 | -0.0265 | -0.0085 | -0.0001 |
| TOWN IN STATE WITH LOCAL FISCAL RESP | 0.0008 | 0.0382 | 0.1138 | -0.1229 | -0.0297 | -0.0002 |

To test whether governmental structure impacts creditworthiness, we included both municipal and town dummies (county governments are the excluded group). The results indicate that both town and municipal governments have a lower probability of receiving Aa2 and higher ratings. Compared to counties, town governments have a 0.03 percentage point lower probability of an Aaa rating, a 2.53 percentage point lower probability of an Aa1 rating and a 23.71 percentage point lower probability of a Aa2 rating, whereas the probabilities of receiving Aa3, A1 and A2 ratings are 16.61, 9.49, and 0.16 percentage points higher, respectively. The impact on municipal government ratings is like that for towns, though smaller. The marginal impacts of the RECALIBRATION dummy indicate a 47.69 percentage point higher probability of an Aa2 rating, a 20.93 percentage point lower probability of falling into Aa3 and a 29.05 percentage point lower probability of falling into an A1 rating.

The results in Table 3 demonstrate that local governments in states with county-level social services fiscal responsibility (LOCAL FISCAL RESP) have different ratings profiles than their counterparts in states where the state government maintains that fiscal responsibility. These results indicate that counties with fiscal responsibility for social services are 0.02 percentage points less likely to be given a Aaa rating, 1.11 percentage point less likely to be given a Aa1 rating, and 6.06 percentage points less likely to be given a Aa2 rating than are counties without that responsibility. They are 5.36 percentage points more likely to have a Aa3 rating, 1.81 percentage point more likely to have a A1 rating, and 0.02 percentage points more likely to have a A2 rating than their counterparts without that responsibility. This shows that the responsibility for making social service expenditures and raising tax revenues for social services is accompanied by lower ratings and potentially higher cost of borrowing.

Further support for these results is shown by the estimated marginal impacts on the interaction variables MUNI IN STATE WITH LOCAL FISCAL RESP and TOWN IN STATE WITH LOCAL FISCAL RESP. In states where counties have been assigned the fiscal responsibility for social services, municipal and town governments are more likely to be given ratings of Aaa, Aa1 and Aa2 and less likely to have Aa3, A1 and A2 ratings than their counterparts in the remainder of the US. Since cities and towns located in states that have assigned fiscal responsibility for social services to counties have a greater likelihood of higher ratings, one might have expected similar results for counties in those states. In fact, the opposite is the case. This supports the proposition that it is the shifting of the fiscal responsibility to county governments that have impaired the perceived creditworthiness of these county governments.

A secondary consequence for counties with the fiscal responsibility for social services is that this responsibility is generally accompanied by an increase in the ratio of intergovernmental aid to total expenditures. The results presented in Table 3 suggest that higher aid to expenditure ratios lead to lower credit ratings. Thus, the assignment of social service responsibility has a negative impact on credit ratings through two separate avenues. Therefore, the assignment of social service responsibility to county governments not only increases their burden for financing these expenditures but is also likely to increase their borrowing costs for all debt[9] [see Capeci (1991) and Cornaggia, Cornaggia, and Israelsen (2018), Kriz and Xiao (2017)].

## CONCLUSION

Following the 2014 Moody's ratings methodology and using an ordered probit model like that which has appeared in the recent literature, we identify the impacts of economic, demographic, financial, governmental and fiscal factors on the perceived creditworthiness of the general obligations of local governments. We stress the importance of translating the ordered probit coefficients into marginal impacts to understand the relationship between each of the explanatory variables and credit ratings.

We find support for the previously established economic, demographic, fiscal and financial factors that have an impact on credit ratings and find a dominant effect of the economic base measurement. As expected, Moody's movement from a relative to a global scale had a positive impact on the credit ratings of local governments. In addition, we find that government type and the assignment of fiscal responsibility for social services are important determinants of Moody's credit ratings.

Our estimates indicate that municipal and town governments are less likely to receive high ratings from Moody's than county governments. However, when state governments, like New York, assign counties the fiscal responsibility for social services, those county governments are less likely to have higher ratings than their counterparts without this responsibility. Further support can be found in the finding that municipalities and towns in states that assign social service responsibilities to county governments have a greater probability of receiving higher ratings than their counterparts in states that maintain this fiscal responsibility.

The reduced ratings of county governments with the responsibility for social service expenditures is likely to lead to higher borrowing costs. Therefore, the policy implication of transferring expenditure and revenue-raising responsibility to county governments is likely not just to increase local taxes but to reduce the perceived creditworthiness of the local government and contribute to higher borrowing costs. State and local government policymakers should be aware of the consequences of this structure as they consider the efficacy of the current level of decentralization.

Finally, we find an inverse relationship between the proportion of the total population that is black, and the perception of credit quality as revealed by the Moody's credit rating. This holds regardless of the governmental type or the assignment of responsibility for social service expenditures.

## ENDNOTES

1. Primarily BLS, Census, and other Department of Commerce sources.
2. The eleven states include California, Colorado, Minnesota, New York, North Carolina, North Dakota, Ohio, Pennsylvania, Virginia, New Jersey, and Wisconsin.
3. Before Moody's moved from a relative to a global ratings scale in 2010, state and local governments were compared to other state and local governments, corporate debt to corporate debt and sovereign debt to other central government debt. In the post-recalibration world, a Baa1 rating for a municipal government should indicate the same perceived level of risk as a corporate or sovereign nation's bond with the same rating.
4. The existing Census data for state and local government pensions does not adequately conform to state and local government boundaries. The absence of such data helps to explain the absence of pension and health insurance variables in the credit rating literature.
5. Local government definitions are as presented in the 2012 Census of Governments, which classifies cities and villages as municipal governments. We treat consolidated city-county governments, independent cities, boroughs and parishes as county governments.
6. See Kaplan and Urwitz (1979).
7. The dummy variables that indicate government type and fiscal responsibility were tested via a likelihood ratio test. The results overwhelmingly supported their significance (p-value=0.0005).
8. For a full description of the transformation of estimated coefficients into marginal impacts for each variable on the probability of inclusion in each ratings category, see Greene (2000) and Palumbo and Zaporowski (2012).
9. We were unable to estimate the effect of this allocation of responsibility to counties on states because there is not enough variation in state credit ratings to make this estimation meaningful, especially after the 2010 recalibration.

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## APPENDIX

**Table 4.** U.S. Local Governments Moody's Underlying Credit Ratings: 2006 & 2014

| Rating | 2014 Frequency | 2014 Percent | 2006 Frequency | 2006 Percent | Percent Change 2006-2014 |
|---|---|---|---|---|---|
| **Aaa** | 209 | 8.44% | 100 | 4.06% | 109% |
| **Aa1** | 254 | 10.26% | 87 | 3.54% | 192% |
| **Aa2** | 786 | 31.76% | 223 | 9.06% | 252% |
| **Aa3** | 508 | 20.53% | 361 | 14.67% | 41% |
| **% above A1** | | **70.99%** | | **31.33%** | |
| **A1** | 482 | 19.47% | 471 | 19.14% | 2% |
| **A2** | 134 | 5.41% | 468 | 19.02% | -71% |
| **A3** | 38 | 1.54% | 409 | 16.62% | -91% |

| | | | | | |
|---|---|---|---|---|---|
| **Baa1** | 30 | 1.21% | 190 | 7.72% | -84% |
| **Baa2** | 17 | 0.69% | 98 | 3.98% | -83% |
| **Baa3** | 9 | 0.36% | 46 | 1.87% | -80% |
| **Ba1** | 3 | 0.12% | 7 | 0.28% | -57% |
| **Ba2** | 1 | 0.04% | 0 | 0% | n.a. |
| **Ba3** | 1 | 0.04% | 1 | 0.04% | 0% |
| **B1** | 3 | 0.12% | 0 | 0% | n.a. |
| **% below A3** | | **2.58%** | | **13.89%** | |
| **Total** | **2475** | | **2461** | | |

# The Role of Emotion in Explaining Economic Anomalies: Evidence from Neuroscience

**Bella Kieser[*] and Matthew Davis[†]**


## ABSTRACT

Behavioral economics has greatly expanded the scope of economic models and their ability to explain human behavior. However, some behavioral models still lack explanatory power or assume fixed preferences. We argue that emotions are a key factor in human choice behavior. Emotional insights stem from behaviorist theories that observe and address deviations from standard economic theory. These deviations can be examined using neuroscientific methods to illuminate their root causes. The relationship between emotions and rational choice is not one directional; while emotions can interfere with rationality, they are also necessary for optimal choice. Recent advances support the role of emotions in facilitating rational choice. The emotional underpinnings of economic behavior, both rational and irrational, are a fruitful area for further modeling.


## INTRODUCTION

Irrational choice has become a major area of inquiry in economics, closely associated with the field of behavioral economics. There is now a large body of evidence showing that individuals fail to optimize, experience preference reversals, and more. These findings have led to calls from academics for policy to be rethought in a world of "Humans" (Thaler and Sunstein 2009) by making use of the findings from behavioral economics. While this has led to many policy improvements, the question of "why?" remains - why are humans subject to these biases? Many behavioral explanations continue to rely on static models that are assumed to persist across different contexts. These same findings are sometimes unable to be replicated (Camerer et al. 2016). One reason for this discrepancy may be that emotions interact with cognitive processes, sometimes resulting in irrational choice and sometimes not. For example, the endowment effect, a classic finding in behavioral economics, can be eliminated or even reversed by inducing disgust or sadness in experimental participants (Lerner, Small, and Loewenstein 2004). Without considering how emotions cause and shape economic behavior, policies informed by behavioral economics are often treating symptoms, rather than the underlying core problem. In fact, "problem" may be a misnomer. Neuroscientific evidence now shows that emotion and cognition are deeply intertwined. Although emotions and cognition do sometimes conflict, emotional response is often a necessary component of cognitive evaluation, and emotional response may be an effective basis for quick choices when resources are limited or information is difficult to obtain. In this article, we provide a (nonexhaustive) overview of recent research

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that examines the interplay between emotion and cognition, particularly focusing on neuroscientific results where available. We provide examples of three topics in behavioral economics - risky choice, other-regarding behavior, and self-control - and briefly discuss findings that illuminate the role of emotion in these topics, either as an explanation for behavioral economics models or as an alternative. In each area, there is evidence that emotional processing both helps and hinders rational decision making. Emotions are, ultimately, impossible to disentangle from the cognitive processes that economists have long focused on. Moving forward, the discipline should continue to explicitly acknowledge the role that emotions have on economic choice.

## BACKGROUND

### EMOTIONS AND CHOICE

Although feelings and emotions are related (and used interchangeably by some social scientists), they are not the same. Emotions are patterns of chemical and neural responses to stimuli, and are directly observable (Damasio 2001). Feelings, by contrast, are mental representations of the physiological effects of emotions (Damasio 2004). While emotions may be unconscious, feelings are consciously perceived (Bechara 2011). There are at least seven basic emotional systems - seeking, rage, fear, lust, care, grief, and play, each with associated neural structures and neurotransmitters (Panksepp 2010). More complex emotions like jealousy, pride, guilt, and shame are combinations of these basic systems. Our focus is on the affect of emotions (how pleasant or unpleasant an emotion is) and on their motor aspect (how they motivate behavior). There are many theories of emotional influence on choice (for a review, see Lerner et al. (2015)). Authors such as Solomon (1973) describe emotions as actions aimed at creating change, clearly linking them to the choice process. Emotions may be integral or incidental (related or unrelated to the choice at hand, respectively) and anticipated or immediate, where anticipated emotions are how people believe they will feel in the future after they obtain an outcome, and immediate emotions are experienced in the present moment of making a decision (Loewenstein and Lerner 2003). To summarize recent findings on the impact of emotions on choice, we will focus on two (admittedly overlapping) areas: emotions experienced when contemplating a choice and emotions experienced when making the choice itself. In both stages, emotions may help or hinder rational decision making.

Before a deliberative choice is made, there is an “information gathering” step. In this stage, anticipated emotions frame how choice options are perceived, provide information about the choice, and illuminate the decision maker's preferences. Individuals consider their expected emotions under different actions, and use this information to help determine the optimal path. The “feelings-as-information” theory treats feelings and emotions as forms of information provision: their impact increases with their relevance to the choice at hand and the extent to which the feeling provides new or differing information (Schwarz 2011). In fact, emotions may do more than simply providing information - they may be an integral part of the choice process. The Somatic Marker Hypothesis (SMH) posits that emotional responses (somatic states) are

*required* to make mental representations of choice options and scenarios (Bechara 2011). In this view (discussed in the risk section), emotions are not simply information, but are the mechanism by which preferences are transmitted to the cognitive system.

The positive or negative affect of emotions can also "spotlight" or weight competing types or pieces of information (Peters 2006). This spotlighting can be thought of as a precursor to the affect heuristic (discussed below) in which individuals seek information that aligns with or supports their emotional response to a choice situation. Different emotions with the same or similar affect may highlight different pieces of information (Pfister and Böhm 2008). For example, regret and disappointment both have negative affect, but regret might highlight alternative choices while disappointment might highlight external forces. Emotions can also influence an individual's estimated probabilities of different outcomes; with negative emotions resulting in increased perceived probability of risk compared to positive emotions (Johnson and Tversky 1983). Emotions also have an effect on *how* decisions are made. For example, positive emotions are associated with increased use of heuristics in decision making, and vice versa (Lerner et al. 2015). Negative emotions appear to signal that a situation is problematic and thus deserving of full cognitive resources, while positive emotions signal that there is more space for creative, top-down thinking (Schwarz 2011).

Emotions felt at the moment of actively selecting a choice are *immediate* emotions, and can be unrelated to the choice (incidental emotions) or directly caused by the choice (integral emotions) (Pfister and Böhm 2008). Immediate emotions of sufficient intensity have the capacity to overwhelm an individual's cognitive system, for example someone who is so fearful of a crash that they cannot board an airplane, despite knowing cognitively that their drive to the airport involves greater risk. Our focus is on less extreme cases. Due to the processing costs of full evaluation of a choice, decision-making often involves heuristics and matching patterns more than explicitly weighing costs and benefits. This is especially true for situations that require complex decisions or when mental resources are limited (Slovic et al 2004). In these situations, individuals may use affect as a heuristic: the choice associated with the most positive feelings is the choice selected (Slovic et al. 2007). Emotional values such as affect are useful heuristics in the decision-making process because of their simplicity and limited resource requirements (Finucane et al. 2000). Reliance on the affect heuristic increases as the uncertainty involved with a choice increases (Faraji-Rad and Pham 2017). Emotional states can also induce choice by motivating an individual to take action (Lerner, Small, and Loewenstein 2004), as well as to select a primary motivation among competing goals (Zeelenberg et al. 2008).

Although emotions can influence choice in many ways (at least as many ways as there are emotions!), in this article we focus on a few examples where recent research exists, with particular emphasis on how these emotional influences affect the rationality of decision making. Do emotions "put sand into the rational choice machinery" (Muramatsu and Hanoch 2005), which would explain their disappearance from mainstream economic modeling as described below? Or could emotions actually underlie rational choice processes? As Loewenstein & Lerner (2003) point out, considering how one would feel in different states

of the world mirrors expected utility maximization - the archetypical rational choice process. On the other hand, emotions have been seen as separate from rationality since Plato (Scherer 2011). The reality is more complex. Intense cognitive evaluation of choice is not the default behavior of humans, so thinking of emotions as a departure from "typical" rationality is incorrect. Emotions provide useful information about choice options, which can complement or substitute for cognitive evaluation - in ways that both enhance and detract from decision rationality. Recent advances in neuroscience have shed light on the neural processes and structures that shape this dance - what we might call the "institutions of the mind." We briefly review some of the literature on emotions and rationality below, and detail three examples in the sections that follow.

The ways in which emotions may lead to a departure from rational choice are likely easy to imagine. Anticipated emotions may be misplaced and lead away from beneficial choices. For example, "hot-cold empathy gaps" mean that anticipated emotions about addictive or emotionally charged situations are likely to be biased (Loewenstein & Schkade 1999). Emotions function as "aversive factors" that influence choice subconsciously, and individuals tend to overestimate their ability to overcome these effects (Loewenstein 1996). Negative affective states are associated with a lack of self-control and long-term planning (Pham 2007). In addition, the current emotional state may bias predictions of future emotions (happy individuals predict future happiness), reducing the quality of information provided by considering future emotional states (Loewenstein and Lerner 2003). Because fleeting incidental emotions can influence choice and previous choices may provide the basis for future decisions, the effects of an emotional state may outlive the original cause of its behavior (Andrade & Ariely 2009). The influence of affect on choice can also be manipulated, for example by advertising associating cigarette smoking with happiness, relaxation, and other positive emotional states (Slovic et al. 2007).

But emotions can also aid rational choice. Negative emotions may serve as an adaptive warning that triggers more extensive information gathering, leading to better choice (Loewenstein and Lerner 2003). They also lead to more deliberative use of the cognitive decision making process (Pham 2007). Anticipated emotions such as guilt can serve as commitment devices to prevent self-interested behavior and promote long-term interests (Pfister and Böhm 2008); the immediate emotion of anger can serve the same purpose (Zizzo 2008). In a general sense, the use of heuristics instead of complex cognitive decision making can be optimal given resource constraints, and heuristics may give results on par with a fully rational calculation (Gigerenzer, Todd, and Group 1999). Preliminary research suggests that emotions are the first heuristic used in a choice process (Trujillo 2018). Research on the somatic marker hypothesis (SMH, further discussed in the risk example) indicates that emotions are not only helpful, but required for optimal choice in some situations. The SMH posits that emotions act as signals of the perceived consequences of choice, and it is these signals that guide decisions. Individuals with normal reasoning capabilities but damage to emotional processing (specifically, lesions on a specific area of their ventromedial prefrontal cortex) were unable to effectively learn over time in a risky choice scenario, while those with typical emotional processing

incorporated their experiences, felt an emotional response, and learned to choose advantageously (Bechara and Damasio 2005).

Overall, the relationship between emotions and rationality is multifaceted and multidirectional, even within a single choice. The two are so intertwined that Pfister and Bohm (2008) argue that debates about rationality should be reframed as debates about "appropriateness of emotions," while Pham (2007) writes that "any categorical statement about the overall rationality or irrationality of emotion would be misleading." We agree with this characterization. In this article, we focus on the impact of emotions on three well-discussed "anomalies," or behaviors that appear to depart from rational choice. In all three areas, we show that neuroscientific evidence sheds light on the relationship between emotions and the anomalous behavior. The evidence shows that in different contexts both rational and irrational behavior can be explained by emotional states, and that these emotional explanations may underlie common behavioral economics explanations.

## EMOTIONS IN ECONOMICS

Before discussing specific examples, we first provide an overview of the role of emotions in economic models. By the 1980s, the discipline of economics was dominated by the "neoclassical" school, which modeled humans as rational maximizers of their own self-interest (modeled via a utility function). The tractability of this model led to a great deal of prestige and influence, but also had gaps that began to be obvious. These discrepancies or "anomalies" began to be cataloged (often by psychologists or other cognitive scientists), and it became apparent that there were systematic variances from the neoclassical model. Kahneman and Tversky collected some of these into a set of heuristics, and later, prospect theory (discussed below). Richard Thaler continued to popularize both anomalies and their explanations. Although economic anomalies and departures from rationality occur in all domains, behavioral research has focused on a few main areas: self-interest (or lack thereof); reference-dependent preferences (a feature of the prospect theory model); probability weighting (also included in the prospect theory model); and hyperbolic discounting (Angner and Loewenstein 2012). We touch on all of these areas in this paper, as well as others.

Prior to the mainstream acceptance of behavioral economics, emotions played little role in modern economic theory (Elster 1998). That tastes cannot be accounted for (*de gustibus non est disputandum*) and must be accepted as given was developed even further by two Nobel Laureates into the idea that not only could tastes not be explained, they were stable over time and across individuals and as a result, differences in taste could not be an explanatory factor for economic phenomena (Stigler and Becker 1977). Clearly, if tastes are stable across time and individuals, emotions cannot play an important role in economic decision-making. Although Becker (1991) would allow for altruism within a family, rational self-interest ruled the marketplace, what Paula England described as "separative" selves (2002). When economists did consider emotion, it was often in the context of explaining rational behavior, either for the individual responding to the emotion or at a societal level (Frank 1988). For example, early explorations of the effect of altruism on

choice considered it as a preference itself - part of the utility function - rather than a cause of failed utility maximization (Fehr and Fischbacher 2003).

Early behavioral economists continued to neglect the role of emotion in explaining anomalies (Elster 1998). As more and more seemingly irrational behavior was demonstrated in experimental settings, researchers first began to look to the rational application of unexpected preferences as a cause. However, even preferences that incorporated fairness or altruistic preferences failed to predict all behavior. For example, research showed that rejection of ultimatum game offers was associated with the anger levels of subjects (Pillutla and Murnighan 1996). Emotions such as sadness also interact with preferences over fairness or altruism to condition responses (Harlé and Sanfey 2007). Furthermore, since choices can be path dependent, even fleeting emotions may have an impact on decision-making far into the future (Andrade and Ariely 2009).

At the same time as behavioral economists started to consider the role of emotion in explaining economic behavior, neuroscientists began using new technologies to study the brain activity associated with choice behaviors. Early pioneers at the intersection of these fields, for example George Loewenstein, dubbed the crossover “neuroeconomics” (Camerer, Loewenstein, and Prelec 2005). The study of neuroeconomics has focused mainly on the types of anomalies studied by behavioral economists, for example, by associating “controlled” or “System 2” rational behavior with activity in the prefrontal cortex ( Camerer, Loewenstein, and Prelec 2005). This early research started from the perspective of studying how the cognitive brain could overwhelm emotional or affective impulses (Cohen 2005). Although this provides a biological basis for these behaviors, it continues the pattern of treating decision-making as a fixed process or function, albeit one with some defined errors. Recent neuroscientific evidence has shown emotional and cognitive systems to be closely interlinked, with the concept of separate brain regions for each system no longer the accepted view among neuroscientists (Serra 2021). More interesting are the roles of transient emotions in actually altering preferences, biases, or both - but in a way that is dynamic and may be fleeting. In this article, we review the current understanding of the role of emotions in decision-making, focusing on how emotional states can explain some well-established deviations from rational decision-making. Where possible, we integrate recent neuroscientific evidence that has shed light on the relationship between (and overlap of) emotional and cognitive decision making.

## NEUROECONOMICS

Advances in neuroscience have allowed researchers to see inside the “black box” of the brain. Because of the “default” model of rational choice, applications of neuroscience to economics have focused on deviations from rational choice - “anomalies” - similar to behavioral economics (Camerer, Loewenstein, and Prelec 2005). Evidence from neuroeconomics shows that much of the brain’s activity is “cognitively inaccessible” despite our tendency to over-attribute our actions to deliberative decisions (Camerer et al 2005). For example, electroencephalogram (EEG) recordings show that our conscious awareness of an intention to perform an action comes after the initial brain waves associated with that action, with the gap

being about 300 milliseconds (msec). 200 msec after this sensation of intention is when we finally show the behavioral response (Libet 1985). Since our consciousness can not access the neural activity before the intention, we observe “free will” in that the intention precedes the action, when in actuality the sensation of an intention along with the subsequent action is caused by neural events we are unaware of (Wegner and Wheatley 1999). Because of this, we may misattribute the cause of actions, thinking we are exercising cognitive control when our emotions are actually the deciding factor.

Neuroscience demonstrates that certain brain areas are crucial for rational decision-making, and that properly processing emotions is linked to this process. Bechara et al. (1994) provide the observation that patients with damage to the ventromedial prefrontal cortex (vmPFC) engage in detrimental behaviors to their well-being. Their actions lead to financial, social, and relationship losses and they do not seem able to learn from their mistakes since they tend to repeatedly engage in the same types of behaviors that led to negative consequences. Interestingly, patients with vmPFC damage largely exhibit normal intellectual and problem-solving abilities. The implications here are that semantic knowledge, language comprehension/expression, attention, and memory can not explain their decision-making deficits. Evidence for the importance of emotions in decision-making is that these patients have a flat affect and an impaired ability to react to emotional situations, leading to the hypothesis that emotions aid decision-making in these realms. Bechara and Damasio (2005) show that when feeling emotions we experience corresponding physical changes in our body and mind. Their model of the role of emotions in guiding decisions, especially in situations of uncertainty, is known as the somatic-marker hypothesis (SMH). Somatic markers are changes in the body and brain that together indicate emotions, like nausea when feeling disgusted. Perceptions of external or imagined events trigger somatic markers, and they can cause perceptible changes like facial expressions, and imperceptible changes such as heart rate and endocrine release, which are integral parts of the mental processing associated with making a risky choice (further discussed below).

Another tool used by neuroeconomists is to observe activity in the brian is functional magnetic resonance imaging (FMRI). This technique measures the blood flow and metabolic activity in the brain. Neurons that are active require more glucose and oxygen, and the brain responds to this neural activity by directing more blood to active regions. Therefore these measures are directly correlated to the amount of electroactivity in each region of the brain. By observing individuals making choices while in an FMRI machine, researchers can identify if areas associated with cognitive processing (eg the prefrontal cortex) or emotional responses (eg the amygdala) are differentially activated.

Neuroscience and economics are different fields, and we leave much of the technical discussion of neuroscientific research to others. A good recent overview for economists is provided by Serra (2021), and the seminal introduction to neuroeconomics and methodology is Camerer et al. (2005). In our examples below, we describe neuroscientific evidence that supports the hypothesis that emotions are key drivers of choice. None of the examples rely on neuroscience, and neuroeconomics still has only extensively engaged with selected topics in economics. Even there, many neuroeconomists have experimented within the

context of dual process theories (see the section on self-control), and only now are beginning to examine the overlap between emotions and rational choice. Our hope is that the interrelationship between emotions and optimization will be a major research area moving forward. We expect that as this research continues to develop, it will continue to show the effect of emotions is multifaceted, complex, and far greater than previously hypothesized.

## APPLICATION TO SELECTED ANOMALIES

In the sections below, we describe how analysis of emotions can facilitate greater understanding of three major areas of decision making: choices involving risk, interpersonal and social choices, and self-control. Within each area, we briefly describe the behaviors that attracted the attention of behavioral economics and their proposed solutions. We then provide selected examples of how the study of emotions could enhance our understanding of these behaviors. Where possible, we describe how the emotional analysis fits into the behavioral economics theories (replacing, supporting, etc.). We also provide neuroscientific evidence supporting the roles of emotions, and briefly touch upon the overall effect of rationality. In most cases, emotions can both aid and hinder rational choice, depending on context.

### RISK

One might expect that any choice which does not maximize the expected value of the outcome is irrational. However, even mainstream economic theory allows for individuals to have preferences over risk, such that behavior that is (consistently) risk averse or risk seeking can be rational. This canonical model of expected utility maximization, introduced by von Neumann and Morganstern (2007), posits that individuals maximize their probability-weighted utility. The form of the utility function is largely unspecified, allowing for incorporation of preferences over risk. Despite with this flexibility, risky choices are an area where irrational behavior is frequently seen, and explanations for choices involving risk is a major area within behavioral economics. Even behavior that is seemingly described by incorporating diminishing marginal utility into the von Neumann-Morganstern framework does not appear consistent upon closer inspection. Rabin (2000) shows that this explanation for risk aversion would, if followed to its logical conclusion, imply individuals who are unwilling to take any risk whatsoever over economically meaningful stakes. This line of reasoning implies that individuals, at best, have unstable relative risk aversion parameters (Rabin and Thaler 2001). However, the problems with the mainstream model of expected utility maximization go beyond this and have been noted from the start, with the Allais Paradox being proposed just six years after von Neumann and Morganstern's work (Allais 1953). Another well-studied issue is that individuals respond to the same risky choice differently based on how it is presented. For example, Tversky and Kahneman (1981) show that whether a choice is framed in terms of lives saved or lives lost causes preference reversal. Even among experts - doctors - preferences for radiation or surgery as a cancer treatment varied depending on whether the data was provided in the form of survival probabilities or as probability of death, despite the two being fully codetermined (McNeil et al. 1982).

Many of these choices have clear implications for policy. In addition to the implications for health care from doctors reversing their preferences, there is now a well-developed literature on behavioral finance explaining anomalies such as the equity premium, market bubbles, and the disposition effect (see Hirshleifer (2015) for a review).

**BEHAVIORAL ECONOMICS APPROACH**

As described above, behavioral economics has long engaged with issues of risky choice. Under the assumptions of the rational choice model we can expect that preferences are stable and are also assumed to be complete and transitive. Actors are assumed to not only know how to maximize their utility, but more subtly, to always know what their preferences are. The rational choice model also ignores reference points, and proposes invariance, in that actors will prefer the same option despite the way the information about the choice is presented. The main behavioral economics contribution has been Tversky and Kahneman's prospect theory, for which Kahneman won the Nobel Prize in 2002. First described in Kahneman and Tversky (1979) and subsequently refined in Tversky and Kahneman (1992), prospect theory has four main components: (1) that individuals evaluate choices as gains or losses relative to a reference point, rather than absolute levels; (2) that individuals are more sensitive to a loss than to a gain of the same value; (3) that diminishing sensitivity leads to risk aversion when choices involve gains, but risk seeking when they involve losses; and (4) that individuals making risky choices do not use objective probability weights, but rather modify the weights to overweight very unlikely outcomes (N. C. Barberis 2013). Prospect theory has been used to explain a wide variety of irrational behavior under risk, e.g. the equity premium puzzle (Benartzi and Thaler 1995), favorite-longshot bias (Snowberg and Wolfers 2010), and suboptimal crop insurance purchases (Babcock 2015).

In addition to prospect theory, behavioral scientists have already proposed a number of shortcuts that individuals use when making decisions - sometimes called the "heuristics and biases program" (Tversky and Kahneman 1974). An overwhelming number of heuristics and biases have been suggested; one behavioral consulting firm lists over 100 ("List of Cognitive Biases and Heuristics," n.d.). Many relate to risk - ambiguity aversion, the hot hand fallacy, the representativeness heuristic, etc. Some of these are even contradictory - see both an "optimism bias" and a "pessimism bias" ("List of Cognitive Biases and Heuristics," n.d.). One reason there may be so many different heuristics is that these are not simply fixed traits that an individual may or may not have, but rather that each choice is considered within an entirely new context, conditioned by emotional state. Happy individuals may experience optimism bias, and sad individuals pessimism bias. This view argues for incorporating the emotional state of the individual when making the choice rather than simply selecting from the menu of heuristics.

**EMOTIONAL EXPLANATIONS**

**THE ROLE OF EMOTIONS IN PERCEPTION AND LEARNING**

Emotions may lead to incorrect perceptions of the choice at hand, especially the levels of risk involved. *Incidental* emotions - those that are not generated or affected by the choice itself - can alter assessment of situations involving uncertainty. Early “valence-based” approaches suggested that incidental emotions with positive affect tend to generate more optimistic judgements, while emotions with negative affect result in more pessimistic judgements (for a review see Lerner and Keltner (2000)). More recent research indicates a more nuanced picture. The appraisal tendency framework (ATF) examines multidimensional emotions and links the appraisal process of specific emotions with judgments and choices. The ATF predicts emotions of the same valence (i.e. anger and fear, which both have negative valence) may be able to exert opposite influences on choices (Lerner and Keltner 2001). The ATF posits that once an emotion is activated, it triggers appraisal dimensions that prompted the original emotion. This prediction points towards the idea of emotion-specific influences on choices and judgments, offering insight into why people perceive things like the level of risk in a situation differently. For example, the appraisal tendency of anger is perceived as predictable, under human control, and brought about by others. These appraisals are interpreted as low risk. Fear has the same valence as anger in that it is similarly unpleasant, but the appraisal tendency for fear is that negative events are outside of the individual’s control and unpredictable, raising the perception of risk. Angry people see less risk and fearful people see more (Lerner and Keltner 2001). Neuroscientific evidence utilizing FMRI studies suggests that brain activation during feelings of anger is stronger on the left side of the brain, while fear generates a right lateralized response (Alia-Klein et al. 2020). Since the left side of the brain is associated with “approach motivation” and the right side with “avoidance motivation,” (Kelley et al. 2017) we suggest the possibility that the differently perceived risk is hardwired to the emotion.

Although the effect of emotions on risk perception seems likely to lead to irrational choice, there is evidence that emotions are integral to all choices with uncertainty - both rational and irrational. The somatic marker hypothesis (SMH) posits that decisions are mediated by the somatic (physiological) states induced by the emotional response to a choice. In this model, the physical experience of an emotion is part of the judgment process. These somatic states can be caused by primary or secondary inducers. Primary inducers are actual events or signals of events (e.g. seeing a snake) while secondary inducers are memories or hypothetical events (e.g. imagining being bitten by a snake) (Bechara and Damasio 2005). One way of measuring somatic states is skin conductance response (SCR), which is affected by the activation of sweat glands. Skin conductance responses (SCR) are measured through non-invasive sensors that measure electrical conductance changes on the skin. Sensors measure tonic activity which refers to baseline levels of arousal which can fluctuate gradually over time. Phasic activity is also measured which refers to the spikes in conductance associated with specific stimuli which is indicative of an emotional and physiological response. In analyzing SCR, comparisons are made to the baseline (tonic) activity as well as looking at the amplitude of SCR peaks, frequency of responses, and latency. Neurotypical individuals have variance in SCRs when receiving gains or losses in a game of risky choice, and after a

period of learning, SCRs are generated before making the risky choices themselves, and these "anticipatory" SCRs are strongest in the moments before a subject makes a high-risk (and lower expected value) choice. Importantly, individuals have measurable SCR differences for different options *before* they cand articulate that the options are in fact differently risky (Bechara et al. 1997). The somatic response to learned emotions functions is a form of "time travel," bringing the physiological experience of those anticipated emotions to the present. Notably, individuals with damage to their vmPFC do not experience these differential SCRs and are simultaneously more likely to select the option with lower expected value, suggesting that the somatic states caused by emotions in response to punishment/reward play a role in learning how to optimally choose between risky options (Bechara and Damasio 2005).

Pre-existing somatic states may influence the present through their influence on the release of neurotransmitters such as dopamine. Increased levels of neurotransmitters (such as dopamine) lower the threshold of neuronal cell firing, generating a stronger response for the same anticipated outcome (and vice versa for decreased levels of dopamine from negative somatic states). This may explain some irrational behavior, for example investors suffering a losing streak, who may experience the "thought" of another loss becoming more painful and triggering an even stronger negative somatic state, causing them to rush to safety. The same logic applies in the opposite direction with a streak of wins (Bechara and Damasio 2005). The same mechanism likely applies to similar situations in daily life, with individuals who have had a streak of bad luck being biased towards lower-risk choices, even if these are suboptimal.

Another related methodology in examining choices under risk is the Iowa Gambling task (Bechara et al 1994). This task aimed to simulate real-life decision making and was tested on healthy subjects and those with damage to their vmPFCs. In order to maximize their overall gains, subjects were asked to pick cards from four decks each with different rewards and losses, having to figure out which decks were advantageous based on their overall net gains. The cards were selected one at a time, without prior knowledge of the decks, and participants were able to immediately see what they gained or lost after each selection. Healthy Participants usually started off by favoring the high-reward decks, but as they continued, they typically learned to avoid those decks due to the high long-term losses. Instead, they tend to choose the decks with lower immediate rewards but also lower long-term losses, which leads to better overall outcomes. This process takes around 40 or 50 selections. Subjects with damage to their vmPFCs did not get over the learning curve that the healthy subjects did, continuing to choose the risky bad desks that gave them large net losses after continuous rounds. These results echo real life behaviors exhibited by those with damage to their vmPFC, taking risks in a whole host of domains. The cognitive functioning of these individuals was largely normal in all regards, except for their flat affect, suggesting that emotional expression/regulation is crucial for reward processing. Those who continuously picked the bad decks were unable to feel the emotional consequences of loss and learn from it, ultimately impacting their decision-making abilities

**REGRET AND DISAPPOINTMENT**

Being faced with a choice may alter *integral* emotions (directly related to the specific choice), which could explain framing effects and other situations where procedural invariance is violated. One well-studied example is the roles and different effects of regret and disappointment. These emotions usually result from counterfactual comparisons of what could have been obtained versus what actually was, which can signal that a bad decision has been made. Both regret and disappointment have different behavioral tendencies depending on the cause of the bad outcome. Regret implies that one's own previous decisions are the relevant cause which results in attempts to undo one's decision. With disappointment, blame is placed on someone or something else (Pfister and Böhm 2008). Regret theory has two main tenets: that regret is commonly experienced and that people actively attempt to not only anticipate regret but also avoid it (Loomes and Sugden 1982). The anticipation of (potential) regret, in particular, can alter choices in a manner inconsistent with expected utility maximization, an observation that has roots in Savage (1951) and which can explain many of the anomalous choices associated with prospect theory.

Recent research on regret theory has found that while it can lead to deviations from rationality, in some contexts regret aversion may actually improve decision making (Zeelenberg and Pieters 2007). For example, individuals seeking to reduce potential regret may exert more cognitive effort examining a choice to increase decision quality (improving rationality). They may also seek "typical" decisions that are justified with ease, or they may select choices for which the feedback about alternatives is hidden (both strategies with an ambiguous effect on rationality). Empirical studies are still rare, although becoming more numerous, especially in finance and health. Barberis et al. (2006) argue that anticipated regret aversion can explain issues of "narrow framing" in the stock market. Evidence that anticipated regret drives choices in financial decisions is provided by Fioretti et al. (2022), who use a stock market experiment to show that individuals alter behavior in response to "future" (anticipated) regret only if they know they will be able to observe future prices. Interestingly, when participants knew they would not observe future prices, they still appeared to exhibit regret, but used past prices as their counterfactual. Attempts to minimize regret can also explain why households simultaneously purchase more insurance and undertake more investment risk as their wealth increases, a finding contrary to expected utility theory (Armantier, Foncel, and Treich 2023). Regret aversion may lead to better health decisions (serving as a form of commitment device). Individuals motivated by regret minimization have lower body mass indices (BMIs) than individuals motivated by utility maximization (Boeri et al. 2013). Anticipated regret from inaction (e.g. not getting vaccinated) is associated with engaging in protective behaviors (Brewer, DeFrank, and Gilkey 2016). Health researchers now argue for explicitly highlighting regret during the choice process as a way of improving patient decision making (Djulbegovic et al. 2016). There are many more areas where regret might play an important role; the role of regret as a commitment device is a fruitful area for future research by economists.

The experience of regret is one of the areas that has been well studied by neuroscientists, so we understand well the areas of the brain that are involved in anticipating regret. Neuroimaging data supports the role of the occipital frontal cortex (OFC) in an individual's experience of regret. Camille et al. (2004)

looked at the decisions and emotions of normal subjects compared to those with lesions to their OFC. Subjects were asked to choose between two gambles with different probabilities and expected outcomes. In the partial feedback condition, participants did not learn the results of their unchosen gamble, while in the full feedback (regret-inducing) condition, participants saw the results of both their chosen and unchosen gamble. For neurotypical individuals, knowing how the unchosen gamble played out strongly moderated their happiness with their choice (if the unchosen gamble won, they were much less happy than if it lost, even if they had won their chosen gamble). After several trials of experiencing regret, these subjects began to choose the gambles that were likely to produce a minimal amount of regret, demonstrating that they learned from their prior emotional experiences, a finding replicated by Coricelli et al. (2005). Observing neurotypical patients in an FMRI shows that the OFC was strongly responsive to results of the unchosen gamble (Coricelli et al. 2005), while OFC is not involved in the processing of gains and losses when the outcome of the unchosen gamble is hidden (Chua et al. 2009). In Camille et al. (2004)'s experiment, those with OFC damage did not report regret, nor did they anticipate negative consequences from their choices. Their self-reported emotions were happiness when winning and disappointment when losing, neither of which was affected by the outcome of the unchosen gamble (Camille et al. 2004). Individuals with OFC damage were apparently unable to create outcome evaluations and expectancies by comparing the values chosen and the rejected alternatives. Notably, the individuals who were responding to regret had higher payoffs and made choices that were closer to the rational choice equilibrium (Camille et al. 2004; Coricelli et al. 2005). The implication of these studies is that the OFC is likely to use cognitive and emotional information to anticipate and avoid regret, and that this is "hardwired" into the brain. In fact, the intensity of regret feelings is negatively correlated with the size of the OFC, as measured by gray matter volume (Zhang et al. 2022). Decisions involving these emotional influences may not correspond to the typical view of a cognitive, maximizing choice (and appear to require some learning), but are clearly preferred.

## INTERPERSONAL RELATIONSHIPS

### BEHAVIORAL ECONOMICS APPROACH

Although economics allows for other-regarding preferences, they are largely ignored. Individuals were assumed to be self-interested in almost all practical applications of mainstream economic theory (Fehr and Gintis 2007). A key tenet of rational choice models is that agents will maximize utility. At times this may be achieved through 'rational altruism' in which decisions are strategically made by self-interested actors to cooperate in promoting others' welfare. Rational choice models attribute prosocial behavior to personal gains through different forms of utility, where the benefits outweigh the costs of these actions. The individual actions of decision makers are assumed to contribute to an aggregate social behavior. The model is also in congruity with the view that 'true' altruism may not exist. A divergence from rational behavior is seen when agents engage in altruistic behavior that provides themselves with no benefit. In fact, the concept of "cooperation" was so outside the mainstream of economic theory that it was an early topic of Richard

Thaler's "Anomalies" column (Dawes and Thaler 1988). Even studying neoclassical economics has made people more selfish (Ifcher and Zarghamee 2018). Of course, cases where individuals behave in other-regarding fashion are not difficult to find. We hold doors for others, give anonymously, tip even where there is no likelihood of returning to the restaurant, etc. This type of behavior was (and still is) underexamined relative to its proportion of economic activity.

In this case, experimental and behavioral economists simply applied the tools of neoclassical economics, in what was called the "beliefs, preferences, and constraints" (BPC) approach (Fehr and Gintis 2007). As the name implies, these models assumed that individuals had a utility function that included other-regarding preferences, either directly (e.g. positive weight on others' consumption) or indirectly (e.g. negative weight on inequality). These preferences, when modeled via evolutionary game theory, can result in evolutionary stable states with a population of other-regarding individuals (Gintis et al. 2003). Of course, the BPC approach does not deny the rationality of other-regarding preferences. It continues to involve the maximization of a stable preference function, just one that includes the well-being of others or aspects of the distribution. BPC approaches may be termed "retroclassical" since they incorporate the tools of neoclassical economists with the insights of classical economists (Binmore 2010).

**EMOTIONAL EXPLANATIONS**

Experimental and behavioral economics have identified that people are much more prosocial than previously expected (Fehr and Gintis 2007). But the explanation that individuals have a preference for altruism (as per the BPC) fails to capture that prosocial behavior is context dependent. For example, subjects angered by an offer are more likely to reject in the ultimatum game, even after controlling for the fairness of the offer, indicating that the decision is driven by more than just a preference for fairness (Pillutla and Murnighan 1996). Neuroimaging evidence supports this view, showing that the anterior insula, an area associated with negative emotional states, is activated when individuals reject unfair offers (Sanfey et al. 2003). And as we all know, incidental emotions can drastically change social interactions. Individuals who are sad are more likely to reject low offers in the Ultimatum Game - even with sadness induced by short video clips unrelated to the subject (Harlé and Sanfey 2007). This effect appears to operate in a similar manner to anger caused by the offer itself - via the anterior insula, which reacts more strongly to unfair offers when an individual is sad (Harlé et al. 2012). Unfortunately, because of the reliance on the BPC approach, results such as these have not yet been integrated into economic models of behavior. Further work to bridge the gap between social neuroscience and economics is needed (Alós-Ferrer 2018).

In the context of social interaction, emotions both aid and hinder rationality. In a public goods game with costly punishment, angry participants earned less than happy participants as a result of their increased spending on punishment (Drouvelis and Grosskopf 2016). However, reliance on the affect heuristic is associated with higher earnings in the ultimatum game (Stephen and Pham 2008). Empathy in particular, by allowing better prediction of others' behavior, may help make optimal offers in ultimatum games, however to date we are only aware of one study examining this phenomenon (Artinger et al. 2014). In a broader

context, the role of empathy in improving strategy is well understood (Yorke 2023).

## SELF-CONTROL

Individuals often take actions that are contrary to their stated preferences. They procrastinate, overindulge, undersave, and impulse buy, among many others. Awareness of this fact among economists goes back to Adam Smith, who described the conflict as emotional in nature (Ashraf, Camerer, and Loewenstein 2005). This short-sighted decision making has been described as a "want/should conflict" where long-term planning indicates a choice that *should* be made, but a more impulsive *want* is chosen (Bazerman, Tenbrunsel, and Wade-Benzoni 1998). Although self-control issues may pertain to choices that do not have an obvious intertemporal component, the intertemporal conflict described in the want/should model is the focus of most research. Individuals are often aware of their self-control issues, leading to the use of (often costly) commitment devices (for an overview see Brocas et al. (2003)). This is a clear example of irrational behavior, albeit one that did not gain much attention in mainstream economic thought until the behavioral economics movement. Since the rational choice model is, as the name implies, defined by the assumption that humans rationally maximize their utility, this is one of the cleanest and most common examples of a failure of the model, making failure to exercise self-control a large topic within behavioral economics. Although emotions are clearly involved and the language used by behavioral economists often implies emotion as a counterweight to rational choice, the actual mechanisms by which emotions affect decisions that require self-control have gained far less attention.

## BEHAVIORAL ECONOMICS APPROACH

Inconsistent choice over time and failures of self control are two (related) major areas of research in behavioral economics. Two main classes of explanations have evolved: inconsistent discounting preferences and dual-selves. Inconsistent discounting models posit individuals who consistently apply a discount function to choice over time; it just happens that this discount function is dynamically inconsistent. The most popular is the hyperbolic discounting model. Under a hyperbolic discounting model, consumption delays matter more when they come earlier in time, even if the length of the delay is the same (Loewenstein and Prelec 1992). For example, a choice between consumption in the present vs. a year from the present would see a much higher discount rate applied than a choice between consumption in 10 years vs. 11 years, even if the values were the same. However, the hyperbolic discounting model fails to explain why individuals tend to prefer sequences of events that are increasing in pleasure (Loewenstein and Prelec 1991).

Dual selves models better capture the sense of inner conflict individuals feel when choosing a want rather than a should. Although dual self (sometimes called dual process) models vary in their definitions of the competing mental systems (Alós-Ferrer and Strack 2014; Rustichini 2008), the general split is between a rational, calculating, long-term planning self (which we will call the cognitive system) and an impulsive self focused on immediate gratification (the affective system). Often, the cognitive system is considered

primary, with the affective system coming into use when resources are limited (Alós-Ferrer and Strack 2014). Both classes of models have contributed to more accurate predictions of human behavior; for example, inconsistent time preferences models are useful for explaining broad trends in retirement savings (too little) and health behaviors (overeating, smoking, etc.) while dual selves models can help explain why self-control varies for an individual over time, even for the same decisions (cognitive load, time pressure). Inconsistent preferences models maintain the veneer of "rational" choice - consistent application of a discounting function. Dual selves models are sometimes explained in emotional terms ("affective" or "impulsive"), but are often thought of as fixed or moderated by cognitive load, time pressure, etc. There is also debate as to how well supported dual selves models are, especially in light of neuroscientific evidence (Grayot 2020).

**EMOTIONAL EXPLANATIONS**

Recent research has begun to investigate the specific role of emotions in intertemporal choice and self-control. Attempts to exercise self-control involve a number of emotions, both hedonic (pleasure, frustration) and self-conscious (guilt, pride) (Kotabe, Righetti, and Hofmann 2019). Anticipated guilt has the strongest effect on self-control behavior, while anticipated pride has the least (Kotabe, Righetti, and Hofmann 2019). For example, individuals with stronger anticipated guilt or shame should they succumb to temptation are more likely to follow through on intentions of condom use (Hynie, MacDonald, and Marques 2006). The importance of anticipated guilt indicates that framing or other background information that differentially amplifies guilt and pride may be able to improve self-control (Kotabe, Righetti, and Hofmann 2019).

One explanation for discounting anomalies, proposed by Rick and Loewenstein (2008) is not that individuals have an unusual form to their discounting function (as hyperbolic discounting would suggest), but rather that future rewards are "intangible" - less specifically defined than the alternative immediate reward, and so individuals use their emotional responses to the options as the "common currency" to compare options. Neuroscientific evidence shows that temporally displaced choices engender weaker emotional responses, supporting the idea that an individual who uses emotional response to weigh these intangible rewards will have a stronger signal from the immediate option (Blackburn et al. 2012). Similarly, sadness may amplify the salience of the current self (who is associated with the emotion) and has also been shown to increase takeup of immediate rewards (Lerner, Li, and Weber 2013).

The most recent research has begun to consider self-control as a fundamentally emotional process - not simply influenced by emotions, but driven by them. In this view, self-control is triggered by the emotional response to conflict between competing goals, and without the emotional response, cognitive control is not activated (Inzlicht, Bartholow, and Hirsh 2015). This view is supported by research showing that emotion and cognitive control activate overlapping areas of the anterior cingulate cortex (Shackman et al. 2011).

The rationality of emotions in choices involving temptation or self-control is not as simple as the dual-selves model implies. First, activities associated with the cognitive system are sometimes irrational - the system makes errors, for example when individuals reflect (incorrectly) on the costs and benefits of a choice

(Grayot 2020). Second, the “emotional” system may aid in what some researchers call “ecological rationality” - success (even compared to fully rational cognitive calculation) in a given environment (Gigerenzer and Brighton 2009). The view of emotional response as a requirement for rational choice is repeated below in the discussion of risk.

## FUTURE RESEARCH

Despite interdisciplinary efforts to explain economic anomalies through the lenses of emotion and neuroscience, questions remain concerning the implications and practicality of such findings. With each anomaly neuroscientific evidence points to one or several parts of the brain being activated but what to do with this information is still unclear. Of great importance are the next steps in these emerging fields, which should consist of investigatory efforts into how to apply this new information to behavioral nudges and policies.

From a psychological standpoint, the current literature also lacks sufficient information on how to deal with emotional influences. Whether or not they hinder or help decision-making is quite context dependent, but how to harness these influences into positive outcomes still lacks substantive information. In a similar vein, future findings should also target a strategy to reconcile immediate short-term gains with those that are more future-oriented and typically provide larger payoffs.

## CONCLUSION

In this article, we present a broad overview of the relationship between emotions and rationality, with supporting evidence from neuroscience. Modern neoclassical economics has typically disregarded emotions in favor of modeling choice as the rational expression of stable preferences. Behavioral economists have contributed greatly to the study of irrational choice, but have often relied on contrasting emotional responses (irrational) with cognitive responses (rational). Although behavioral economics can be considered an intellectual path leading to the exploration of emotions through neuroscience, we believe that the relationship between emotions and rationality is more complex. Indeed, neuroscientific evidence indicates that emotions may be necessary for rational choice and learning. Emotions can engender intuitive ‘gut feelings’ that combine past experiences with only the most relevant information to make decisions quicker and more accurately than cognitive processes alone.

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