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Managerial Manipulation, Corporate Governance, and Limited Market Participation

Abstract

The low fraction of U.S. households participating in equity markets, despite the sizable equity premium, has been referred to as the stock market participation puzzle. We explore a part of this puzzle by examining the role of managerial manipulation in accounting for the properties of stock market participation. We show that when investors have heterogeneous beliefs about managerial manipulation, investors who are relatively pessimistic about reporting quality consider stock prices unjustified by the underlying firm value and rationally withdraw from the stock market, giving rise to limited market participation in equilibrium. Our model also suggests that tightened accounting standards have the effect of reducing the dispersion of investor beliefs regarding financial reporting and thus help encourage stock market participation. Consistent with this idea, we find that stronger accounting and governance policies are associated with higher market participation across countries.

Keywords: Managerial manipulation, Corporate Governance, Accounting standards, Limited stock market participation

JEL Classifications: D82, D83, G12, G14

1 Introduction

Historically, stock market participation in the U.S. has been low, with fewer than half of U.S. households holding stocks. The low rate of participation in equity markets, despite the sizable equity premium, has been referred to as the stock market participation puzzle (Haliassos and Bertaut (1995) and Campbell (2006)).[1] However, there has been a steady growth in stock market participation over the last 30 years: the fraction of households who participate in equity markets increased from 30.6% in 1983 to 43.9% in 2001 and fell slightly to 40.6% during the Great Recession (Favilukis 2013). The purpose of this paper is to analyze the implication of managerial manipulation of financial information for stock market participation and thereby shed light on the role of governance policies and accounting standards in contributing to the observed patterns in equity markets.

We construct a simple rational expectations model in which managerial manipulation occurs and the market is uncertain about the degree of managerial manipulation. One crucial element of our model is that there exist heterogeneous expectations of managerial manipulation within the community of potential investors, because they have different degrees of confidence in firms' internal control systems designed to prevent manipulation. For example, faced with identical earnings reports, investors relatively optimistic about financial reporting credibility would perceive large accruals as a signal of managers possessing private information, whereas investors who are pessimistic about governance stringency would believe that the quality of earnings reports has been compromised by managerial manipulation. Our assumption of heterogeneous beliefs on managerial manipulation is motivated by a growing body of literature suggesting that managerial manipulation reduces earnings quality and thus causes dispersions in financial analysts' earnings

[1] It has been well documented that a significant proportion of U.S. households do not participate in stock markets. Mankiw and Zeldes (1991) find that only 27.6% of households own stocks, and for families with liquid assets of $100,000 or more, only 47.7% own stocks. More recent surveys show that even with the tremendous growth of the U.S. stock market over the past couple of decades, such limited market participation still persists. For instance, the 2005 Survey of Consumer Finances shows that only less than 50% of U.S. households own stocks or stock mutual funds (including holdings in their retirement accounts)

forecasts,[2] among which Peng, Yan, and Yan (2012) specifically document an empirical link between heterogeneity in investors' beliefs and accounting accruals.

We show that limited market participation can arise endogenously in equilibrium when we allow for beliefs about managerial manipulation to vary across investors. When the dispersion of investor beliefs about managerial reporting is large, only the investors optimistic about reporting quality, and hence underlying true performance, participate in the equity market. Investors sufficiently pessimistic about the credibility of financial reporting will consider the market price unjustified by firm value and optimally choose not to invest in stocks in the equilibrium, giving rise to limited market participation.

We use our model as a natural laboratory to study the determinants of market participation. The equilibrium rate of market participation is determined by how demand for stocks is distributed across investors with heterogeneous beliefs regarding managerial manipulation. If the demand is sensitive to investor beliefs of managerial manipulation, a small portion of the most optimistic investors can demand a large volume of stocks, thus driving up the stock price sufficiently high to force out other investors. A small fraction of investors fully absorb the market in this case. If investors' demand does not vary much with their beliefs, the equilibrium stock price must adjust to induce a large proportion of investors to hold stocks for the market to clear.

We find that the equilibrium participation rate may increase when the policy parameter governing the cost of managerial manipulation increases, suggesting that the increasing stringency of accounting standards may have played a role in the growth of market participation in the past few decades. Raising the cost of managerial manipulation has two effects on the distribution of investor demand: on the one hand, the degree of manipulation is reduced, and thus the demand heterogeneity across investors with differential beliefs becomes smaller; on the other hand, a decreased degree of manipulation brings with it reduced uncertainty of manipulation, causing investor demand to be more sensitive to investor beliefs. When the cost of manipulation is not negligibly small, the first effect

[2]See for example, Lang and Lundholm (1996), Rajgopal and Venkatachalam (2011), and He et al. (2012).

— that is, the effect of reduced importance of investor optimism — dominates. Investor demand is less sensitive to investor beliefs when the manipulation cost increases. As a result, the equilibrium participation rate increases in response to tightened accounting standards. To test this implication empirically, we study whether stronger accounting standards and corporate governance policies are associated with higher market participation across countries. Our regression results show that widely-used measures of accounting standards, corporate governance, and legal enforcement all have a positive effect on market participation, and the effects are statistically and economically significant.

We also show that the institutionalization of the equity market and consequently reduced heterogeneity in investor beliefs could account for the increased market participation. Under limited participation, only investors relatively optimistic about reporting credibility invest in stocks. Thus when beliefs become more dispersed, those investors who actually participate in the market on average have a more favorable view about the accountability of managers' reports and thus the financial worth of the firm. The increased market optimism drives up the equilibrium market price, forcing more investors to withdraw from the market.

To study the role of revelations of corporate scandals in affecting stock market participation, in a two-period extension of the model we introduce a public signal about the extent of managerial manipulation. Managerial concerns about reputation loss in the event of fraud detection lowers manipulation incentives, which in turn can encourage stock market participation. More importantly, we show that although detections of managerial manipulation level the playing field for investors by revealing additional information, they can cause a loss of trust in the reporting system and consequently lower stock market participation.

Our model builds on Fischer and Verrecchia (2000), which analyzes rational expectations equilibria with earnings management. We extend their model by incorporating diverse investor beliefs, and we focus on the effects of varying accounting standards. Similarly, Dye (2002) and Dye and Sridhar (2004) study the reliability of accounting information in a capital market equilibrium. Guttman, Kadan, and Kandel (2006) use a signaling model to understand the discontinuity in the distribution of earnings reports. These papers do not address the issue of stock market participation, which is the primary focus of our paper.

Our model of managerial reporting is related to the analysis in Arya, Glover, and Sunder (1998). They examine the conditions for the Revelation Principle to hold, including unblocked communication, unrestricted contract form, and full commitment by the principal to use reports in a pre-specified manner. At least one of the assumptions must be violated for managerial manipulation to occur. They replace the Revelation Principle's artificial mechanism designer with the principal for the classification exercise, making use of the Revelation Principle in a way other than its original intended use — as a taxonomy instead of as a solution technique. They introduce a model where allowing a manager to manipulate earnings serves as a commitment device. Described in terms of Arya, Glover, and Sunder's taxonomy, our model places restrictions on the manager's ability to communicate the truth. Glover, Ijiri, Levine, and Liang (2005) study the case where there is information asymmetry about manipulability and the agent is not allowed to communicate his private information about manipulability to the principal. Similar to their model, in our model information asymmetries about manipulation, rather than manipulation itself, result in a qualitative change in the equilibrium outcome.

Our paper also adheres to the literature on limited market participation. Allen and Gale (1994) and Williamson (1994) show that transaction cost and liquidity needs can create limited market participation. Vissing-Jorgensen (1999) and Yaron and Zhang (2000) examine the effect of fixed entry cost on investors' participation decisions. Haliassos and Bertaut (1995) show that risk aversion, heterogeneous beliefs, habit persistence, time-nonseparability, and quantity constraints on borrowing do not account for the observed phenomenon. Among the models that have been proposed to explain why limited market participation may exist, most similar to ours is Cao, Wang, and Zhang (2005). They consider uncertainty-averse investors who evaluate an investment strategy according to the expected utility under the worst case probability distribution in a set of prior distributions. They generate limited participation in the presence of model uncertainty and heterogeneous uncertainty-averse investors. This paper can be viewed as complementary to theirs in that our results indicate that limited participation can arise endogenously in the presence of managerial manipulation without behavioral utility specifications. In addition, our model yields implications about how accounting standards and governance policies influence market participation rates.

In a broad sense, our model is related to existing theoretical research investigating the role of information in financial markets. Indjejikian, Lu, and Yang (2012) studies a setting where the insider rationally leaks the information to a single designated trader or a select few traders who benefit from the information at the expense of all other traders in the marketplace. Information leakage from corporate managers to a selected few investors can be one important source of diverse investor beliefs in our model. Cen, Lu, and Yang (2013) incorporates both disagreement and sentiment into a dynamic multi-asset model to formalize their joint effects on the breadth-return relationship. We take the belief dispersion as given, and focus on its implications for asset prices and equilibrium participation.

The rest of this paper is organized as follows. Section 2 lays out the model. Section 3 characterizes the full-participation equilibrium. In Section 4, we derive the condition under which limited market participation endogenously arises, and we characterize the equilibrium under limited participation. Section 5 analyzes the equilibrium market participation rate, and examines how it is influenced by accounting standards both theoretically and empirically. Section 6 analyzes managerial reputation concerns and fraud revelations in a two-period extension of our model. Section 7 concludes.

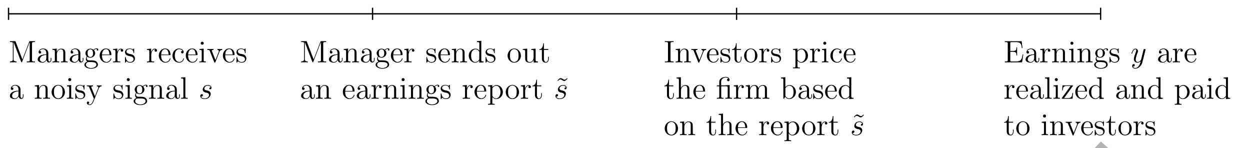


Figure 1: Model Timeline

2 Model

2.1 Setup

We consider a simple one-period economy with a representative firm. The time line of Figure 1 chronicles the sequence of events in the model. The manager is running a firm whose actual earnings at the end of the period are denoted by y, where y is normally distributed with mean μ_y and variance σ_y^2. Before the stock is traded in the market, the manager of the firm receives a private signal of the future realization of earnings, denoted by s: $s = y + \epsilon$, where the noise term ϵ is independent of y and is normally distributed with mean 0 and variance σ_ϵ^2. This signal represents a noisy observation of fundamental variables that will determine future dividends. The manager is mandated to publish a report of his private signal, denoted by $\tilde{s}$, which investors use to make their investment strategies. At the end of the period, actual earnings y are realized and distributed as dividends to investors. The discrepancy between the original signal and the financial report, denoted by $m = \tilde{s} - s$, is interpreted as the amount of managerial manipulation undertaken by the manager.

If the manager produces an inaccurate report, the manager incurs a personal cost denoted by $C(m) = k_1 m^2/2 + k_2 m$, where k_1 is a known positive parameter and k_2 is a parameter unknown to investors. Similar to Dye and Sridhar (2008), the cost of managerial manipulation involves a deterministic component (k_1) and a stochastic component (k_2). This is intended to capture the idea that accounting reports produced under a common standard may have both a common bias (captured by k_1) and an idiosyncratic bias specific to the firm and time period (captured by k_2). Following Liang (2004), Guttman, Kadan, and Kandel (2006) and Nan (2008), the personal cost of managerial manipulation is quadratic in the amount of manipulation.[3]

We also assume that the marginal cost of inflating reports increases with the deviation from the original signal, which is determined by $k_1 > 0$. Intuitively, the manager sacrifices cheaper resources to manipulate before utilizing more expansive resources, and it is increasingly costly to deviate from true earnings. k_1 represents the cost of manipulating financial statements imposed by accounting standards and governance systems, and it is known to investors.[4]

Investors cannot observe the true value of k_2 and only know that k_2 is a random draw from a normal distribution: $k_2 \sim N(\mu_k, \sigma_k^2)$. The unobserved nature of k_2 is intended to capture the notion that manipulating financial records often involves personal costs or benefits that are the manager's private information and the market does not precisely know.[5] Note that k_2 can be positive or negative, reflecting the fact that some managers have preferences toward overstatement and some managers have preferences toward understatement. In particular, a manager with a negative k_2 prefers a larger (more positive) amount of managerial manipulation than a manager with a positive k_2. In reality, we observe managerial manipulation in both directions. The financial report ($\tilde{s}$) thereby conflates the exogenous shock to the firm value and the amount of manipulation (influenced by k_2). This assumption of *unobserved* manipulation cost is motivated by the substantial discrepancy between investors' expectations and the underlying financial worth of the firm highlighted by many recent financial scandals.

Following the key insight from Arya, Glover, and Sunder (1998) and Glover, Ijiri, Levine, and Liang (2005), this model places restrictions on the ability of the manager to

[3]For analytic tractability, we adopt a quadratic function of manipulation costs to make the optimization problem concave and well-defined. The quadratic functional form can be interpreted as a local approximation of a more general convex function.

[4]For example, CEO/CFO certification and reimbursement of executive bonuses required by the 2002 Sarbanes-Oxley Act can make managers more susceptible to legal costs and increase the value of k_1, which is public information known to investors.

[5]For example, investors may not have perfect information about managers' time horizon, personal stigma, the degree of risk-aversion, the costs involved in bribing auditors not to report a discrepancy in financial statements, or the amount of resources and effort required to modify financial records.

communicate the truth. That is, (i) communication is costly when it involves managerial manipulation and (ii) the manager observes multiple dimensions of information, including the value of earnings and the cost of manipulating earnings. However, the manager is only permitted to communicate a single-dimensional signal, which is an earnings announcement. Communication is restricted in that the manager cannot communicate the full dimensionality of his private information due to a limited message space. As a result, the reporting function is not invertible, and true earnings cannot be unambiguously backed out from the reports.

2.2 Preferences

The manager's utility in our model is given by $U^M(s,m) \equiv P(s+m) - C(m)$, where $P(\tilde{s})$ denotes the price of the stock given the report ($\tilde{s} = s + m$). The first term reflects the manager's desire to maximize the share price of the firm. Typically, managers prefer higher stock prices because their pay package often contains a substantial equity component. The second term is the manager's cost of manipulating the report.

All investors in the economy have preferences exhibiting constant absolute risk aversion (CARA) and have initial wealth W_0 to invest in the firm's stock and one risk-free asset. The investors' utility is defined as

$$U^I(W) \equiv -\exp(-\gamma W),$$

where W is investors' terminal wealth and $\gamma > 0$ is investors' risk-aversion coefficient. There is a risk-free asset available to investors at no cost. For simplicity, we assume that the risk-free rate is normalized to zero. The quantity of stock is normalized to one perfectly divisible share. Thus, investors' wealth constraints are $W_0 = pq + q_f, W = yq + q_f$, where q and q_f are the investors' demand for the firm's asset and the risk-free asset respectively. In the following, we permit the case where $p < 0$, for ease of exposition.

2.3 Investors' beliefs

The crucial element in our model is that there exist heterogeneous expectations on the degree of managerial manipulation within the community of potential investors, because they have different beliefs of how strong firms' reporting systems are in deterring managerial manipulation. Recall that k_2 represents the unobservable component in manipulation cost that is specific to the firm, influenced by internal control systems. To capture heterogeneous beliefs about how effective managerial manipulation is deterred overall, we let the expected value of k_2 (i.e., μ_k) be dispersed across investors instead of a constant and common parameter.

We design our heterogeneous-agent model with the objective of delivering a complete characterization of both market participation and equilibrium asset prices that can be reconciled with empirical evidence. In order to achieve this objective in a parsimonious setting, we follow Cao, Wang, and Zhang (2005) and assume a uniform distribution of investor beliefs. That is, μ_k is uniformly distributed among investors on the interval

$$[\bar{\mu}_k - \theta, \bar{\mu}_k + \theta],$$

with density $(1/2\theta)$, where $\bar{\mu}_k > \theta$, and θ measures the dispersion of investor beliefs.[6] When $\theta = 0$, the model is reduced to a standard representative-agent framework.

Diverse perceptions of managerial manipulation can arise for a number of reasons. For example, investors with access to different (non-public) information about firms' internal control system over financial reporting have different perceptions about how costly manipulation is to managers. Investors may also arrive at different subjective assessments even when they have the same substantive information. In addition, differences in investors' ability to see through (part of) manipulation can contribute to the heterogeneity in the perceived degree of manipulation. Specifically, because accrual accounting relies on managerial discretion and is subjective and difficult to verify in nature, accruals may

[6] The assumption of uniform distribution is made for analytic tractability. Our results and intuition do not hinge on the properties of uniform distribution and should apply for general distributions of investor beliefs.

induce different interpretations and disagreement among investors on firm value. Our assumption of heterogeneous beliefs is also motivated by a large literature that hints at managerial manipulation as an important factor underlying the substantial dispersion in financial analysts' earnings forecasts.[7]

Our model follows the key insight of Harrison and Kreps (1978) and Scheinkman and Xiong (2003) that when investors agree to disagree, asset prices may differ from fundamental values. In the model in Harrison and Kreps (1978), agents trade because they disagree about the probability distributions of dividend streams. The reason for the disagreement is not made explicit. Scheinkman and Xiong (2003) study overconfidence as a source of disagreement. Here we argue that the unobservable nature of managerial manipulation can be one way by which disagreement among investors may arise, and it allows us to specifically analyze the properties of market participation and to show a plausible yet overlooked link between accounting standards and market participation.[8]

One of the key arguments in the literature on heterogeneous beliefs is built on Savage's (1954, page 3) notions of subjective probability:

> "Probability measures the confidence that a particular individual has in the truth of a particular proposition, for example, the proposition that it will rain tomorrow. These views postulate that the individual concerned is in some ways "reasonable", but they do not deny the possibility that two reasonable individuals faced with the same evidence may have different degrees of confidence in the truth of the same proposition."

When faced with the same earnings report, investors may have different beliefs in its

[7]See for example, Lang and Lundholm (1996), Rajgopal and Venkatachalam (2011), and He et al. (2012).

[8]In our setting investors do not turn to public information such as stock prices to learn what their fellow investors' beliefs are. There is no denying that this approach entails some irrational learning on the part of investors. But there is ample precedent for it in the literature, including Harris and Raviv (1993) and Cecchetti, Lam, and Mark (2000). See Morris (1995) for a discussion of this approach and Kandel and Pearson (1995) for empirical evidence. In addition, Rothschild (1974) shows that heterogeneous beliefs can persist even when investors learn, as long as learning is costly and endogeneous. Even in the absence of endogenous learning, Kurz (1994) and Acemoglu, Chernozhukov, and Yildiz (2009) also show that agents' heterogeneous beliefs may never converge.

credibility, possibly because they have different degrees of confidence in internal control systems designed to prevent manipulation. In particular, investors relatively optimistic about financial reporting credibility would perceive large accruals as an indication that managers possess valuable private information, whereas investors who are pessimistic about reporting quality would be skeptical that earnings have been artificially inflated. Peng, Yan and Yan (2012) empirically documents a link between heterogeneous investor beliefs and accounting accruals.

2.4 Equilibrium definition

We formally define the equilibrium of our model below.

Definition 1 *(A Perfect Bayesian Equilibrium:) A Perfect Bayesian Equilibrium involves a reporting strategy, $m(s)$, for the manager, joint with a pricing function, $P(\tilde{s})$, for investors, that satisfies the following conditions:*

(i) Given the manager's reporting strategy and the pricing rule, investors maximize their expected utility. Beliefs are consistent with Bayes' rule.

(ii) Given the pricing function, the manager's reporting strategy maximizes the utility of the manager.

(iii) Market clearing requires that the stock voluntarily held by investors be equal to the total quantity of the stock.

3 Full-participation equilibrium

In this section, we solve for the equilibrium under full market participation. The procedure we follow to obtain an equilibrium of the economy is similar to that of Grossman (1976). We first conjecture an equilibrium pricing function and an equilibrium reporting function. Based on the assumed pricing function, we solve the manager's optimization problem, and based on the assumed reporting function, we solve the investors' investment problem. The market clearing condition is then imposed to verify the conjectured pricing and reporting functions.

3.1 Manager's reporting strategy

The objective of the manager in this environment is to maximize his utility by choosing a reporting strategy represented by $m(s)$, subject to the market reaction.

$$\max_{m} \quad P(s+m) - k_1 \frac{m^2}{2} - k_2 m. \tag{1}$$

We first guess that the price of the firm is a linear function of the report: $P(\tilde{s}) = \alpha + \beta \tilde{s}$. With the conjectured price function, the first-order condition for the manager's problem yields $\beta - k_1 m - k_2 = 0$, and therefore

$$m = \frac{\beta - k_2}{k_1}, \quad \forall s. \tag{2}$$

The manager faces a trade-off in reporting: On the one hand, he wants to manipulate the report to bump up the stock price; on the other hand, he does not want to inflate performance too much because of the increasing marginal cost of manipulation. Since the marginal benefit of manipulating reports (determined by the sensitivity of stock price to managerial reports, i.e., β) is constant across different levels of earnings, and the marginal cost (i.e. $k_1 m + k_2$) is linear in the amount of manipulation, this trade-off determines an optimal level of managerial manipulation (m) that is independent of the original signal (s) the manager privately observes. Because k_2 is not precisely known to investors, the amount of manipulation remains the private information of the manager.

Now the amount of managerial manipulation, m, can be expressed as a function of the random variable k_2. Therefore, m itself is a random variable. With an abuse of notation, from here on, let us denote m as this random variable, with relationship (2) in mind. Note that m follows a normal distribution with mean $\mu_m \equiv \dfrac{\beta - \mu_k}{k_1}$ and variance $\sigma_m^2 \equiv \dfrac{\sigma_k^2}{k_1^2}$. Note that μ_m still contains an unknown β at this point and investors have diverse beliefs of μ_k.

3.2 Investors' stock holding

Under the assumption of normality and CARA utility, the investors' utility maximization problem is

$$\max_{q,q_f} \quad E[U^I(W)|\tilde{s}] = E[W|\tilde{s}] - \gamma \frac{Var[W|\tilde{s}]}{2}, \tag{3}$$

where $E[\cdot|\tilde{s}]$ is the expected value given the report $\tilde{s}$, and $Var[\cdot|\tilde{s}]$ is the variance given $\tilde{s}$. For an investor with a given belief $\mu_k \in (\bar{\mu}_k - \theta, \bar{\mu}_k + \theta)$, the mean and variance of final earnings conditional on reports $\tilde{s}$ are derived in Appendix B and are expressed as follows.

$$\begin{aligned} E[y|\tilde{s}] &= \frac{(\sigma_m^2 + \sigma_\epsilon^2)}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}\mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}(\tilde{s} - \mu_m), \\ Var[y|\tilde{s}] &= \frac{(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}, \end{aligned}$$

where $\mu_m = \dfrac{\beta - \mu_k}{k_1}$. The weights put on the report and the prior are given by their relative precisions respectively, invariant across investors. Conditional on $\tilde{s}$, investors optimally put a greater weight on reports when manipulation uncertainty (σ_m^2) is reduced. Given the manager's report, investors form their expectation of the future wealth as follows, given their respective belief:

$$\begin{aligned} E[W|\tilde{s}] &= E[y|\tilde{s}]q + q_f = \left[\frac{\sigma_\epsilon^2 + \sigma_m^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}\mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}(\tilde{s} - \mu_m)\right] q + (W_0 - pq), \\ Var[W|\tilde{s}] &= Var[y|\tilde{s}]q^2 = \frac{(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}q^2. \end{aligned}$$

Substituting these into investors' objective function, Equation (3), the problem of each investor is given by[9]

$$\max_q \left[\mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}(\tilde{s} - \mu_y - \mu_m)\right] q + (W_0 - pq) - \frac{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}{2(\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2)}q^2.$$

The optimization problem of investors can be characterized by the following first-order condition: $\mu_y + \dfrac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}(\tilde{s} - \mu_y - \mu_m) - p - \dfrac{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}q = 0$. Solving for the optimal share of the stock investors are willing to hold, we arrive at the following expression:

$$q = \frac{(\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2)\mu_y + \sigma_y^2(\tilde{s} - \mu_y - \mu_m) - p(\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2)}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}.$$

[9]Because m and ϵ follow normal distributions, the distribution of y conditional on $\tilde{s}$ is a linear combination of normal distribution and is thus also a normal distribution.

The higher the overstatement (i.e., $\mu_m = \dfrac{\beta - \mu_k}{k_1}$) investors perceive, the lower the estimated firm value, and the lower demand for the stock. That is, for an investor with a given μ_k, the investor's optimal holding in the stock is expressed as below.

$$q = \frac{1}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)}\left(\tilde{s} - \frac{\beta - \mu_k}{k_1}\right) + \frac{(\sigma_\epsilon^2 + \sigma_m^2)\mu_y - p(\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2)}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}. \tag{4}$$

An investor who believes that μ_k is high expects a small (or negative) amount of average managerial manipulation μ_m, and perceives a high actual performance for a given $\tilde{s}$. An investor who believes μ_k is low thinks there is a large positive level of managerial manipulation, and undervalues the firm compared to the report. Investors with $\mu_k \geq \bar{\mu}_k$ are referred to as "optimistic investors", and investors with $\mu_k < \bar{\mu}_k$ are referred to as "pessimistic investors" hereafter.

3.3 Equilibrium stock prices

We assume that short sales are not permitted. In equilibrium all investors participate in the market if the most pessimistic investor (i.e., the investor with the lowest μ_k: $\mu_k = \bar{\mu}_k - \theta$) holds the stock. This implies

$$\frac{1}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)}\left(\tilde{s} - \frac{\beta - (\bar{\mu}_k - \theta)}{k_1}\right) + \frac{(\sigma_\epsilon^2 + \sigma_m^2)\mu_y - p(\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2)}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2} > 0. \tag{5}$$

Using the market clearing condition, we arrive at the following equation.

$$1 = \int_{\bar{\mu}_k - \theta}^{\bar{\mu}_k + \theta} \frac{1}{2\theta}\left[\frac{(\sigma_\epsilon^2 + \sigma_m^2)\mu_y + \sigma_y^2\left(\tilde{s} - \frac{\beta - \mu_k}{k_1}\right) - p(\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2)}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}\right] d\mu_k.$$

Equating the aggregate market demand to the quantity of stock available, which is normalized to 1, we obtain the equilibrium stock price:

$$p = \frac{(\mu_y - \gamma\sigma_y^2)(\sigma_\epsilon^2 + \sigma_m^2)}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2} + \frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}\left(\tilde{s} - \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2} - \bar{\mu}_k}{k_1}\right).$$

Therefore, the price is in fact linear in $\tilde{s}$, and matching the coefficients with the conjectured price, $P(\tilde{s}) = \alpha + \beta\tilde{s}$, yields the solutions: $\alpha = \dfrac{(\sigma_m^2 + \sigma_\epsilon^2)}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}\mu_y - \dfrac{\sigma_y^2\bar{\mu}_m}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2} - \dfrac{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}$, where $\bar{\mu}_m = \dfrac{\frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2} - \bar{\mu}_k}{k_1}$ and $\beta = \dfrac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}$.

We summarize the results below.

Proposition 1 *(*Characterization of full-participation equilibrium*) The equilibrium price of the stock under full market participation can be expressed as* $P(\tilde{s}) = \frac{(\sigma_m^2 + \sigma_\epsilon^2)}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}\mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}(\tilde{s} - \bar{\mu}_m) - \frac{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}$*, where* $\bar{\mu}_m = \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2} - \bar{\mu}_k}{k_1}$ *and* $\sigma_m^2 = \sigma_k^2/k_1^2$*. The optimal reporting strategy of the manager is* $m = \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2} - k_2}{k_1}, \forall s.$

The equilibrium stock price is the average perception of the expected value of the risk-adjusted future dividends. When using the report, investors subtract the expected amount of manipulation (μ_m) from the manager's report to value the firm. The weights put on investors' prior (μ_y) and the manager's report ($\tilde{s}$) depend on their relative precisions. The last term in the price represents the discount on the price of the stock to compensate for the risk involved in future dividends. Under full market participation, the market price behaves as if all investors have the average perception of manipulation ($\bar{\mu}_k$).

The dispersion in investors' perceptions has no impact on prices, as an increased dispersion of investor beliefs (θ) does not change the proportion of optimistic investors and pessimistic investors participating in the market under full participation. Due to the symmetry in the distribution of investor beliefs, the degree of managerial manipulation perceived by the average investor determines the equilibrium stock price. The investors who are more optimistic about the reliability of reporting and thus the value of the firm will hold more stock, while investors whose estimated overstatement is relatively higher will hold less. Combining the equilibrium price with Equation (5), we obtain the condition for full market participation, stated below.

Proposition 2 *(Condition for full participation) All investors participate in the stock market in equilibrium if*

$$\gamma(\sigma_m^2 + \sigma_\epsilon^2) - \frac{\theta}{k_1} > 0.$$

This full participation condition indicates that whether the most pessimistic investor participates in the stock market depends on the dispersion in investors' perceptions of managerial manipulation. When (θ/k_1) is sufficiently small, the discrepancy in the perceived degree of managerial manipulation among investors is small enough such that all investors are willing to hold a positive share of the stock under the equilibrium market price. When investor beliefs about managerial manipulation are distinguishable enough that condition (2) is not satisfied, some investors will consider the equilibrium price too high for their estimated firm worth and optimally withdraw from the stock market.

4 Endogenous limited participation

When investors have distinct views about the extent of overstatement, the investors sufficiently pessimistic about the credibility of financial reporting will consider the market price unjustified by the underlying value of the firm. If short selling is not permitted, they withdraw from the stock market, and limited stock market participation endogenously arises in equilibrium.

Let μ_k^* denote the lowest level of belief about μ_k at which investors hold the stock. The investor with μ_k^* is referred to as the "marginal investor" hereafter. Then we have

$$\frac{1}{\gamma(\sigma_\epsilon^2+\sigma_m^2)}\left(\tilde{s}-\frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2}-\mu_k^*}{k_1}\right)+\frac{(\sigma_\epsilon^2+\sigma_m^2)\mu_y-p(\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2)}{\gamma(\sigma_\epsilon^2+\sigma_m^2)\sigma_y^2}=0. \tag{6}$$

By aggregating investors demand and imposing the market clearing condition, we have

$$1=\int_{\mu_k^*}^{\bar{\mu}_k+\theta}\frac{1}{2\theta}\left[\frac{(\sigma_\epsilon^2+\sigma_m^2)\mu_y+\sigma_y^2\left(\tilde{s}-\frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2}-\mu_k}{k_1}\right)-p(\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2)}{\gamma(\sigma_\epsilon^2+\sigma_m^2)\sigma_y^2}\right]d\mu_k,$$

and combining this with Equation (6), we arrive at the following expression that determines μ_k^*:

$$1=\frac{[(\bar{\mu}_k+\theta)-\mu_k^*]^2}{4k_1\theta\gamma(\sigma_m^2+\sigma_\epsilon^2)}. \tag{7}$$

We split the overall investor demand into the number of individuals participating and the amount of stocks demanded by those participating. This reflects the distinction between whether to participate and how much to purchase at the individual level and is referred to, respectively, as the extensive and intensive margin of investor demand. The extensive margin is represented by the marginal investor at the individual level and is represented by the total number of individuals participating in the stock market at the aggregate level.

4.1 Accounting/governance regimes and prices

We interpret k_1, the cost of manipulation common to all firms, as a policy parameter reflecting the stringency of accounting standards and governance policies. In this subsection we consider how k_1 influences the equilibrium stock price by influencing investor demand for the stock in both a direct and an indirect manner.

The direct effect of increasing k_1 is to affect stock prices through the extensive margin (i.e., the marginal investor). To see this clearly, we rewrite Equation (6) which defines the marginal investor as follows.

$$\frac{(\sigma_m^2 + \sigma_\epsilon^2)}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}\mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}(\tilde{s} - \mu_m^*) = p. \tag{8}$$

The right-hand side is the price of the stock and can be considered as the cost to the marginal investor of participating in the market. The left-hand side is the firm value perceived by the marginal investor, and it symbolizes his expected benefit of holding the stock. Here we focus on upward manipulation, that is, $\mu_m^* = \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2} - \mu_k^*}{k_1} > 0$. Holding the marginal investor and stock price unchanged, an increase in k_1 increases the marginal investor's benefit of participating in the stock market, and leads the original marginal investor (before k_1 changes) to demand more stocks due to a favorable perception of the firm value.

Increasing k_1 also has an indirect impact on the stock price by influencing the intensive margin. The intensive margin for an investor with given μ_k is expressed as Equation (4) and restated below:

$$q* = \frac{1}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)}\left(\tilde{s} - \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2} - \mu_k}{k_1}\right) + \frac{(\sigma_\epsilon^2 + \sigma_m^2)\mu_y - p(\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2)}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}. \tag{9}$$

Combining the above equation with Equation (6), the demand q^* for each participating investor (that is, an investor with $\mu_k \geq \mu_k^*$) can be expressed as

$$q^* = \frac{\mu_k - \mu_k^*}{k_1 \gamma(\sigma_m^2 + \sigma_\epsilon^2)}. \tag{10}$$

Recall that the amount of managerial manipulation is $\mu_m = \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2} - \mu_k}{k_1}$. Thus, Equation (10) can be rewritten as

$$q^* = \frac{\mu_m^* - \mu_m}{\gamma(\sigma_m^2 + \sigma_\epsilon^2)}.$$

For an investor with the risk aversion γ, the intensive margin decreases with the payoff uncertainty $(\sigma_m^2 + \sigma_\epsilon^2)$. Because the marginal investor's belief (μ_m^*) is already reflected in the equilibrium price, individual demand by market participants increases with the *relative* optimism about reporting credibility compared to the marginal investor $(\mu_m^* - \mu_m)$.

An increase in k_1 thus has two conflicting effects on the intensive margin. On the one hand, a higher k_1 reduces the manipulation uncertainty (that is, $\sigma_m^2 = \sigma_k^2/k_1^2$) and causes individual demand to rise. On the other hand, as increased k_1 compresses the distribution of the perceived managerial manipulation among market participants, the relative optimism shrinks holding μ_k^* constant (that is, $\mu_m^* - \mu_m = (\mu_k - \mu_k^*)/k_1$). The reduced relative optimism of market participants leads the intensive margin to decline. The intensive margin may rise or fall when k_1 changes, depending on which effect dominates individual decisions. The direct (through the extensive margin) and indirect (through the intensive margin) effects jointly determine the comparative static feature of the equilibrium stock price with respect to k_1.

As long as k_1 is not too small, the change of intensive margins is dominated by the effect of the varying degree of payoff uncertainty. As k_1 increases, individual demand of market participants increases due to a reduction of manipulation uncertainty. As both the extensive margin and intensive margin tend to enlarge in response to a higher k_1, the stock price will therefore adjust upwards to depress demand and clear the market. This is characterized in the following lemma.

Lemma 1 *Suppose that the full-participation condition (Equation (2)) is not satisfied. As long as* $k_1 \geq \dfrac{(\bar{\mu}_k + \theta)^2}{\theta\gamma(\gamma_m^2 + \gamma_\epsilon^2)}$ *holds, the equilibrium stock price for a given report is increasing in* k_1*, i.e.,* $\partial p/\partial k_1 > 0$.

4.2 Belief dispersion and prices

We now turn to analyze how changes in investors' belief dispersion (θ) affect the equilibrium stock price. We derive the expression of μ_k^* from (7) as follows.

$$\mu_k^* = \bar{\mu}_k + \theta - 2\sqrt{k_1\theta\gamma(\sigma_m^2 + \sigma_\epsilon^2)}.$$

Let μ_k^s and μ_m^s be the average μ_k and the average extent of managerial manipulation perceived by the investors participating in the stock market. Thus, we have

$$\mu_k^s = \frac{\mu_k^* + \bar{\mu}_k + \theta}{2} = \bar{\mu}_k + \theta - \sqrt{k_1\theta\gamma(\sigma_m^2 + \sigma_\epsilon^2)}, \quad \mu_m^s = \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2} - \mu_k^s}{k_1}.$$

Combining this and $\mu_k^* \geq \bar{\mu}_k - \theta$, we obtain $\mu_k^s \geq \bar{\mu}_k$, which implies that the participating investors are on average more optimistic about reporting quality than the investor population.

We can then write the equilibrium stock price as a function of μ_m^s: when there is limited market participation, the equilibrium stock price is determined by the average degree of managerial manipulation perceived by the investors who are actually participating in the market. We have the following results regarding the impact of belief dispersion on price dynamics under limited participation.

Lemma 2 *Suppose that the full-participation condition (Equation (2)) is not satisfied. The following results hold under limited market participation.*

(i) The average μ_k *perceived by market participants increases with the dispersion in investor beliefs about managerial manipulation, i.e.,* $\partial\mu_k^s/\partial\theta > 0$.

(ii) The average level of managerial manipulation perceived by market participants decreases with the dispersion in investor beliefs about managerial manipulation, i.e., $\partial\mu_m^s/\partial\theta < 0$.

(iii) The equilibrium stock price for a given report increases with the dispersion in investor beliefs about managerial manipulation, i.e., $\partial p/\partial\theta > 0$.

Let us consider the effect of increasing θ when there is limited participation. A greater dispersion is associated with a broader spectrum of beliefs. Unlike the case of full market participation where an increase in belief dispersion equally affects optimistic investors and pessimistic investors, the effect of an increased θ on market participants is not symmetrical under limited participation. Because investors who are sufficiently pessimistic about financial reporting credibility do not hold stocks in the first place, an increase in belief dispersion essentially raises the level of market optimism about reporting quality. That is, the average degree of managerial manipulation perceived by market participants is lower when θ is larger. As investors participating in the market become more optimistic about firm value on average, the increased market optimism drives up the equilibrium stock price.

5 Equilibrium participation rate

The low rate of stock market participation, despite the considerable equity premium, has been noted to be puzzling. For instance, the 2005 Survey of Consumer Finances shows that about 50% of U.S. households own stocks or stock mutual funds (including holdings in their retirement accounts). To understand why limited participation may exist, Allen and Gale (1994) and Williamson (1994) study transaction costs and liquidity needs as possible causes, and Vissing-Jorgensen (1999) and Yaron and Zhang (2000) examine the effect of fixed entry cost on investors' participation decisions. Cao, Wang, and Zhang (2005) use uncertainty aversion of investors to generate limited market participation. We offer an alternative explanation for limited participation based on the existence of managerial manipulation, without behavioral utility specifications. Our model also allows us to derive implications for how corporate governance policies and accounting standards influence market participation.

Let η be the equilibrium participation rate in our model:

$$\eta = \frac{(\bar{\mu}_k + \theta) - \mu_k^*}{2\theta}.$$

We can then rewrite Equation (7) as a function of η: $1 = \dfrac{\theta\eta^2}{k_1\gamma(\sigma_m^2 + \sigma_\epsilon^2)}$. We solve for the equilibrium participation rate in closed form as follows.

$$\eta = \sqrt{\frac{k_1\gamma(\sigma_m^2 + \sigma_\epsilon^2)}{\theta}}.$$

5.1 Accounting/governance regimes and market participation

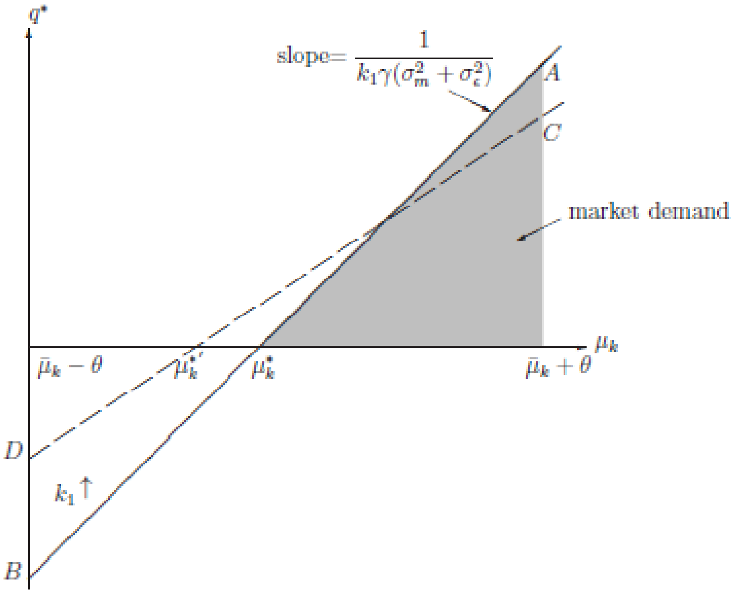
Accounting standard setters commonly perceive managerial manipulation as undesirable and reduce managerial discretion for manipulation by tightening accounting standards (Ewert and Wagenhofer 2005). Similarly, legal systems and governance policies protect investors by granting them the rights to discipline managers and consequently increase managers' cost to mask true firm performance. Leuz, Nanda, and Wysocki (2003) find that investor protection plays an important role in influencing international differences in earnings management. Based on prior research that identifies accounting standards and corporate governance as key institutional features affecting the cost and degree of managerial manipulation, we analyze whether they constitute a significant determinant of stock market participation.

We examine the impact of manipulation costs influenced by accounting standards and governance regimes on market participation. When the cost of managerial manipulation (k_1) varies, each participating investor changes the size of their stock holding (the intensive margin), and therefore the set of investors participating in the market (the extensive margin) must change as well for the market to clear. Using Equation (9), we write the individual demand of each market participant (for a given μ_k) as

$$q^* = \frac{1}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)}\left(\tilde{s} - \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2} - \mu_k}{k_1}\right) + \frac{(\sigma_\epsilon^2 + \sigma_m^2)\mu_y - p(\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2)}{\gamma(\sigma_\epsilon^2 + \sigma_m^2)\sigma_y^2}.$$

The individual demand (q^*) is described as the line AB in Figure 2. It depicts how the optimal holding of market participants varies with their perceived μ_k. The total demand

Figure 2: Effects of k_1



In this figure, $\mu_k \in [\bar{\mu}_k - \theta, \bar{\mu}_k + \theta]$ is the expected value of k_2 perceived by investors, and q^* is investor demand for the stock.

by market participants is thus represented by the shaded area below the AB line, which must equal the total quantity of stock outstanding (normalized to 1) for the stock market to clear. In other words, the price p, which shifts the AB line up and down in a parallel manner (as seen from the above equation), adjusts so that the shaded area is equal to 1.

As a high value of μ_k represents optimism about firm performance for a given financial report, the slope of the individual demand curve AB (that is, $\partial q^*/\partial \mu_k = 1/k_1\gamma(\sigma_m^2+\sigma_\epsilon^2)$) determines the marginal increase in demand due to investor optimism and thus also determines how demand is distributed across market participants with differential beliefs. If the AB line is steep, a small number of the most optimistic investors can demand a large volume of stocks, thus driving up the stock price to a sufficiently high level that forces out other investors. A small fraction of investors fully absorb the market in this case. With a more flat AB line, the equilibrium price adjusts so that a greater proportion of investors are induced to hold stocks and clear the market.

There are two conflicting forces that determine how the slope of the AB line varies with k_1. Consider an increase in k_1 due to tightened policies. On the one hand, the difference in the belief of μ_k is translated less into the difference in perceived manipulation and firm value (i.e., $-\partial\mu_m/\partial\mu_k = 1/k_1$ decreases). A large value of μ_k implies a small value of m, which represents an optimistic view of the firm performance given the report (recall that $s = \tilde{s} - m$). When k_1 is large, the degree of manipulation becomes small, and a large heterogeneity in the beliefs of μ_k does not lead to a large heterogeneity in the perceived manipulation (m). Thus the demand heterogeneity across investors with different beliefs of μ_k becomes small. This flattens the AB line. On the other hand, the reduced manipulation uncertainty ($\sigma_m^2 = \sigma_k^2/k_1^2$) causes the demand to be more sensitive to the information and investor beliefs. This effect makes the AB line steeper. It turns out that the first effect, that is, the effect of the reduced relevance of optimism, dominates when $k_1 > \sigma_k/\sigma_\epsilon$. Therefore, the AB line becomes flatter when k_1 increases. For the market to clear, the price has to adjust so that μ_k^* decreases (to $\mu_k^{*'}$ on the CD line in Figure 2). The following lemma summarizes the relationship between market participation and manipulation costs.

Proposition 3 *Suppose that the full-participation condition (Equation (2)) is not satisfied and $k_1 > \sigma_k/\sigma_\epsilon$ holds. Then the equilibrium participation rate is increasing in k_1, i.e., $\partial\eta/\partial k_1 > 0$.*

When k_1 is large compared to the relative uncertainty associated with k_2, the effect of decreased manipulation uncertainty is dominated by that of the reduced importance of investor optimism. The demand is less sensitive to investor beliefs (μ_k) when k_1 increases. The intensive margin consequently falls for each investor initially participating in the market, and thus the extensive margin must increase to clear the market. In a nutshell, the market participation rate increases in response to an increased k_1 associated with tightened governance policies.

5.2 Belief dispersion and market participation

We now turn to discuss the impact of belief dispersion on the equilibrium participation rate. Under limited participation, investors sufficiently pessimistic about the credibility of reporting optimally choose not to invest in stocks. When investor beliefs about the extent of managerial manipulation become more dispersed, investors who are in the market are more optimistic on average. As market participants on average have a more favorable view about firm value, stronger demand driven by market optimism raises the equilibrium stock price, forcing more pessimistic investors to withdraw from the market. The proportion of investors participating in the stock market therefore decreases as their perceptions about manipulation become more dispersed. The following lemma points out a negative relationship between market participation and the dispersion in investor beliefs about managerial manipulation.

Lemma 3 *Suppose that the full-participation condition (Equation (2)) is not satisfied, the equilibrium participation rate is decreasing in the dispersion in investor beliefs about managerial manipulation, i.e.,* $\partial\eta/\partial\theta < 0$.

5.3 Cross-country patterns

One main implication from our model is that a more strict reporting system (k_1), possibly caused by tightened accounting standards or governance regime, can have an effect of encouraging stock market participation (Proposition 3). We will test this implication across countries. A large part of the stock market participation puzzle is centered on the wealthy: why *wealthy* people do not invest in stocks. Thus, in addition to the percentage of population participating in the stock market, we also include the participation rate of the wealthy across countries.

We assemble participation information from two sources. We obtain the domestic stock market participation rate from Giannetti and Koskinen (2010), that is, the percentage of population directly holding stocks. For stock ownership by the wealthy, we obtain from Guiso, Sapienza, and Zingales (2008) the percentage of individuals in the top 5% of the wealth distribution that own stock directly and the same proportion when indirect ownership via mutual funds or pension funds is included.

We use two direct measures of the quality of reporting systems for each country. The first is an index of accounting quality: Accounting Index computed in La Porta et al. (1998). The Accounting Index measures the inclusion or omission of 90 items in firms' 1990 annual reports and has been used to reflect the quality of (or compliance of) accounting standards at the country level. We also include a measure of how compliance with accounting standards is promoted through external audit, that is, the Audit Index constructed in Brown, Preiato, and Tarca (2014), to proxy for the strength of accounting system in a country. A higher Accounting Index or Audit Index implies a more stringent reporting system in a given country and thus a greater cost of manipulation to managers (k_1). In addition, we obtain corporate governance measures from La Porta et al. (1998) and a global rating published by Governance Metrics International (2010). We also obtain an index of legal enforcement from La Porta et al. (1998) as an alternative measure of policy-related factors that influence the reporting system or managerial cost of manipulation.

We first plot how overall stock market participation varies with our four measures that proxy for the stringency of the reporting system. In Figure 3 and Figure 4, the vertical axis is the percentage of population directly holding stocks, which exhibits considerable variation across countries, ranging from only 1.2% in Turkey to 40.4% in Australia. Evident in the figures, the participation rate is positively associated with all the four policy measures.

It might be important to separate developed economies and developing economies in light of potentially different considerations in market participation decisions. We thus restrict ourselves to a smaller set of countries for which we have participation data by the wealthy available, all in developed economies. We display how (i) the fraction of population that directly hold stocks, (ii) the fraction of the wealthiest that directly hold stocks, and (iii) the fraction of the wealthiest directly and indirectly hold stocks vary with Accounting Index in the first row of Figure 5. Market participation of the wealthy also shows significant variation: the participation rate varies from 3.5% (and 5.4%) in Spain to 40.8% (and 66.2%) in Sweden for direct (and indirect) ownership. A high Accounting Index tends to be associated with high market participation, proxied by all the three participation measures. Similarly, a high Audit Index is associated with high market participation by both the population and the wealthy. Using all the three measures, stock market participation also exhibits remarkable positive correlation with corporate governance and legal enforcement.

We formally test this relation by regressing stock market participation in each country on our measures of reporting system (k_1), reported in Table 1. As expected, Accounting Index, Audit Index, corporate governance, and legal enforcement all have a positive effect on stock ownership, and the effects are statistically and economically significant. The results are largely unchanged when we control for the transaction cost in the stock market in each country, which has been considered as a major cause for limited market participation. Our reporting-based theory also has the advantage of accounting for worldwide differences in stock ownership even among wealthy individuals.[10]

[10]Our results should not be interpreted as advocating for stringent accounting regulation. Rather, we argue that criticism of such patterns should be balanced by the potential effects on stock market participation.

6 Discussion

Thus far, we have analyzed financial reporting and market participation in a single-period model. But a static structure makes it difficult to study the role of fraud detections in affecting managerial manipulation and stock ownership. To incorporate managerial reputation and regulatory investigations into reporting, in this section we analyze an extended model where an external signal of managerial manipulation is available to investors at the beginning of the second period. Specifically, we introduce a public signal of m (i.e., the extent of manipulation), denoted by $t = m + \tau$, where $\tau \sim N(0, \sigma_\tau^2)$ and is independent of y, ϵ, and k_2. A perfect detection of managerial manipulation would imply $\sigma_\tau^2 = 0$.

6.1 Managerial reputation

In this environment with the revelation of accounting frauds (t), we can study the role of managerial reputation by assuming that managers incur a disutility when their manipulation is detected. Specifically, each manager stays in the office for one period, and their cost of manipulation in period 1 has an additional term $\frac{r}{2}E[t^2]$. The larger r is, the more concerned the manager is about his reputation damage in the event of a fraud detection. The reputation damage is increasing in the deviation in the report from the underlying true value, either positive or negative.

Intuitively, a higher r has an effect of depressing manipulation:

$$m = \frac{\beta - k_2}{k_1 + r}, \forall s.$$

The amount of manipulation is decreasing in the degree of reputation concern (r).

When r is known to investors, managerial reputation concerns can have an effect of encouraging market participation. Specifically, there are two conflicting forces that influence market participation when r increases. On the one hand, the difference in the belief of μ_k is translated less into the difference in perceived manipulation and firm value (i.e., $-\partial \mu_m / \partial \mu_k = 1/(k_1 + r)$ decreases). Thus the demand heterogeneity across investors is lowered, inducing more investors to hold the stock. On the other hand, the reduced manipulation uncertainty ($\sigma_m^2 = \sigma_k^2/(k_1+r)^2$) causes the demand to be more sensitive to investor beliefs. This effect tends to reduce participation. The first effect, that is, the effect of the reduced relevance of optimism, dominates when $k_1 + r > \sigma_k/\sigma_\epsilon$, leading to a higher percentage of individuals holding the stock. The following lemma summarizes the relationship between market participation and reputation concerns.

Lemma 4 *Suppose that the full-participation condition (Equation (2)) is not satisfied and $k_1 + r > \sigma_k/\sigma_\epsilon$ holds. Then the equilibrium participation rate is increasing in r, i.e., $\partial\eta/\partial r > 0$.*

6.2 Manipulation detection

How do revelations of accounting frauds directly affect stock market participation then? Intuitively, there could be an information effect: the detection of managerial manipulation reveals information about manipulation and thus reduce the dispersion of beliefs among investors. As an additional signal levels the playing field for investors with different information and processing ability, it may help improve the participation rate. However, the detection of managerial manipulation may also affect the trust individuals place on the reporting system. As Guiso, Sapienza, and Zingales (2008) state, "episodes like the collapse of Enron may change not only the distribution of expected payoffs, but also the fundamental trust in the system that delivers those payoffs." The "mistrust" effect may deter participation.

To account for the effects of fraud revelations on participation, we follow Guiso, Sapienza, and Zingales (2008) and model trust as the subjective perception of the fairness of the reporting system.[11] In this case, the parameter k_1 reflects how much investors trust the reporting system (influenced by accounting/governance policies), i.e., their subjective perception of the manager's manipulation cost. In period 1 (without revelation of frauds), there is a regime in which investors trust the system (a trust regime): $k_1 = k_{10} > 0$, where

[11]Specifically, Guiso, Sapienza, and Zingales (2008) define trust as the subjective probability of being cheated by the system.

k_{10} represents the objective, true value of the policy parameter in the manager's manipulation cost. In period 2 after the fraud revelation (i.e., a public signal t), investors are disappointed and enter a regime in which they do not trust the system (a mistrust regime): investors' subjective belief (k_1) of the policy parameter is different from its objective value.

A larger absolute value of t implies a more severe manipulation, and thus, would have a larger impact on the level of investors' trust. Therefore, we assume that after the detection of managerial manipulation, $k_1 = k_1(t^2, \sigma_\tau^2) \geq 0$ is a function of the signal, satisfying that $\frac{\partial k_1}{\partial t^2} < 0$.[12]

A public signal of m will influence investors' posterior beliefs about k_2 and hence affect their estimated conditional mean and variance of final earnings, that is, $E[y|\tilde{s}]$ and $Var[y|\tilde{s}]$ respectively. Recall that $m = \frac{\beta - k_2}{k_1}$, where β is the price-report sensitivity and in equilibrium is expressed as $\beta = \frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}$. It is then straightforward to derive investors' posterior beliefs of k_2 as follows.

$$\begin{aligned} E[k_2|t] &= \frac{\sigma_\tau^2}{\sigma_m^2 + \sigma_\tau^2}\mu_k + \frac{\sigma_m^2}{\sigma_m^2 + \sigma_\tau^2}(\beta - k_1 t), \\ Var[k_2|t] &= \frac{k_1^2 \sigma_\tau \sigma_k^2}{k_1^2 \sigma_\tau^2 + \sigma_k^2}, \end{aligned}$$

where $\beta = \frac{\sigma_y^2}{\sigma_\epsilon^2 + \sigma_m^2 + \sigma_y^2}$. To estimate the conditional mean of k_2, investors weigh their prior (μ_k) and information from the detection signal ($\beta - k_1 t$) based on their relative precision.

Recall that without the detection signal (t), investors' prior of μ_k is uniformly distributed over the interval $[\bar{\mu}_k - \theta, \bar{\mu}_k + \theta]$. Investors' posterior beliefs of μ_k therefore lie in $[\frac{\sigma_\tau^2}{\sigma_m^2 + \sigma_\tau^2}(\bar{\mu}_k - \theta) + \Omega, \frac{\sigma_\tau^2}{\sigma_m^2 + \sigma_\tau^2}(\bar{\mu}_k + \theta) + \Omega]$, where $\Omega = \frac{\sigma_m^2}{\sigma_m^2 + \sigma_\tau^2}(\beta - k_1 t)$. The dispersion among investors' posteriors (after receiving the detection signal), denoted by $\hat{\theta}$, is thus expressed as $\hat{\theta} = \frac{\sigma_\tau^2 \theta}{\sigma_m^2 + \sigma_\tau^2}$. Following the same procedure as in Section 4, we can derive

[12] Moreover, such an effect should be larger if the signal is more precise (i.e., σ_τ^2 is smaller): $\frac{\partial^2 k_1}{\partial t^2 \partial \sigma_\tau^2} > 0$. In addition, if the signal is noisy, it should have muted effect on investors' trust, so we also assume that $k_1(t^2, \sigma_\tau^2)$ approaches k_{10}, as σ_τ^2 goes to infinity. For example, a functional form such as $k_1(t^2, \sigma_\tau^2) = \frac{e^{-t^2}}{\sigma_\tau^2+1} + \frac{k_{10}\sigma_\tau^2}{\sigma_\tau^2+\sigma_m^2}$ satisfies all the properties specified. Our results do not depend on these assumptions though.

the equilibrium participation rate after receiving the detection signal as follows.

$$\hat{\eta} = \sqrt{\frac{k_1(t^2, \sigma_\tau^2)\gamma(\hat{\sigma}_m^2 + \sigma_\epsilon^2)}{\hat{\theta}}},$$

where $\hat{\sigma}_m^2$ represents the conditional variance of m upon receiving the detection signal and is calculated as $\hat{\sigma}_m^2 = \frac{Var[k_2|t]}{k_1^2} = \frac{\sigma_\tau^2 \sigma_m^2}{\sigma_\tau^2 + \sigma_m^2}$.

Taken together, allowing for a fraud detection (t) has two conflicting effects (i.e., information effect and trust effect) on market participation. On the information side, having an additional signal of managerial manipulation reduces the dispersion of beliefs among investors (i.e., $\hat{\theta}$), which increases the participation rate; in the meantime, it also reduces market uncertainty regarding reporting (i.e., $\hat{\sigma}_m^2$), which causes investor demand to be more sensitive to their beliefs, making the market fully absorbed by a smaller fraction of the most optimistic investors. The overall effect turns out to be positive, and increases the equilibrium participation rate after revelations of accounting scandals. On the trust side, the detection of a severe manipulation (i.e., t^2 is large) will have a large negative effect on how much investors trust the system, leading to a lower participation rate. We summarize our results below.

Lemma 5 *Suppose that investors' perception $k_1(t^2, \sigma_\tau^2)$ satisfies that $\frac{\partial k_1}{\partial t^2} < 0$.*

1) If there exists t_0 such that $k_1(t_0^2, \sigma_\tau^2) \leq \frac{k_{10}(\sigma_m^2 + \sigma_\epsilon^2)}{\sigma_m^2 + \sigma_\epsilon^2(\frac{\sigma_\tau^2 + \sigma_m^2}{\sigma_\tau^2})}$, then when $t^2 > t_0^2$, revelations of managerial manipulation decrease the equilibrium market participation.

2) If $\lim_{t^2, \sigma_\tau^2 \to 0} k_1(t^2, \sigma_\tau^2) > 0$, then when t^2 and σ_τ^2 are small, revelations of managerial manipulation increase the equilibrium market participation.[13]

In line with a dominating mistrust effect, Giannetti and Wang (2016) show that after the revelation of corporate fraud in a state, household stock market participation in that state decreases. Households decrease holdings in fraudulent as well as nonfraudulent firms, even if they do not hold stocks in fraudulent firms. They also provide evidence for a trust-based explanation for the data pattern.

[13] It is easy to verify that a functional form such as $k_1(t^2, \sigma_\tau^2) = \frac{e^{-t^2}}{\sigma_\tau^2 + 1} + \frac{k_{10}\sigma_\tau^2}{\sigma_\tau^2 + \sigma_m^2}$ satisfies both conditions.

7 Conclusion

We study the implication of managerial manipulation for stock market participation in a rational expectations model. We show that the existence of managerial manipulation can endogenously give rise to limited market participation when investors have heterogeneous perceptions of its practice. When the dispersion among investor beliefs about manipulation is sufficiently large, investors who are pessimistic about the credibility of financial reporting will consider the market price unjustified by firm value and optimally choose not to invest in stocks in equilibrium.

We also show that tightening accounting standards can have an effect of improving market participation. Increasing the cost of manipulating earnings by tightening accounting standards reduces the degree of managerial manipulation, which lowers the demand heterogeneity across investors with differential beliefs; the equilibrium stock price must adjust in this case to induce a larger proportion of investors to hold stocks and absorb the market, raising the market participation rate. In addition, although revelations of managerial manipulation through regulatory detections provide additional public information (directly about reporting practices) and level the playing field for investors with differential information, they can also cause a loss of trust in the reporting system and hence lower stock ownership.

Our study does not aim to find complete explanations for the size and growth of stock market participation, and factors such as financial literacy and transaction costs are admittedly crucial to individuals' financial decision-marking. We paint the set of phenomena related to market participation with an intentionally broad brush, given our objective to examine the implications of managerial manipulation for market-wide patterns in equity markets. Certainly much more work lies ahead to develop a richer understanding of how and whether financial reporting is quantitatively important in affecting stock ownership in aggregate.

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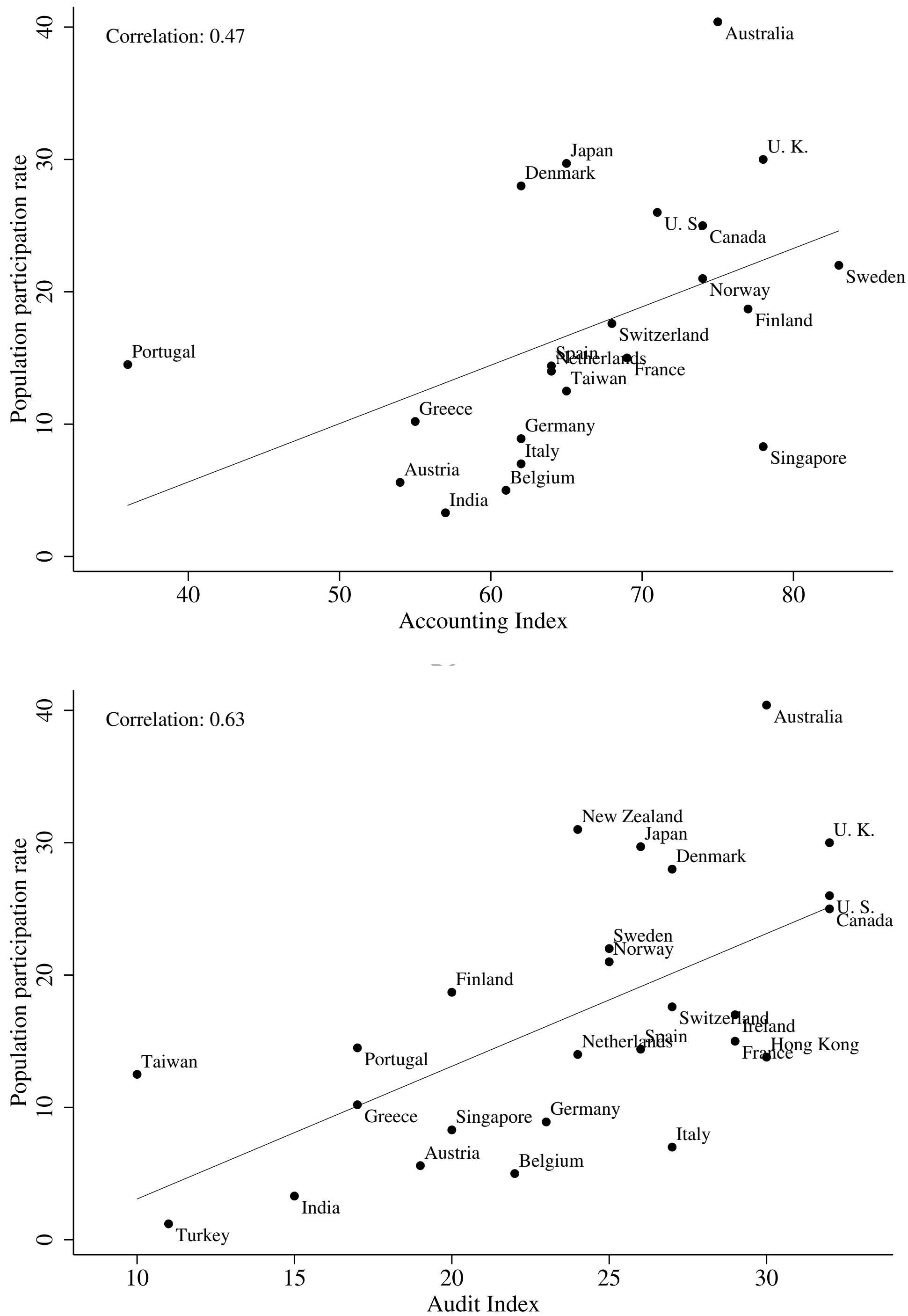
Table 1: **Regression analysis**

	% population investing directly in stock market							
Audit Index	1.003***	0.979***						
	(0.254)	(0.273)						
Accounting Index			.0.441**	0.423**				
			(0.184)	0.201				
Corporate Governance					3.702**	3.453**		
					(1.378)	(1.452)		
Legal Enforcement							4.139***	3.610**
							(1.152)	(1.4095)
Control		0.070		0.081		0.177		0.220
		(6.360)		(0.298)		(0.284)		(0.262)
Number of Observations	26	26	22	22	26	12	34	23
R^2	0.394	0.396	0.223	0.226	0.231	0.244	0.2876	0.282

	% wealthiest investing directly in stock market							
Audit Index	2.554*	2.694*						
	(1.289)	(1.278)						
Accounting Index			1.868***	2.106***				
			(0.560)	(0.483)				
Corporate Governance					13.002**	12.640**		
					(4.702)	(5.139)		
Legal Enforcement							17.476***	14.243***
							(2.319)	(3.416)
Control		−1.706		−2.419*		−0.378		−0.599
		(1.522)		(1.076)		(1.490)		(1.098)
Number of Observations	12	12	12	12	12	12	20	12
R^2	0.282	0.370	0.528	0.697	0.433	0.437	0.576	0.679

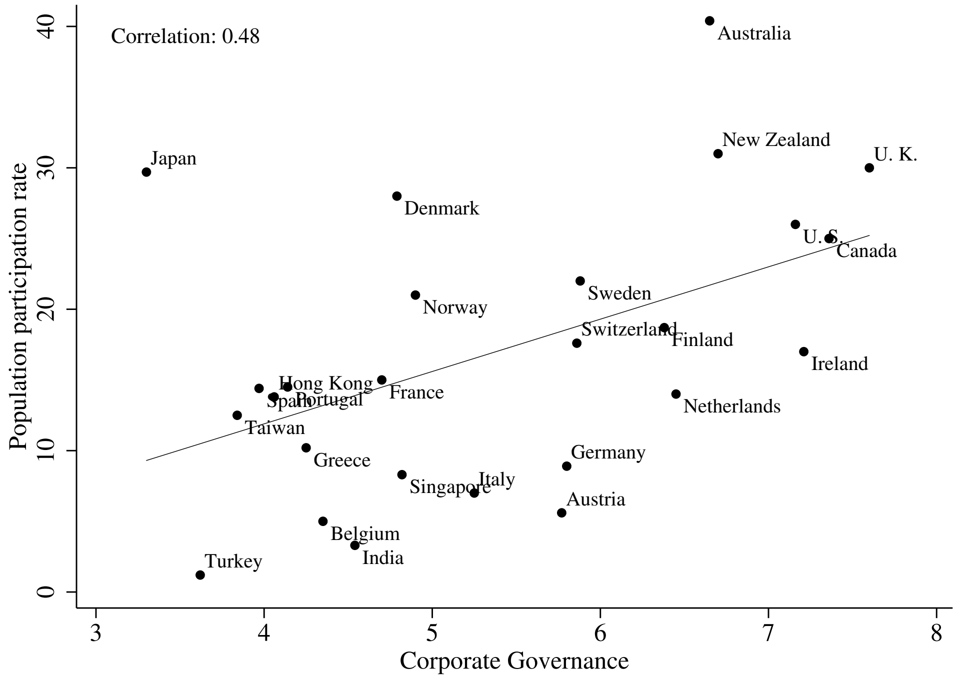
	% wealthiest investing directly & indirectly in stock market							
Audit Index	3.417**	3.622***						
	(1.205)	(1.066)						
Accounting Index			2.110***	2.431***				
			(0.552)	(0.339)				
Corporate Governance					14.164**	13.180**		
					(4.913)	(5.257)		
Legal Enforcement							17.622***	11.361**
							(3.565)	(4.692)
Control		−2.509		−3.273		−1.031		−1.455
		(1.269)		(0.755)		(1.524)		(1.508)
Number of Observations	12	12	12	12	12	12	20	12
R^2	0.446	0.614	0.594	0.868	0.454	0.4803	0.576	0.466

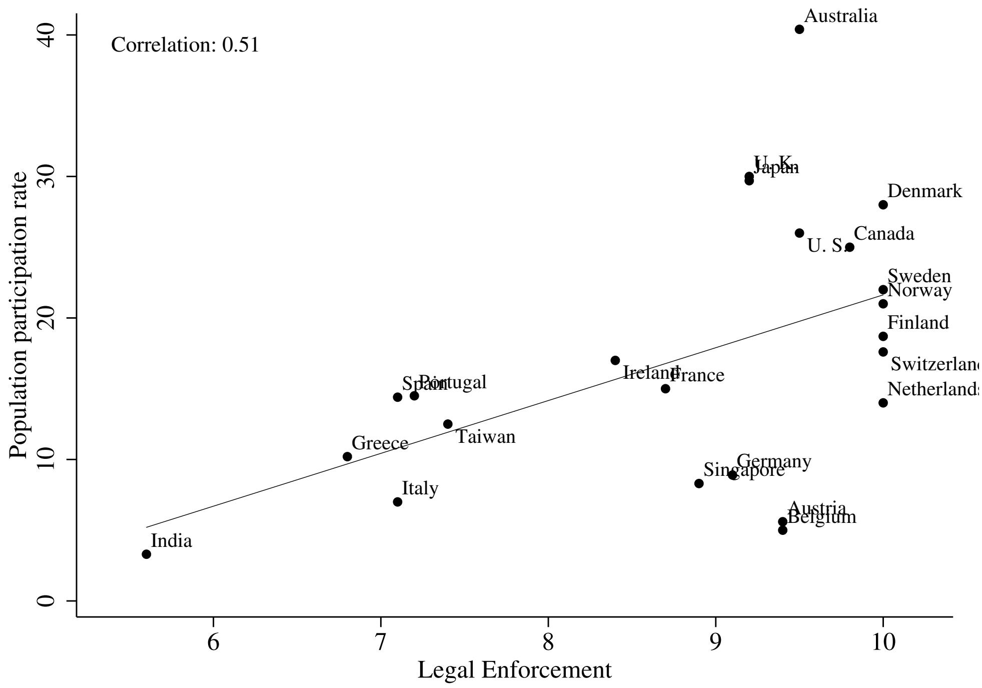
Figure 3: **Stock market participation (population, Accounting/Audit Index)**



The figures plot the percentage of the population directly holding stocks against the Accounting Index and Audit Index.

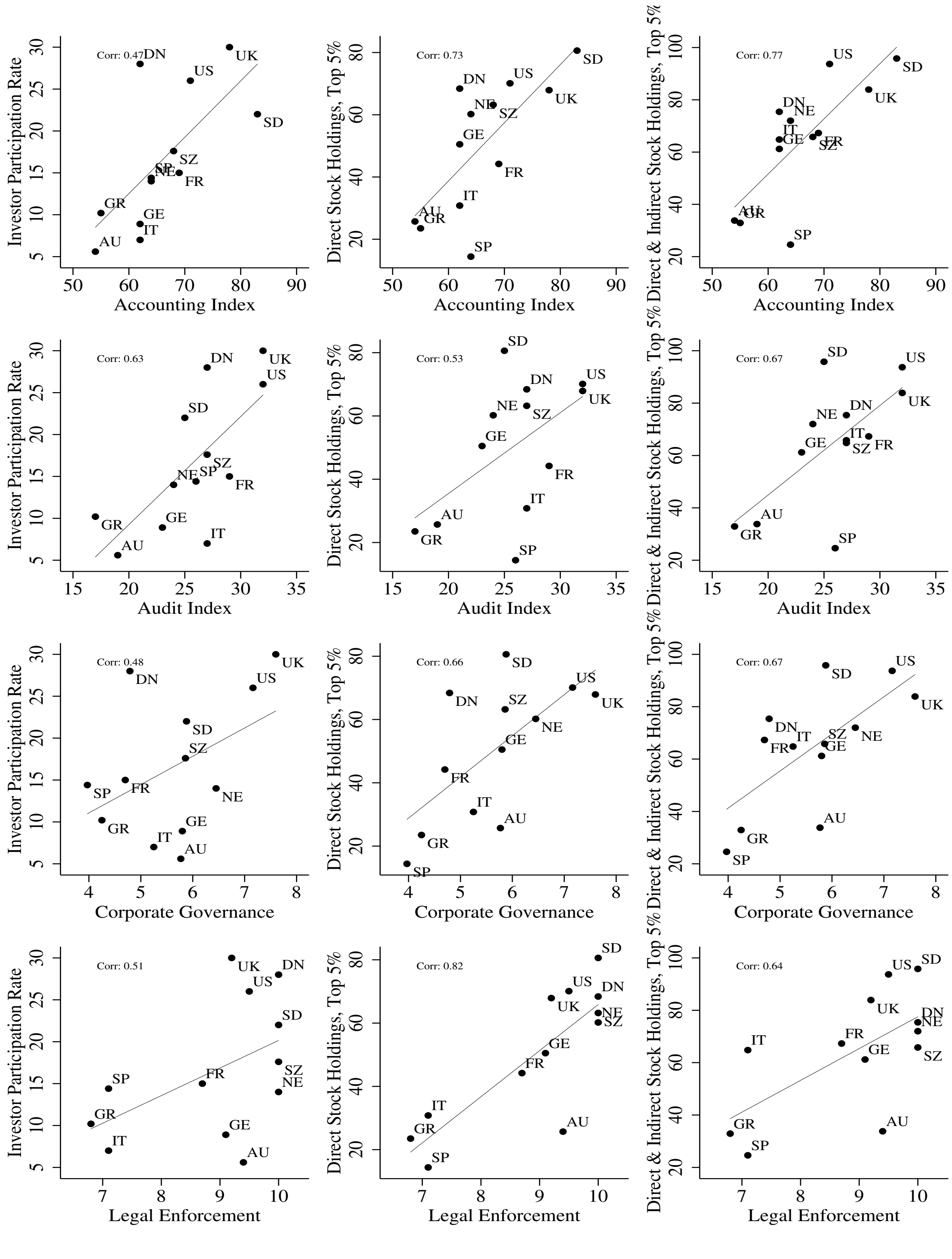
Figure 4: **Stock market participation (population, Governance/Enforcement)**





The figures plot the percentage of the population directly holding stocks against the measures of corporate governance and legal enforcement.

Figure 5: **Stock market participation (population and the wealthy)**



These figures plot (i) the percentage of the population directly holding stocks (far left), (ii) the percentage of the top 5% wealthiest directly holding stocks (middle), and (iii) the percentage of the top 5% wealthiest directly and indirectly holding stocks (far right) against the Accounting Index, Audit Index, and measures of corporate governance and legal enforcement.

Appendix

A Equilibrium stock price under truthful reporting

Given the prior about y, the investors' conditional expectation and conditional variance over the dividend should instead be given by

$$\begin{aligned} E[y|\tilde{s}] &= \frac{\sigma_\epsilon^2}{\sigma_\epsilon^2+\sigma_y^2}\mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_y^2}\tilde{s}, \\ Var[y|\tilde{s}] &= \sigma_y^2(1-\rho^2) = \frac{\sigma_\epsilon^2\sigma_y^2}{\sigma_\epsilon^2+\sigma_y^2}. \end{aligned}$$

That is, the conditional expectation should be a linear combination of the truthful report $\tilde{s} = s = y + \epsilon$, and the mean of the prior for y. Furthermore, the weights on the report and the prior are given by their relative precision respectively. This yields an equilibrium price given by

$$\frac{\sigma_\epsilon^2}{\sigma_\epsilon^2+\sigma_y^2}\mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_y^2}\tilde{s} - \gamma\frac{\sigma_y^2\sigma_\epsilon^2}{\sigma_y^2+\sigma_\epsilon^2}.$$

B Conditional mean and variance of y

Note that $\tilde{s} = s + m = y + \epsilon + \frac{\beta-k_2}{k_1} = y + x$, where $x = \epsilon + \frac{\beta-k_2}{k_1}$ is independent of y, normally distributed with mean $\mu_x = \mu_m = \frac{\beta-\mu_k}{k_1}$ and variance $\sigma_x^2 = \sigma_\epsilon^2 + \sigma_m^2 = \sigma_\epsilon^2 + \frac{\sigma_k^2}{k_1}$. Define $U = \frac{y+x-\mu_y-\mu_x}{\sqrt{\sigma_x^2+\sigma_y^2}}$. Then U is standard normal, and $\tilde{s} = \mu_s + \sigma_s U$ where $\mu_s = \mu_y + \mu_x$ and $\sigma_s = \sqrt{\sigma_x^2+\sigma_y^2}$. Meanwhile, y can be written as $y = \mu_y + \sigma_y(\rho U + \sqrt{1-\rho^2}V)$, where $\rho = \frac{\sigma_y}{\sqrt{\sigma_x^2+\sigma_y^2}}$. It is easy to check that V is standard normal and $Cov(U,V) = 0$ (thus, U and V are independent). Now it is straightforward to calculate that

$$\begin{aligned} E[y|\tilde{s}] &= E[\mu_y + \sigma_y(\rho U + \sqrt{1-\rho^2}V)|U] = \mu_y + \sigma_y\rho U = \mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2}(\tilde{s} - \mu_y - \mu_m), \\ Var[y|\tilde{s}] &= Var[\mu_y + \sigma_y(\rho U + \sqrt{1-\rho^2}V)|U] = \sigma_y^2(1-\rho^2) = \frac{(\sigma_\epsilon^2+\sigma_m^2)\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2}. \end{aligned}$$

C Proofs

Proof of Lemma 1: By Equation (6), the equilibrium price under limited participation can be derived as follows.

$$\begin{aligned} p &= \frac{(\sigma_\epsilon^2+\sigma_m^2)\mu_y}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2} + \frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2}\left(\tilde{s} - \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2} - \mu_k^*}{k_1}\right) \\ &= \mu_y + \frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2}\left(\tilde{s} - \mu_y - \frac{\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2} - \mu_k^*}{k_1}\right), \end{aligned}$$

where $\mu_k^* = \bar{\mu}_k + \theta - 2\sqrt{\theta k_1 \gamma(\sigma_\epsilon^2+\sigma_m^2)}$.

$$\begin{aligned} \frac{\partial p}{\partial k_1} &= \frac{(\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2})^2}{k_1^2} + (\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2})\frac{\partial(\frac{\mu_k^*}{k_1})}{\partial k_1} \\ &= \frac{(\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2})^2}{k_1^2} + (\frac{\sigma_y^2}{\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2})\frac{\sqrt{\theta k_1\gamma(\sigma_\epsilon^2+\sigma_m^2)} - (\bar{\mu}_k+\theta)}{k_1^2} \end{aligned}$$

Thus, $\frac{\partial p}{\partial k_1} > 0$ as long as $k_1 \geq \frac{(\bar{\mu}_k+\theta)^2}{\theta\gamma(\sigma_\epsilon^2+\sigma_m^2)}$ □

Proof of Lemma 2 (i): $\frac{\partial \mu_k^s}{\partial \theta} = 1 - \frac{1}{2}\sqrt{\frac{k_1\gamma(\sigma_\epsilon^2+\sigma_m^2)}{\theta}}$. As (2) is not satisfied, $\sqrt{k_1\gamma(\sigma_\epsilon^2+\sigma_m^2)/\theta} <$ 1 holds under limited participation. Thus, $\frac{\partial \mu_k^s}{\partial \theta} > 1 - \frac{1}{2} > 0$.□

Proof of Lemma 2 (ii): $\frac{\partial \mu_m^s}{\partial \theta} = -\frac{1}{k_1}\frac{\partial \mu_k^s}{\partial k_1} < 0$.□

Proof of Lemma 2 (iii): $\frac{\partial p}{\partial \theta} = \frac{\sigma_y^2}{k_1(\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2)}\frac{\partial \mu_k^*}{\partial \theta} = \frac{\sigma_y^2}{k_1(\sigma_\epsilon^2+\sigma_m^2+\sigma_y^2)}\left[1 - \sqrt{\frac{k_1\gamma(\sigma_m^2+\sigma_\epsilon^2)}{\theta}}\right] >$ 0.□

Proof of Lemma 3: Let $g(k_1) = \sigma_k^2/k_1 + k_1\sigma_\epsilon^2$. Then η can be rewritten as $\eta = \sqrt{\frac{\gamma}{\theta}g(k_1)}$. Taking derivative of η with respect to θ yields $\frac{\partial \eta}{\partial k_1} = \sqrt{\frac{\gamma}{\theta}}\frac{1}{2}\frac{\partial g(k_1)/\partial k_1}{\sqrt{g(k_1)}} = \frac{1}{2}\sqrt{\frac{\gamma}{\theta}}\frac{(\sigma_\epsilon^2 - \sigma_k^2/k_1^2)}{\sqrt{\sigma_k^2/k_1^2 + k_1\sigma_\epsilon^2}}$. When $k_1 > \sigma_k^2/\sigma_\epsilon^2$ holds, $\partial\eta/\partial\theta > 0$ holds as well.□

Proof of Lemma 3: $\frac{\partial \eta}{\partial \theta} = -\frac{1}{2}\sqrt{\frac{k_1\gamma(\sigma_k^2/k_1^2+\sigma_\epsilon^2)}{\theta^3}} < 0$.□

Proof of Lemma 5: 1) For brevity, let $M = \frac{k_{10}(\sigma_m^2+\sigma_\epsilon^2)}{\sigma_m^2+\sigma_\epsilon^2(\frac{\sigma_\tau^2+\sigma_m^2}{\sigma_\tau^2})}$. Then we obtain $\hat{\eta} = \sqrt{\frac{k_1(t^2,\sigma_\tau^2)\gamma\left(\sigma_m^2+\sigma_\epsilon^2(\frac{\sigma_\tau^2+\sigma_m^2}{\sigma_\tau^2})\right)}{\theta}} < \sqrt{\frac{M\gamma\left(\sigma_m^2+\sigma_\epsilon^2(\frac{\sigma_\tau^2+\sigma_m^2}{\sigma_\tau^2})\right)}{\theta}}$ for any $t^2 > t_0^2$, since

$\frac{\partial k_1}{\partial t^2} < 0$. Recall that the participation rate before revelations of managerial manipulation is $\eta = \sqrt{\dfrac{k_{10}\gamma(\sigma_m^2 + \sigma_\epsilon^2)}{\theta}}$. So it is straight-forward to see that $\eta > \hat{\eta}$ for any $t^2 > t_0^2$. 2) If $\lim_{t^2,\sigma_\tau^2 \to 0} k_1(t^2, \sigma_\tau^2) > 0$, then it is easy to derive that $\lim_{t^2,\sigma_\tau^2 \to 0} \hat{\eta} \to 1$.[14] Thus, $\eta < \hat{\eta}$ when t^2 and σ_τ^2 are small.□

[14]We actually obtain that $\lim_{t^2,\sigma_\tau^2 \to 0} \hat{\eta} \to \infty$ in mathematics, but since the participation rate is at most 1, we can claim that $\lim_{t^2,\sigma_\tau^2 \to 0} \hat{\eta} \to 1$.