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HKUST Institute for Emering Market Studies
The Hong Kong University of Science and Technology
Clear Water Bay, Kowloon, Hong Kong
T: +852 3469 2215 E: iems@ust.hk W: iems.ust.hk

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Abstract

Our experiment and survey suggest that some investors are naive, being unaware of the possible financial fraud of high-return products. We build a model with firms strategically choosing whether to offer normal or fraudulent products to possibly unaware investors. Having new firms in the market makes offering normal products less profitable and thus discourages firms from behaving honestly. In a leader-follower environment, an honest firm may sell a normal product to sophisticated investors, while a dishonest firm targets only naive investors. By disclosing information about financial fraud, the honest firm can steal market share from the dishonest firm, but doing so may induce the dishonest firm to deviate and compete for the normal-product market, which limits the honest firm's incentive to disclose information. Policy instruments, such as increasing legal punishment, implementing a public education program, and lowering the interest rate ceiling, may also trigger the honest firm to strategically shroud information. As a consequence, these policies cannot ensure an improvement in investors' welfare

Key words: financial fraud, investor naivety, unawareness, shrouding

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Author's contact information

Zhengqing Gui
Economics and Management School, Wuhan University.
E: zq.gui@whu.edu.cn

Yangguang Huang
Hong Kong University of Science and Technology.
E: huangyg@ust.hk

Xiaojian Zhao
Hong Kong University of Science and Technology.
E: huangyg@ust.hk

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1 Introduction

With the rise of financial market liberalization, individuals hold more responsibility for their wealth management through their own decisions. However, not every investor is sophisticated enough to correctly foresee the underlying risk of financial products, especially as many products have become increasingly complex. When making decisions, investors may be unaware of important factors, such as add-on pricing (Kosfeld and Schu¨wer, 2017), hidden contract terms (Agarwal et al., 2017), certain options (Auster and Pavoni, 2018), and the financial product issuer's informational advantage (Kondor and K˝oszegi, 2017), and thus may be exploited by firms.

In this paper, we investigate a widespread and important problem: financial fraud. It refers to firms taking deceptive actions to exploit investors, such as Ponzi schemes and running away with the money.[1][2] The existence of a large number of financially "illiterate"[3] investors opens the door for financial fraud because these investors are likely to be attracted by products that offer toogood-to-be-true returns. In 2015, 220 thousand Fanya Metal Exchange investors from 20 provinces in China lost a total of CNY 48 billion in investments.[4] The case of Fanya is a typical financial fraud in which the firm claims an unrealistically high return without providing any information about risks.[5] Misleading product descriptions may induce naive investors to underestimate default risk and purchase products that are not consistent with their risk attitudes. In June 2017, China Central Television reported a list of 350 cases of financial fraud that had occurred since 2016. Based on these cases, a police department in China gave a simple and clear warning: "All financial frauds have the same feature — high returns."[6]

The spread of financial fraud suggests that many naive investors may be unaware of the possibility of such fraud. To prevent firms from exploiting these naive investors, policymakers may

[1] See "China's P2P lending boom: Taking flight" (www.economist.com/news/finance-and-economics/

[2] -allure-and-peril-chinese-fintech-companies-taking-flight).

[3] Lusardi and Mitchell (2014) develop a set of measures of people's financial literacy such as the ability to process economic information and make informed financial decisions

[4] See "China cracks down on alleged $7.6 billion Ponzi scheme" (https://money.cnn.com/2016/02/01/investing/ china-ezubao-alleged-ponzi-scheme-arrests/index.html).

[5] For the Fanya product description, see https://chuansongme.com/n/659162852657.

[6] See www.sohu.com/a/153362230_479788.

employ regulatory policies in financial markets such as interest rate ceilings,[7] restrictions on product design,[8] and minimum legislative standards for firms.[8] However, excessive regulations may limit the product choices of investors and possibly reduce welfare. Therefore, the level of sophistication possessed by general investors is an important factor in determining whether certain regulations are necessary. After the 2008 financial crisis, the question of how to strike a balance between protecting investors and respecting investors' own decisions has received considerable attention in policy discussions (Campbell et al., 2011; Campbell, 2016).

Given this background, we design an experiment and survey to elicit the driving force for investors to purchase fraudulent financial products: Is it because of risk-seeking preferences or unawareness of the possible fraud for financial products with too-good-to-be-true returns?[9] The experiment and survey was conducted in Shenzhen, China. We experimentally measured subjects' risk preferences by the multiple-price-list method (Holt and Laury, 2002; Andersen et al., 2006) and surveyed their demographic characteristics. We randomly assigned subjects into a treated group (Y1) and a control group (N1). Subjects in the treated group receive an eye-opening education program before they answered the survey and experimental questions. The education program was intended to increase naive investors' awareness of the possibility of financial fraud for products with unrealistically high returns. Detailed information about the design of the experiment and survey, as well as the empirical results are in Appendix C.

Figure 1 and 2 provide an overview of the effectiveness of the education program. While the education program is fairly simple, based on respondents' hypothetical investment decisions, it significantly reduces investors' tendency to purchase the fraudulent product. In particular, we find that the education program is more effective for risk-averse investors. These empirical patterns are robust under various regression specifications with controls of subjects' demographic characteristics,

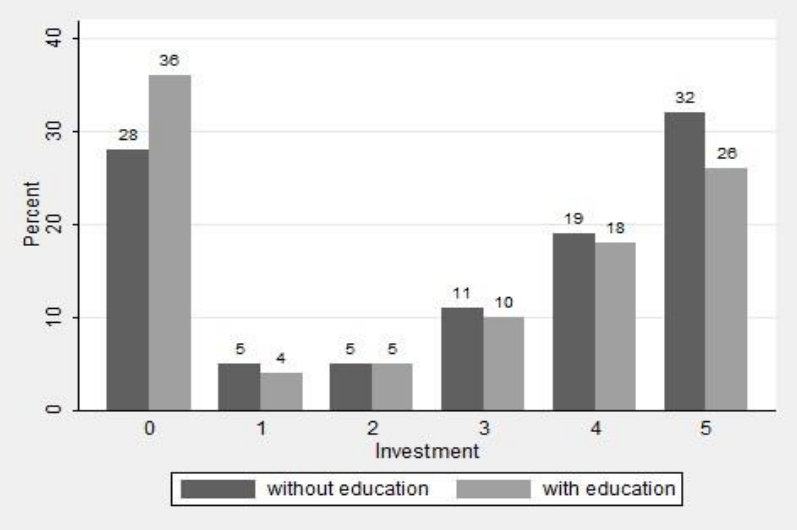
[7] Many countries have imposed interest rate ceilings (https://en.wikipedia.org/wiki/Interest_rate_ceiling). See Modigliani and Sutch (1966) for a discussion.

[8] For example, the Investment Company Act of 1940 strictly regulates the structure of mutual funds, imposing severe restrictions on liabilities and complex capital structures. See Campbell et al. (2010) for an extensive discussion. [8]One example of such policy is the SAFE Mortgage Licensing Act passed in 2008. See https://mortgage.nationwidelicensingsystem.org/SAFE/Pages/default.aspx

[9] We let the fraudulent product have an annual return of 20%. To mirror the Fanya scandal in China, the product description was the same as that of the actual Fanya product except that we did not print the name "Fanya".

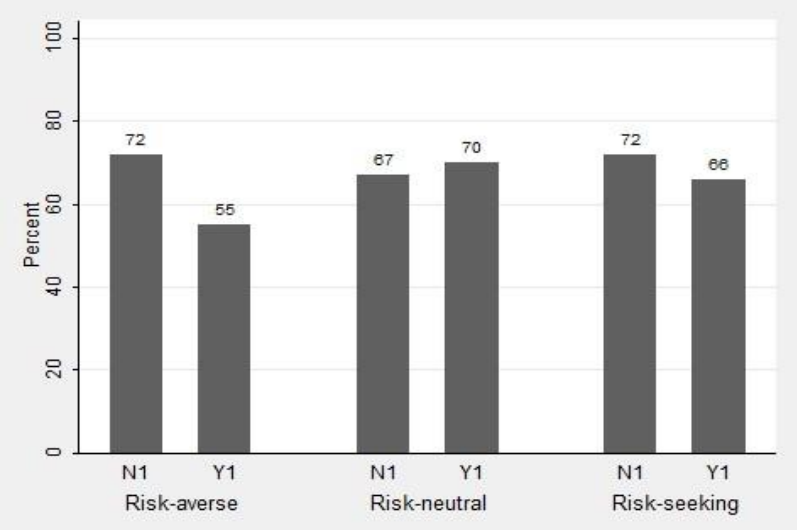
past experiences, and financial literacy (Lusardi and Mitchell, 2014). These results provides a foundation for the key assumption of our theoretical analysis: some investors that are unaware of the possibility of financial fraud associated with the high-return product. If risk-averse investors are aware of the high risk, we cannot "discourage" them from purchasing the high-return product. In other words, if risk-averse investors are already aware, then they should not respond to an education program that reveals the possibility of financial fraud.[10]

Figure 1: Distribution of *Investment* in groups N1 and Y1



Note: Number 0 to 6 of *Investment* indicate the respondent's choice on the investment decision question. *Investment*= 0 if the respondent does not invest at all, *Investment*= 1 if the respondent chooses to "invest no more than CNY 60", *Investment*= 2 if the respondent chooses to "invest between CNY 60 and CNY 180", *Investment*= 3 if the respondent chooses to "invest between CNY 180 and CNY 1,300", *Investment*= 4 if the respondent chooses to "invest between CNY 1,300 and CNY 2,600", *Investment*= 5 if the respondent chooses to "invest CNY 2,600 or more".

Figure 2: Percentage of subjects with *Investment*> 0



[10] Our survey and experiment suggest that the financial education program is effective in reducing investor unawareness. Moreover, the current standard questions of financial literacy test are not associated with subjects' tendency of purchasing fraudulent financial products. Thereby, in Appendix C, we propose a new question that help identify naive investors, which can be potentially applied to alleviate financial illiteracy and resolve the problem of financial fraud in practice.

Based on our findings in the experiment and survey, we build a model with firm(s) strategically choosing whether to exploit naive investors by offering financial products with too-high-to-be-true returns. There is a fraction of naive investors who are unaware that a firm can commit financial fraud. Specifically, they do not know that the firm can seize the return on their investment, and thus underestimate the true risk of a fraudulent financial product. Therefore, naive investors' investment decisions are inconsistent with their risk attitudes. Their behaviors, in turn, create an incentive for the firm to commit financial fraud.

If policymakers can reduce the proportion of naive investors through an education program, they can compel the firm to behave honestly. Moreover, if this proportion drops below a certain threshold, the firm will not offer fraudulent products even if doing so is costless because of the fear of losing the majority of sophisticated investors. Note that, after becoming aware of possible financial fraud, risk-averse investors will completely avoid products with too-high-to-be-true returns, but some highly risk-seeking investors may still take a gamble even though the net expected return is negative. This may count for our observation that risk-averse investors are more sensitive to the education program.

After studying the case with a monopoly firm, we introduce an entrant firm and thus change our benchmark case into a leader-follower model. In this leader-follower environment, three types of equilibrium may arise depending on the costs of committing financial fraud. When the costs are high,

both firms offer normal products, but their profits will be driven down to zero due to rateof-return competition. When the costs are low, both firms offer fraudulent products with returns at the interest rate ceiling, and they share the market for naive investors. Between these cases, the market may fall into a separating equilibrium: One firm offers a high-return fraudulent product that attracts all naive investors, while the other firm sells a normal product to all sophisticated investors. In this case, both firms earn positive profits. As a result, if the market leader offers a normal product in a monopoly, investors' welfare may be harmed after the follower comes in, since the follower may offer a fraudulent product in a separating equilibrium. Interestingly, we show that the leader has a stronger incentive to commit financial fraud than in the monopoly case, because a competing entrant firm makes it less attractive to offer a normal product.

Next, we study firms' private incentive to disclose or unshroud information as well as its policy implications. Suppose that each firm can costlessly disclose the information about the possibility of financial fraud, which reduces the proportion of naive investors. We find a trade-off in the case of separating equilibrium: The honest firm has the incentive to increase the proportion of sophisticated investors to obtain a larger market share. However, it does NOT want to increase this proportion too much because if exploiting naive investors becomes unprofitable, the other firm will deviate from offering a fraudulent product and start competing for sophisticated investors. Under this trade-off, while lowering the interest rate ceiling makes the fraudulent product less attractive, it may not be welfare-improving because the honest firm may decide to conceal information, which prevents the dishonest firm from competing in the market for normal products. Similarly, increasing legal punishment and implementing a public education program also discourage the honest firm from disclosing information.

Our paper contributes to the growing literature on bounded rationality and its applications to contracting problems and public policy.[10] In many markets, firms exploit naive consumers through hidden add-on prices or surcharges (e.g., Gabaix and Laibson, 2006), complex pricing schemes (e.g., Carlin, 2009), steep marginal charges (e.g., Grubb, 2009), deceptive products (e.g., Heidhues et al.,

[10] Relatedly, in the moral hazard literature, researchers have also studied the cases in which the agent is unaware of some of his own actions (von Thadden and Zhao, 2012) and some possible states (Auster, 2013).

2017), or automatic renewal (e.g., Murooka and Schwarz, 2018).[11] A similar mechanism of competition exacerbating dishonest behaviors may also exist in these markets because competition can make the market for sophisticated consumers less attractive. In addition, honest firms may also exhibit limited incentive of unshrouding if a separating equilibrium emerges. Our paper differs from the existing literature by considering a sequential-move model in which the follower can observe the leader's action and hence will have strategic responses. Consequently, we find that having a follower in the market will increase the leader's incentive to commit financial fraud, and limit his willingness to disclose information even if doing so is costless.[12]

The paper proceeds as follows. In Section 2 we introduce a stylized model that captures the interaction between a firm and a representative investor who is possibly unaware that the firm may commit financial fraud. Section 3 extends our model to a leader-follower environment and studies each firm's incentive to disclose information and implications of policy instruments. Section 4 concludes. Some proofs are relegated to Appendix B.

2 Baseline Model

Motivated by our empirical and experimental observation introduced above, we build a model with boundedly rational investors and a firm strategically choosing whether to offer normal or fraudulent products. A firm needs outside finance $I > 0$ to fund a risky project that may succeed with probability p and fail with probability $1 - p$. If the project succeeds, it generates a positive cash return $\omega = R$ for the firm. If it fails, the return is normalized to $\omega = 0$. The outcome of the project ω is publicly observable. A representative investor (he) has Bernoulli utility $u = m^{\alpha}$, where m is the net payoff in a contingency. The risk preference parameter α is distributed over $(0,+\infty)$ with a commonly known

[11] In parallel to the behavioral economics literature differentiating naive and sophisticated consumers, an alternative modeling approach assumes that consumers differ in their costs of acquiring information such as search costs (e.g., Armstrong et al., 2009).

[12] For other papers studying the firm's incentive to obfuscate investors in a dynamic setting, see, e.g., Carlin and Manso (2010).

c.d.f. $F(\alpha)$ and a strictly positive p.d.f. $f(\alpha)$.[13] We assume that the distribution of α satisfies the standard monotone likelihood ratio property (MLRP), namely, $\frac{f(\alpha)}{1-F(\alpha)}$ is nondecreasing in α.

The firm offers a financial product as a contract that specifies a monetary return $r \leq \bar{R}$ repaid to the investor when $\omega = R$ and zero otherwise. The upper bound $\bar{R}$ represents the interest rate ceiling permitted by law, which is assumed to be sufficiently high.[14] In addition to r, the firm also chooses whether to behave honestly ($x = 0$) or commit financial fraud ($x = 1$). If the firm chooses $x = 0$, it repays r to the investor as stated in the contract when $\omega = R$. We call the contract with $x = 0$ a normal product. If the firm chooses $x = 1$, it refuses to repay r when the project succeeds ($\omega = R$) but instead repays $\underline{r} \in [0,R]$. We call the contract with $x = 1$ a fraudulent product. Providing a fraudulent product incurs a cost $c > 0$ to the firm, which can be interpreted as the expected reputation loss or legal punishment. $\underline{r}$ is exogenously given, which consists of the fixed assets or intellectual property created by the project that the firm cannot reap from the fraud.[15]Therefore, the firm's private benefit from committing financial fraud is $R - \underline{r}$ when the project succeeds. Suppose that $p\underline{r} < I < p(R - \underline{r})$. The first inequality means that the project is not profitable if the firm defaults, and the second inequality induces the risk-neutral firm to operate the project before taking away the money.

The timing of the game is depicted in Figure 3 and described as follows. The firm first chooses x and offers a contract with repayment r to the investor. If the investor rejects the offer, both parties receive zero payoffs and the game ends. If the investor accepts the offer, ω is realized and observed. Given that $\omega = R$, the firm repays r if $x = 0$ and repays $\underline{r}$ if $x = 1$. Note that the firm decides whether to commit financial fraud before the realization of the project outcome, because it involves certain preparations before offering the fraudulent product to the investor.[16]

[13] Our utility function modifies the isoelastic utility function, and $\alpha > 1$ represents risk-seeking preferences.

[14] Specifically, we need the interest rate ceiling to be non-binding for the firm offering a normal product.

[15] An alternative explanation is that $\underline{r}$ may represent the fraudulent product's future discounted value in a dynamic setting. Risk-seeking investors may want to gamble for this return or resale this product to others even when the product is fraudulent; this is likely to be observed in pyramid or Ponzi schemes.

[16] For example, the firm has to prepare exaggerated marketing materials to attract potential investors and/or provide a forged auditor's report to deceive the regulators. Detailed descriptions of these preparations can be found in many court cases. See, e.g., United States of America vs. Robert A. Stanford (im.ft-static.com/content/ images/b6eabf92-b631-11e1-8ad0-00144feabdc0.pdf).

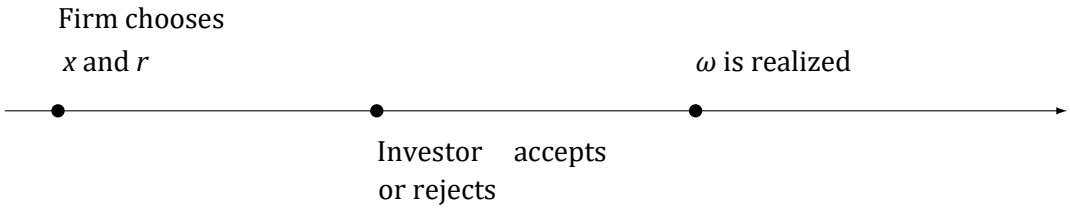


Figure 3: Timeline in the baseline model.

When the investor observes that the firm is behaving honestly ($x = 0$), he accepts the firm's offer if $pr^{\alpha} \geq I^{\alpha}$. Hence, when $r > I$, the product is purchased by an investor of type α if

$$\alpha \geq \log_{\frac{r}{I}} \frac{1}{p} \equiv \underline{\alpha}(r).$$

The lower threshold $\underline{\alpha}(r)$ is decreasing in p and r and increasing in I, which implies that an investor is more likely to invest in a project with lower default risk, a higher rate of return, and less initial investment.

An honest firm chooses r to maximize its expected profit, i.e., $p(R - r)[1 - F(\underline{\alpha}(r))]$. The first-order condition is

$$-p[1 - F(\underline{\alpha}(r))] + \frac{p(R-r)\log_{\frac{r}{I}}\frac{1}{p}}{r \ln \frac{r}{I}} f(\underline{\alpha}(r)) = 0. \quad (1)$$

When $r \to I$, the left-hand side of (1) goes to $+\infty$; when $r = R$, the left-hand side of (1) becomes negative. Hence, under the MLRP, there is an interior solution $r^* \in (I,R)$ that yields a profit $p(R - r^*)[1 - F(\underline{\alpha}(r^*))]$ to the firm. We assume $\underline{r}$ is sufficiently small and R^- is sufficiently large so that $\underline{r} < r^* < R^-$. If $R^- \leq r^*$, the firm will simply choose R^- since its profit function is nondecreasing when $r \in (0,r^*)$. Note that setting $R < r^{-*}$ hurts investors' welfare as the binding interest rate ceiling prevents the firm from offering its optimal product and distorts the market.

2.1 Investor awareness

Suppose that there are two types of investors in the population. A fraction $\lambda \in (0,1)$ of investors are *naive*: They are unaware that the firm has the option $x = 1$. In other words, they mistakenly believe

that the firm can only choose $x = 0$ and do not have financial fraud in mind.[17] The remaining fraction $1 - \lambda$ of investors are *sophisticated*, as they are fully aware of and can observe the firm's action x.[18]

For expositional clarity, let

$$\pi^0 = p(R - r^*)[1 - F(\underline{\alpha}(r^*))],\ \pi_s^1 = p(R - \underline{r})[1 - F(\underline{\alpha}(\underline{r}))],\ \pi_n^1 = p(R - \underline{r})[1 - F(\underline{\alpha}(\bar{R}))].$$

Here, π^0 is the firm's revenue when it provides a normal product ($x = 0$); π_s^1 is the firm's revenue when it provides a fraudulent product ($x = 1$) to sophisticated investors; and π_n^1 is the firm's revenue when it provides a fraudulent product ($r = R, x = 1$) to exploit naive investors.

Because $\underline{\alpha}(r)$ is decreasing in r and $\underline{r} < r^* < R$, when $\underline{r}$ is sufficiently small and R is sufficiently large, we have $\pi_s^1 < \pi^0 < \pi_n^1$. From the firm's perspective, selling a fraudulent product to sophisticated investors is less profitable than selling a normal product, but the latter is less profitable than selling a fraudulent product to exploit naive investors. Note that, while $p\underline{r} < I$, some risk-seeking and sophisticated investors will purchase the product as long as $\underline{r} > I$. As $\underline{r} \to I$, $\underline{\alpha}(\underline{r}) \to +\infty$.

Let (r,x) denote the firm's pure strategy. From our previous analysis, when the firm chooses $x = 0$, it will offer $r = r^*$ to maximize its expected profit. When the firm chooses $x = 1$, it will propose $r = R$ to attract as many naive investors as possible. Therefore, the firm plays $(r^*, 0)$ if

$$\pi^0 \geq \lambda\pi_n^1 + (1 - \lambda)\pi_s^1 - c \ \Leftrightarrow\ c \geq \lambda\pi_n^1 + (1 - \lambda)\pi_s^1 - \pi^0 \equiv c^*.$$

The results above are summarized in Proposition 1.

Proposition 1. *There exists c^* such that:*

[17] We assume that naive investors are unaware that they may be unaware. That is, when they see the firm offering an unreasonably high rate of return, such as $r = R$, they will simply take it as a mistake without further reasoning. Some other works, e.g., Chung and Fortnow (2016); Tirole (2009, 2016); Zhao (2015), assume that agents recognize that their cognitive ability is limited and that their understanding of the game could be incorrect. In other words, agents are aware of their unawareness.

[18] This assumption resembles that in the add-on pricing literature. In Gabaix and Laibson (2006), naive consumers are unaware of part of the price that they need to pay when making the purchasing decision, but sophisticated consumers can anticipate the add-on price. On the empirical side, Brown et al. (2010) find that, for online auctions, there are indeed naive consumers underestimating the hidden shipping charges.

(a) When $c \geq c^*$, there exists an equilibrium in which the firm plays $(r^*,0)$, i.e., it offers a normal product with a rate of return r^*; both types of investors with $\alpha \geq \underline{\alpha}(r^*)$ accept the contract.

(b) When $c \leq c^*$, there exists an equilibrium in which the firm plays $(R^-,1)$, i.e., it offers a fraudulent product with a rate of return R^-; sophisticated investors with $\alpha \geq \underline{\alpha}(\underline{r})$ accept the contract, and naive investors with $\alpha \geq \underline{\alpha}(R^-)$ accept the contract.

Note that, if the firm proposes $r = r^*$, the default risk is $1 - p$; if the firm proposes $r = R^-$, the default risk is 1. Therefore, a high-return financial product is associated with a high risk of default as a result of financial fraud.

It is also instructive to compute investors' welfare W when the firm offers different products. When a normal product is provided, the representative investor's welfare is

$$W_N^m = \int_{\underline{\alpha}(r^*)}^{+\infty} [p(r^*)^\alpha - I^\alpha] dF(\alpha), \tag{2}$$

where the superscript m represents "monopoly". When a fraudulent product is provided, investors' welfare is

$$W_F^m = \lambda \int_{\underline{\alpha}(\bar{R})}^{+\infty} [p\underline{r}^\alpha - I^\alpha] dF(\alpha) + (1-\lambda) \int_{\underline{\alpha}(\underline{r})}^{+\infty} [p\underline{r}^\alpha - I^\alpha] dF(\alpha). \tag{3}$$

Since when $\alpha < \underline{\alpha}(\underline{r})$, $p\underline{r}^\alpha - I^\alpha < 0$, we have $W_F^m < W_N^m$.

2.2 Education program

Based on Proposition 1, we can study the effect of a financial education program that reduces the fraction of naive investors. Suppose that the equilibrium is characterized by (b) of Proposition 1. Our first observation is that, when $pR^- \geq I$, risk-averse investors are more sensitive to the education program. This is consistent with our empirical evidence discussed in the introduction. Before the education program, naive investors with $\alpha \geq \underline{\alpha}(R^-)$ purchase the fraudulent product, which consists of all the risk-seeking investors and some of the risk-averse investors since $pR > I^-$, $\underline{\alpha}(R^-) < 1$. However, after the education program, only those with $\alpha \geq \underline{\alpha}(\underline{r})$ will still invest in the fraudulent product. Since

$p\underline{r} < I$, $\underline{\alpha}(\underline{r}) > 1$, risk-averse investors never buy the fraudulent product after education, while some risk-seeking investors still purchase it. We state this result in Proposition 2.

Proposition 2. *Suppose that the equilibrium is characterized by (b) of Proposition 1, and* $pR^{-} \geq I$. *The education program prevents risk-averse investors from investing in the fraudulent product with probability* 1 *and prevents risk-seeking investors from investing in the fraudulent product with probability* $\frac{1-F(\underline{\alpha}(\underline{r}))}{1-F(1)}$. *Therefore, risk-averse investors are more sensitive to the education program.*

Our second observation is that the education program not only directly prevents some of the naive investors from being mis-sold, but also indirectly reduces or even eliminates financial fraud. Note that a firm commits financial fraud if the cost c is below the cutoff c^*, and this cutoff is increasing in λ. Therefore, having more naive investors triggers the firm to offer a fraudulent financial product. In contrast, if the education program reduces λ, thereby lowering the cutoff cost c^*, then the firm will more often find it less worthwhile to commit financial fraud. Moreover, when λ is sufficiently low, i.e.,

$$\lambda \leq \frac{\pi^0 - \pi_s^1}{\pi_n^1 - \pi_s^1} \equiv \lambda^*,$$

c^* becomes nonpositive, and thus the firm has no incentive to commit financial fraud at all. This result is summarized in Proposition 3.

Proposition 3. c^* *increases with* λ, *and there exists* λ^* *such that when when* $\lambda \leq \lambda^*$, $c^* \leq 0$. *That is, a decrease in* λ *implies a decrease in the firm's incentive to commit financial fraud. When* λ *is sufficiently small, the firm has no incentive to commit financial fraud irrespective of c.*

Note that Propositions 1 and 2 are consistent with our empirical findings in the survey and experiment. Following Propositions 1 and 2, the comparative statics result in Proposition 3 leads to a common result in the behavioral contracting literature: Education not only prevents some naive investors from being exploited but also reduces the firm's incentive to offer a fraudulent product. The firm is more likely to behave honestly in a market with a larger proportion of sophisticated

investors.[19] [20]

3 Leader-follower Model

There is mounting evidence that the reputation or credibility of financial intermediaries depends on their historical performance, so well-established firms may suffer huge reputation loss after their financial misconduct gets detected (Chemmanur and Fulghieri, 1994; Gopalan et al., 2011). Besides, CEOs and board members get financial penalties or reputation losses after financial fraud, and these penalties are related to firm-specific factors such as firm size and corporate governance (Agrawal et al., 1999; Fich and Shivdasani, 2007). Therefore, well-established firms may have a larger cost of committing financial fraud, because they either have good performance records in the past, or attract substantially more attention from regulatory authorities, while newcomers are likely to care less about their reputation. In this section, we model the incumbent firm as the market leader with a (possibly) higher cost of committing financial fraud, and introduce an entrant acting as the follower that can observe the leader's action and respond strategically. We are also interested in their incentive to disclose information about the possibility of financial fraud. The analysis provides several insights into regulations and policies.

Consider the same environment as in the baseline model except that now there are two firms in the market: a leader and a follower. The two firms may differ in their costs of committing financial fraud but are identical in all other respects. In particular, we denote the leader as firm H, and the follower as firm L. Let c_j be firm j's cost of committing financial fraud, and assume that $0 < c_L \leq c_H$.

[19] This self-reinforcing pattern is similar to the results in von Thadden and Zhao (2012) and Li et al. (2016), who find that a monopolistic firm is more likely to reveal the adverse effects of its product in a market with fewer naive consumers. Relatedly, Zhou (2008) suggests that naive consumers tend to overestimate the importance of certain attributes of a product after firms' advertising and finds that increasing the proportion of naive consumers will also reduce the surplus of sophisticated consumers. Schumacher and Thysen (2017) provide a synthetic model with this self-reinforcing pattern in a more general setting.

[20] Our result in Proposition 3 is in line with Jin and Leslie (2003) offering empirical evidence that mandatory information disclosure increases restaurants' hygiene scores by making consumers aware of the health risks. That is, information disclosure may have both direct effects (i.e., it increases consumers' awareness of health risks) and indirect effects (i.e., as more consumers become aware of health risks, restaurants have higher incentive to improve their hygiene scores). In this sense, Jin and Leslie (2003) complements our experiment and survey in which treatments are imposed only on investors, leading us to be capable only to see the direct effect of education, i.e., how investors change their behaviors after the education program.

In this section, we take firm L's entry as given and assume that entry is costless. In Appendix A we study a variant of our model where there is a positive entry cost, and firm L makes its entry decision endogenously after observing firm H's move. Interestingly, we find that there is no NE when the entry cost is positive, and firm H's incentive to offer a fraudulent product is also affected by the entry decision.

Investors are wealth-constrained, so each investor can purchase only one product. This assumption implies that, *ceteris paribus*, investors will purchase whichever product offers a higher rate of return. If an investor is indifferent between two products, he purchases each product with equal

probability.

The timing of the game is now depicted in Figure 4 and described as follows. First, firm H chooses whether to commit financial fraud (x_H) and the rate of return of its product (r_H). Observing firm H's decision, firm L chooses whether to commit financial fraud (x_L) and the rate of return of its product (r_L). Then, investors decide whether and which product to purchase. Finally, the outcomes of both projects are realized and payments are made according to contracts.

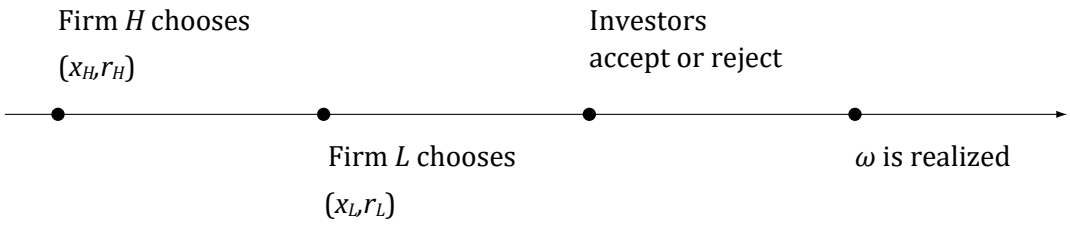


Figure 4: Timeline in the leader-follower model.

Depending on c_H and c_L, there are several types of equilibrium based on x_H and x_L. In a *normalproduct equilibrium* (NE), both firms offer normal products ($x_H = x_L = 0$). In a *fraudulent-product equilibrium* (FE), both firms commit financial fraud ($x_H = x_L = 1$). Finally, in a *separating equilibrium* (SE), one firm provides a normal product, while the other firm commits financial fraud.[21] For simplicity, we focus on the case with a nonbinding interest rate ceiling, i.e., $R > \bar{R}$.

[21] Relatedly, Armstrong et al. (2009) studies prominent firms in search markets. In this paper, if consumers differ in their search costs, a prominent firm will serve the entire market of consumers with infinite cost of searching, while other firms will share the market of consumers with zero search cost.

Proposition 4 summarizes our results in the leader-follower environment.

Proposition 4. *(a) When c_L is large, there exists an NE in which both firms offer a normal product with $r = R$.*

(b) When c_H is small, there exists an FE in which both firms offer a fraudulent product with $r = \bar{R}$.

(c) Otherwise, there exists an SE in which one of the firms offers a normal product, while the other firm offers a fraudulent product with $r = \bar{R}$.

Figures 5 and 6 illustrate two cases for the results of Proposition 4 depending on a cutoff

$$\bar{\lambda} = \frac{\pi_s^1}{\pi_n^1 + \pi_s^1 - 2\pi^0}.$$

Suppose $\lambda \geq \bar{\lambda}$. Then there exist c_H^* and c_L^* such that: (1) If $c_L \geq c_L^*$, there exists an NE; (2) If $c_H \leq c^*_H$, there exists an FE; (3) If $c_H \geq c^*_H$ and $c_L \leq c_{L^*}$, there exists an SE. Suppose that $\lambda < \bar{\lambda}$.
Then there exist c^*_H and c^*_L such that: (1) If $c_L \geq c^*_L$, there exists an NE; (2) If either $c_H \leq c^*_H$, or $c_L \leq c_H^*$ and $c_H - (1-\lambda)c_L \leq c_H^* - (1-\lambda)(c_L^* - \pi^0)$, there exists an FE; (3) If $c_H \geq c_H^*$, $c_L \leq c_L^*$ and $c_H - (1-\lambda)c_L \geq c^*_H - (1-\lambda)(c_{L^*} - \pi^0)$, there exists an SE. The proof of these two cases is relegated to Appendix B. To avoid redundant discussion, we will focus on the case where $\lambda \geq \bar{\lambda}$ in the following discussion.

We are especially interested in the conditions for an SE where firm *H* offers a normal product with a rate of return r^*. These conditions can be obtained by plugging $r_H = r^*$ into the proof of Proposition 4, so we state them here without an extra proof: Suppose that $\lambda \geq \bar{\lambda}$. Then, there exists an SE where firm *H* plays $(r^*, 0)$ if either $c_L \leq c_H^* \leq c_H$, or $c_L \geq c_H^*$ and $c_H \geq c_L^* - (1-\lambda)\pi^0$.

In sum, when both firms have low costs of committing financial fraud, they will offer fraudulent products. When their costs are high, both firms behave honestly and an NE arises. SE occurs between these two regions.

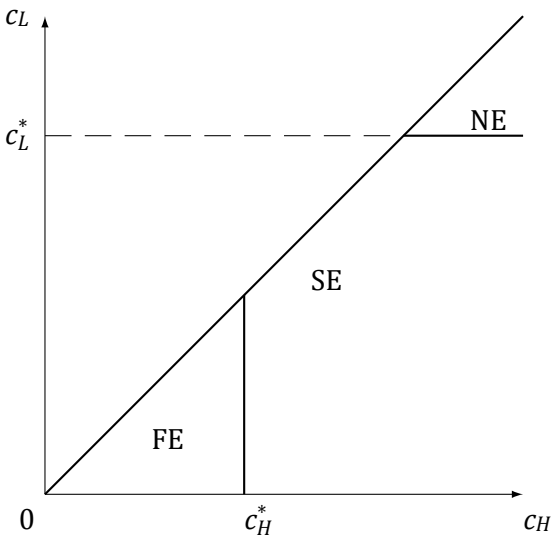


Figure 5: Graphical illustration of Proposition 4 ($\lambda \geq \bar{\lambda}$).

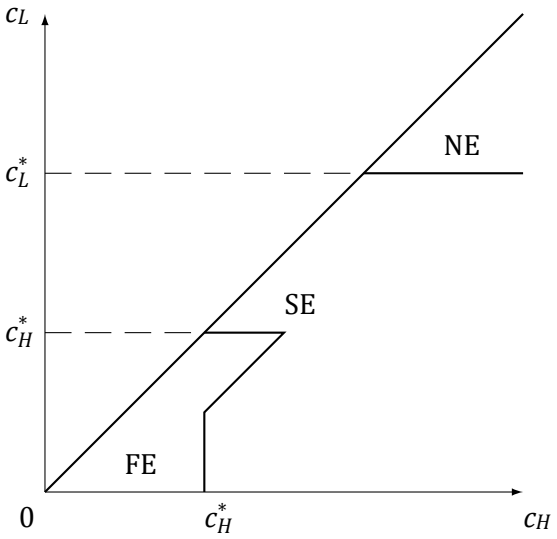


Figure 6: Graphical illustration of Proposition 4 ($\lambda < \bar{\lambda}$).

Corollary 1 shows that education also reduces a firm's incentive to commit financial fraud in a leader-follower model; this is consistent with Proposition 3.

Corollary 1. *c^*_H and c^*_L both increase with λ, and there exists λ^*_H such that when $\lambda \leq \lambda^*_H$, $c^*_H \leq 0$.*

It is worth noting that firm H may commit financial fraud in an SE. Although the market leader faces more severe punishment than the follower, there are still cases where the market leader

commits financial fraud, while the follower behaves honestly. According to the proof of Proposition 4, this is the case when $c_H \le c^*_L - (1-\lambda)\pi^0$, or $c_H - (1-\lambda)c_L \le \lambda c^*_L$. Therefore, by comparing these two cutoffs with c^* in Proposition 1 for the case of monopoly, we can determine whether having firm L in the market changes firm H's incentive to commit financial fraud. Besides, we can also discuss whether firm L's presence affects investors' welfare. Here are the results:

Proposition 5. *(a) When* $\lambda \ge \frac{\pi_s^1}{\pi_s^1+\pi^0}$, *we have* $c^* \le c_L^* - (1-\lambda)\pi^0$; *when* $c_L \ge c_L^* + \pi_s^1 - \frac{\pi^0}{1-\lambda}$, *we have* $c^* \le \lambda c^*_L + (1-\lambda)c_L$. *That is, when either* λ *or* c_L *is sufficiently large, firm H has a stronger incentive to commit financial fraud in a leader-follower model than in a monopoly. Having firm L in the market exacerbates financial fraud.*

(b) Suppose that firm H plays $(r^*, 0)$ *in an SE. Then,* $W_{FE^c} = W_{F^m} < W_{SE^c} < W_{N^m} < W_{NE^c}$. *In other words, having firm L in the market will make investors worse off.*

Intuitively, a monopolistic firm can sell its product to the whole market; however, in a leaderfollower environment, firms earn zero profit in the NE. If any of them deviates to offer a fraudulent product, it immediately obtains a positive profit that is the same as that of a monopoly, as it can always capture most of the naive investors. Therefore, selling a normal product becomes undesirable, while selling a fraudulent product turns to be attractive to the leader when a follower is present.

Proposition 5 suggests that opening the monopoly market may harm investors: If the incumbent firm offers a normal product in a monopoly, while the entrant offers a fraudulent product and the market equilibrium is an SE or FE, then investors may be worse off after firm L's entry. Intuitively, having a follower drives each firm's profit in an NE down to zero, making it easier for firms to deviate and offer a fraudulent product. The welfare loss comes from naive investors who purchase normal products in a monopoly but get exploited by fraudulent products in an SE.

Our findings echo several theoretical and empirical results in the literature. Shleifer (2004) provides several examples in which unethical conduct emerges as a result of market competition. The key idea is that unethical conduct sometimes reduces costs or raises revenues, so firms may engage in censured behaviors as a response to intensified competition. This intuition is similar to that

of Proposition 5, but we provide a formal model of this effect. Relatedly, Ru and Schoar (2016) find that less-sophisticated households are much more likely to be offered credit cards with backloaded or hidden fees as a result of the screening strategies implemented by credit card companies, but this paper does not specifically focus on competition between firms. Agarwal et al. (2017) document that deregulation and competition increase the proportion of naive borrowers and, thus, may change the former unshrouded-price equilibrium into a shrouded-price equilibrium. Di Maggio et al. (2018) find that deregulation intensifies competition and increases the supply of more complex and risky mortgages.

3.1 Information disclosure

Suppose that firms can costlessly disclose information to investors or unshroud (Gabaix and Laibson, 2006) about the fact that $x = 1$ is included in their choice sets when making offers to investors. Information disclosure changes some naive investors into sophisticated ones. We assume that the fraction of naive investors will change from λ to $\lambda - \delta$ ($\delta \in (0,\lambda)$) as long as one of the two firms decides to unshroud.[22] We restrict our attention to the combinations of c_L and c_H that lead to an SE without information disclosure.

Firm L offering a fraudulent product has no incentive to unshroud. Firm H, which behaves honestly, may have an incentive to unshroud because doing so increases the proportion of sophisticated investors. As investors become aware of the possible financial fraud, they will stop purchasing the fraudulent product offered by firm L.

However, firm H does not always want to unshroud. In an SE, firm L and firm H both obtain some market power by offering differentiated products to two groups of investors. Both firms earn positive profits in this situation. However, reducing λ may change the market equilibrium into an NE. Recall that c^*_L is increasing in λ, so reducing λ has two effects: On the one hand, it raises the proportion of sophisticated investors, thereby making it more profitable to offer a normal product, and benefits firm

[22] The education program in Section C is an example of reducing the proportion of naive investors. We can allow for other forms of technology for unshrouding without changing the key insights of our model. For simplicity, we adopt the extreme assumption that the two firms' information disclosure decisions are perfect substitutes.

H. On the other hand, as offering a normal product becomes attractive, it may induce firm *L* to deviate from committing financial fraud and provide a normal product to compete with firm *H*. As a consequence, when δ is small, firm *H* may have to increase its rate of return offered to investors and forgo some of its profits; when δ is large, information disclosure may change an SE into an NE and drive firm *H*'s profit down to zero. Therefore, whether firm *H* is willing to unshroud depends on the aggregation of these two opposite driving forces.

In the proof of Proposition 4, we show that firm *H*'s profit in an SE is bounded above by firm *L*'s incentive constraint. Thus, firm *H*'s profit will be increased only when this incentive constraint still holds after information disclosure, otherwise unshrouding makes firm *H* worse off. Therefore, firm *H* will unshroud only if

$$(\lambda - \delta)\pi_n^1 - c_L \geq \pi^0 \;\Leftrightarrow\; \delta \leq \lambda - \frac{c_L + \pi^0}{\pi_n^1} \equiv \delta^*.$$

Here, we assume that firm *H* will unshroud if it is indifferent and that the market equilibrium will not switch in the boundary cases. Proposition 6 formally states this result.

Proposition 6. *There exists δ^* such that in an SE with $r_H = r^*$, firm H will unshroud if and only if $\delta \leq \delta^*$.*

In other words, when financial fraud is present, an honest firm has some private incentive to educate investors such that some naive investors who would be attracted by the fraudulent product become aware of the danger and purchase the normal product offered by the honest firm. However, the incentive is limited: The honest firm does not want to reduce the proportion of naive investors to the extent that offering a fraudulent product becomes unprofitable, which intensifies the competition in the normal product market.[23] From Proposition 6, δ^* decreases with c_L, implying that firm *H* is more likely to shroud if firm *L*'s cost advantage in exploiting naive investors is small. Proposition 6 provides a new angle for the firm's incentive to shroud in a competitive market. In Gabaix and Laibson (2006) and Heidhues et al. (2017), naive consumers are exploited by firms through hidden add-ons. In Gabaix

[23] If firms can control the proportion of investors receiving the disclosed information, i.e., δ becomes a choice variable, then firm *H* will choose $\delta = \delta^*$.

and Laibson (2006), a firm cannot convert its competitor's naive consumers by educating (or debiasing) them because these educated consumers can now benefit from products with shrouded prices. In Heidhues et al. (2017), Bertrand competition drives down the transparent part of the prices but not the add-on prices due to consumer naivety, so firms will shroud their add-on prices to avoid competition on the total prices. In our model, firm
L has a cost advantage in exploiting naive investors and, thus, chooses not to compete with firm *H* for sophisticated investors. By shrouding, firm *H* restricts the profitability of offering a normal product and indirectly discourages firm *L* from competing with it. In contrast, shrouding directly increases the profitability of firms in Gabaix and Laibson (2006) and Heidhues et al. (2017).

In our model, firms cannot influence the proportions of naive and sophisticated investors but may design their products to target a certain type of investor. Firms cannot obfuscate investors, i.e., affect investors' awareness. Fraudulent products are more likely to appear in a leader-follower market only because having a competing firm makes the market for sophisticated investors less
attractive.

3.2 Policy implications

The model brings forth several avenues for the analysis of regulations and policies. We consider three policy instruments: increasing legal punishment, implementing a public education program, and lowering the interest rate ceiling. Increasing legal punishment raises firms' costs of committing financial fraud, while public education programs reduce firms' profits from offering fraudulent products. In the absence of private information disclosure, they are clearly beneficial to investors. Lowering the interest rate ceiling reduces the profitability of fraudulent products and, thus, improves investors' welfare as long as it is not binding for normal products.

However, the welfare effects of these policies are ambiguous when competition and unshrouding are both present. All three policies may reduce firms' private incentive to disclose information. We focus on the SE case since it is most relevant to policy design.

Increasing legal punishment. Suppose that policymakers increase c_L to c^0_L.[24] Such a policy can be interpreted as an increase in legal punishment, or auditing power, and thereby increases firm *L*'s cost of committing financial fraud. As in the previous case, the direct effect of increasing c_L is to make financial fraud a less favorable choice for firm *L*, while the indirect effect is to make firm *H* less likely to disclose information about its choice set. Similarly, increasing c_L to c'_L will prevent firm *H* from unshrouding if and only if $\lambda - \frac{c'_L+\pi^0}{\pi^1_n} < \delta \leq \delta^*$.

If we further assume that $\lambda - \frac{c'_L+\pi^0}{\pi^1_n} \geq 0$, then firm *H* offers $r_H = r^*$ before and after the policy, and the policy does not transform the current SE into an NE. However, investors' welfare is decreased because firm *H* loses its incentive to unshroud. Our analysis can be summarized in Proposition 7.

Proposition 7. *Suppose that* $0 \leq \lambda - \frac{c'_L+\pi^0}{\pi^1_n} < \delta \leq \delta^*$. *Then, raising* c_L *to* c'_L *is not welfare-improving.*

The discussion on the effect of legal punishment can date back to the seminal paper by Becker (1968), which provides an economic approach to analyze the optimal level of punishment. In law and economics, there are also papers that emphasize the role of courts in protecting consumers with bounded rationality or asymmetric information (Korobkin, 2003; Becher, 2008), but usually they do not have a complete analysis with a full model and are loosely related to industrial organization.

Implementing a public education program. Suppose that policymakers also own a technology that can reduce λ to λ^0, which may stand for a public education program about the possibility of firms committing financial fraud. Then, according to Proposition 6, when $0 \leq \lambda' - \frac{c'_L+\pi^0}{\pi^1_n} < \delta \leq \delta^*$, the public education program does not change the rates of return offered by firm *L* and firm *H* but crowds out firm *H*'s incentive to disclose information, which is effective in naive investors of measure δ. Therefore, if the public education program is not as effective as firm *H*'s unshrouding behavior, i.e., λ

[24] There is no need to increase c_H because firm *H* already offers a normal product in the SE.

$-\lambda^0 \leq \delta$, investors' welfare will not increase due to the crowding-out effect. Proposition 8 characterizes the condition under which the crowding-out effect occurs.

Proposition 8. *Suppose that* $\lambda - \lambda^0 \leq \delta$ *and that* $0 \leq \lambda' - \frac{c'_L + \pi^0}{\pi_n^1} < \delta \leq \delta^*$. *Then, reducing* λ *to* λ^0 *is not welfare-improving.*

Gabaix and Laibson (2006) suggest that regulators can warn consumers to pay attention to shrouded costs, which is similar to the public education above. However, in Gabaix and Laibson (2006), educated consumers would exploit the firm with a shrouded price and would not deviate to the unshrouding firm. Thus, education is not preferred by the firm that behaves honestly. Li et al. (2016) study the effect of mandatory disclosure policy and find that it may discourage the firm's investment and harm consumers from an ex ante perspective. In their model, investment is costly, while in the present paper, firms have limited incentive to disclose even if doing so is costless.

Lowering the interest rate ceiling. Suppose that policymakers reduce $\bar{R}$ to $\bar{R}^0$. Namely, a lower interest rate ceiling is imposed on the financial products sold in the market. Then, depending on the relationship between $\bar{R}^0$ and r^*, there are two different cases.

If $\bar{R}^0 > r^*$ still holds, then the new interest rate ceiling's direct effect is to make the fraudulent product less attractive to naive investors, because firm L would always advertise the highest possible rate of return for its product. Thus, financial fraud becomes less favorable to firm L, and fraudulent products are less likely to appear in the market. However, this policy also weakens firm H's incentive to unshroud because now firm L is more likely to offer a normal product and become a competitor of firm H. Mathematically, a decrease in $\bar{R}$ implies an increase in $\underline{\alpha}(\bar{R})$, which leads to decreases in π_n^1 and δ^*. In particular, lowering $\bar{R}$ to $\bar{R}^0$ will change firm H's decision on information disclosure from unshrouding to shrouding if

$$\lambda - \frac{c_L + \pi^0}{p(R - \underline{r})[1 - F(\underline{\alpha}(\bar{R}'))]} < \delta \leq \delta^*, \tag{4}$$

where the left-hand side is the new cutoff that makes firm H indifferent between unshrouding and shrouding after the imposition of the policy.

We can also compute the welfare effect of lowering the interest rate ceiling. Suppose that (4) is satisfied. Without this policy, firm H will disclose, and thus, investors' welfare is

$$(\lambda-\delta)\int_{\underline{\alpha}(\bar{R})}^{+\infty}[p\underline{r}^{\alpha}-I^{\alpha}]dF(\alpha)+(1-\lambda+\delta)\int_{\underline{\alpha}(r^{*})}^{+\infty}[p(r^{*})^{\alpha}-I^{\alpha}]dF(\alpha).$$

If this policy is implemented, firm H will shroud, and investors' welfare is

$$\lambda\int_{\underline{\alpha}(\bar{R}')}^{+\infty}[p\underline{r}^{\alpha}-I^{\alpha}]dF(\alpha)+(1-\lambda)\int_{\underline{\alpha}(r^{*})}^{+\infty}[p(r^{*})^{\alpha}-I^{\alpha}]dF(\alpha).$$

Therefore, the welfare effect of this policy is negative if

$$-\lambda\int_{\underline{\alpha}(\bar{R})}^{\underline{\alpha}(\bar{R}')}[p\underline{r}^{\alpha}-I^{\alpha}]dF(\alpha)<\delta\Big\{\int_{\underline{\alpha}(r^{*})}^{+\infty}[p(r^{*})^{\alpha}-I^{\alpha}]dF(\alpha)-\int_{\underline{\alpha}(\bar{R}')}^{+\infty}[p\underline{r}^{\alpha}-I^{\alpha}]dF(\alpha)\Big\}. \tag{5}$$

Proposition 9 summarizes our discussion.

Proposition 9. *Suppose that $\bar{R}^{0} > r^{*}$ and that δ satisfies (4) and (5). Then, reducing $\bar{R}$ to $\bar{R}^{0}$ is not welfare-improving.*

If $\bar{R}^{0} \le r^{*}$, the firm offering a normal product will find it optimal to choose $\bar{R}^{0}$, since its profit function is nondecreasing in $[0,r^{*}]$. Similarly, the firm offering a fraudulent product will also choose $\bar{R}^{0}$ to attract naive investors. No firm can deviate from offering $\bar{R}^{0}$, but whether they will commit financial fraud depends on their costs. This policy is also distortionary and may be harmful to investors, since sophisticated investors cannot obtain a return of r^{*} from the honest firm.

There are papers that empirically study the effect of interest rate ceilings. Benmelech and Moskowitz (2010) show that a binding interest rate ceiling reduces credit and economic activity, especially for small firms. A tight interest rate ceiling is in fact a distortionary policy that restricts the freedom of contract.

In summary, the net effect of policy intervention is ambiguous when firms can disclose information to investors. If public policies cannot change an SE into an NE, or make the high-cost firm increase its rate of return offered to investors, the high-cost firm's incentive to unshroud may be weakened due to the fear of inducing competitors. Based on similar logic, a public education program may crowd out firms' unshrouding behaviors. In the behavioral industrial organization literature, there are other examples in which firms will strategically respond to policy interventions and jeopardize the effectiveness of regulation. Policies can harm consumers because firms respond by changing the attributes of their products. For instance, Murooka and Schwarz (2018) show that choice-enhancing policies that make it easier for consumers to switch can decrease consumer and social welfare if the firms adjust their pricing strategies in response. In this paper, we characterize a new mechanism that may lead to perverse welfare effects of policy interventions. As we separate the firm's product choice and information disclosure strategy, firms respond to policies by changing their decisions on information disclosure despite that they do not change their products.

4 Conclusion

Widespread financial fraud has emerged as a pressing problem in China and other developing countries. Investors are attracted by unrealistically high returns because some of them may not have a proper awareness of the underlying high risks and the possibility of financial fraud. In this paper, we model how boundedly rational investors get exploited by firms providing fraudulent financial products, and show that reducing the proportion of naive investors not only directly helps these investors but also attenuates or even eliminates the firms' incentive to commit financial fraud. Therefore, educating investors to be aware that unrealistically high returns always come with high risks as a result of financial fraud is essential for developing a healthy financial market.

Our model offers several implications on competition and public policies. We find that there exists a separating equilibrium in which both firms earn positive profits. Having naive investors allows the two firms to offer differentiated products targeting two types of investors. In this equilibrium, the honest firm offering a normal product to sophisticated investors may have an incentive to unshroud the possibility of financial fraud because doing so increases its market share. However, if the proportion of naive investors becomes too small, the previously dishonest firm will turn to compete

for sophisticated investors. Because of the second force, the honest firm may be reluctant to take the welfare-improving action of disclosing information. Lowering the interest rate ceiling, increasing legal punishment, and implementing a public education program may all discourage the honest firm from unshrouding. Therefore, in protecting boundedly rational consumers, policymakers should devote more attention to the key mechanisms behind nudges to avoid undesirable outcomes.

This paper contributes to the field of behavior industrial organization that studies the interaction between market players when some of them are not fully rational. If we explain fraudulent financial products as products with hidden side-effects, then our paper is especially comparable with the add-on pricing literature starting from Gabaix and Laibson (2006) and then developed by Armstrong and Vickers (2012), Grubb (2014), Heidhues et al. (2017), and Murooka and Schwarz (2018). Future research following this work may focus on how to empirically identify unaware investors, and how to measure the net effect of different policy interventions.

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Appendix

A Firm Entry

In Section 3, firm *L*'s entry is taken as given. Now we relax this assumption and study firm *L*'s entry decision when it has to incur a positive fixed cost $k > 0$ to enter the market.

Proposition 10. *Suppose that* $\lambda \geq \bar{\lambda}$. *Consider the following three conditions: (1)* $c_L > c^*_L - k$; *(2)* $c_H < c^* + \lambda\pi^0$; *(3)* $c_H - (1-\lambda)c_L \leq c^* + \pi^0 - (1-\lambda)c_{L^*}$.

(a) When $k \leq (1-\lambda)\pi^0$, *firm L's entry is deterred if (1) holds. In this case, firm H offers a normal product.*

(b) When $(1-\lambda)\pi^0 < k \leq \pi^0$, *firm L's entry is deterred if* $c_L > c^*_H + (1-\lambda)\pi^0 - k$, *and one of (1), (2) and (3) holds. In this case, firm H offers a normal product if* $c_L > c^*_L - k$ *and* $c_H > c^* + \pi^0 - k$; *otherwise it offers a fraudulent product.*

(c) *When $k > \pi^0$, firm L's entry is deterred if $c_L > c^*_H + (1-\lambda)\pi^0 - k$, and (1) or (2) holds. In this case, firm H offers a normal product if $c_L > c^*_L - k$ and $c_H > c^*$; otherwise it offers a fraudulent product.*

(d) *When $c_L \le c^*_H + (1-\lambda)\pi^0 - k$ and $c_H \le c^*_H$, firm L's entry is accommodated, and there exists an FE.*

(e) *Otherwise, firm L's entry is accommodated, and there exists an SE.*

Figure A.7 gives a graphical illustration of Proposition 10 with an intermediate entry cost, i.e., $(1-\lambda)\pi^0 < k \le \pi^0$.

We want to make several remarks regarding Proposition 10. First, the effect of the entry cost on entry deterrence is monotone; a higher entry cost results in less entry. To see this, note that condition (3) implies either $c_H < c^* + \lambda\pi^0$ or $c_L > c^*_L - \pi^0$, the latter inequality is sufficient for $c_L > c^*_L - k$ when $k > \pi^0$.

However, a higher entry cost does not imply less financial fraud. It is worth mentioning that there is no NE when the entry cost is positive, since both firms earn zero profit in an NE. Therefore,

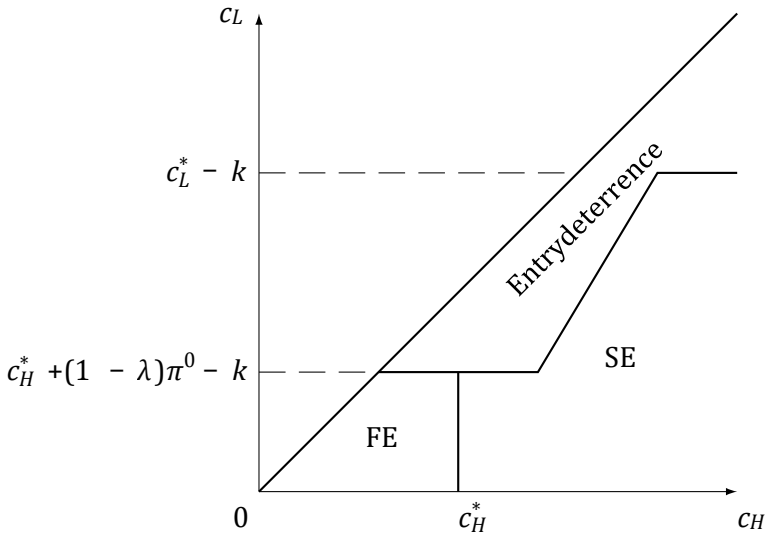

Figure A.7: Graphical illustration of Proposition 10 ($(1-\lambda)\pi^0 < k \le \pi^0$).

naive investors are free from exploitation only when firm *H* offers a normal product to deter entry. This is the case when c_H and c_L are both sufficiently large. Nevertheless, there is no monotonic

relationship between k and the cutoff for c_H, suggesting that increasing the entry barrier for low cost firms may not guarantee a welfare improvement for naive investors.

We also find that, whether the incumbent provides a normal product to deter entry relies heavily on the new entrant's entry cost k as well as its cost of committing financial fraud c_L. These two costs are complimentary because condition (1) is essentially equivalent to $c_L + k > c^*_L$.

B Proofs

B.1 Proof of Proposition 4

Normal-product equilibrium (NE). In an NE, both firms offer normal products ($x_H = x_L = 0$). Suppose that firm H chooses $r_H < R$, then firm L's best response would be choosing r_L slightly higher than r_H to capture the whole market. Therefore, $r_H < R$ cannot be played in an NE. Given that firm H chooses $r_H = R$ in the equilibrium, firm L's equilibrium strategy must be $r_L = R$, and both firms' equilibrium profit is zero.

If firm L deviates to choosing $x_L = 1$, the most profitable strategy is setting $r_L = \bar{R}$ to attract as many naive investors as possible. Upon such deviation, firm L's profit is $\lambda\pi_n^1 - c_L$. Thus, firm L's incentive constraint is

$$\lambda\pi_{n1} - c_L \leq 0 \Leftrightarrow c_L \geq \lambda\pi_{n1} \equiv c_{*L}.$$

Now suppose $c_L \geq c^*_L$. If firm H deviates to choosing $x_H = 1$, it will also set $r_H = \bar{R}$. Observing firm H's deviation, firm L will stick to $x_L = 0$. Firm H's profit upon deviation is $\lambda\pi_n^1 - c_H$, which is nonpositive. Hence, an NE exists if and only if $c_L \geq c_L^*$.

Fraudulent-product equilibrium (FE). In an FE, both firms commit financial fraud ($x_H = x_L = 1$). They will propose $r_H = r_L = \bar{R}$ to attract as many naive investors as possible, so each firm earns a profit $\frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_j$.

If firm L deviates to choosing $x_L = 0$, the most profitable strategy is setting $r_L = r^*$ to maximize its profit from selling a normal product to sophisticated investors. Upon such deviation, firm L's profit is $(1 - \lambda)\pi^0$. Thus, firm L's incentive constraint is

$$\frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_L \geq (1-\lambda)\pi^0 \;\Leftrightarrow\; c_L \leq \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - (1-\lambda)\pi^0 \equiv c_H^*.$$

If firm H deviates to choosing $x_H = 0$ and $r_H < R$, it can make a positive profit only when firm L does not follow its deviation and sticks to $x_L = 1$. Put differently, if firm L also deviates and plays $x_L = 0$, it will capture the whole by setting r_L slightly above r_H. Firm H only gets zero profit from deviation. This is the case if

$$\lambda\pi_n^1 - c_L \leq p(R - r_H)[1 - F(\underline{\alpha}(r_H))].$$

Moreover, even if the above inequality is violated, and firm H can make a positive profit upon deviation, it is also possible that such profit is less than firm H's equilibrium profit. In other words, firm H's incentive constraint is

$$\frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_H \geq (1-\lambda)p(R - r_H)[1 - F(\underline{\alpha}(r_H))].$$

Combining the above two inequalities gives us either $c_H \leq c^*_H$, or

$$c_H - (1-\lambda)c_L \leq \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - (1-\lambda)\lambda\pi_n^1 = c_H^* - (1-\lambda)(c_L^* - \pi^0).$$

Hence, an FE exists if and only if either $c_H \leq c_H^*$, or $c_L \leq c_H^*$ and $c_H - (1-\lambda)c_L \leq c_H^* - (1-\lambda)(c^*_L - \pi^0)$.

Separating equilibrium (SE). Suppose that, in an SE, firm H provides a normal product with $r_H < R$, while firm L commits financial fraud with $r_L = \bar{R}$. Firm H's equilibrium profit is $(1 - \lambda)p(R - r_H)[1 - F(\underline{\alpha}(r_H))]$, and firm L's equilibrium profit is $\lambda\pi_n^1 - c_L$.

If firm L deviates to choosing $x_L = 0$, its most profitable strategy is setting r_L slightly above r_H to capture the whole market. Thus, firm L's incentive constraint is

$$\lambda\pi_n^1 - c_L \geq p(R - r_H)[1 - F(\underline{\alpha}(r_H))].$$

A necessary condition is $c_L \leq c^*_L$. Note that, if the right-hand side is strictly less than π^0, this constraint must be binding, otherwise firm H will deviate on r_H to increase its profit. In other words,

$$p(R - r_H)[1 - F(\underline{\alpha}(r_H))] = \min\{\lambda\pi_n^1 - c_L, \pi^0\}.$$

If firm H deviates to choosing $x_H = 1$ and $r_H = \bar{R}$, firm L will either sticks to $x_L = 1$ or switches to $x_L = 0$. The former case happens when

$$\frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_L \geq (1-\lambda)\pi^0 \;\Leftrightarrow\; c_L \leq c_H^*.$$

In this case, firm H will earn $\frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_H$ upon deviation. Its incentive constraint is

$$(1-\lambda)p(R - r_H)[1 - F(\underline{\alpha}(r_H))] \geq \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_H,$$

which implies $c_H \geq c_H^*$ and $c_H - (1-\lambda)c_L \geq c_H^* - (1-\lambda)(c_L^* - \pi^0)$.

The latter case happens when

$$\frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_L \leq (1-\lambda)\pi^0 \;\Leftrightarrow\; c_L \geq c_H^*.$$

In this case, firm H will earn $\lambda\pi_n^1 - c_H$ upon deviation. Its incentive constraint is

$$(1-\lambda)p(R - r_H)[1 - F(\underline{\alpha}(r_H))] \geq \lambda\pi_n^1 - c_H,$$

which implies $c_H \geq c_L^* - (1-\lambda)\pi^0$ and $c_H - (1-\lambda)c_L \geq \lambda c_L^*$.

Consider an alternative case where firm H commits financial fraud with $r_H = \bar{R}$, and firm L provides a normal product with $r_L = r^*$ in an SE. By a similar discussion, firm L's incentive constraint is

$$(1-\lambda)\pi^0 \geq \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_L \;\Leftrightarrow\; c_L \geq c_H^*.$$

If firm H deviates to choosing $x_H = 0$, firm L will stick to $x_L = 0$ when

$$p(R - r_H)[1 - F(\underline{\alpha}(r_H))] \geq \lambda\pi_n^1 - c_L.$$

In this case, firm H's profit upon deviation is zero. Alternatively, firm L will switch to $x_L = 1$ when the above inequality is violated. In this case, firm H's incentive constraint is

$$\lambda\pi_n^1 - c_H \geq (1-\lambda)p(R - r_H)[1 - F(\underline{\alpha}(r_H))].$$

Combining the above two inequalities gives us either $c_H \leq c^*_L - (1-\lambda)\pi^0$, or $c_H - (1-\lambda)c_L \leq \lambda c^*_L$.

B.2 Proof of Proposition 5

Proving part (a) of the proposition is straightforward, so we only need to verify part (b).

In an NE, investors with $\alpha \geq \underline{\alpha}(R)$ purchase both firms' normal products with equal probability. Investors' welfare is

$$W_{NE}^c = \int_{\underline{\alpha}(R)}^{+\infty} [pR^\alpha - I^\alpha] dF(\alpha).$$

Compared to the welfare with a monopoly offering a normal product given in (2), we find that competition improves welfare, i.e., $W_{NE}^c > W_N^m$, because the rate of return for the normal product increases from r^* to R.

In an FE, sophisticated investors with $\alpha \geq \underline{\alpha}(\underline{r})$ and naive investors with $\alpha \geq \underline{\alpha}(\bar{R})$ purchase both firms' fraudulent products with equal probability. Investors' welfare is

$$W_{FE}^c = W_F^m = \lambda \int_{\underline{\alpha}(\bar{R})}^{+\infty} [p\underline{r}^\alpha - I^\alpha] dF(\alpha) + (1-\lambda) \int_{\underline{\alpha}(\underline{r})}^{+\infty} [p\underline{r}^\alpha - I^\alpha] dF(\alpha),$$

where W_F^m is given in (3). Hence, competition does not improve welfare if firms offer fraudulent products.

In an SE, sophisticated investors with $\alpha \geq \underline{\alpha}(r^*)$ purchase firm H's normal product, and naive investors with $\alpha \geq \underline{\alpha}(\bar{R})$ purchase firm L's fraudulent product. Investors' welfare is

$$W_{SE}^c = \lambda \int_{\underline{\alpha}(\bar{R})}^{+\infty} [p\underline{r}^\alpha - I^\alpha] dF(\alpha) + (1-\lambda) \int_{\underline{\alpha}(r^*)}^{+\infty} [p(r^*)^\alpha - I^\alpha] dF(\alpha),$$

which lies in between welfare measures under NE and FE.

B.3 Proof of Proposition 10

We consider the following cases separately:

- Case 1: Firm H offers a normal product; firm L enters and offers a fraudulent product;
- Case 2: Firm H offers a normal product; firm L does not enter;
- Case 3: Firm H offers a fraudulent product; firm L enters and offers a normal product; • Case 4: Firm H offers a fraudulent product; firm L enters and offers a fraudulent product;
- Case 5: Firm H offers a fraudulent product; firm L does not enter.

Case 1. Firm L's incentive constraints are

$$k \leq \lambda \pi_n^1 - c_L,$$
$$\lambda \pi_n^1 - c_L \geq p(R - r_H)[1 - F(\underline{\alpha}(r_H))]$$

If firm H deviates to offering a fraudulent product, the first inequality suggests that firm L will at least enter the market and offer a normal product at a rate of return r^*. Hence, firm H's incentive constraint is

$$(1-\lambda)p(R-r_H)[1-F(\underline{\alpha}(r_H))] \geq \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_H \quad \text{if } c_L \leq c^*_H, \text{ if } c_L \geq c^*_H,$$

$$(1-\lambda)p(R-r_H)[1-F(\underline{\alpha}(r_H))] \geq \lambda\pi_n^1 - c_H$$

which implies

$$\begin{array}{ll} c_H \geq c^*_H,\ c_H - (1-\lambda)c_L \geq c^*_H - (1-\lambda)(c^*_L - \pi^0) & \text{if } c_L \leq c^*_H, \\ c_H \geq c_L^* - (1-\lambda)\pi^0,\ c_H - (1-\lambda)c_L \geq \lambda c_L^* & \text{if} c_L \geq c_H^*. \end{array}$$

Note that $c_H - (1-\lambda)c_L \geq c^*_H - (1-\lambda)(c^*_L - \pi^0)$ is implied by $c_H \geq c_H{}^*$ and $c_L \leq c^*_H$. **Case 2.** Firm L's incentive constraints are

$$k > \max\{p(R-r_H)[1-F(\underline{\alpha}(r_H))], \lambda\pi_n{}^1 - c_L\}.$$

If $k \geq \pi^0$, firm H will choose $r_H = r^*$, and it can be verified that when firm H deviates to offering a fraudulent product, firm L will not enter. Hence, firm H's incentive constraint is $c_H \geq c^*$. If $k < \pi^0$, firm H will choose r_H according to

$$p(R-r_H)[1-F(\underline{\alpha}(r_H))] = k.$$

When firm H deviates to offering a fraudulent product, firm L will enter and offer a normal product at a rate of return r^* if $k \leq (1-\lambda)\pi^0$; otherwise firm L will not enter. Therefore, Firm H's incentive constraint is

$$\begin{array}{ll} p(R-r_H)[1-F(\underline{\alpha}(r_H))] \geq \lambda\pi_n{}^1 - c_H, & \text{if } k \leq (1-\lambda)\pi^0, \\ p(R-r_H)[1-F(\underline{\alpha}(r_H))] \geq \lambda\pi_n^1 + (1-\lambda)\pi_s^1 - c_H & \text{if } k > (1-\lambda)\pi^0. \end{array}$$

In the first inequality, the left-hand side equals k, so it can be replaced by firm L's incentive constraint. In sum, an equilibrium exists if $k > c^* - c_L$, and

$k \le (1-\lambda)\pi^0$,

$(1-\lambda)\pi^0 < k \le \pi^0$, and $c_H \ge c^* + \pi^0 - k$, $k > \pi^0$,

and $c_H \ge c^*$.

Case 3. Firm *L*'s incentive constraints are

$$k \le (1-\lambda)\pi^0,$$
$$(1-\lambda)\pi^0 \ge \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_L \;\Leftrightarrow\; c_L \ge c_H^*.$$

If firm *H* deviates to offering a normal product, firm *L*'s response is determined by the relationship between $\lambda\pi_n^1 - c_L$, k and π^0. If $\lambda\pi_n^1 - c_L < k$, firm *H*'s most profitable deviation is to choose r_H according to

$$p(R - r_H)[1 - F(\underline{\alpha}(r_H))] = k$$

to deter firm *L*'s entry. If $k \le \lambda\pi_n^1 - c_L < \pi^0$, firm *H*'s most profitable deviation is to choose r_H according to

$$p(R - r_H)[1 - F(\underline{\alpha}(r_H))] = \lambda\pi_n^1 - c_L$$

to accommodate firm *L*'s entry. If $\lambda\pi_n^1 - c_L \ge \pi^0$, firm *H*'s most profitable deviation is to choose $r_H = r^*$. Hence, firm *H*'s incentive constraint is

$$\begin{cases} \lambda\pi_n^1 - c_H \ge k & \text{if } \lambda\pi_n^1 - c_L < k, \\ \lambda\pi_n^1 - c_H \ge (1-\lambda)(\lambda\pi_n^1 - c_L) & \text{if } k \le \lambda\pi_n^1 - c_L < \pi^0, \\ \lambda\pi_n^1 - c_H \ge (1-\lambda)\pi^0 & \text{if } \lambda\pi_n^1 - c_L \ge \pi^0. \end{cases}$$

Note that the first case is degenerate due to $c_H \ge c_L$. The second case can be simplified as $c_H - (1-\lambda)c_L \le \lambda c_L^*$. The third case can be simplified as $c_H \le c_L^* - (1-\lambda)\pi^0$.

Case 4. Similar to Case 3, we know that firm *L*'s incentive constraints are

$$k \leq \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_L$$
$$c_L \leq c_H^*. \quad ,$$

If firm *H* deviates to offering a normal product, firm *L*'s response is determined by the relationship between $\lambda\pi_n^1 - c_L$ and π^0. If $\lambda\pi_n^1 - c_L < \pi^0$, firm *H*'s most profitable deviation is to choose r_H according to

$$p(R - r_H)[1 - F(\underline{\alpha}(r_H))] = \lambda\pi_n^1 - c_L$$

to accommodate firm *L*'s entry. If $\lambda\pi_n^1 - c_L \geq \pi^0$, firm *H*'s most profitable deviation is to choose $r_H = r^*$. Hence, firm *H*'s incentive constraint is

$$\begin{array}{ll} \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_H \geq (1-\lambda)(\lambda\pi_n^1 - c_L &) \quad \text{if} \lambda\pi_n^1 - c_L < \pi^0, \\ \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_H \geq (1-\lambda)\pi^0 & \text{if} \lambda\pi_n^1 - c_L \geq \pi^0. \end{array}$$

Note that $\lambda\pi_n^1 - c_L < \pi^0$ contradicts $c_L \leq c^*_H$. Only the second case is relevant and can be simplified as $c_H \leq c_H^*$.

Case 5. Similar to Case 2, firm *L*'s incentive constraints are

$$k > \max\{(1-\lambda)\pi^0, \frac{1}{2}[\lambda\pi_n^1 + (1-\lambda)\pi_s^1] - c_L\}.$$

If firm *H* deviates to offering a normal product, firm *L*'s response is determined by the relationship between $\lambda\pi_n^1 - c_L$, k and π^0. If $\lambda\pi_n^1 - c_L < k < \pi^0$, firm *H*'s most profitable deviation is to choose r_H according to

$$p(R - r_H)[1 - F(\underline{\alpha}(r_H))] = k$$

to deter firm L's entry. If $k \leq \lambda\pi_n^1 - c_L < \pi^0$, firm H's most profitable deviation is to choose r_H according to

$$p(R - r_H)[1 - F(\underline{\alpha}(r_H))] = \lambda\pi_n^1 - c_L$$

to accommodate firm L's entry. Otherwise, firm H's most profitable deviation is to choose $r_H = r^*$. Hence, firm H's incentive constraint is

$$\lambda\pi_n^1 + (1-\lambda)\pi_s^1 - c_H \geq k \quad \text{if} \quad \lambda\pi_n^1 - c_L < k < \pi^0,$$

$$\lambda\pi_n^1 + (1-\lambda)\pi_s^1 - c_H \geq (1-\lambda)(\lambda\pi_n^1 - c_L) \quad \text{if} \quad k \leq \lambda\pi_n^1 - c_L < \pi^0,$$

$$\lambda\pi_n^1 + (1-\lambda)\pi_s^1 - c_H \geq \pi^0 \quad \text{if } k > \max\{\lambda\pi_n^1 - c_L, \pi^0\},$$

$$\lambda\pi_n^1 + (1-\lambda)\pi_s^1 - c_H \geq (1-\lambda)\pi^0 \quad \text{if } k \leq \pi^0 \leq \lambda\pi_n^1 - c_L, \text{or } \pi^0 \leq k \leq \lambda\pi_n^1 - c_L.$$

Summarizing all the five cases, we have the results stated in the proposition.

C Experiment and Survey

The purpose of our experiment and survey is twofold: First, we attempt to check whether investors purchase financial products with too-good-to-be-true returns because they are unaware of the possibility of financial fraud. Otherwise, if these investors fully understand the high default risk of the high-return product and purchase based on their risk-seeking preferences, then policymakers should not intervene. Second, we want to learn, among the population, which group of people is more vulnerable to financial fraud. Such knowledge can help policymakers design education programs targeted at those people.

C.1 Experiment and survey design

We conducted the experiment and survey in the city of Shenzhen, China with the support of the Qianhai Institute of Innovative Research. The study was conducted in 2016 at 30 randomly chosen communities in Shenzhen, China, as depicted in Figure A.8. We went to these communities with each community's committee of residents, randomly chose residents from each community and conducted a face-to-face experiment and survey. To increase the response rate, we offered USB cables as small

rewards for participation. In sum, we recruited 1216 effective participants after removing those who provided inconsistent responses in part 3 of our incentivized experiment.[25]

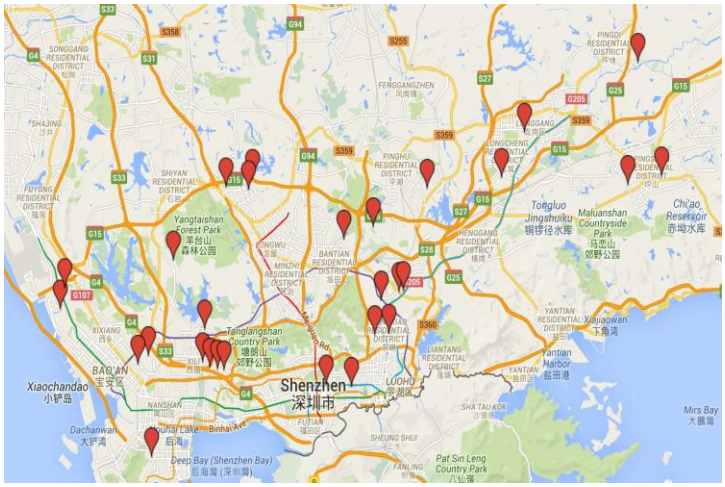

Figure A.8: Distribution of participants in Shenzhen, China

Table A.1: Treatments adopted in four groups

	Education program	
	No	Yes
Normal product (8% return)	N0	Y0
Observations	304	300
Fraudulent product (20% return)	N1	Y1
Observations	306	306

We randomly assigned the participants into four groups as shown in Table A.1. In groups Y1 and Y0, we gave each participant an education flyer before they answered the survey and experimental questions. We did not provide any educational intervention in groups N1 and N0. Appendix D provides the experimental scripts for group Y1. The education program transmits a simple message: Financial products with high returns are associated with high risk.

[25] In part 3 of our experiment, we let the participants indicate their preferences between a lottery and a constant amount of money. If one preferred a smaller amount of money to the lottery but again chose to play the same lottery rather than accept a larger amount of money, then the participant's response was inconsistent because it violated the axiom of transitivity of risk preferences if monotonicity over money is implicitly assumed. This way of removing inconsistent responses also excludes the observations with multiple switching points.

The hypothetical financial product offered to groups Y1 and N1 has a different annual return rate from that offered to groups Y0 and N0. Participants in groups Y1 and N1 were offered a potentially fraudulent product with an annual return of 20%. The product description of the fraudulent product is the same as those of the actual Fanya products except that we did not print the name "Fanya".[26][27] Participants in groups Y0 and N0 were offered a normal product with an annual return of 8%.[28]

The questionnaire used in our experiment and survey consists of three parts. In part 1, we adopted the four questions in Lusardi and Mitchell (2014) to measure participants' objective and self-assessed financial literacy, followed by a hypothetical investment decision question. The participants were required to report whether they would invest in the listed (fraudulent or normal) product, and if so, how much they would invest.

In part 2, we asked the participants a series of peripheral questions to collect some demographic information, including gender, age, marital status, education, income, and their previous experiences with financial activities.

In part 3, we used the multiple-price-list format in an incentivized experiment to elicit each participant's risk attitude. In particular, we designed ten questions, asking the participants to choose between a constant reward amount ranging from CNY 5 to CNY 95 and a lottery with a 50% probability of a CNY 100 reward and a 50% probability of no reward.

In sum, the questionnaire collects information on participants' demographics, financial literacy, and risk preferences. By comparing the results of the groups on the dimension of 1 and 0, we can investigate the difference in participants' purchasing behaviors between a fraudulent product and a normal product. Similarly, by comparing groups on the dimension of Y and N, we can analyze the effect of education on their purchasing behaviors. The results are reported below.

[26] For further details on the Fanya products and the Fanya events, see blog.sina.com.cn/s/blog_

[27] e2674c30102wrnd.html.

[28] The average annual return of the Dow Jones Industrial Average over the past 30 years is approximately 8.13%.

C.2 Data

Table A.2 reports summary statistics for the data we obtained. Two dummy variables, *Education treatment* and *Fraudulent product*, indicate whether the respondent received our education program and whether a fraudulent product was offered to the respondent, respectively. *Edu*Fraud* is their product. *Literacy Q1-Q3* indicate whether the respondent correctly answered the 1st, 2nd, and 3rd questions regarding his objective financial literacy. *Confidence* measures respondents' selfassessed knowledge of finance. *Investment* indicates the respondent's choice on the investment decision question, where a higher choice of *Investment* represents a higher level of investment, i.e., *Investment* = 5 if the respondent chooses to "invest CNY 2,600 or more" and *Investment* = 0 if the respondent does not invest at all. We use the binary variable *Investment dummy* to indicate whether *Investment* is strictly positive. *Male*, *Single*, *Schooling*, *Income*, *Past involvement*, and *Past experience* are categorical demographic variables that correspond to the respondent's answers to questions 2 to 6 and question 9 in part 2 of the questionnaire. The alphabetical choices in these questions are transformed into positive integers in order.[29]

Risk preference measures the respondent's risk attitudes. *Risk preference* = *J* means that the respondent answered "Disagree" only on the first *J* questions in part 3 of the questionnaire, so a larger *J* implies a more risk-seeking preference. Figure A.9 depicts the distribution of respondents' Table A.2: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	Obs.
Education treatment	0.498	0.5	0	1	1216
Fraudulent product	0.503	0.5	0	1	1216
*Edu*Fraud*	0.252	0.434	0	1	1216
Literacy Q1	0.693	0.462	0	1	1214
Literacy Q2	0.615	0.487	0	1	1210
Literacy Q3	0.55	0.498	0	1	1210
Confidence	2.655	1.792	1	7	1152
Investment	2.642	2.049	0	5	1156

[29] We transform the multiple-choice question in part 2 of the questionnaire regarding respondents' marital status into a dummy variable *Single* because the size of the sample with "Divorced or separated" or "Widowed" is too small. Therefore, *Single* equals 1 if the respondent had never been married, and 0 otherwise.

Investment dummy	0.687	0.464	0	1	1156
Age	37.04	12.99	12	95	1161
Male	0.342	0.474	0	1	1215
Single	0.258	0.438	0	1	1210
Schooling	4.094	0.972	1	6	1212
Income	1.992	0.881	1	5	1195
Past experience	0.538	0.499	0	1	1198
Past involvement	1.619	0.756	1	5	1206
Risk preference	5.535	2.943	0	10	1158

risk attitudes. The horizontal axis shows the value of α calculated from each respondent's answer in part 3 of the questionnaire, based on the utility functions in our model. Specifically, if the respondent switches from "Disagree" to "Agree" in the J + 1th question, i.e., *Risk preference* = J, we take the midpoint of the two constant returns in the Jth and J + 1th questions as the respondent's certainty equivalent. Therefore, if *Risk preference* = 5, the respondent is identified as risk-neutral. If *Risk preference* is higher or lower than 5, the respondent is classified as risk-seeking or risk-averse, respectively.

Table A.3 shows the two-sample *t*-test results for the equality of the means of *Risk preference*, corresponding to each of the three financial literacy dummies, i.e., *Literacy Q1-Q3*. Shenzhen residents receive similar scores to their counterparts in survey results in the United States (Lusardi and Mitchell, 2014) (Tables A.12 and A.13). In none of the three tests can we reject the null hypothesis that an investor's financial literacy and risk attitude are independent (Table A.3).[30]

Regarding demographic information, 55.01% of the respondents are risk-averse or risk-neutral, among whom 69.34% are female, 41.35% have a college education or equivalent, and 76.76% have an annual income of no more than CNY 50,000 (USD 7,250). Table A.4 presents the results of

[30] For this reason, we assume that λ and α are independent in the model.

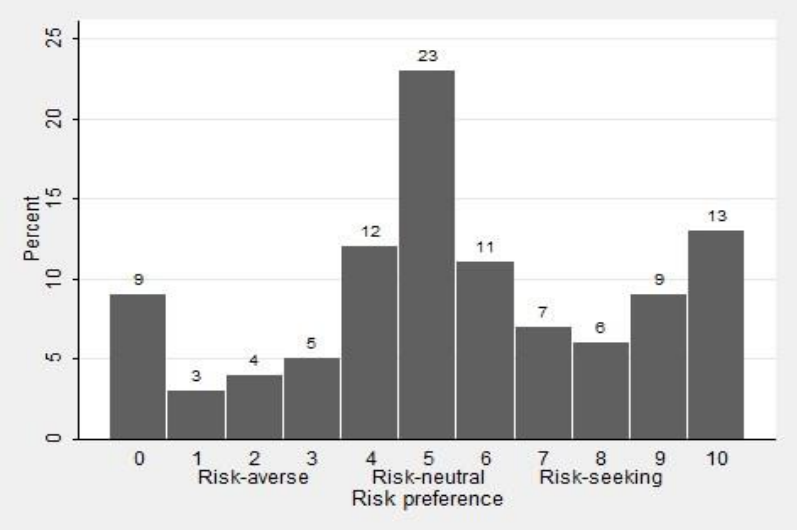

Figure A.9: Distribution of *Risk preference*

Table A.3: Relationship between *Risk Preference* and financial literacy

	Mean of α		
	Incorrect	Correct	*t*-test *p*-value
Literacy Q1	5.32	5.62	0.12
	(0.17)	(0.10)	
Literacy Q2	5.41	5.61	0.27
	(0.15)	(0.11)	
Literacy Q3	5.50	5.55	0.75
	(0.13)	(0.12)	

Table A.4: Ordered probit model

	Dependent variable: *Risk preference*				
	(1)	(2)	(3)	(4)	(5)
Age	-0.00714***			-0.00604**	-0.00613**
	(0.00242)			(0.00289)	(0.00289)
Male		0.181***			0.168**
		(0.0635)			(0.0667)
Single			0.147**	0.0670	0.0258
			(0.0692)	(0.0838)	(0.0854)
Observations	1106	1157	1152	1102	1102
Pseudo R^2	0.002	0.002	0.001	0.002	0.003

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

regressing *Risk preference* on other

demographic variables using an ordered probit model. From the regression results, we find that *Risk preference* is negatively correlated with *Age* and positively correlated with *Male*. The correlation between *Risk preference* and *Single* becomes insignificant after controlling for *Age*; it is thus possible that the vanishing correlation is due to the collinearity between *Single* and *Age*. In sum, men and young people are more risk-seeking than women and the elderly.

C.3 Eye-opening education program

In Table A.5, we conduct *t*-tests between the four groups to compare their risk preferences and the proportion of respondents who chose a positive investment level in the investment decision question. We do not observe a significant difference in risk preferences among the four groups, while the education program did make a difference in the investment decision. This suggests that the education program affected investors' awareness but not their preferences.[31]

Table A.5: Differences in *Risk preference* and *Investment dummy*

			Educationprogram		
			No	Yes	Difference
Normal product	*Risk preference*	Mean	5.562	5.560	0.002
			(0.182)	(0.164)	(0.245)
		Observations	290	291	
	Investment dummy	Mean	0.682	0.711	-0.029
			(0.027)	(0.027)	(0.039)
		Observations	292	280	
Fraudulent product	*Risk preference*	Mean	5.463	5.552	-0.088
			(0.178)	(0.168)	(0.245)
		Observations	287	290	
	Investment dummy	Mean	0.716	0.639	0.077**

[31] Relatedly, Kawaguchi et al. (2018) show that advertisements may influence both consumers' attention and preferences, which can be identified by their product availability approach.

			(0.026)	(0.028)	(0.039)
		Observations	296	288	
DID	*Risk preference*	Mean			0.090
					(0.346)
	Investment dummy	Mean			-0.107*
					(0.055)

We then apply the Difference-in-Difference (DID) method to estimate the net effect of our eyeopening financial education program on preventing investors from purchasing fraudulent products. While we use random assignment in groups Y1 and N1, comparing the results in groups Y0 and N0 still plays a key role in controlling for the placebo effect. It is possible that our action of offering education, rather than the content of the education per se, affected participants' willingness to invest. Therefore, by introducing two control groups, Y0 and N0, and applying the DID technique, we can potentially control for the factors that may simply increase one's tendency to invest, irrespective of the product's return.

Table A.6 presents the DID regression results using probit and ordered probit models with *Investment dummy* and *Investment* as dependent variables, respectively. Both the *t*-tests in Table A.5 and regression results in Table A.6 suggest that our education program significantly reduced respondents' tendency to invest in fraudulent products, even after controlling for a series of demographic variables. Surprisingly, we do not find that the three standard financial literacy questions in Lusardi and Mitchell (2014) (*Literacy Q1-Q3*) can predict investors' tendency to purchase fraudulent products. We provide further discussion of financial literacy in the next subsection.

Following the theory in Section 2, λ represents the proportion of investors who are unaware of the link between the too-high-to-be-true return on a financial product and its underlying high risk. Therefore, we estimate λ using the proportion of participants who chose to invest a positive amount in the fraudulent product in groups N1 and Y1. Overall, we obtain that λ_b = 71.62% for N1 and λ_b = 63.89% for Y1, suggesting that our education program helped 7.73% of investors become aware of financial fraud. Note that a large fraction of investors remain willing to purchase the fraudulent

product after our education program. One reason could be that the investment decision question is hypothetical. The effect would likely be greater if people make real investment decisions or receive more complete and systematic education programs.

Therefore, to maximize the effect of the education program, policymakers should utilize limited educational resources by targeting risk-averse investors. These investors can be identified by survey questions and the relationships between investors' risk attitudes and observed characteristics. Our survey suggests that risk-averse preferences are often observed among female and elderly investors. As a policy practice, the China Security Regulatory Commission imposes a mandatory Table A.6: Probit and ordered probit model (full sample)

	Dependent variable: *Investment dummy*		Dependent variable: *Investment*	
	(1)	(2)	(3)	(4)
Education treatment	0.120	0.0830	0.107	0.0569
	(0.118)	(0.136)	(0.0948)	(0.106)
Fraudulent product	0.113	0.0777	0.175*	0.170
	(0.116)	(0.133)	(0.0936)	(0.105)
*Edu*Fraud*	-0.372**	-0.391**	-0.286**	-0.291*
	(0.165)	(0.190)	(0.134)	(0.151)
Literacy Q1		-0.0988		0.0163
		(0.113)		(0.0871)
Literacy Q2		-0.152		-0.0494
		(0.109)		(0.0839)
Literacy Q3		0.258**		0.198**
		(0.106)		(0.0833)
Confidence		0.0341		0.0553**
		(0.0293)		(0.0233)
Age		-0.00759		-0.00690*
		(0.00517)		(0.00417)
Male		-0.0661		0.0633

		(0.111)		(0.0878)
Single		-0.0737		-0.121
		(0.142)		(0.112)
Past experience		-0.239**		-0.267***
		(0.110)		(0.0867)
Risk preference	No	Yes	No	Yes
Schooling	No	Yes	No	Yes
Income	No	Yes	No	Yes
Past involvement	No	Yes	No	Yes
Community fixed effect	Yes	Yes	Yes	Yes
Observations	1079	917	1079	917
Pseudo				

$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01.$ R^2 0.066

0.112 0.020 0.045 risk preference survey on investors before their purchase of risky financial products.[32] Based on this mandatory survey, policymakers can add a personalized education program for investors before they make their investment decisions.

In Tables A.7 and A.8, we add covariates and conduct DID regressions over respondents with different risk attitudes. The conclusion is the same.

Table A.7: Probit model (by risk preference)

	Dependent variable: *Investment dummy*					
	Risk-averse		Risk-neutral		Risk-seeking	
	(1)	(2)	(3)	(4)	(5)	(6)
Education treatment	0.331	0.214	0.0491	0.124	0.132	0.150
	(0.234)	(0.295)	(0.268)	(0.365)	(0.184)	(0.221)
Fraudulent product	0.263	0.279	0.0652	0.359	0.186	0.102
	(0.228)	(0.268)	(0.284)	(0.401)	(0.180)	(0.213)
*Edu*Fraud*	-0.821**	-0.773*	-0.171	-0.257	-0.295	-0.346
	(0.327)	(0.402)	(0.379)	(0.513)	(0.261)	(0.307)

[32] The survey asks for age, income, wealth, investment experience, and some hypothetical investment decision questions. Then, each investor is told that he or she belongs to one of three categories: conservative, prudent, or proactive. See www.sac.net.cn/tzzyd/fzgj/201205/t20120503_15058.html.

Literacy Q1		0.272		-0.395		-0.337*
		(0.223)		(0.319)		(0.186)
Literacy Q2		-0.291		-0.223		-0.00664
		(0.221)		(0.300)		(0.163)
Literacy Q3		-0.00143		-0.201		0.400**
		(0.220)		(0.274)		(0.174)
Age		-0.0147		-0.000422		-0.0104
		(0.0107)		(0.0157)		(0.00821)
Male		0.102		0.0800		-0.217
		(0.238)		(0.314)		(0.173)
Confidence		0.0941		0.0690		0.0289
		(0.0655)		(0.0872)		(0.0447)
Single		-0.365		0.354		-0.0736
		(0.312)		(0.389)		(0.214)
Past experience		-0.677***		-0.636**		0.0223
		(0.231)		(0.311)		(0.185)
Schooling	No	Yes	No	Yes	No	Yes
Income	No	Yes	No	Yes	No	Yes
Past involvement	No	Yes	No	Yes	No	Yes
Community fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	303	268	219	172	449	392
Pseudo R^2	0.092	0.201	0.089	0.221	0.078	0.149

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In Tables A.9, A.10, and A.11, we present the heterogeneous effect of the education program Table A.8: Ordered probit model (by risk preference)

	Dependent variable: *Investment*					
	Risk-averse		Risk-neutral		Risk-seeking	
	(1)	(2)	(3)	(4)	(5)	(6)
Education treatment	0.181	-0.0189	0.149	0.0791	0.122	0.157
	(0.183)	(0.217)	(0.210)	(0.252)	(0.145)	(0.163)

Fraudulent product	0.210	0.183	0.371*	0.498*	0.264*	0.214
	(0.182)	(0.207)	(0.223)	(0.264)	(0.144)	(0.162)
*Edu*Fraud*	-0.516**	-0.383	-0.335	-0.242	-0.283	-0.367
	(0.259)	(0.293)	(0.301)	(0.357)	(0.209)	(0.232)
Literacy Q1		0.301*		-0.0966		-0.137
		(0.167)		(0.228)		(0.133)
Literacy Q2		-0.114		-0.0366		0.0518
		(0.168)		(0.213)		(0.122)
Literacy Q3		0.0346		-0.151		0.435***
		(0.168)		(0.194)		(0.127)
Age		-0.00157		-0.0157		-0.00349
		(0.00806)		(0.0112)		(0.00630)
Male		0.0377		0.175		0.000977
		(0.177)		(0.214)		(0.131)
Confidence		0.0680		0.0940		0.0610*
		(0.0473)		(0.0603)		(0.0347)
Single		-0.159		0.0992		-0.132
		(0.223)		(0.268)		(0.164)
Past experience		-0.747***		-0.561***		0.0423
		(0.173)		(0.208)		(0.137)
Schooling	No	Yes	No	Yes	No	Yes
Income	No	Yes	No	Yes	No	Yes
Past involvement	No	Yes	No	Yes	No	Yes
Community fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	318	283	241	211	471	423
Pseudo R^2	0.043	0.101	0.057	0.126	0.038	0.076

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

by sub-samples based on answers to financial literacy questions. However, there is no consistent relationship between people correctly answering financial literacy questions and their sensitivity to the education program.

Table A.9: Probit and ordered probit model (by financial literacy Q1)

	Dependent variable: *Investment dummy*				Dependent variable: *Investment*			
	Literacy Q1=0		*Literacy Q1=1*		*Literacy Q1=0*		*Literacy Q1=1*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education treatment	0.243	-0.0951	0.0758	0.0255	-0.0629	-0.298	0.147	0.0813
	(0.245)	(0.370)	(0.140)	(0.157)	(0.186)	(0.249)	(0.113)	(0.125)
Fraudulent product	0.117	-0.292	0.115	0.0762	-0.0249	-0.285	0.247**	0.233*
	(0.239)	(0.325)	(0.138)	(0.157)	(0.183)	(0.227)	(0.112)	(0.124)
*Edu*Fraud*	-0.516	-0.210	-0.303	-0.301	-0.120	0.0785	-0.318**	-0.299*
	(0.332)	(0.466)	(0.198)	(0.223)	(0.256)	(0.327)	(0.161)	(0.178)
Age		-0.0107		-0.00804		-0.00929		-0.00706
		(0.0113)		(0.00663)		(0.00814)		(0.00535)
Male		0.198		-0.0731		0.111		0.0840
		(0.300)		(0.132)		(0.186)		(0.105)
Confidence		0.0352		0.0346		0.00302		0.0844***
		(0.0761)		(0.0342)		(0.0488)		(0.0281)
Single		0.0241		-0.0911		0.0249		-0.135
		(0.372)		(0.169)		(0.249)		(0.134)
Past experience		-0.329		-0.282**		-0.465**		-0.248**
		(0.266)		(0.131)		(0.185)		(0.103)
Risk preference	No	Yes	No	Yes	No	Yes	No	Yes
Schooling	No	Yes	No	Yes	No	Yes	No	Yes
Income	No	Yes	No	Yes	No	Yes	No	Yes
Past involvement	No	Yes	No	Yes	No	Yes	No	Yes
Community fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	281	203	737	649	317	248	761	673
Pseudo R^2	0.112	0.255	0.045	0.084	0.058	0.119	0.025	0.049

$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01.$

Table A.10: Probit and ordered probit model (by financial literacy Q2)

	Dependent variable: *Investment dummy*				Dependent variable: *Investment*			
	Literacy Q2=0		*Literacy Q2=1*		*Literacy Q2=0*		*Literacy Q2=1*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education treatment	0.275	0.185	0.0628	-0.0102	0.312**	0.247	-0.0132	-0.0811
	(0.199)	(0.272)	(0.153)	(0.173)	(0.156)	(0.193)	(0.124)	(0.136)
Fraudulent product	0.413**	0.198	0.0274	0.0412	0.512***	0.382**	0.00922	0.0480

	(0.205)	(0.268)	(0.147)	(0.168)	(0.157)	(0.191)	(0.120)	(0.134)
*Edu*Fraud*	-0.750***	-0.841**	-0.226	-0.280	-0.629***	-0.577**	-0.0723	-0.119
	(0.288)	(0.381)	(0.211)	(0.241)	(0.225)	(0.272)	(0.173)	(0.192)
Age		-0.0240**		-0.000738		-0.0104		-0.00610
		(0.0109)		(0.00658)		(0.00790)		(0.00521)
Male		-0.129		-0.131		0.117		-0.0192
		(0.229)		(0.141)		(0.158)		(0.114)
Confidence		0.0386		0.00492		0.0238		0.0467
		(0.0564)		(0.0383)		(0.0410)		(0.0310)
Single		-0.218		0.0446		-0.0495		-0.119
		(0.272)		(0.186)		(0.187)		(0.149)
Past experience		0.0608		-0.423***		0.0378		-0.495***
		(0.207)		(0.143)		(0.146)		(0.115)
Risk preference	No	Yes	No	Yes	No	Yes	No	Yes
Schooling	No	Yes	No	Yes	No	Yes	No	Yes
Income	No	Yes	No	Yes	No	Yes	No	Yes
Past involvement	No	Yes	No	Yes	No	Yes	No	Yes
Community fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	380	287	665	596	409	323	665	596
Pseudo R^2	0.094	0.173	0.060	0.117	0.065	0.115	0.016	0.047

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.11: Probit and ordered probit model (by financial literacy Q3)

	Dependent variable: *Investment dummy*				Dependent variable: *Investment*			
	Literacy Q3=0		*Literacy Q3=1*		*Literacy Q3=0*		*Literacy Q3=1*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education treatment	-0.0132	-0.169	0.249	0.0459	-0.128	-0.248	0.265**	0.141
	(0.180)	(0.234)	(0.169)	(0.191)	(0.150)	(0.180)	(0.128)	(0.142)
Fraudulent product	0.0859	-0.204	0.0791	0.0764	0.0960	-0.102	0.216*	0.235*
	(0.182)	(0.231)	(0.162)	(0.185)	(0.151)	(0.182)	(0.125)	(0.139)
*Edu*Fraud*	-0.0898	0.0179	-0.515**	-0.417	0.0369	0.0908	-0.452**	-0.361*
	(0.256)	(0.326)	(0.231)	(0.265)	(0.213)	(0.253)	(0.180)	(0.202)
Age		-0.00796		-0.0106		-0.00534		-0.00683
		(0.00840)		(0.00757)		(0.00655)		(0.00587)

Male		-0.0407		-0.126		0.0962		0.0141
		(0.198)		(0.151)		(0.151)		(0.115)
Confidence		0.0611		0.0210		0.0728*		0.0498
		(0.0542)		(0.0407)		(0.0416)		(0.0310)
Single		0.0290		-0.113		-0.149		-0.0922
		(0.257)		(0.194)		(0.194)		(0.147)
Past experience		-0.397**		-0.280*		-0.297**		-0.300***
		(0.193)		(0.151)		(0.145)		(0.114)
Risk preference	No	Yes	No	Yes	No	Yes	No	Yes
Schooling	No	Yes	No	Yes	No	Yes	No	Yes
Income	No	Yes	No	Yes	No	Yes	No	Yes
Past involvement	No	Yes	No	Yes	No	Yes	No	Yes
Community fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	442	344	587	517	466	379	608	540
Pseudo R^2	0.088	0.195	0.049	0.105	0.052	0.102	0.023	0.047

$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01.$

C.4 Financial literacy

A few papers have attempted to theoretically study the link between financial literacy and investment decisions, as well as the (mis-)selling behaviors of financial professionals in the market (e.g., Inderst and Ottaviani, 2012; Lusardi et al., 2017). In contrast to these papers, we explicitly model the investor's unawareness as a special form of financial illiteracy. Lusardi and Mitchell (2014) and Fernandes et al. (2014) provide excellent reviews of the literature on financial literacy and report worldwide findings on financial illiteracy, but data from China are largely underdeveloped.[33]Consistent with reports from around the world, we find that Chinese investors have inadequate financial knowledge, as those in other countries do, but the Chinese respondents exhibit lower self-confidence about their knowledge of finance. Moreover, we do not find an apparent gender difference in financial literacy, which is observed in many other countries, as reported in

[33] Song (2018) conducts a survey in rural China and finds a strong relationship between neglecting compound interest and pension contributions. Moreover, Song (2018) finds that financial education contributes to a correct understanding of compound interest and, thus, increases individuals' investment in pension plans.

Lusardi and Mitchell (2014). We find that replies to questions in Lusardi and Mitchell (2014) do not predict an investor's tendency to purchase fraudulent products.

Questions 1-3 in part 1 of Appendix D are the standard questions as shown in Lusardi and Mitchell (2014) to objectively test an individual's (i) numeracy and capacity to calculate compound interest rates, (ii) comprehension of inflation, and (iii) the sense of risk diversification, respectively. Table A.12 describes the financial literacy patterns in China. Our study suggests that compared to the patterns in the United States (Table A.13), Chinese participants appear to have a higher tendency to choose "don't know" and "refuse" in response to all three questions. While Chinese participants are more likely to mark a correct answer to questions 1 and 3, this is not the case for question 2. As suggested in the international evidence documented in Lusardi and Mitchell (2014), national historical experiences may play a role. In particular, countries that had planned economies in the past, such as Romania and Russia, exhibit lower knowledge of inflation.

Table A.14 summarizes the respondents' self-assessed financial knowledge. We find that the average score is lower than that in the US data reported in Table A.15, implying that the Chinese respondents have lower self-confidence about their financial knowledge. Relatedly, Lusardi and Mitchell (2014) find that Japanese respondents report the lowest scores on self-assessed financial knowledge.

Figure A.10 depicts the financial literacy patterns by age. Consistent with Lusardi and Mitchell (2014), we find that financial literacy is lower among the young and the old than middle-aged people.

Figure A.11 depicts gender differences in financial literacy. Interestingly, we do not observe an obvious gender difference, unlike the differences found in many other countries, as reported in Figure 1 in Lusardi and Mitchell (2014). Based on evidence from many countries, Hsu (2016) proposes a hypothesis on the specialization of labor and knowledge within households. Our study finds that this hypothesis does not hold in China.

Figure A.12 depicts the differences in financial literacy according to schooling. We find that participants with postgraduate degrees have a lower percentage of completely correct responses

than those with college degrees. This may be a result of our small sample size (only 16) of participants with postgraduate degrees.

Table A.12: Financial literacy patterns in Shenzhen, China

	Responses				
	Correct	Incorrect	Don'tknow	Refuse	Observations
Compound interest	69.28%	17.88%	11.12%	1.73%	1214
Inflation	61.49%	19.91%	16.94%	1.65%	1210
Stock risk	54.96%	12.23%	28.76%	4.05%	1210
	Number of correct responses				
	3	2	1	0	Observations
Proportion	30.60%	36.65%	21.06%	11.69%	1206

Table A.13: Financial literacy patterns in the US

	Responses			
	Correct	Incorrect	Don't know	Refuse
Compound interest	67.1%	22.2%	9.4%	1.3%
Inflation	75.2%	13.4%	9.9%	1.5%
Stock risk	52.3% Nu	13.2%	33.7% rect	0.9%
	mber of corresponses			
	3	2	1	0
Proportion	34.3%	35.8%	16.3%	9.9%

Source: Lusardi and Mitchell (2014)

Last but not the least, based on the results in Tables A.6, A.7, and A.8, we do not find that the

Table A.14: Self-reported financial literacy in Shenzhen, China

Scores	1	2	3	4	5	6	7	Average
Percentage	39.50%	15.36%	16.93%	9.72%	10.50%	2.86%	5.12%	2.65

Observations: 1152

Table A.15: Self-reported financial literacy in the US

Scores	1-2	3	4	5	6	7	Average
Percentage	3.9%	5.2%	14.9%	33.2%	26.1%	13.6%	5.1

Source: Lusardi and Mitchell (2014)

three standard financial literacy questions can predict an investor's awareness of financial fraud.[34]

Therefore, adding another question regarding investors' awareness of financial fraud may make the financial literacy test more valuable in predicting the extent to which investors can protect themselves from financial fraud. Based on our model, the awareness of the link between high risk and unrealistically high returns can also indicate the overall potential of financial fraud in an economy. For instance, we may consider adding the following question.

Suppose you had invested in two financial products: one with an 8% annual return and the other with a 20% annual return. Which product is more likely to be repaid to you?
A. The 8%-annual-return one;
B. Equally likely;
C. The 20%-annual-return one;
D. Do not know;
E. Refuse to answer.

While we take a step in the direction of designing a question to elicit respondents' awareness of the possible financial fraud in high-return products as our modest aim here, we leave a more elaborate design of the question for future work on this subject.

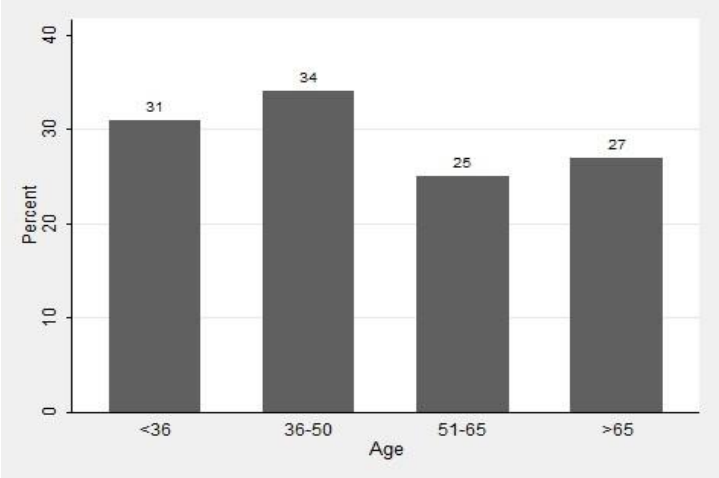

Figure A.10: Correct answers to all three questions (by age)

[34] These three questions are known as the "Big Three". The 2015 National Financial Capability Study added three other questions regarding mortgage payment, how interest rate affect bond prices, and computing compound interest payment. See https://www.usfinancialcapability.org/quiz.php.

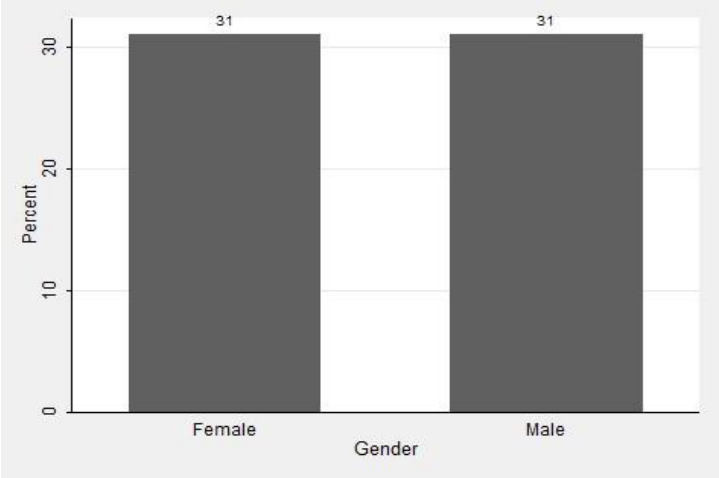

Figure A.11: Correct answers to all three questions (by gender)

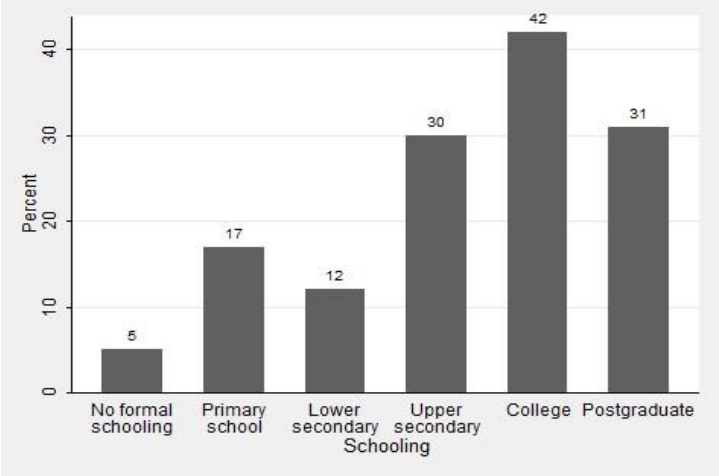

Figure A.12: Correct answers to all three questions (by schooling)

D Experimental Scripts for Group Y1

Survey introduction

Greetings! We are researchers from the Qianhai Institute for Innovative Research and are currently conducting a survey with the Hong Kong University of Science and Technology on purchasing behaviors for financial products. We are not employees of the government or any for-profit organization. All your answers will be used only for academic research and will remain confidential unless you authorize otherwise.

If you agree to participate in this survey, we will give you a small gift. Moreover, one of ten participants will randomly be selected as lucky participants and will be rewarded based on their choices in this survey. CNY is used as the monetary unit throughout this survey.

Please do not talk to other participants, and please keep your mobile phones, computers, and other electronic devices off during the survey. You can raise your hand if you have any questions regarding the survey.

Thank you very much for your cooperation!

Before choosing your answers to the questions in the survey, please review the following message very carefully. You can raise your hand if you have any questions.

Table A.16: A Summary of Return/Risk for Different Financial Products

Annual Rate of Return: 3% Access: Fixed deposit Risk: Almost zero
Annual Rate of Return: 5% Access: Short-term financial products sold by banks Risk: Almost zero
Annual Rate of Return: 6% Access: Long-term (6 months or longer) financial products sold by banks Risk: Almost zero
Annual Rate of Return: 7% Access: Fixed return funds; bonds of listed companies Risk: Bankruptcy of mutual fund companies or listed companies (never happened before)
Annual Rate of Return: 8-9% Access: Financial products or P2P products sold by famous companies Risk: Bankruptcy of companies such as Pingan, Baidu, Alibaba, Sina, or Netease, and no re-organization is performed
Annual Rate of Return: 10-11% Access: Trust; first-tier P2P products Risk: Breach of rigid payment; the P2P company goes bankrupt, and no re-organization is performed
Annual Rate of Return: 12% Access: Private loans between friends Risk: Your friend has no money to repay debts
Annual Rate of Return: 13-15% Access: Second-tier P2P products Risk: The P2P company goes bankrupt, and no re-organization is performed

Annual Rate of Return: 15-20%
Access: Third-tier P2P products; Applying for IPOs
Risk: The P2P company goes bankrupt, and no re-organization is performed; unexpected fall in stock prices

Annual Rate of Return: 20%
Access: Fourth-tier P2P products; junk bonds
Risk: The P2P company goes bankrupt, and no re-organization is performed; the issuer of junk bonds usually faces financial difficulties and needs a helping hand from the government

Annual Rate of Return: 24%
Access: Private loans between friends
Risk: The borrower runs away

Annual Rate of Return: 25%
Access: Fifth-tier P2P products
Risk: You are simply unlucky

Annual Rate of Return: 30%
Access: Usury
Risk: Hard to get your money back unless you are a gang member

Annual Rate of Return: 40%
Access: Predatory lending
Risk: Hard to get your money back even if you are a gang member

Generally speaking, financial products with high returns always have high risk.

Part 1

1. Suppose you had CNY 100 in a savings account and the interest rate was 2 percent per year.

After 5 years, you would have __ in the account if you left the money to grow.

A. More than CNY 102;

B. Exactly CNY 102;

C. Less than CNY 102;

D. Do not know;

E. Refuse to answer.

2. Imagine that the interest rate on your savings account was 1 percent per year and inflation was2 percent per year. After 1 year, you would be able to buy __ today with the money in this account.
   A. More than;
   B. Exactly the same as;
   C. Less than;
   D. Do not know;
   E. Refuse to answer.
3. "Buying a single company stock usually provides a safer return than a stock mutual fund." Youthink the above statement is __
   A. True;
   B. False;
   C. Do not know;
   D. Refuse to answer.
4. On a scale from 1 to 7, where 1 means "very low" and 7 means "very high", how do you assess your overall financial knowledge? __
5. "Now there is a newly developed financial product that could give you a 20% annual return atmost.[35] The highest return for this product is 70 times the demand deposit interest rate, or 15 times the one-year deposit interest rate. Additionally, it can be withdrawn at any time after the second day of your investment, and no transaction fees are charged for this product."

   The description above is about a financial product. Based on the description, which of the options are you most likely to choose?[36]
   A. Invest CNY 2,600 or more in this product;
   B. Invest more than CNY 1,300 but no more than CNY 2,600 in this product;
   C. Invest more than CNY 180 but no more than CNY 1,300 in this product;
   D. Invest more than CNY 60 but no more than CNY 180 in this product;
   E. Invest no more than CNY 60 in this product;

[35] In groups N0 and Y0, the annual return of the product provided in this question is 8%.
[36] The six choices offered here come from the product descriptions designed by the Fanya Metal Exchange.

F. Do not invest in this product.

Part 2

1. Your year of birth __
2. You are __
    A. Male;
    B. Female.
3. You are __
    A. Single;
    B. Married;
    C. Divorced or separated;
    D. Widowed.
4. Your education level is __
    A. No formal schooling;
    B. Primary school;
    C. Junior high school;
    D. Senior high school or specialized secondary schools;
    E. Undergraduate or polytechnic college;
    F. Graduate school or above.
5. You have an annual income level __
    A. No more than CNY 20,000;
    B. Higher than CNY 20,000 but no more than CNY 50,000;
    C. Higher than CNY 50,000 but no more than CNY 100,000;D. Higher than CNY 100,000 but no more than CNY 500,000;
    E. Higher than CNY 500,000.
6. Have you ever had experience investing in financial products before? __A. Never (skip questions 7 and 8);
    B. Yes.
7. What kinds of financial products have you ever invested in? (multiple choices) __
    A. Financial products sold by banks;

B. Government bonds;

C. Corporate bonds;

D. Money market funds;

E. Public funds;

F. Private equity funds;

G. Investment trusts;

H. Stocks;

I. Commercial insurance;

J. Others, please specify ___.

8. From where have you obtained information when making financial investment decisions? (multiple choices) __

A. Friends/family members;

B. Newspapers/books/TV;

C. Clerks or advisors in banks/funds/securities company;

D. Internet;

E. Others, please specify ___

9. Have you ever heard of or invested in the recent financial scams such as "Fanya" or "e-zubao"?

__

A. Never heard of or invested in any of them;

B. Never invested in any of them but have a basic knowledge of some of them;C. Never invested in any of them but have a detailed understanding of some of them;

D. Have invested in some of them but did not lose any money.

E. Have invested in some of them and lost money.

Part 3

Now you are invited to play a game. Flip a fair coin, if it is numbers, you get CNY 100; otherwise, you get nothing.

1. If we give you CNY 5, will you agree to give up playing this game?

A. Agree B. Disagree

2. If we give you CNY 15, will you agree to give up playing this game?

A. Agree B. Disagree

3. If we give you CNY 25, will you agree to give up playing this game?

A. Agree B. Disagree

4. If we give you CNY 35, will you agree to give up playing this game?

A. Agree B. Disagree

5. If we give you CNY 45, will you agree to give up playing this game?

A. Agree B. Disagree

6. If we give you CNY 55, will you agree to give up playing this game?

A. Agree B. Disagree

7. If we give you CNY 65, will you agree to give up playing this game?

A. Agree B. Disagree

8. If we give you CNY 75, will you agree to give up playing this game?

A. Agree B. Disagree

9. If we give you CNY 85, will you agree to give up playing this game?

A. Agree B. Disagree

10. If we give you CNY 95, will you agree to give up playing this game?

A. Agree B. Disagree

Now we will randomly pick one lucky participant out of ten participants and randomly choose one out of ten questions listed above. For example, if you are selected as a lucky participant, and the 3rd question is chosen, and your answer to this question is "Agree", you will be rewarded CNY 25 immediately; if your answer is "Disagree", we will flip a coin, and if it is numbers, you get CNY 100; otherwise you get nothing.

Our survey ends here. Thank you again for your participation!