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Competition and Misconduct

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ABSTRACT

Misconduct is widespread. Practices such as misselling, pump and dump, and money laundering cause harm while raising profits. This paper presents a mechanism that can determine what sorts of misconduct can be sustained in competitive equilibrium in concentrated markets, oligopoly settings, and markets with many small competing firms. The model studied allows general demand and distinguishes types of ethical dilemma using current psychological understanding. The paper shows, for example, that markets with many small competing firms are not vulnerable to misconduct if firms respond to entry with niche strategies or if the ethical dilemma draws an emotional response.

MISCONDUCT IS WIDESPREAD IN FINANCIAL MARKETS. Recent types of misconduct that have been prosecuted and resulted in fines being levied include misselling and pressure-selling (e.g., by financial advisors in the United

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Kingdom, Australia, and the United States),[1] pump and dump (P&D) schemes such as those made famous in the *Wolf of Wall Street* (also known as "ramping"),[2] and money laundering.[3]

This paper presents a mechanism that can determine what kinds of misconduct can be sustained in competitive equilibrium in concentrated markets, in oligopoly settings, and in markets with many small competing firms. The model allows for general demand and distinguishes types of ethical dilemma using current psychological understanding.

A simple link between the level of competition and misconduct is elusive. Empirically, one can point to prominent misconduct cases in industries with many small competing firms and in concentrated markets. For example, in a very crowded market in the United Kingdom (6,619 active firms in 2008), mortgage default insurance—known as PPI (Payment Protection Insurance)—was missold resulting in tens of billions of pounds in fines,[4] while in a concentrated market, the London Inter-Bank Offered Rate (LIBOR) was set by between 7 and 18 member banks.[5]

Theoretically, seemingly good arguments link misconduct with both concentrated markets and markets characterized by competition among many small firms. On the one hand, a small amount of misconduct by a large firm in a concentrated market can lead to a large increase in profits, increasing incentives for misconduct in concentrated markets, and a small amount of misconduct in the service to individual clients can be hard for a regulator to catch. On the other hand, small firms in a competitive market may make only small profits in the absence of misconduct, leading to a strong incentive for misconduct in competitive markets, and a small market share implies a negative impact on only a small number of clients which is more palatable ethically. Deeper analysis is therefore required to identify the vulnerabilities that different market structures have to misconduct.

To identify the link between misconduct and competition, in this paper we add two new characteristics to a model of competition. First, we distinguish between demand functions that model niche markets and demand functions that model mass-market competition. Second, we draw on advances in psychology to distinguish between misconduct that arises from moral dilemmas which

[1] In the United Kingdom, see the mortgage default insurance (PPI) scandal, in the United States see Egan, Matvos, and Seru (2016), and in Australia see the Australian Royal Commission into Misconduct in Banking.

[2] See Jason Geddis v. Financial Services Authority, Securities and Exchange Commission v. George Georgiou, Nigel Derek Heath v. Australian Securities and Investments Commission, Securities and Exchange Commission v. Mikhail Galas, Alexander Hawatmeh, Christopher Mrowca, and Tovy Pustovit, all cited in FMSB (2018).

[3] See the recent cases ABN AMRO Bank NV v. Netherlands Public Prosecution Service and National Westminster Bank Plc (NatWest) v. Financial Conduct Authority.

[4] Fines exceeded £50 billion, and the sales techniques used included training in "disturbance techniques." See Competition Commission (2009, Section 2.54) and https://www.theguardian.com/business/2011/may/05/how-ppi-scandal-unfolded.

[5] See links at https://www.justice.gov/opa/pr/barclays-bank-plc-admits-misconduct-related-submissions-london-interbank-offered-rate-and.

generate an emotional or instinctive response, and misconduct that generates a nonemotional or reasoned response.

A. Niche- versus Mass-Market Demand

If a number of firms were to enter a market, each incumbent firm would suffer a negative shock to its sales volume ("volume" hereafter) and hence would seek to reoptimize against its residual demand. One option would be to raise prices in an effort to increase profits made from the remaining inframarginal consumers—a niche strategy. The alternative approach would be to reduce prices in an effort to win back some of the marginal consumers who left for the entrant(s)—a mass-market strategy. The niche strategy is optimal when the proportion of inframarginal consumers with high valuations for the firm's product is large enough. In this case increased competition does not reduce margins, but rather induces them to rise. In the mass-market setting, increased competition sees margins drop toward zero, and products can be thought of as commodities as many consumers do not value a firm's product significantly more than that of a rival. To allow for this richness in competitive response, we adapt the random utility model (Perloff and Salop (1985)), which others note can accommodate both cases (Gabaix et al. (2016)).

Examples of niche financial markets in which margins remain high despite substantial competition are plentiful. Ausubel (1991) and Stango (2000) demonstrate that credit card interest rates are significantly in excess of the costs of funds even though hundreds of competing banks issue cards. Hortaçsu and Syverson (2004) document the presence of high markups in the mutual fund market, even when the market has hundreds of competitive funds.[6] Biais and Green (2019) show that margins for over-the-counter (OTC) providers trading corporate bonds have remained high despite substantial competition, whereas equity exchanges observe much lower margins, a finding consistent with the argument that OTC markets separate themselves into niches according to the level of counterparty transparency they offer (Easley, Kiefer, and O'Hara (1996), Claessens (2019)). Specialized lending secured on aircraft or medical equipment is a further example (Remolona and Wulfekuhler (1992)).[7]

An alternative definition of niche markets is one in which own-firm cost pass-through is greater than one. Suppose that a firm suffers an upward shock to its marginal cost. In response, the firm will have to adjust its prices. An optimal response will be achieved when marginal revenue rises to equal marginal cost. The firm therefore faces the same trade-off as above: whether to increase prices by less than the cost shock, reducing margins so as to retain marginal consumers, or to increase prices by more than the cost shock, seeking to profit from

[6] Niches in fund management can be created by the type of asset that the fund invests in. For example, in "*Hedge fund GSA moves low-cost fund into high-fee markets*," November 2, 2020, the *Financial Times* cites niche funds targeting German power, cheese, sunflower seeds, and cryptocurrencies.

[7] Mass-market setups occur when differentiation is harder and hence products become commoditized, such as in the provision of independent financial advice to consumers.

inframarginal consumers. In a niche market, there are enough inframarginal consumers that the firm will prefer to raise prices by more than the cost shock; the own-firm cost pass-through in this case will exceed one (Weyl and Fabinger (2013)). There are few empirical studies in finance of cost pass-through rates at the firm level.[8] Own-firm cost pass-through can be estimated, however, as Besanko, Dubé, and Gupta (2005) demonstrate. They find that pass-through rates are significantly greater than one for 14% of products in a major Chicago supermarket chain and reach a high of 558% (for beer).

B. Types of Moral Dilemma

Recent advances in psychology identify a link between the nature of a moral dilemma, the region of the brain used to resolve it, and the subsequent nature of our moral reasoning. Prior research shows that humans exhibit two modes of reasoning: fast versus slow, intuitive versus rational (Kahneman (2011)). Prior research also shows which parts of the brain are responsible for the two types of thinking. The reasoning part of the brain is associated with the dorsolateral prefrontal cortex (DLPFC), while instinctive responses are mediated by the ventromedial prefrontal cortex (VMPFC).[9]

Moral dilemmas can be categorized by the part of the brain they trigger. Greene et al. (2001) demonstrate that intuitively personal moral dilemmas induce an instinctive response that is mediated by the part of the brain associated with thinking fast (the VMPFC). A prominent example of such a moral dilemma is the *transplant problem* (Thomson (1985)). Other types of moral dilemma can be categorized as intuitively impersonal and are reliably mediated by the part of the brain responsible for thinking slow (the DLPFC). An example of such a moral dilemma is the *trolley problem* (Thomson (1985)).

Building on this insight, subsequent work reveals a link between the type of moral dilemma and the nature of the reasoning it will induce. By using functional Magnetic Resonance Imaging (fMRI) to link brain regions to methods of reasoning, Greene et al. (2004) argue that impersonal moral dilemmas, which are nonemotional and trigger a thinking-slow reasoned response, cause agents to behave as if they are consequentialist, whereas personal moral dilemmas, which are emotional and trigger a thinking-fast intuitive response, cause agents to behave as if they are deontological. Under consequentialism, agents weigh the consequences of their actions and act in an attempt to realize the best overall consequences.[10] Under a deontological approach (an approach which is closely associated with Kant (Kant (1785)) rules dominate, although

[8] Most empirical studies focus instead on industry-wide pass-through of tax or exchange rates. See, for example, Bodnar, Dumas, and Marston (2002), Poterba (1996), and Besley and Rosen (1999). Market-wide cost pass-through rates are less illuminating for the curvature of individual firms' demand functions as these typically depend on a conduct parameter that is model-specific and that generally depends on the competitive conditions (Weyl and Fabinger (2013)).

[9] See Davidson and Irwin (1999), Reiman (1997), and Drevets and Raichle (1998).

[10] Consequentialism, and the related concept of utilitarianism, are associated with Mill and Bentham (see Mill (1863)).

the emotional response can be overridden when the stakes are large enough (Nichols and Mallon (2006)).

Which types of misconduct in finance present an emotional moral dilemma (triggering a thinking-fast reflex) versus a nonemotional moral dilemma (triggering a thinking-slow reflex) is an open question.[11] Those who are better at solving mathematical problems are more disposed to consequential reasoning and to more readily consider the best response to moral dilemmas (Paxton, Ungar, and Greene (2012)). Finance is likely to contain many such mathematically adept people. Actions that directly harm others, particularly if the link to the decision maker is immediate or physical, are likely to lead to an emotional thinking-fast response (Royzman and Baron (2002), Greene and Paxton (2009)). We conjecture that being asked to engage in money laundering or to support a P&D strategy are likely to generate an emotional, that is, thinking-fast, response to the moral dilemma, while pressure to engage in misselling, cherry picking,[12] or front-running are more likely to generate a nonemotional thinking-slow, response.

C. Model Results

The two innovations in this analysis—demand type (mass vs. niche) and moral dilemma type (emotional vs. nonemotional)—allow us to establish and study a correspondence between the number of competing firms and the vulnerability of the market to misconduct. We obtain four main results.

We first demonstrate that in the case of nonemotional moral dilemmas, that is, those that trigger a thinking-slow response, more competition increases misconduct in a mass-market context but reduces it in a niche-market context. The equilibrium level of misconduct is governed by the balance of three forces: more misconduct (i) increases profits, (ii) increases the agent's disutility from being unethical as she acts as a consequentialist, and (iii) increases the expected penalty due to the increased probability of being caught. The equilibrium level of misconduct sets the net effect of these three forces to zero.

Suppose a new firm enters the market and matches existing prices. Volumes, and in turn profits, would fall for each of the incumbent firms. We show that there would be no incentive to change misconduct levels—the lower volume would reduce the profit benefit of misconduct but would also reduce the disutility of misconduct arising from both ethics, and expected penalties.[13] The

[11] One well-established result that is arguably less relevant here is that damage in one of the brain regions causes the other to be favored (Mendez, Anderson, and Shapira (2005)).

[12] Cherry picking is the practice whereby a trader conducts multiple trades on the same day and assigns the best ones to his account and the less good ones to a client's account. See, for example, Aviva Investors Global Services Limited v. Financial Conduct Authority cited in FMSB (2018).

[13] The penalty to being caught need not be an explicit regulatory fine. Penalties can be generated by reductions in future payoffs—for example, a CEO losing their position (and therefore the rents associated with it) after unethical firm behavior due to investor or consumer pressure (Hart and Zingales (2017); CEOs are getting fired for ethical lapses more than they used to, *Harvard Business Review*, June 6, 2017).

net result would be no change in the level of misconduct despite the decrease in profits.

Prices, however, do not remain unchanged after entry. Specifically, firms decrease prices if they choose to compete to win back marginal consumers (mass-market strategy) and increase prices if they seek to exploit inframarginal consumers (niche strategy). Suppose that firms respond to entry by raising prices, so that their price-cost margin grows even as their volume falls. Then although all three forces related to misconduct (profits, ethics, and penalties) shrink, the break applied by penalties falls less rapidly than the other two forces as penalties are a function of profits, and profits equal volume times margin. As margins grow with the niche strategy, the penalty effect shrinks more slowly than the other two and therefore more competition results in less misconduct. In a mass-market context, the intuition is reversed.

We next demonstrate that in the case of emotional moral dilemmas, oligopoly competition can generate multiple equilibria in which the market can be clean or feature widespread misconduct; by contrast, markets with many small firms are always clean, while concentrated markets are clean in mass-market settings but foster misconduct in niche-market settings. The emotional nature of the moral dilemma creates a significant emotional fixed cost from engaging in misconduct. Multiple equilibria can be sustained if there is enough profit from misconduct to counteract the fixed ethical cost—in oligopoly settings this can be achieved. With many small firms, however, the available profits are low whether engaging in misconduct or not, and hence it is not worth the disutility of introducing misconduct. In this case, the market is clean.

In a third set of results, we establish when more competition reduces consumer surplus overall due to misconduct. More competition increases consumers' choice and improves the match between client and service provider. More competition also reduces prices in mass-market settings. However, in such settings misconduct increases in response to nonemotional moral dilemmas, which pushes consumer surplus down. Which effect dominates? We show that if consumers' valuations are drawn from uniform, power law, or Weibull[14] density functions then more competition always reduces consumer surplus—the harm of misconduct outweighs the benefits of greater choice and lower prices. However, if consumers' valuations are drawn from the normal distribution, then more competition must raise consumer surplus overall. The difference arises from the specific shape of the tails of the distributions.

Finally, we characterize when a financial market improves from professionalization. Professional accreditation organizations mandate a given level of training to join, and often require ongoing training as well. This training commonly covers ethics, which are tested in an exam format.[15] Such training, if successful, conditions members to see ethics in terms of rules and to develop an instinctive response as to whether a rule has been broken. An implication of professionalization therefore is to make ethical choices analogous to the

[14] For Weibull distributions ($f(x) = kx^{k-1}\exp(-x^k)$) with shape parameter ($k$) greater than one.
[15] An example is the Chartered Financial Analyst Institute (CFA) qualification exam.

emotional type of moral dilemma. Building on these insights, we argue that professionalization offers a clear advantage in markets with many small firms where demand leads to mass-market competition. This would rationalize the professionalization of independent financial advisors (IFAs) and suggests it might be advisable to extend such professionalization to sellers of mortgages, but not those of credit cards. Professionalization offers little benefit in concentrated markets, however, and may be harmful in oligopolies by generating scope for multiple equilibria to include misconduct outcomes. This rationalizes the institutional choice in the United Kingdom not to require professionalization among fixed income, commodities, and currency traders.

D. Paper Structure

In Section I, we discuss related literature. We develop the model in Section II. Section III presents the paper's four main results. In Section IV, we study an asymmetric duopoly version of the model that establishes a channel for ethics to spill over across a market, and in Section V we consider extensions to the harm, detection, and punishment functions to demonstrate robustness of the results. Section VI considers the empirical predictions of this study and explores empirical evidence on competition and misconduct. Finally, Section VII concludes. All proofs are in the appendices.

I. Literature Review

Many have noted the desirability of introducing moral reasoning into economic modeling (Arrow (1973), Hausman and McPherson (1993)). The majority of the literature, however, eschews attempts to address ethics. Instead, the literature identifies a number of avenues through which competition may lead to undesirable outcomes. Gabaix and Laibson (2006) examine firm competition when consumers are behavioral and ignore likely future purchases. The authors show that exploitative pricing can survive in competitive settings. Easley and O'Hara (2023) study a network model of an exchange and establish conditions on the density of the network that allow misconduct to spread. The two most relevant settings for this work concern (i) the link between competition in banking and risk-taking, and (ii) the debate as to whether competition facilitates R&D.

In the banking literature, Keeley (1990) started a lively debate by arguing that competition leads to more fragile banks by increasing risk-taking. Keeley's seminal work hypothesizes that the constraint on risk-taking is the concern that a bank will lose its charter and all the future rents associated with it. If regulations change to permit bank entry, then future profits will decline. Keeley (1990) demonstrates empirically in U.S. data that as Tobin's Q decreases (so future profits are anticipated by the market to be lower), banks choose to take on more risk, that is, choose lower capital-to-asset ratios, and they must offer higher interest rates to attract large certificates of deposits.[16] Our results suggest that it would be misleading to conclude from this literature that misconduct is negatively related to profits.

If misconduct were observable, then choosing some level of misconduct would be a cost-saving change in the production process, which one might think of as similar to the choice over R&D or quality. Prior literature considers whether competition increases or decreases R&D, an important contribution being Vives (2008), but offers little insight into the link between misconduct and competition. The question of misconduct differs fundamentally from that of R&D due to timing and observability. In the simplest formulation of the R&D debate, firms decide how much to innovate, firms incur the sunk costs of developing innovative products, consumers observe the resulting products, and firms subsequently compete. In competitive markets profits will be low, and therefore in the innovation stage firms will be less inclined to incur the fixed costs of R&D and will innovate less (Vives (2008)).[17] When studying misconduct, the timing is reversed and misconduct is not observable. Reversing the timing implies that firms set prices, clients choose their providers, and then firms choose whether to engage in misconduct. The unobservability of misconduct creates a difference in response between those with rational expectations and those without.[18] The result is a nuanced link between competition and misconduct with economic intuition that does not have an analog in the R&D debate.

This study complements reputation models in which firms commit to a quality level that is declared through a signal and then compete (e.g., Ely and Välimäki (2003), Rhodes and Wilson (2018)). In the current context, firms do not publicly offer misconduct as a service and misconduct in finance (e.g., money laundering) can be conducted opportunistically, so the setting is quite different. Furthermore, the foundational studies in the reputation field require that consumers punish firms forever when they are found to have lied about their quality (e.g., Klein and Leffler (1981)), whereas in the case of misconduct it is more common for firms to pay fines and to then continue competing with the promise of adherence to sound ethical conduct.

This paper is the first attempt to try to link ethical decision making about misconduct to product market competition in financial markets, and the

[16] Empirically, this link has been subject to debate. It is not found by Goetz (2018), Boyd and De Nicolo (2005), or Schaeck, Cihak, and Wolfe (2009), for example, while it finds support in Beck, Demirgüç-Kunt, and Levine (2006) and for the loan market in Jiménez, Lopez, and Saurina (2013).

[17] At the logical extreme, a monopolist would have the greatest incentive to pay for an innovation—a point prominently made by Gilbert and Newbery (1982). The R&D literature has extended this insight, in particular by considering dynamic innovation as it generates a new "escape the competition" effect. Running neck-and-neck can cause firms to invest more effort in innovation for the future (e.g., Aghion et al. (2001)). Empirical evidence suggests that competition between firms can increase expenditures on future innovation, but reduce expenditures on current assets (Thakor and Lo (2022)).

[18] In misconduct cases, clients often have not considered the possibility that their service provider was lying, that their IFA was seeking to harm them, or that their counterparty was conducting an illegal P&D scheme.

mechanism considered is likely to offer insights into markets beyond finance. In an influential essay, Shleifer (2004) suggests that ethical behavior may be a normal good, that is, a good for which the demand increases in income. It follows that as profits decline in competitive settings, agents will be less ethical. The claim that wealthier people are more ethical is debatable, and formal modeling delivers a different prediction.

Perhaps the most prominent work on ethics in financial markets (and similar settings) is that by Bénabou and Tirole (2006, 2011), who argue that agents care about the image they project to others and to themselves. Nonaltruistic behavior will be engaged in if the observer is not likely to conclude, as a result, that the agent is bad. Our setting abstracts from these principal-agent concerns and instead studies ethics in a firm context. Important contributions in this context focus on the screening effects of employment contracts—Song and Thakor (2019, 2022), Bénabou and Tirole (2016), and Carlin and Gervais (2009). Beyond finance, related studies include Besley and Ghatak (2005) and Gorton and Zentefis (2019). These contributions explore equilibria in which remuneration incentives are competitively adjusted so that some firms attract the most able, or those with a focus on purpose, whereas others accept that some agents will come who are less ethical and more prone to excessive risk-taking. This approach differs from the present study, in which ethical actions across the market are taken to be a function of the incentives created by the competitive setting together with owner-managers' ethical preferences.

Finally, an important related literature considers corruption among officials and whether competition between firms increases or decreases graft. Prominent contributions include Bliss and Di Tella (1997), Acemoglu and Verdier (2000), and Ades and Di Tella (1999). In this literature, corrupt officials extract a tax from firms by requiring kickbacks for licenses to operate, which gives rise to a trade-off between extracting large payments from a few large firms and extracting small payments from many small firms. Unlike these studies officials seeking a kickback are absent from the present analysis and thus the works speak to distinct settings.

II. Model

There are n firms that compete. Each firm produces a single type of product or service ("product" hereafter) at constant marginal cost c. The firms compete in a three-stage game. In the first stage, the firms simultaneously and publicly set the prices they will charge $\{p_i\}$, and consumers select their providers. In the second stage each firm privately decides whether, and to what extent, it will engage in misconduct. Misconduct allows costs to be decreased or profits increased by $y_i \geq 0$ per unit. In the final stage, the regulator attempts to prove that misconduct occurred and will issue fines if successful. The firms are run by owner-managers who have ethical concerns. We study subgame-perfect equilibria in pure strategies of this game. Initially, we focus on symmetric such equilibria. In the main discussion therefore managers are homogeneous, which allows us to study industry-wide misconduct. We always focus on equilibria that are stable.[19]

There is a unit mass of consumers who all value the product on offer enough to purchase. Each consumer has expected utility from the product offered by seller i of x_i, which is a random variable drawn from the probability density $f(\cdot)$. We assume that the firms are equally attractive, so the expected utility is drawn from the same density function. The density function $f(\cdot)$ is assumed to be positive on its support, (a, b), where $b = \infty$ is permitted, differentiable almost everywhere, and has bounded expectation that guarantees interior solutions. After purchase from firm i, the consumer's realized utility $(\tilde{x}_i)$ is the sum of random noise plus the expected utility, x_i. The noise term has zero mean if the firm has been honest and has negative mean if the firm has engaged in misconduct. This is formalized by

$$\text{Realized utility, } \tilde{x}_i = \begin{cases} x_i + \varepsilon, & \text{no misconduct,} \\ x_i - \alpha y_i + \varepsilon, & \text{misconduct,} \end{cases}$$

where ε is a zero-mean random variable. The parameter $\alpha > 1$ captures the propensity of the misconduct to cause harm: for each \$1 a firm gains through misconduct, the client loses \$$\alpha$. This is an extension of the random utility model (Perloff and Salop (1985)) and would collapse back to the standard model if the expected valuation for product i, x_i, were equal to the realized valuation, $\tilde{x}_i$, which would occur if there were no misconduct cost to consumers ($\alpha = 0$) and no noise term ($\varepsilon = 0$).[20]

We assume that all consumers purchase. This is standard in random utility models (e.g., Perloff and Salop (1985), Zhou (2017)) and in many horizontal differentiation models more generally (Hotelling (1929)). Assuming that all consumers need the product and hence will purchase from one of the competing firms parsimoniously focuses the analysis on the strategic interaction between firms. Formally, this assumption implies that consumers do not have an outside option for the product, or that they have a sufficiently high base valuation for the product that they will purchase in all equilibrium outcomes.

The adaptation of the random utility model in this study allows us to separate the price paid for the financial product from firm i and the realization of the financial return from the product. Examples of unethical practices captured by this model are given in the introduction. For example, P&D is captured by price p representing the cost of the shares purchased by the client,

[19] An equilibrium is stable if, were each firm to alter its actions at a rate proportional to the local first-order gain, small deviations from equilibrium would be dampened and lead the system back to the equilibrium values. See, for example, Dixit (1986), with a textbook treatment available at Anishchenko, Vadivasova, and Strelkova (2014, Chapter 2).

[20] Random utility models capture the fact that a firm cannot predict the value of its product to a consumer, nor that of rivals' products. There is a positive probability that a consumer will leave one firm in response to a price increase and migrate to a competitor. Random utility models therefore represent an elegant way of extending the Hotelling duopoly framework to competition with multiple firms without the strong restrictions on preference orderings required by circular city models.

the realization of the future share value is captured by $\tilde{x}_i$, and the cost saving to the firm from sourcing low-cost low-quality shares and selling them as high-quality shares is captured by y_i. The negative impact of misconduct can also affect society as a whole rather than simply the client (e.g., money laundering).[21]

A proportion r of consumers have rational expectations. These consumers draw appropriate expectations about misconduct from the prices observed in the first stage, and $r = 1$ is permitted. The remainder of consumers, proportion $1 - r$, have passive expectations. These consumers are naive and do not anticipate misconduct. Such consumers exist in many contexts, such as the misselling of mortgage default insurance (PPI) to U.K. consumers.[22]

For reasons that will become apparent, if the reliability function generated by the density of expected utilities, $1 - F(x)$, is log-concave, then the demand system models mass-market competition, whereas if the reliability function is log-convex, niche competition is captured. Example distributions generating mass-market competition include the normal, uniform, power law, and Weibull with shape parameter of at least one, while the Weibull with shape parameter less than one, and the Pareto density function model niche-market competition (Bagnoli and Bergstrom (2005)).

We can illustrate the difference between niche- and mass-market generating density functions. Consider the residual firm-level inverse demand curves at symmetric, though not equilibrium, prices for the Pareto distribution (log-convex reliability function, niche-market competition) and the normal distribution (log-concave reliability function, mass-market competition). These curves are plotted in Figure 1. It is immediate from the figure that, compared to the normal distribution, the Pareto distribution leads to a clockwise rotation in the residual demand curve around the candidate equilibrium price-quantity pair. This creates a substantial minority of inframarginal consumers who value the product very highly, while the normal distribution has a smaller dispersion in residual valuations. Because prices are not in equilibrium, the larger proportion of high-valuation inframarginal consumers with the Pareto distribution encourages the firm to deviate in response to its residual demand by raising prices. In the normal distribution case, the more profitable deviation is to seek to capture more marginal consumers by deviating to lower prices (Johnson and Myatt (2006)).

[21] Money laundering fits into the model by having p represent the fees for honest banking services. The extra profits generated by the bank from money laundering are captured by y. Net of the fees for the money laundering service, laundering would lead to a change in the client's utility of αy, which would be negative to indicate that the client gains. However, the banker would be aware that laundering is detrimental to society and that the source of the funds might be linked to criminal activity. Below we argue that this represents an emotional moral dilemma and so financiers' ethical concerns would be relevant and their utility would be affected.

[22] This model would also fit situations in which consumers, though aware of the misconduct, decline to alter their purchasing decisions. This is known as the intentions-behavior gap in marketing science (Auger and Devinney (2007), Carrington, Neville, and Whitwell (2010)).

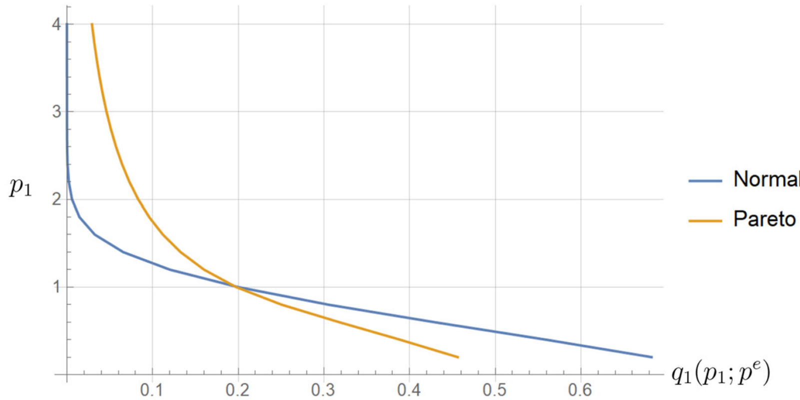

Figure 1. Inverse demand curves. The curves set $n = 5$, and common price $p^e = 1$. For the normal distribution $\mu = 2$, and $\sigma = 1/2$, for the Pareto the shape parameter is $\beta = 2$. The analytical expression for the residual demand curves is given in (A5). The figure depicts passive-expectations consumers ($r = 0$). (Color figure can be viewed at wileyonlinelibrary.com)

The second way to identify niche markets, beyond pricing behavior in response to entry or disequilibrium, is via the own-firm cost pass-through rate. A firm's residual demand is log-concave (log-convex) if and only if own-firm cost pass-through is < 1 (> 1).[23] If the reliability function in the random utility model, $1 - F$, is log-concave, then each firm's residual demand curve is also log-concave (Quint (2014)), so mass markets with respect to entry have own-firm cost pass-through rates below one. The converse that niche markets with respect to entry have own-firm cost pass-through rates greater than one has been confirmed numerically ((Quint, 2014, Section 4.2)) but cannot be shown analytically with existing analytical techniques.

In the third stage, the regulator will look for evidence to substantiate a fine in the case of misconduct. Suitable evidence would need to show managerial intent and would typically require internal documents or other corroborating evidence. The greater the level of misconduct, y_i, the easier it is to find such evidence of misconduct. The probability of successful prosecution is therefore modeled as $\varphi \cdot y_i$ and is increasing in y_i given $\varphi > 0$. In the event of successful prosecution, a proportion $\delta > 0$ of profit is confiscated in the form of damages. These assumptions yield a tractable analysis, but they can be relaxed, which we do in Section V.

[23] This is noted in Bulow and Pfleiderer (1983) with a full discussion offered by Weyl and Fabinger (2013). The result can be shown directly. Define the price-cost margin of a firm as

$$\mu := p - c \Rightarrow \frac{dp}{dc} = \frac{1}{1 - \mu'},$$

where $'$ denotes derivatives with respect to own price. The cost pass-through is greater than one if and only if $\mu' > 0$. But the firm's first-order condition yields $\mu = -q/q'$, which is the reciprocal of $-(\log q)'$.

Each owner-manager optimizes her misconduct decision. To capture the ethics of the owner-managers alongside other considerations, I model overall utility as:

$$U_1(p_1, y; p^e) = q_1(p_1; p^e)\big[(p_1 - c + y)(1 - \varphi y) + \varphi y(1 - \delta)(p_1 - c + y)\big] - \begin{cases} \omega\alpha q_1(p_1; p^e)y & \text{for nonemotional dilemmas,} \\ \kappa \mathbb{I}_{y>0} & \text{for emotional dilemmas.} \end{cases} \quad (1)$$

The top line reflects that there is a probability $1 - \varphi y$ of not being convicted, but if convicted damages are equal to a proportion δ of profits. If the dilemma being modeled generates a nonemotional reflex, triggering the thinking-slow response, then the agent will behave *as if* she is consequentialist. This is achieved by causing the manager to dislike engaging in misconduct by the amount $\omega \cdot \alpha y \cdot q$. This term is increasing in volume, that is the number of clients harmed and the extent of harm done to each client (αy), and therefore is increasing in the level of misconduct. The weighting term ω captures the agent's willpower, that is, her propensity to act in accordance with her moral preferences (Roberts (1984)).[24] If the dilemma being modeled triggers an emotional, thinking-fast response, then the agent will behave *as if* she is deontological. This is achieved by creating a discontinuous reduction to utility $\kappa \cdot \mathbb{I}_{y>0}$ that is triggered by any misconduct but that does not increase in the number of consumers affected or in the extent of misconduct.

We conjecture that money laundering is an emotional moral dilemma that triggers a thinking-fast response. The rationale is that money laundering would be seen by a financier as morally wrong by reflex. This is because money laundering is often linked to predicate offences that generate the proceeds to be laundered, often drug dealing or other organized crime (see Alldridge (2001)). Such reflexes can be overruled, however, if the benefits are great enough (Nichols and Mallon (2006))—a feature permitted by the utility function (1). We also conjecture that misselling is a nonemotional dilemma that triggers a thinking-slow response. The rationale in this case is that the moral status of misselling is not clear beyond doubt. But if the clients are vulnerable people who stand to be significantly harmed, such as the elderly,[25] then the harm parameter α will be high, and potentially high enough for misconduct not to occur. In short, this model offers a clearly derived functional form for managerial utility that draws from neuroscience and philosophy.

III. Main Results

In this section, we establish the degree of vulnerability to misconduct of concentrated markets, oligopolies, and markets with many small competing firms. Section III.A focuses on nonemotional moral dilemmas, Section III.B

[24] This model of consequentialism rationalizes, for example, a preference for fairness in offers made in the ultimatum game (Camerer and Thaler (1995)).

[25] We thank a referee for suggesting the elderly as an example.

on emotional moral dilemmas. In Section III.C, we consider whether increasing competition can harm consumer surplus, given the potential for misconduct. In Section III.D, we draw out the implications of this study for the professionalization of finance. Proof for all the results in this section are provided in Appendix A.

A. Nonemotional Moral Dilemmas and Market Misconduct

In this section, we explore the link between competition and misconduct when the moral dilemma generates a nonemotional, thinking-slow response. In this case, agents reason as if they are consequentialist.

PROPOSITION 1: *For nonemotional moral dilemmas, so triggering thinking-slow responses, we have the following characterization. If the product of the proportion of rational consumers and the harm from misconduct is not too high,*

$$\alpha \cdot r < 2, \tag{2}$$

then there is a threshold number of competing firms, N, such that for any stable symmetric equilibrium:

1. *In a mass-market framework:*
   - *(a) There is no misconduct if the number of competing firms is $n \leq N$.*
   - *(b) The level of misconduct is increasing in the number of competing firms if the number of firms competing is greater than the critical threshold, N.*
2. *In a niche-market framework:*
   - *(a) When n is below the threshold N, there is a positive level of misconduct that declines in the number of competing firms.*
   - *(b) There is no misconduct if the number of competing firms is $n > N$.*
3. *If condition (2) does not hold, then any symmetric equilibrium is without misconduct.*

The proof first solves the second stage of the owner-manager's decision. Given a price set in the first stage, the objective function is concave in misconduct. The optimal level of misconduct as a function of the first stage price is solved, subject to the misconduct being bounded below by zero. We can then determine the indirect utility of the owner-manager as a function only of the price set by embedding in the subsequent choice of misconduct. In a stable symmetric equilibrium, no owner-manager will have an incentive to deviate from the equilibrium. This generates a first-order condition that can be used to solve the competitive game between the owner-managers. This also establishes a relationship between equilibrium prices and the number of competing firms in any stable symmetric equilibrium. By then applying the optimal second-stage behavior, we establish the relationship between the equilibrium level of misconduct and the number of competing firms, as reported in Proposition 1.

To develop the intuition underlying Proposition 1, we start by noting that we can rewrite each owner-manager's utility function (1) as follows:

$$U_1(p_1, y_1^*(p_1); p^e) = \overset{\text{ethics}}{-q_1 \cdot \omega\alpha y_1^*(p_1)} \; \overset{\text{penalties}}{-q_1 \cdot \varphi\delta y_1^*(p_1) \cdot \big(p_1 - c + y_1^*(p_1)\big)} \; \overset{\text{profits}}{+q_1 \cdot \big(p_1 - c + y_1^*(p_1)\big)},$$

where $y_1^*(p_1)$ is the optimal level of misconduct chosen at the second stage as a function of price (and established formally in (A7)). The above formulation makes clear the three conflicting forces acting on owner-managers: ethics and penalties as deterrents, and profits as inducements. It is helpful now to consider the second-stage incentive to increase misconduct, holding fixed the price that firm 1 has set:

$$\frac{\partial U_1}{\partial y_1} = \underset{\propto\ \text{volume}}{\underset{\uparrow}{\overset{\text{ethics}}{q_1 \cdot (-\omega\alpha)}}} \quad \underset{\propto\ \text{profits}\ (+\ \text{volume})}{\underset{\uparrow}{\overset{\text{penalties}}{-q_1 \cdot [(p_1 - c + y_1)\ + y_1]\varphi\delta}}} \quad \underset{\propto\ \text{volume.}}{\underset{\uparrow}{\overset{\text{profits}}{+q_1}}} \tag{3}$$

Equation (3) demonstrates the impact of marginal changes in the level of misconduct on the three key forces—ethics, penalties, and profits. At an optimal level of misconduct, these three forces must be balanced to set (3) to zero. Note that ethics and profits move in proportion to volumes. The effect of penalties can be split into two parts, one part that is proportional to volume, and more importantly, a second part that is proportional to volume times margins, that is, to profits.

Consider now an additional firm entering the market at some price. We first consider the incentive for firm 1 to alter the level of misconduct in the second stage, holding own price constant, followed by the full incentive to optimize against entry.

The immediate implication of entry, before any competitive price response, is that volume, and therefore profits, fall. Consider again the second-stage incentive to increase misconduct, holding prices fixed, captured in (3). There is no incentive for firm 1 to alter the level of misconduct as the set of forces determining misconduct outlined in the first derivative (3) remain balanced. With firm 1's prices constant but volume reduced, the ethics effect declines, but so do the effects of penalties and profits—all at the same pace.

We establish that firms do not simply respond to lower volume and in turn profits with more misconduct. We must therefore understand the effect of entry on profit margins, that is, on prices.

Now consider firm 1's first-stage response, that is, the optimization of prices to adapt to new entry. Firm 1 might lower prices to try to attract back some marginal consumers (the mass-market strategy), or might raise prices to extract greater rents from the remaining inframarginal consumers (the niche strategy). Suppose incumbent firms adapt to new entry by raising their prices and pursuing a niche strategy. (This is the case if the own-firm cost pass-through rate is greater than one.) Such a price response reduces volume, and of course increases margins. Turning to the resulting misconduct decision in

(3), we again note that the volume effect is common across the three forces, and so does not lead to a change in the balance of incentives. The margins effect, however, increases the deterrent effect arising from penalties while not altering the other two forces making up the misconduct incentive.

In sum, in the niche competition case, entry causes firm 1's volume to fall but the firm's prices, and in turn margins, to rise. It follows from the volume reduction that the magnitudes of the three forces (profits, ethics, and penalties) are all reduced. However, the margin increase implies that the penalties effect is reduced less rapidly than the other two forces. In other words, although entry lowers the absolute magnitude of the constraint on misconduct from ethics and penalties and also lowers the absolute magnitude of the incentive to engage in misconduct from potential profit, the margin effect means that the penalties effect declines less rapidly than other two forces, so the balance of incentives tips against misconduct.

In this benchmark model, the main determinant of the probability of conviction for misconduct is the level of misconduct the manager chooses. In Section V, we allow this conviction probability to also depend on the firm's volume so that entry, which reduces volume, weakens a regulator's ability to detect and punish misconduct. This reinforces the results for mass-market settings, but weakens the results for niche markets.

Consumers who have rational expectations anticipate that firms will conduct some misconduct and so adjust down their overall utility from products. It follows that such consumers are less responsive to firm-level price differences as they understand that price reductions will be clawed back in part through misconduct. This lowers the elasticity of demand with respect to prices for such consumers, which raises the equilibrium price level, hence lowering the equilibrium level of misconduct by the logic above. Note that even if all consumers are rational, misconduct cannot be ruled out if the harm to consumers is not too high.[26] If the misconduct is very harmful to consumers, however, then rational consumers would distrust low prices sufficiently to render the market clean.

Proposition 1 has implications for the link between misconduct with respect to nonemotional moral dilemmas and the degree of competitive tension in mass and niche markets. I discuss these empirical implications and the available empirical evidence in Section VI.

B. Emotional Moral Dilemmas and Market Misconduct

In this section, we consider moral dilemmas that generate an emotional, thinking-fast, response.

PROPOSITION 2: *For emotional moral dilemmas, so triggering thinking-fast responses, stable symmetric equilibria when rationality or harm caused is not too high (product $\alpha \cdot r$ satisfies (A22)) are characterized by:*

[26] Part 3 of Proposition 1 indicates that if $r = 1$ misconduct is possible in equilibrium if $\alpha < 2$.

1. *In a mass-market framework, there are two double-thresholds of competition:* $(\underline{\nu}_2, \overline{\nu}_2) \subseteq (\underline{\nu}_1, \overline{\nu}_1)$.
   (a) *There is no misconduct equilibrium if* $n < \underline{\nu}_1$ *or* $n > \overline{\nu}_1$.
   (b) *When the emotional disutility of the moral dilemma* (κ) *is small,*
      (i) *Any symmetric equilibrium is one of misconduct for* $n \in (\underline{\nu}_2, \overline{\nu}_2)$, *with misconduct levels increasing in the number of competing firms.*
      (ii) *Both clean and misconduct stable symmetric equilibria can exist in the border regions:* $n \in (\underline{\nu}_1, \underline{\nu}_2)$ *and* $n \in (\overline{\nu}_2, \overline{\nu}_1)$.
2. *In a niche-market framework, there is a single double-threshold of competition:* $\underline{\nu} < \overline{\nu}$.
   (a) *When n is below the threshold* $\underline{\nu}$, *there is a positive level of misconduct that declines in the number of competing firms.*
   (b) *Both clean and misconduct stable symmetric equilibria can exist for oligopolistic competition:* $n \in [\underline{\nu}, \overline{\nu}]$.
   (c) *There is no misconduct if the number of competing firms is high:* $n > \overline{\nu}$.

The proof begins by considering the owner-manager's optimal choice of misconduct having set the price in the first stage and secured a given volume. If the owner-manager decides to pursue misconduct, she will incur the fixed utility cost of doing so. Utility can be optimized under this assumption to determine a candidate level of misconduct as a function of price. However, the problem is not concave as the owner-manager may decide not to engage in misconduct due to the discontinuous and large utility cost incurred. A second candidate is therefore zero misconduct. The utility generated by these candidate optimal misconduct levels can be compared and an optimal level of misconduct as a function of first-stage prices developed. This level of misconduct can then be plugged in to the first-stage utility. The competitive game now occurs just over price. There are, however, two candidate types of equilibria: with or without misconduct. The discontinuous nature of the utility cost requires that we check that the price ensuring no incentive to deviate from symmetry is consistent with second-stage misconduct optimization. Comparative static analysis of the price and therefore misconduct levels with respect to the number of firms then yields Proposition 2.

To develop intuition into Proposition 2, first consider a setting in which there are a large number of firms competing. Regardless of whether under the mass- or niche-market framework; the profits available to each firm are low. There is therefore insufficient profit available to overcome the fixed cost (κ) of engaging in misconduct. It follows that a symmetric equilibrium must be clean if a large number of firms compete. This is established in parts 1(a) and 2(c) of Proposition 2.

Recall that an emotional dilemma creates a fixed cost of engaging in misconduct. However, when overridden (if optimal to do so), the utility function is analogous to that governing a nonemotional moral dilemma ($\omega = 0$). Now consider the opposite extreme of only a small number of firms competing. Suppose that the market takes the form of mass-market competition. Based on the nonemotional dilemma result (Proposition 1), equilibrium would be clean in this case. The fixed cost of misconduct in this emotional-dilemma case does not encourage misconduct. The result therefore holds. This explains part 1(a) of Proposition 2.

Now turn to the case of a niche market with only a small number of firms competing. For nonemotional moral dilemmas, this setting is vulnerable to misconduct if the proportion of rational expectations consumers is not too great. This continues to be the case for emotional dilemmas. The increase in margins available from misconduct multiplied by the large volume is sufficient to overcome the fixed cost of misconduct. Hence, a symmetric equilibrium involves misconduct, explaining result 2(a).

The analysis is more nuanced in the case of oligopoly, with the predictions differing between mass and niche markets. In the niche-market case, there is one range of the number of competing firms that can generate multiple equilibria (one clean, the other with misconduct). In the mass-market setting, there can be (depending on parameters) disconnected ranges of the number of firms with multiple equilibria, and misconduct in between.

In the case of a niche market, margins and volume move in the opposite directions with the number of firms. Low margins reduce the relative force of penalties as discussed following Proposition 1, while large volume makes it more likely that misconduct will generate enough profit to outweigh the discontinuous disutility of misconduct. The effects therefore reinforce each other. The fixed cost creates a boundary region in which both types of equilibria are possible – a high-price/clean equilibrium in which margins are high enough that the deterrent of penalties is enough to prevent deviation to misconduct, and a low-price/misconduct equilibrium in which the penalties effect is weak enough not to deter misconduct and volume is large enough to overcome the disutility cost.

In a mass-market setting, both margins and volume fall with the number of competing firms. The relative pace of decline depends on the specifics of the value density function. As margins shrink, this lowers the deterrent effect of penalties. But as volume shrinks, the extra profit benefit of misconduct falls, making it less likely to be sufficient to overcome the fixed cost. When one of these effects overtakes the other, there is a transition and hence multiple equilibria can occur.

C. Can Competition Reduce Consumer Surplus?

In this section, we establish market conditions such that more competition ultimately always reduces consumer surplus. The candidate setting can only be nonemotional moral dilemmas with mass-market competition. With emotional moral dilemmas, so triggering a thinking-fast response, if competition is great enough then only clean symmetric equilibria survive (Proposition 2). The same result applies for nonemotional moral dilemmas when the market is characterized by niche competition (Proposition 1).

Consider therefore nonemotional moral dilemmas in mass-market competition when the number of competing firms is large. The extent of misconduct, $y_1^*(p^e)$, is inversely proportional to $\frac{1}{2}p^e$ from the owner-managers' second-stage optimization (see equation (A7)). As the extent of harm to consumers is proportional to α times the extent of misconduct that firms engage in by assumption, the harm to consumers is inversely proportional to $\alpha \cdot \frac{1}{2}p^e$. It is therefore immediate that if the harm multiple α is greater than two the increase in harm will exceed the price reduction from an increase in competition. However, this is not enough to guarantee that competition reduces consumer surplus.

More competition improves the match between consumers and the firms they choose. If n firms are competing in a symmetric equilibrium, then each consumer will buy from the firm associated with the highest expected utility draw from n draws from the density function $f(x)$. The larger the number of competitors, the greater the expectation of the highest draw from n. It is therefore not clear whether competition increases or decreases consumer surplus overall. An answer is available.

PROPOSITION 3: *Consider a nonemotional moral dilemma and suppose (2) is satisfied, so misconduct equilibria are possible. For any symmetric stable equilibrium, increasing competition for n large:*

1. *Reduces consumer surplus if there are irrational consumers* ($r < 1$)*, if the density function of expected utility* $f(\cdot)$ *is drawn from the*
   - *Weibull class (shape parameter* ≥ 1*),*
   - *uniform class,*
   - *power law class,*

   and if the harm parameter is large enough $\alpha \in (\alpha^\dagger, \frac{2}{r})$ *for given constant* $\alpha^\dagger$*, while willpower is not* ($\omega\alpha < 1$)*.*
2. *Raises consumer surplus if the density function* $f(\cdot)$ *is drawn from the class of normal distributions.*

Proposition 3 solves for the limiting behavior of consumer surplus in the case of four leading distributions. The proof gives the required bounds $\alpha^\dagger$ for each distribution in part 1 of the proposition. The techniques in the proof can be applied to other distributions also. To prove Proposition 3, we use the large n approximations of integrals such as those determining the demand function given in (A3) and explored in Gabaix et al. (2016). The results in Gabaix et al. (2016) can be applied immediately to approximate the large-n functional form for the total match value created by the industry (given explicitly in (A24)). The large-n behavior of prices and misconduct are endogenous to the model. However, their rate of change with respect to the number of firms can be established, and combined with the large-n properties of the taste distributions to establish a bound on the rate of change of consumer surplus with respect to the number of firms. Under the conditions of Proposition 3, this bound can be placed strictly above or below zero, yielding the results.

Proposition 3, part 1, demonstrates when generically more competition will harm consumers. Intuitively, the critical issue is how sensitive the consumer match value is to competition as compared to misconduct. The Weibull density function has a relatively thin upper tail, while the uniform and power law density functions are on bounded support and so do not have upper tails. The match value is given by the highest of n draws from the distribution. With thin tails and an already high n, the match value is close to its maximum. Misconduct does not face such a hard bound. With match value playing a lesser role, misconduct grows in importance and so competition in these mass markets ultimately harms consumers.

We note in the discussion of Proposition 1 that markets with naive consumers are more vulnerable to misconduct than markets in which consumers have fully rational expectations. Nonetheless, Proposition 1 confirms that with fully rational consumers ($r = 1$), equilibrium misconduct can be increasing in the number of firms. Proposition 3 reveals that overall consumer surplus does not decline with the number of firms at large n when all consumers are rational. The harm multiple (α) must exceed two for price reductions to be outweighed by harm and potentially reduce overall consumer surplus. But at such high harm parameters misconduct equilibria do not arise,[27] as rational consumers avoid firms that decrease their prices as these consumers anticipate the concomitant misconduct.

When the market is almost entirely rational, Proposition 3 reveals that consumer surplus can decline in competition when the number of competitors is large. With more irrational consumers, the range of parameters for which increasing competition reduces consumer surplus grows.[28]

With the normal density for valuations, the tails are fat enough that the match value remains responsive to increases in the number of firms, with this effect dominating the misconduct that is perpetrated. Under the normal distribution therefore, competition with large n must always (ultimately) improve consumer surplus.

The results above can be demonstrated numerically. As Figure 2 shows, the mass-market formulations captured by the uniform distribution and the normal distribution have increasing amounts of misconduct and declining margins, both of which reflect Proposition 1, and increasing match values ignoring any misconduct. Factoring in misconduct, however, we see that the realized consumer surplus declines at large n in the case of the uniform distribution but not under the normal distribution, as predicted by Proposition 3. The niche setup has no misconduct for large n as predicted by Proposition 1.

D. In What Markets Should Finance be Made a Profession?

Professionalization of an industry would require that individuals practicing in the industry are members of an appropriate professional body, as is the case in medicine and law. Most, if not all, professional bodies require that their members receive training in ethics, and sometimes this training is ongoing.

[27] If $r = 1$ and $\alpha > 2$, then Proposition 1, part 3 applies as equation (2) is violated.

[28] Simple algebra confirms that the gap $\frac{r}{2} - \alpha^{\dagger}$ (see equation (A31)) is declining in r.

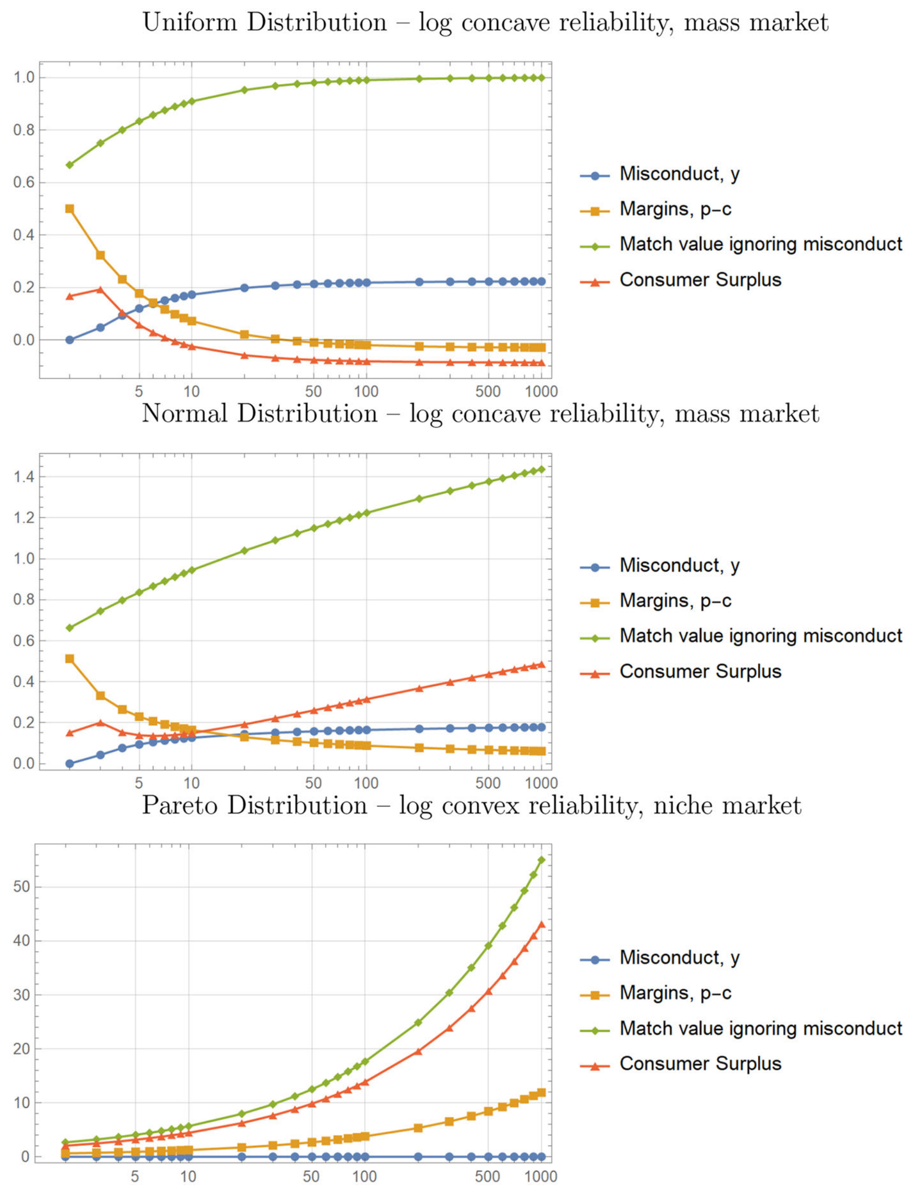

Figure 2. Numerical examples of misconduct, prices, consumer surplus, and match value. Note log scale. Match value is the expected value of the highest of n draws. Consumer surplus is the match value less the price paid and less the total harm from misconduct ($\alpha \cdot y$). Misconduct rises with the number of competing firms in the mass-market case, but not the niche market case. With large n, consumer surplus rises under the normal distribution, but not the uniform distribution (Proposition 3). The parameters are $\alpha = 5, \omega = 0.15, \delta = 1, \varphi = 0.6, c = 0$, and $r = 0$. The uniform distribution is on $[0, 1]$, the normal has moments that match $\mu = 0.5$, and $\sigma = 0.289$. The Pareto distribution has scale parameter 2. The model assumes full coverage, so the simulation of the normal case ignores the small measure of consumers who draw n valuations that are all more negative than the valuation for the product. (Color figure can be viewed at wileyonlinelibrary.com)

For example, the Chartered Institute for Securities and Investments (CISI) requires that its members pass an Integrity Test, the CFA devotes 10% of its exam to ethical issues, the Chartered Institute of Bankers in Scotland (CIOBS) has made only one of the modules mandatory for a Chartered designation—*Professionalism, Ethics & Regulation*, and the Institute of Chartered Accountants in England and Wales (ICAEW) requires that members pass a module in *Professional Ethics*.[29]

The ethics training mandated by professional bodies is typically not nuanced. It teaches a lexicographic ordering to ethics according to which clients' interests come first. For example, the CISI code of conduct requires its members to "*put the interests of clients and customers first*."[30] The CFA similarly requires that members "*place their clients' interests before their employer's or their own interests*."[31] By including tests of such principles in an exam, members are trained to think that ethics have clear right-wrong implications devoid of trade-offs. Professionalization of a market, if conducted successfully, conditions agents to respond to moral dilemmas in a thinking-fast manner—a rule is either broken, or it is not.

Any gain from professionalization can therefore be identified by comparing the market's susceptibility to misconduct from nonemotional and emotional moral dilemmas.

To analyze this formally, consider an industry and let N be the critical number of firms at which industry equilibrium is on the cusp between misconduct and clean behavior when a given moral dilemma is nonemotional and triggers a thinking-slow response. Such a critical number of firms exists by Proposition 1.

Suppose that ethical training mandated by professional bodies causes market participants to be conditioned to change their psychological approach to the moral dilemma such that they have a thinking-fast response with an emotional distaste parameter of

$$\kappa^* = \frac{1}{N\varphi\delta}(\alpha\omega)^2. \tag{4}$$

PROPOSITION 4: *Changing the ethical response from thinking slow to thinking fast with distaste parameter (4) results in the following misconduct equilibrium characterization:*

1. *Under niche-market competition, the upper bound of the potential misconduct range (Proposition 2) is $\overline{\nu} = N$. Hence, the market is possibly cleaner for $n \in [\underline{\nu}, \overline{\nu}]$, and unchanged for other firm numbers.*

[29] Requirements are cited in Patel (2014).

[30] See https://www.cisi.org/cisiweb2/docs/default-source/cisi-website/ethics/cisi-code-of-conduct-2021.pdf.

[31] See https://www.cfainstitute.org/-/media/documents/code/code-ethics-standards/code-of-ethics-standards-professional-conduct.ashx.

2. *Under mass-market competition,* $N \in [\underline{\nu}_1, \overline{\nu}_1]$ *(Proposition 2) with* $\overline{\nu}_1 < \frac{N}{(\alpha\omega)^2} < \infty$. *Hence, the market is clean for a large number of firms, but may permit misconduct for* $n \in [\underline{\nu}_1, N]$.
3. *If the ethical conditioning results in* $\kappa > (<)\ \kappa^*$, *then the misconduct regions shrink (grow) further.*

Proposition 4 suggests that if professionalization is moderately successful in converting nonemotional into emotional dilemmas (so equation (4) is satisfied), then professionalization is beneficial in mass markets with a large number of competitors. These are markets that would observe misconduct under nonemotional (thinking-slow) moral dilemmas, but can be rendered clean if the number of competing firms is large enough. This argument therefore supports professionalization for markets such as that for IFAs, many of which do belong to professional bodies, and also for sellers of mortgages.

There is no comparable gain, however, if the market is of a niche variety, such as the credit card market. Indeed, in a market with few competing firms, creating a professional body confers few advantages, and may even be damaging. In the case of niche markets, such as OTC bond markets, for example, professionalization may reduce misconduct in oligopoly settings, but multiple equilibria are possible that would render the professionalization ineffective. In the case of mass-market competition (cost pass-through rates that are low), professionalization can introduce misconduct in oligopoly settings that might have been clean when agents were thinking slow. This argument supports the existence of institutions such as the Financial Markets Standards Board (FMSB) in the United Kingdom that identifies best practices for exchanges and for fund managers (among others) without having any enforcement powers or overseeing the creation of a professional organization.

IV. Ethical Spillovers across a Market

Thus far we consider settings in which firms are identical: owner-managers have the same ethical willpower and run equally efficient firms. In this section, we relax both of these restrictions. For tractability, we focus on duopoly.

Suppose there is a duopoly in a financial market subject to a nonemotional moral dilemma that triggers a thinking-slow response. We allow each firm's owner-manager to have her own attitude to ethics: $\{\omega_1, \omega_2\}$. Suppose that the firms are in a misconduct equilibrium and both firms are active, that is, sell nonzero quantities. Now consider that, perhaps because of a corporate acquisition or training, the owner-manager of firm 2 becomes more ethical, that is, ω_2 increases. How do market-wide misconduct and price levels change?

To address this question, we generalize the owner-managers' utility function from the main model explored in Section III to allow for individual ethics:

$$\begin{aligned} U_1(p_1, y_1; p_2) =& q_1(p_1; p_2)\big[(p_1 - c + y_1)(1 - \varphi y_1) + \varphi y_1(1 - \delta)(p_1 - c + y_1)\big] \\ &- \omega_1 \alpha q_1(p_1; p_2) y_1. \end{aligned}$$

We allow for any level of rational expectations in the population (r), which permits a misconduct equilibrium and establish the following result.

PROPOSITION 5: *In the case of nonemotional moral dilemmas, so triggering thinking-slow responses, the comparative statics in a stable duopoly competitive equilibrium with respect to the ethics of firm 2, ω_2, satisfy:*

1. *A more ethical firm 2 raises her own prices:* $\frac{dp_2^e}{d\omega_2} > 0$;
2. *A more ethical firm 2 causes firm 1 to reduce her misconduct if and only if firm 1's log demand displays increasing differences in firm 2's prices:*

$$\frac{dy_1^e}{d\omega_2} =_{sign} -\frac{\partial^2 \ln q_1}{\partial p_1 \partial p_2};$$

3. *A more ethical firm 2 causes firm 1 to raise her prices if and only if firm 1's log demand displays increasing differences in firm 2's prices:*

$$\frac{dp_1^e}{d\omega_2} =_{sign} +\frac{\partial^2 \ln q_1}{\partial p_1 \partial p_2};$$

4. *A more ethical firm 2 reduces her level of misconduct* ($\frac{dy_2^e}{d\omega_2} < 0$).

If the market is characterized by mass-market competition (log-concave reliability function), then demand displays increasing differences so that

$$\frac{dy_1^e}{d\omega_2} < 0 < \frac{dp_1^e}{d\omega_2}.$$

PROOF: See Appendix B. □

We explore the intuition for these results in turn. That the manager of firm 2 should reduce her level of misconduct when she is more ethical is intuitive. This follows as greater dislike of misconduct mechanically makes the owner-manager less keen to take actions which cause clients harm. Note that at any given price, firm 2 will have higher final costs (as her misconduct will be lower). It follows therefore that firm 2 will choose to increase prices.

Given the manager of firm 2 responds to her increased morality by raising retail prices, she becomes a less effective competitor. It follows that firm 1 gains volume. This increases all three forces operating on firm 1's misconduct choice—-ethics, penalties, and profits—but does so at the same rate. The manager of firm 1 will seek to reoptimize her prices, but doing so will alter the relative weight from penalties as compared to the other two forces. She could reduce prices to further attract new customers, or she could raise prices somewhat to profit more from those new consumers who switch to the firm in any case.

If the log of firm 1's realized demand has increasing differences in prices ($\partial^2 \ln q_1/\partial p_1 \partial p_2 > 0$), then should firm 2 raise its price, $\partial \ln q_1/\partial p_1$ will increase. Because this derivative is negative, this implies that firm 1's realized demand becomes less sensitive to own prices if the rival firm's price goes up. This encourages firm 1 to raise its price.

Firm 1's level of misconduct now moves in the opposite direction of its prices. If the equilibrium dynamics cause firm 1's prices to rise, then the effect of penalties becomes more prominent in the decision calculus. Hence, the owner-manager of firm 1 lowers her level of misconduct.

If the market is characterized by mass-market competition (log-concave reliability function generated by the distribution $F(x)$), then the proof of Proposition 5 shows that log demand displays increasing differences at all prices. Thus, in a mass-market setting (with own-cost pass-through rates less than one), misconduct and good behavior propagate in an industry. A more ethical firm 2 induces a reduction in misconduct at the competing firm 1.

Discussion and Empirical Evidence

If a less corrupt, or more ethical, firm should acquire a competitor in a perhaps corrupt local market, will the newcomer raise the ethical conduct of rivals? Proposition 5 describes a mechanism through which positive spillovers of ethics can occur between firms. The result here is novel in capturing a competitive channel for good behavior to spill over between firms.[32] Proposition 5 has some supporting empirical evidence: Kwok and Tadesse (2006) find that entry into a market by a (more ethical) multinational lowers corruption and misconduct among home firms.

V. Extensions to the Market Model

In the analysis above, we make a number of assumptions:

(i) We use linear functional forms for consumer harm and the detection and conviction technology.
(ii) We assume that regulatory fines are proportional to profits; we do not consider revenue-based fines.
(iii) We assume that the detection and conviction technology improves with the level of misconduct, but not in the volume of product sold.

In this section, we discuss and relax these assumptions. We establish general conditions under which the comparative static relationship between competition (number of firms) and the level of equilibrium misconduct remains as described in Propositions 1 and 2. We consider the case in which all consumers have passive expectations (i.e., $r = 0$) to allow for a clearer focus on each extension. The model extends naturally to a repeated game in which penalties can be interpreted as a reduced form for future profits and punishments. All proofs are contained in Appendix C.

[32] One way a firm can influence the ethics of another firm is if the "bad apples" employed by one firm move to the other (Dimmock, Gerken, and Graham (2018)).

A. Harm and Detection General Functions of Misconduct

In the analysis underpinning Propositions 1 and 2, both the harm done by misconduct and the probability of detection are assumed to increase linearly with the level of misconduct. Here we generalize these relationships to functions $\alpha(y)$ and $\varphi(y)$, which are differentiable at least twice. We focus first on the setting of nonemotional moral dilemmas. Adapting (1), owner-managers have objective function

$$U_1(p_1, y_1; p^e) = q_1(p_1, p_e)\big[(p_1 - c + y_1)(1 - \delta\varphi(y_1)) - \omega\alpha(y_1)\big]. \quad (5)$$

We require that the second-period misconduct choice is a concave problem and that detection and harm are more likely with more misconduct. A sufficient condition for these features to hold is that over the relevant range of misconduct,

$$\varphi'(y) > 0\ ,\ \varphi''(y) \geq 0\ \text{ and } \alpha'(y) > 0\ ,\ \alpha''(y) \geq -2\frac{\delta}{\omega}\varphi'(y). \quad (6)$$

PROPOSITION 6: *With general harm and detection functions $\alpha(y)$ and $\varphi(y)$ satisfying (6) for any stable symmetric misconduct equilibrium, whether a moral dilemma is nonemotional (triggers thinking slow) or emotional (triggers thinking fast):*

1. *In a mass-market framework, the level of misconduct is increasing in the number of competing firms.*
2. *In a niche-market framework, the level of misconduct declines in the number of competing firms.*

The general functional forms for harm and detection force a change in the proof. Nonetheless, the generalized functions maintain a link between the penalties deterrent and both margins and volume, while the ethics and profits forces remain linked to volume. The intuition of Propositions 1 and 2 therefore continues to apply.

B. Revenue Fines, rather than Profit Fines

Above we assume that regulatory fines are proportional to profits. This may seem critical as the distinction between profits and volume is important in ranking the deterrent effects of fines versus ethics. Here we extend the exploration of generalized harm and detection functions by allowing for revenue fines rather than profit fines.

Revenue-based fines are important. In the Goldman Sachs *Abacus* scandal, for example, the fine of \$550 million was an order of magnitude greater than the profit of \$15 million. Moreover in antitrust cases, the European authorities have set the base fine level to 30% of the revenue from sales based on wrongful behavior.[33]

To explore the role of revenue fines, we adapt the owner-managers' utility function (5) studied in Section V.A and consider

$$U_1(p_1, y_1; p^e) = q_1(p_1, p_e)\big[p_1 - c + y_1 - \delta\varphi(y_1)p_1 - \omega\alpha(y_1)\big]. \tag{7}$$

Objective function (7) indicates that the firm faces a fine related to total revenues if caught engaging in misconduct. We maintain assumption (6).

COROLLARY 1: *Proposition 6 is unchanged under revenue fines relative to profit fines.*

Corollary 1 may seem surprising as the key results of Propositions 1 and 2 note the dependence of penalties on profits as compared to the volume-dependent misconduct incentives caused by ethics and profit considerations. There is no contradiction, however, as profits equal volume times margin, and margins are closely related to prices. So revenues (i.e., volume times price) differ from volume in much the same way that profits (i.e., volume times margin) differ from volume.

To make this clearer, we rewrite the incentive to engage in misconduct from the first-order condition, given in (3), in the revenue-based penalties case:

$$\begin{array}{ccccc} & \underline{\text{ethics}} & \underline{\text{penalties}} & \underline{\text{profits}} & \\ \frac{\partial U_1}{\partial y_1} = & q_1 \cdot (-\omega\alpha'(y)) & -q_1 \cdot p_1\delta\varphi'(y) & +q_1 & \\ & \uparrow & \uparrow & \uparrow & \\ & \propto \text{volume} & \propto \text{ volume} \times \text{price} & \propto \text{volume.} & \end{array} \tag{8}$$

One can see that, as argued above, if volume changes but prices do not change, then the three forces determining misconduct remain in balance. If firm 1 responds to entry by, for example, raising prices to target a niche, then the penalties effect drops less rapidly than the other two effects, preserving the intuition and results described above.

C. Conviction Probability a Function of Volume

In the model, the probability of detection and conviction grow with the level of misconduct targeted by the owner-manager, not with the volume of products sold by an individual firm. As we note above, this modeling choice reflects the need to demonstrate corporate liability before imposing a substantial fine, which is easier to detect the greater the level of misconduct targeted. Nonetheless, we assess the robustness of the analysis by extending the model to allow the probability of detection and conviction to grow with an individual firm's sales volume.

[33] See Factsheet "*Fines for breaking EU Competition law*" available at https://ec.europa.eu/competition/cartels/overview/.

Some care is needed in formulating a model to study this setting. Equilibrium can be destroyed if the detection technology creates a sufficiently large incentive to raise prices so as to lower volume which, by assumption, removes (or substantially diminishes) the authority's ability to detect misconduct. This would then allow the firm to raise misconduct without limit in the second stage potentially rendering such a strategy optimal. A parsimonious way to study this extension while avoiding this problem is to extend the benchmark model in (1) by altering the detection technology to

$$\varphi y(1 + \epsilon q). \tag{9}$$

The probability of detection then grows in misconduct and in volume (as $\epsilon > 0$), but remains positive even if volume drops to zero. We thus have the following result.

PROPOSITION 7: *Consider nonemotional moral dilemmas, so triggering thinking-slow responses, passive-expectation consumers* ($r = 0$)*, and misconduct detection technology (9). For any stable symmetric equilibrium:*

1. *Mass-market framework: the results of Proposition 1 hold.*
2. *Niche-market framework: for ϵ sufficiently small,*
   (a) *When n is below the threshold $\tilde{N}$, any equilibrium involves market-wide misconduct;*
   (b) *There is no misconduct if the number of competing firms is $n > \tilde{N}$.*

Proposition 7 demonstrates that the dependence of the misconduct detection technology on volume does not affect the relationship between misconduct and pricing behavior in mass markets. In the case of niche markets, the threshold result is robust to some dependence of conviction probability on volume. However, the comparative static between the level of misconduct and competition is more fragile and does not apply in this extension.

The addition of volume dependence, as captured in the detection and conviction technology (9), adds one extra force to the model. If entry occurs, then in equilibrium each firm sees its own volume fall. By assumption, this lowers the ability of the authorities to detect and prosecute misconduct. Therefore, at the margin, this encourages more misconduct.

This extra effect reinforces the core economic dynamics for the case of mass-market competition. In the benchmark of Proposition 1, entry leads firms to reduce prices, lower volume, and engage in more misconduct. As volume declines with entry, detection is less likely by assumption in this extension. This makes misconduct more profitable and hence reinforces the link identified in Proposition 1.

The volume dependence in the detection technology is a countervailing force under niche competition. In the benchmark setting, exit leads firms to engage in more misconduct and push prices down, as they seek to attract more marginal consumers. However, exit always raises equilibrium volume, which (by assumption) raises the ability to detect misconduct and this creates a countervailing effect on misconduct. This effect immediately weakens the comparative static between the extent of competitive pressure and the level of misconduct. However although misconduct levels need not increase with exit, Proposition 7 shows that neither do misconduct levels fall back to zero. Hence, the threshold relationship between the number of firms and misconduct equilibria identified in Proposition 1 continues to hold.

VI. Model Predictions and Empirical Evidence

In this section, we explore the extent to which the model's predictions are consistent with existing empirical results. Propositions 1 and 2 each offer a cross-sectional prediction and a longitudinal prediction, with the propositions, respectively, analyzing the setting in which the misconduct generates a nonemotional (thinking-slow) or an emotional (thinking-fast) response among finance practitioners. In the case of nonemotional moral dilemmas, the cross-sectional interpretation predicts market vulnerability to misconduct when niche (mass) markets have high- (low-) concentration firm ratios.[34] The longitudinal interpretation predicts that misconduct is less (more) likely as concentration ratios fall in the case of niche (mass) markets.

The predictions for the case of emotional moral dilemmas can be derived similarly and feature an inverted U-shaped relationship for misconduct in the case of mass-market competition, though not niche-market competition. That is, misconduct is most likely at intermediate levels of competition in the case of mass-market competition.

Markets for commodity products will be characterized by mass-market competition. A rich source of historical examples of misconduct in such markets that conform to the predictions above is available in Rashid (1988).[35] The case of the misselling of mortgage default insurance (PPI) in the United Kingdom is described in the introduction and fits the empirical prediction. As does the financial advisor scandal that has recently been the subject of a Royal Commission in Australia.[36]

More formally, increased competition has been associated empirically with increased misconduct in the case of writing fraudulent online reviews to benefit one's own firm or denigrate rivals (Luca and Zervas (2016)), relaxing required testing standards for vehicles in the United States (Bennett et al. (2013)), and avoiding corporate taxes in China (Cai and Liu (2009)).

Some empirical studies find an inverted U-shaped relationship between competition and misconduct. This is more consistent with the results for emotional moral dilemmas—Proposition 2—in the case of mass markets. Empirically,

[34] A high-concentration firm ratio results from few firms competing in a market so each has a large market share. Niche- versus mass-market competition can be identified by the behavior of margins to entry, or by the own-firm cost pass-through rate as discussed.

[35] The industries discussed include the milk industry in Bangladesh, the rice industry in India, and the cotton industry in England.

[36] See *Banking royal commission told 90% of financial advisers ignored clients' best interests*, Guardian, April 16, 2018.

Table I
Model-Predicted Characteristics of Symmetric Stable Competitive Equilibria

<table>
<tr><th></th><th colspan="2">Nonemotional Dilemma (Trigger Thinking Slow)</th><th colspan="2">Emotional Dilemma (Trigger Thinking Fast)</th></tr>
<tr><th></th><th>Mass</th><th>Niche</th><th>Mass</th><th>Niche</th></tr>
<tr><td>Concentrated</td><td>Clean</td><td>Misconduct</td><td>Clean</td><td>Misconduct</td></tr>
<tr><td>Oligopoly</td><td rowspan="2">Misconduct</td><td rowspan="2">Clean</td><td>Clean & Misconduct</td><td>Clean & Misconduct</td></tr>
<tr><td>Many competing firms</td><td>Clean</td><td>Clean</td></tr>
<tr><td>Conjectured examples:</td><td colspan="2">Pressure selling; Cherry picking</td><td colspan="2">Pump & Dump; AML with strong suspicions</td></tr>
</table>

this has been found to be the case for industrial pollution (Polemis and Stengos (2019)) and the manipulation of reported earnings (Guo, Jung, and Yang (2019)). At least in the case of industrial pollution, the potential risk to human health is clear, and so owner-managers' instinctive ethics may be more pronounced than their thinking-slow reasoning, providing a consistent rationalization of this finding.

VII. Conclusion

In this study, we develop a model of competition between financial firms in which managers have an opportunity to engage in misconduct, but have ethical concerns about doing so. The model draws a distinction between two important types of competition: niche- and mass-market competition. Niche markets are markets in which firms respond to entry by increasing prices so as to extract greater rents from their remaining inframarginal customers. In this case, margins remain high as the number of competitors grows. Examples are credit cards and OTC markets. Mass markets are markets in which margins fall with entry as firms seek to attract marginal customers, so products become commoditized. Professional financial advisor organizations represent an example. Own-cost pass-through rates can also be used to define these markets.

The analysis builds on the psychological insight that the brain has two modes of reasoning. Emotional moral dilemmas trigger our thinking-fast machinery, and agents subject to such dilemmas act as if they are deontological. In contrast, nonemotional moral dilemmas trigger our thinking-slow machinery, and agents subject to such dilemmas act as if they are consequentialist.

This study introduces the two innovations above—type of ethical dilemma and niche versus mass market—to a competitive model. Doing so allows us to identify the market's vulnerability to misconduct under concentrated markets, oligopolies, and competitive markets with many small firms. Table I summarizes the results. Robustness checks show that the relationship between the level of misconduct and the number of competing firms is robust to very general specifications of harm and detection, and to the choice of revenue- or profit-based fines.

Several open questions remain. A leading one is which types of incentives to engage in misconduct are best categorized as generating an emotional versus a nonemotional response among financiers. Conjectures drawing on the available experimental literature are possible, but uncertainty remains. Second, the regulator is not strategic in the analysis considered in this paper. With multiple competitors, a regulator can use relative firm performance to prioritize its investigations. This would have a feedback effect on the strategies used by firms to avoid drawing attention to themselves. How these forces might interact to impact the results presented here remains a topic for future research.

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Appendix A: Proofs from Section III

We first establish a useful result on the demand system. Recall that the expected utility a consumer obtains at each firm absent misconduct is drawn from the density function f. The associated density function for the second-highest of n draws is given by

$$g_{(n-1)}(x) := n(1-F(x))(n-1)f(x)F(x)^{n-2}. \tag{A1}$$

LEMMA A.1: *Suppose the proportion r of consumers have rational expectations and anticipate that the level of misconduct is a function of price as given by $y(p) = \gamma_0 - \gamma_1 \cdot p$ for some constants $\{\gamma_0, \gamma_1\}$. Suppose the proportion $1-r$ of consumers have passive expectations and do not anticipate misconduct. The derivative of own-firm demand with respect to own-price deviations from symmetric pricing at p^e is then given by*

$$\frac{\partial q_1(p^e; p^e)}{\partial p_1} = -(1-\gamma_1 \cdot \alpha r)\frac{1}{n}\int_{x=a}^{b} g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx. \tag{A2}$$

PROOF: All consumers are served. Consumers choose the firm that gives them the highest expected utility. Then the following proportion of passive-expectation consumers select firm 1 at price p_1 when all other firms set price p^e:

$$\int_x f(x) \cdot \Pr\left(x - p_1 > x_j - p^e\ \forall j \neq i\right)dx = \int_x f(x)\big(F(x - p_1 + p^e)\big)^{n-1}dx. \tag{A3}$$

Consumers with rational expectations anticipate that firm 1 will choose misconduct level $y(p_1)$. Therefore, the proportion of these consumers choosing firm

1 is

$$\int_x f(x) \cdot \Pr\left(x - p_1 - \alpha y(p_1) > x_j - p^e - \alpha y(p^e)\ \forall j \neq i\right) dx$$
$$= \int_x f(x)\big(F(x - p_1 + p^e - \gamma_1 \alpha(p^e - p_1))\big)^{n-1} dx. \quad \text{(A4)}$$

The total demand enjoyed by firm 1 when deviating from a market-wide price of p^e is therefore

$$q_1(p_1; p^e) = \int_x f(x)\left(r\big(F(x - p_1 + p^e - \gamma_1\alpha(p^e - p_1))\big)^{n-1} + (1-r)\big(F(x - p_1 + p^e)\big)^{n-1}\right) dx. \quad \text{(A5)}$$

Equation (A5) is used to construct Figure 1.

To establish the first derivative of demand, differentiate (A5) with respect to p_1. Evaluating at $p_1 = p^e$ and using the order statistic (A1) yields (A2).[37] □

PROOF OF PROPOSITION 1: Suppose that the owner-manager of firm 1 has set a price p_1 and secured demand q_1 in the first period. She now considers her optimal level of misconduct, y_1. The owner-manager's utility function (1) under nonemotional moral dilemmas simplifies to

$$U_1(p_1, q_1, y; p^e) = q_1\big[-\varphi\delta y^2 + y(1 - \omega\alpha - \varphi\delta(p_1 - c)) + p_1 - c\big]. \quad \text{(A6)}$$

This objective function is concave in misconduct y. Denoting the optimal second-stage level of misconduct by $y_1^* \geq 0$, which is a function of the model parameters and the first-stage pricing decision, we have

$$y_1^*(p_1) = \begin{cases} \frac{1}{2\varphi\delta}\big(1 - \omega\alpha - \varphi\delta(p_1 - c)\big) & \text{if } p_1 - c < \frac{1-\omega\alpha}{\varphi\delta} \\ 0 & \text{if } p_1 - c \geq \frac{1-\omega\alpha}{\varphi\delta}. \end{cases} \quad \text{(A7)}$$

Consumers with rational expectations anticipate a reduction in their expected utility from the service of $\alpha y_1^*(p_1)$.

We now consider the first stage. Anticipating her misconduct behavior, the expected utility secured by the owner-manager in the first stage can be determined by substituting (A7) into (A6):

$$U_1(p_1; p^e) = \begin{cases} q_1(p_1; p^e)\left[\frac{1}{4\varphi\delta}\big(1 - \omega\alpha - \varphi\delta(p_1 - c)\big)^2 + p_1 - c\right] & \text{if } p_1 - c < \frac{1-\omega\alpha}{\varphi\delta} \\ q_1(p_1; p^e)(p_1 - c) & \text{otherwise.} \end{cases} \quad \text{(A8)}$$

[37] Zhou (2017) develops the use of order statistics in the analysis of the random utility competition model.

At a symmetric equilibrium, the first-order conditions must hold:[38]

$$\left.\frac{\partial U_1(p_1; p^e)}{\partial p_1}\right|_{p_1=p^e} = 0. \tag{A9}$$

Stability of equilibrium requires that if the system moves to a position of disequilibrium, then myopic adjustments by each firm revert the system back to equilibrium. This condition implies that for small perturbations $\tilde{\varepsilon}$,

$$\frac{\partial U_1}{\partial p_1}(p^e - \tilde{\varepsilon}; p^e - \tilde{\varepsilon}) \;>\; 0 \;>\; \frac{\partial U_1}{\partial p_1}(p^e + \tilde{\varepsilon}; p^e + \tilde{\varepsilon}). \tag{A10}$$

Equations (A9) and (A10) characterize a symmetric equilibrium that is stable.

In a positive-misconduct equilibrium, the owner-managers are in the upper branch of the utility function given by (A8). The incentive to deviate locally from a common price level of p^e is given by

$$\begin{aligned}
&\frac{\partial U_1}{\partial p_1}(p^e; p^e)\\
=&\frac{1}{n}\left[1 - \frac{1}{2}\big(1 - \omega\alpha - \varphi\delta(p^e - c)\big)\right] \qquad (A11)\\
&-\left(1 - \frac{\alpha r}{2}\right)\frac{1}{n}\left(\int_{x=a}^{b} g_{(n-1)}(x)\frac{f(x)}{1 - F(x)}dx\right)\left[\frac{1}{4\varphi\delta}\big(1 - \omega\alpha - \varphi\delta(p^e - c)\big)^2 + p^e - c\right],
\end{aligned}$$

where we use symmetry to determine the market share, and (A2) in Lemma A.1 along with (A7) to deliver $\gamma_1 = 1/2$.

Suppose that (2) holds. Observe that the right-hand side of (A11) is a negative quadratic in p^e. A symmetric equilibrium must be a zero of (A11) by the first-order condition (A9). The stability condition (A10) delivers that only the larger of the two roots in p^e will yield a stable equilibrium. Applying the equilibrium condition (A9) to (A11) and simplifying, we establish that a symmetric stable equilibrium is uniquely identified as the larger solution in p^e of

$$\frac{\big(1 - \omega\alpha - \varphi\delta(p^e - c)\big)^2 + 4\varphi\delta(p^e - c)}{2\varphi\delta\big(1 + \omega\alpha + \varphi\delta(p^e - c)\big)} = \frac{1}{\left(1 - \frac{\alpha r}{2}\right)\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}. \tag{A12}$$

Further simplification establishes that

$$1 + \omega\alpha + \varphi\delta(p^e - c) - \frac{4\omega\alpha}{1 + \omega\alpha + \varphi\delta(p^e - c)} = 2\varphi\delta\frac{1}{\left(1 - \frac{\alpha r}{2}\right)\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}. \tag{A13}$$

By inspection, the left-hand side of (A13) is increasing in p^e.

We can now establish the desired comparative statics in firm numbers if the symmetric equilibrium involves misconduct. If the number of competing firms

[38] Second-order conditions must also hold. They are not very useful, however, for equilibrium comparative statics of this n-firm game as the individual firm conditions do not aggregate helpfully. Stability will be more useful.

increases, then the distribution of the second-highest draw from n draws grows in a first-order stochastically dominant (FOSD) manner. Suppose that the reliability function $1-F(x)$ is log-concave. This implies that $-\frac{f(x)}{1-F(x)}$ is decreasing in x, so that $\frac{f(x)}{1-F(x)}$ is increasing in x. As $g_{(n-1)}$ increases in a FOSD way in the number of firms n, the right-hand side of (A13) declines in n. It follows that at a symmetric misconduct equilibrium $\frac{\partial p^e}{\partial n}<0$. Now using (A7) we have $\frac{dy^e}{dn}=\frac{dy_1^*(p^e)}{dn}=-\frac{1}{2}\frac{dp^e}{dn}>0$. Hence, misconduct grows in the number of firms n. The case for log-convexity is analogous.

Next we establish that there exists a critical threshold number of firms, N, such that any symmetric equilibrium is clean on one side of the threshold and entails misconduct on the other side. The critical threshold will be the number of competing firms N defined implicitly by the relationship

$$\frac{1}{\int_x g_{(N-1)}(x)\frac{f(x)}{1-F(x)}dx}=\frac{1-\omega\alpha}{\varphi\delta}\Big(1-\frac{\alpha r}{2}\Big). \tag{A14}$$

Note that if $\frac{f(x)}{1-F(x)}$ is monotonic, which holds if $1-F(x)$ is log-concave or log-convex, then (A14) is uniquely defined.[39]

We first show that if $1-F(x)$ is log-concave, then any symmetric equilibrium is clean for $n<N$ and entails misconduct for $n>N$.

Suppose $n<N$, with $1-F(x)$ log-concave, and claim that any symmetric equilibrium is clean. Suppose otherwise, that is, that there exists an $n<N$ such that a symmetric misconduct equilibrium exists. From (A7), we have $p^e(n)-c<\frac{1-\omega\alpha}{\varphi\delta}$ and

$$\begin{aligned}
&\frac{1}{\left(1-\frac{\alpha r}{2}\right)\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}\\
&=_{\text{(A13)}}\frac{1}{2\varphi\delta}\left(1+\omega\alpha+\varphi\delta(p^e-c)-\frac{4\omega\alpha}{1+\omega\alpha+\varphi\delta(p^e-c)}\right)\\
&<\left[\frac{1}{2\varphi\delta}\left(1+\omega\alpha+\varphi\delta(p^e-c)-\frac{4\omega\alpha}{1+\omega\alpha+\varphi\delta(p^e-c)}\right)\right]_{p^e-c=\frac{1-\omega\alpha}{\varphi\delta}}\\
&=\frac{1-\omega\alpha}{\varphi\delta}\\
&=_{\text{(A14)}}\frac{1}{\left(1-\frac{\alpha r}{2}\right)\int_x g_{(N-1)}(x)\frac{f(x)}{1-F(x)}dx}.
\end{aligned} \tag{A15}$$

Then $n<N\Rightarrow g_{(N-1)}\succ_{\text{FOSD}} g_{(n-1)}$, and $1-F(x)$ log-concave implies $\frac{f(x)}{1-F(x)}$ is increasing in x. This yields a contradiction to the chain of inequalities in (A15), proving the result.

[39] It could take the value $\pm\infty$, which would imply that the parameters yield only one type of equilibrium.

Now claim that if $n > N$, with $1 - F(x)$ log-concave, then any symmetric equilibrium entails misconduct. Suppose otherwise, that is that there exists an $n > N$ such that there exists a symmetric clean equilibrium. Consumers with rational expectations anticipate that the equilibrium is clean. From (A7) we have $p^e(n) - c \geq \frac{1-\omega\alpha}{\varphi\delta}$. The equilibrium satisfies the first-order condition (A9). Using the lower branch of (A8) and (A2) we therefore have

$$0 = \frac{\partial U_1}{\partial p_1}(p^e; p^e) = \tfrac{1}{n} - \tfrac{1}{n}\left(\int_{x=a}^{b} g_{(n-1)}(x)\tfrac{f(x)}{1-F(x)}dx\right)(p^e - c)$$
$$\Rightarrow p^e(n) - c = \frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}, \tag{A16}$$

so we can write

$$\frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} = p^e(n) - c \geq_{(A7)} \frac{1-\omega\alpha}{\varphi\delta} =_{(A14)} \frac{1}{\left(1-\frac{\alpha r}{2}\right)\int_x g_{(N-1)}(x)\frac{f(x)}{1-F(x)}dx}$$
$$> \frac{1}{\int_x g_{(N-1)}(x)\frac{f(x)}{1-F(x)}dx}. \tag{A17}$$

Thus $n > N \Rightarrow g_{(n-1)} \succ_{\text{FOSD}} g_{(N-1)}$, and $1 - F(x)$ log-concave implies $\frac{f(x)}{1-F(x)}$ is increasing in x. This therefore yields a contradiction to the chain of inequalities in (A17), proving the result.

The case for $1 - F(x)$ log-convex is analogous.

We complete the proof by showing that if $\alpha r \geq 2$, then a symmetric misconduct equilibrium cannot exist. Under this condition, the second term in (A11) is positive, as at an equilibrium each firm must derive positive utility. Note from (A6) that $U_1 > 0$ in a misconduct equilibrium implies $y_1 < 1/\varphi\delta$ and $p^e - c > -(\frac{1+\omega\alpha}{\varphi\delta})$ so the first term of (A11) is positive. Taken together, we see that $\partial U_1/\partial p_1 > 0$, so equilibrium is not possible. This delivers the third result. □

PROOF OF PROPOSITION 2: Suppose the firm had set a price of p_1 and secured demand q_1. Consider the level of misconduct that would be chosen. The utility function (1) under an emotional moral dilemma reduces to the quadratic

$$q_1(p_1; p^e)\left[-\varphi\delta y^2 + y(1 - \varphi\delta(p_1 - c)) + p_1 - c\right] - \kappa.$$

The value of the misconduct parameter $y \geq 0$ that maximizes this expression is denoted by y^{**} and given as

$$y_1^{**}(p_1) = \begin{cases} \frac{1}{2\varphi\delta}(1 - \varphi\delta(p_1 - c)) & \text{if } p_1 - c < \frac{1}{\varphi\delta} \\ 0 & \text{otherwise.} \end{cases}$$

Therefore, in the second stage, if $p_1 - c \geq \frac{1}{\varphi\delta}$, then the optimal level of misconduct is $y_1^*(p_1) = 0$. If $p_1 - c < \frac{1}{\varphi\delta}$, then the optimal level of misconduct takes one of only two possible values, $y_1^*(p_1) \in \{0, y_1^{**}(p_1)\}$, where the owner-manager will choose misconduct y_1^{**} if and only if

$$\begin{aligned} & U_1(p_1, 0; p^e) < U_1(p_1, y_1^{**}; p^e) \\ & \Leftrightarrow q_1 \cdot (p_1 - c) < q_1 \cdot \left[\frac{1}{4\varphi\delta}(1 - \varphi\delta(p_1 - c))^2 + p_1 - c \right] - \kappa \\ & \Leftrightarrow \kappa < q_1 \cdot \frac{1}{4\varphi\delta}(1 - \varphi\delta(p_1 - c))^2 \\ & \Leftrightarrow p_1 - c < \frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa}{\varphi\delta q_1}} \quad \text{or} \quad p_1 - c > \frac{1}{\varphi\delta} + 2\sqrt{\frac{\kappa}{\varphi\delta q_1}}. \end{aligned}$$

Recalling that $y_1^{**}(p_1) = 0$ if $p_1 - c \geq 1/\varphi\delta$, we have established

$$y_1^*(p_1) = \begin{cases} \frac{1}{2\varphi\delta}(1 - \varphi\delta(p_1 - c)) & \text{if } p_1 - c < \frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa}{\varphi\delta q_1}} \\ 0 & \text{otherwise.} \end{cases} \tag{A18}$$

Anticipating her optimizing behavior, the expected utility secured by the owner-manager at the first stage is therefore

$$U_1(p_1; p^e) = \begin{cases} q_1(p_1; p^e)\Big[\frac{1}{4\varphi\delta}\big(1 - \varphi\delta(p_1 - c)\big)^2 + p_1 - c\Big] - \kappa, & \text{if } p_1 - c < \frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa}{\varphi\delta q_1(p_1; p^e)}} \\ q_1(p_1; p^e)(p_1 - c), & \text{otherwise.} \end{cases} \tag{A19}$$

Suppose that the market fundamentals yield a stable symmetric misconduct equilibrium. We first establish the relationship between the level of misconduct and the number of competing firms. We proceed as in the nonemotional moral dilemma case. At an interior equilibrium with positive misconduct, the owner-manager is in the upper branch of (A19). The derivative of own-firm demand with respect to own-firm price is given by Lemma A.1 with $\gamma_1 = 1/2$, which derives from (A18). The derivative of the owner-manager's objective function (A19) with respect to p_1 yields an expression analogous to (A11). It follows that a symmetric stable equilibrium must be given by the larger of the two roots to

$$\frac{\big(1 - \varphi\delta(p^e - c)\big)^2 + 4\varphi\delta(p^e - c)}{2\varphi\delta\big(1 + \varphi\delta(p^e - c)\big)} = \frac{1}{\left(1 - \frac{r\alpha}{2}\right)\int_x g_{(n-1)}(x)\frac{f(x)}{1 - F(x)}dx}.$$

This expression simplifies analogously to (A13) to yield

$$p^e - c = -\frac{1}{\varphi\delta} + \frac{2}{\left(1 - \frac{r\alpha}{2}\right)\int_x g_{(n-1)}(x)\frac{f(x)}{1 - F(x)}dx}. \tag{A20}$$

Identical reasoning to that used for the nonemotional moral dilemma case shows that:

- Misconduct equilibria are possible only if (2) is satisfied.
- If $1 - F(x)$ is log-concave, then at a symmetric misconduct equilibrium $\frac{\partial y^e}{\partial n} > 0$.
- If $1 - F(x)$ is log-convex, then at a symmetric misconduct equilibrium $\frac{\partial y^e}{\partial n} < 0$.

We now turn to establishing the equilibrium thresholds. Define the pair of functions

$$\Psi_1(n) := \left(\frac{1}{\varphi\delta} - \sqrt{\frac{\kappa n}{\varphi\delta}}\right)\left(1 - \frac{\alpha r}{2}\right) \tag{A21}$$

$$\Psi_2(n) := \left(\frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa n}{\varphi\delta}}\right).$$

Both functions are declining in n. We assume that $\Psi_2(n) < \Psi_1(n)\ \forall n \geq 2$, which implies

$$\left(\frac{\alpha r/2}{1 + \alpha r/2}\right)^2 \leq 2\varphi\delta\kappa. \tag{A22}$$

Next, define the thresholds for $i \in \{1, 2\}$ as

$$\overline{\nu}_i := \inf\left\{ n \left| \frac{1}{\int_x g_{(\tilde{n}-1)}(x)\frac{f(x)}{1-F(x)}dx} > \Psi_i(\tilde{n})\ \forall \tilde{n} > n \right. \right\} \tag{A23}$$

$$\underline{\nu}_i := \sup\left\{ n \left| \frac{1}{\int_x g_{(\tilde{n}-1)}(x)\frac{f(x)}{1-F(x)}dx} > \Psi_i(\tilde{n})\ \forall \tilde{n} \in [2, n] \right. \right\}.$$

These functions are well defined, though their values could be $+\infty$ or < 2, in which case the regions they identify are degenerate.

Niche Competition

This is the case in which $1 - F(x)$ is log-convex, and hence $\frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}$ is increasing in n. It follows that $\underline{\nu}_i$ does not exist in $[2, \infty)$. We show that the thresholds in the theorem are given by $\overline{\nu}_2 \leq \overline{\nu}_1$.

First claim that for $n < \overline{\nu}_2$, any symmetric equilibrium entails misconduct. Suppose otherwise, that is, that there exists an $n < \overline{\nu}_2$ such that a clean equilibrium exists. In this case the first-order condition matches that in (A16), and we therefore have

$$\frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} =_{(A16)} p^e(n) - c \geq_{(A19)} \frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa n}{\varphi\delta}}$$

$$> \frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa\overline{\nu}_2}{\varphi\delta}} = \frac{1}{\int_x g_{(\overline{\nu}_2-1)}(x)\frac{f(x)}{1-F(x)}dx}.$$

But this is a contradiction to the fact noted above that, with niche products, $\frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}$ is increasing in n. This proves the result.

Suppose instead that $n > \overline{\nu}_1$, and claim that any symmetric equilibrium is clean. Suppose otherwise, that is, that there exists an $n > \overline{\nu}_1$ such that a symmetric equilibrium with misconduct exists. The equilibrium price in this case must satisfy (A20) and lie in the upper branch of (A19). So we have

$$\begin{aligned}
\frac{1}{\left(1-\frac{\alpha r}{2}\right)\int_{x=1}^{\infty} g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} &=_{(A20)} \frac{1}{2\varphi\delta} + \frac{p^e(n)-c}{2} \\
&<_{(A19)} \frac{1}{2\varphi\delta} + \frac{1}{2}\left(\frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa n}{\varphi\delta}}\right) \\
&= \frac{1}{\varphi\delta} - \sqrt{\frac{\kappa n}{\varphi\delta}} \\
&< \frac{1}{\varphi\delta} - \sqrt{\frac{\kappa \overline{\nu}_1}{\varphi\delta}} \\
&= \frac{1}{\left(1-\frac{\alpha r}{2}\right)\int_x g_{(\overline{\nu}_1-1)}(x)\frac{f(x)}{1-F(x)}dx}.
\end{aligned}$$

We again have a contradiction as $n > \overline{\nu}_1 \Rightarrow g_{(\overline{\nu}-1)} \prec_{\text{FOSD}} g_{(n-1)}$; and $1-F(x)$ log-convex implies $\frac{f(x)}{1-F(x)}$ is decreasing in x.

Finally, if $n \in [\overline{\nu}_2, \overline{\nu}_1]$, then the clean stable equilibrium is given by prices (A16), which lie in the lower branch of (A19) when $1-F(x)$ is log-convex as required. The misconduct equilibrium is given by prices (A20), which lie in the upper branch of (A19). Therefore, both types of equilibrium are possible.

Mass-Market Competition

This is the case in which $1-F(x)$ is log-concave, so $\frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}$ is declining in n. First claim that if $n < \underline{\nu}_1$ or $n > \overline{\nu}_1$, then the equilibrium is clean. Suppose otherwise for a contradiction that there is a misconduct equilibrium with $n < \underline{\nu}_1$. The equilibrium price would then be (A20) and would be in the upper branch of (A19). We would therefore have:

$$\begin{aligned}
p^e(n) - c = -\frac{1}{\varphi\delta} + \frac{2}{\left(1-\frac{\alpha r}{2}\right)\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} &< \frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa n}{\varphi\delta}} \\
\therefore \ \frac{1}{\left(1-\frac{\alpha r}{2}\right)\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} &< \frac{1}{\varphi\delta} - \sqrt{\frac{\kappa n}{\varphi\delta}}.
\end{aligned}$$

But this is a contradiction to the definition of $\underline{\nu}_1$. The case for $n > \overline{\nu}_1$ is identical.

For the remainder of the proof, we use the fact that if κ is small, then the functions Ψ_i are guaranteed to intersect the declining $\frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}$ at most twice. We can show that for $n \in (\underline{\nu}_2, \overline{\nu}_2)$, the equilibrium is one of misconduct.

Suppose not. It follows that

$$p^e(n) - c =_{(A16)} \frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} \geq_{(A19)} \frac{1}{\varphi\delta} - 2\sqrt{\frac{\kappa n}{\varphi\delta}} = \Psi_2(n).$$

But this is a contradiction, as $n \in (\underline{\nu}_2, \overline{\nu}_2)$ with κ small must have the opposite inequality.

Finally, if n lies in the border regions and hence satisfies

$$\Psi_2(n) < \frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} < \Psi_1(n).$$

Then the clean stable equilibrium that is given by prices (A16) lies in the lower branch of (A19), while the misconduct equilibrium that is given by prices (A20) lies in the upper branch of (A19), yielding the result. □

PROOF OF PROPOSITION 3: If there are n firms competing, then the expected match value created is

$$V(n) := \int x g_{(n)}(x)dx \text{ with } g_{(n)}(x) = nf(x)F(x)^{n-1}. \tag{A24}$$

Denote by $\overline{F}^{-1}$ the inverse of the reliability function, $1 - F(x)$. Then by applying Theorem 3 of Gabaix et al. (2016), we have

$$\text{for large } n \quad V(n) \sim \overline{F}^{-1}\left(\frac{1}{n}\right) \cdot \Gamma(1-\gamma), \tag{A25}$$

where $\Gamma(\cdot)$ denotes the gamma function[40,41] and γ is the tail index of $f(\cdot)$

$$\gamma := \lim_{x\to b} \frac{d}{dx}\frac{1-F(x)}{f(x)}.$$

Now consider prices and misconduct. In a misconduct equilibrium prices are given by (A13). It will be helpful to define the quotient

$$Q(n) := \frac{1}{\left(1 - \frac{\alpha r}{2}\right)\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx}. \tag{A26}$$

Taking differentials of (A13) we have

$$\frac{dp^e}{dQ}\left[1 + \frac{4\omega\alpha}{(1+\omega\alpha+\varphi\delta(p^e-c))^2}\right] = 2, \tag{A27}$$

which yields $0 < \frac{dp^e}{dQ} < 2$. Furthermore, note that if $Q = 0$, then (A13), using the larger root that captures stability, implies that $1 + \omega\alpha + \varphi\delta(p^e - c) = \sqrt{4\omega\alpha}$,

[40] $\Gamma(t) \equiv \int_{x=0}^{\infty} x^{t-1}e^{-x}dx$.

[41] To derive (A25), apply Theorem 3 of Gabaix et al. (2016) setting $G(x) = x$ and using part 2 of Lemma 1 (Gabaix et al. (2016)) to determine the index of variation in the limit for $t \to 0$ of $\overline{F}^{-1}(t)$.

and inserting this lower bound for p^e into (A27) delivers

$$1 < \frac{dp^e}{dQ} < 2. \tag{A28}$$

Now using (A7) we can establish consumer surplus as a function of the number of firms:

$$CS(n) := V(n) - \alpha y_1^*(p^e(n)) - p^e(n) = V(n) + p^e(n) \cdot \left(\frac{\alpha}{2} - 1\right) + [\text{constant}].$$

It follows that

$$\frac{d}{dn}CS(n) = \frac{dV(n)}{dn} + \frac{1}{2}(\alpha - 2)\frac{dp^e}{dQ}\frac{\partial}{\partial n}Q(n). \tag{A29}$$

The last preliminary is to note that the large n approximation for $Q(n)$ is derived from Gabaix et al. (2016), Theorem 1 as

$$\text{for large } n, \qquad Q(n) \sim \frac{1}{(1-\frac{\alpha r}{2})nf\left(\overline{F}^{-1}\left(\frac{1}{n}\right)\right)\Gamma(\gamma+2)}. \tag{A30}$$

We now prove the first result for the case of a Weibull distribution (e.g., $f(x) = \beta x^{\beta-1}e^{-x^{\beta}},\ \beta \geq 1$). Using Table 4 of Gabaix et al. (2016), we observe that in this case $nf(\overline{F}^{-1}(\frac{1}{n})) = \beta n^{1/\beta}$. It follows from (A30) that $\lim_{n\to\infty} Q(n) = 0$. Assume that the industry is clean. Then from (A16) prices approach cost, but this contradicts the fact that margins lie above $(1-\omega\alpha)/\varphi\delta$ as established in (A7). Hence, a symmetric equilibrium is one of misconduct.

Table 4 of Gabaix et al. (2016) documents that, for a Weibull distribution, for large n, $\overline{F}^{-1}(1/n) \sim -n^{-1/\beta}$. Therefore, using (A25) and (A30) we have that for large n

$$\frac{\partial V(n)}{\partial n} \sim \Gamma(1-\gamma)\cdot\frac{1}{\beta}n^{-\frac{1}{\beta}-1} \quad \text{and} \quad \frac{\partial Q(n)}{\partial n} \sim -\frac{1}{\Gamma(2+\gamma)}\cdot\frac{1}{\beta^2}n^{-\frac{1}{\beta}-1}\cdot\frac{1}{(1-\frac{\alpha r}{2})}.$$

Using (A29) as $dp^e/dQ > 1$ (given in (A28)),

$$\frac{d}{dn}CS(n) \ < \ \frac{1}{\beta^2}n^{-\frac{1}{\beta}-1}\left[\beta\Gamma(1-\gamma) - \frac{1}{2\Gamma(2+\gamma)}(\alpha-2)\frac{1}{(1-\frac{\alpha r}{2})}\right].$$

For the case of the Weibull distribution, $\gamma = -1/\beta$,[42] and thus a sufficient condition for consumer surplus to decline in the number of firms is $\alpha \in (\alpha^{\dagger}, \frac{2}{r})$, where

$$\alpha^{\dagger} := 2\left(\frac{1+\beta\Gamma\left(2-\frac{1}{\beta}\right)\Gamma\left(1+\frac{1}{\beta}\right)}{1+r\cdot\beta\Gamma\left(2-\frac{1}{\beta}\right)\Gamma\left(1+\frac{1}{\beta}\right)}\right), \tag{A31}$$

[42] See Table 4 of Gabaix et al. (2016).

and recalling (2) for a misconduct equilibrium.

The proof for the power law distribution ($f(x) = \beta x^{\beta-1}$), $\beta \geq 1$, $x \in [0, 1]$ is identical. The uniform distribution follows the same steps and is equivalent to the Weibull case with $\beta = 1$. Hence, we have $\alpha^{\dagger} = 4/(1+r)$ from (A31).

We now consider the normal distribution. Table 4 of Gabaix et al. (2016) shows that for large n, $nf(\overline{F}^{-1}(\frac{1}{n})) \sim \sqrt{2\ln n}$. It follows from (A30) that $\lim_{n\to\infty} Q(n) = 0$. By the argument above, a symmetric equilibrium for large n must be one of misconduct. Gabaix et al. (2016) also document that for large n, $\overline{F}^{-1}(1/n) \sim \sqrt{2\ln n}$. Therefore, using (A25) and (A30) in (A29) and the fact that $dp^e/dQ < 2$ (from (A28)),

$$\frac{d}{dn}CS(n) > \frac{1}{n(2\ln n)^{3/2}}\left(2\ln n - \left(\frac{\alpha - 2}{1 - \frac{\alpha r}{2}}\right)\right) > 0 \text{ for large } n,$$

where we use the fact that for the normal, $\gamma = 0$. □

PROOF OF PROPOSITION 4: The critical number of firms under nonemotional (thinking-slow) dilemmas is given by (A14). Consider first niche markets. Then from Proposition 2 we have that $\overline{\nu}$ is the solution in n to

$$\frac{1}{\int_x g_{(n-1)} \frac{f(x)}{1-F(x)} dx} = \left(\frac{1}{\varphi\delta} - \sqrt{\frac{\kappa n}{\varphi\delta}}\right)\left(1 - \frac{\alpha r}{2}\right). \tag{A32}$$

This solution is unique as $\frac{1}{\int_x g_{(n-1)} \frac{f(x)}{1-F(x)} dx}$ is increasing in n under niche markets and the right-hand side is declining in n. Substituting κ^* into (A32), we have that (A14) implies the solution to (A32) is given by N. The first result is now a corollary of Propositions 1 and 2.

For part 2, observe that substituting κ^* into (A21), we have from (A14) that $\underline{\nu}_1 \leq N \leq \overline{\nu}_1$. Next note that $\Psi_1(N/(\alpha\omega)^2)|_{\kappa^*} = 0$. This implies that $\overline{\nu}_1 < N/(\alpha\omega)^2$. The second result is now a corollary of Propositions 1 and 2.

For the final result observe that the functions $\Psi_1(n)$ and $\Psi_2(n)$ given in (A21) shift downward in κ. By inspection of (A23), we therefore have $d\overline{\nu}_i/d\kappa < 0$ for $i \in \{1, 2\}$. This delivers the result for niche markets, and shows that the upper boundary in the mass-market case is declining in κ. For the lower boundary in mass markets, note that given $\frac{1}{\int_x g_{(n-1)} \frac{f(x)}{1-F(x)} dx}$ is decreasing in n, (A23) implies that $d\underline{\nu}_i/d\kappa > 0$, completing the result in this case. □

Appendix B: Proofs from Section IV

PROOF OF PROPOSITION 5: The personalization of the willpower term, ω_1, does not alter the second-stage maximization. Thus, in a misconduct equilibrium the analog of (A7) holds:

$$y_1^*(p_1) = \frac{1}{2\varphi\delta}\left(1 - \omega_1\alpha - \varphi\delta(p_1 - c)\right). \tag{B1}$$

Substituting back into the owner-manager's objective function yields the indirect utility from (A8):

$$U_1(p_1, y_1^*(p_1); p_2) = q_1(p_1; p_2)\left[\frac{1}{4\varphi\delta}\big(1 - \omega_1\alpha - \varphi\delta(p_1 - c)\big)^2 + p_1 - c\right]. \quad \text{(B2)}$$

In an equilibrium, using the notation $U_{1;p_1} \equiv \partial U_1/\partial p_1$, first- and second-order conditions are given by

$$U_{1;p_1} = 0 = U_{2;p_2} \text{ and } U_{1;p_1p_1}, U_{2;p_2p_2} < 0. \quad \text{(B3)}$$

Now consider the requirements of stability (Dixit (1986)). Suppose firms find themselves at a nonequilibrium point $\{\tilde{p}_1, \tilde{p}_2\}$, which is close to the equilibrium values $\{p_1^e, p_2^e\}$. Suppose each firm updates its prices proportionally to its first-order gain. Using a Taylor expansion for each firm for points close to the equilibrium, the system path near an equilibrium point is given by

$$\begin{pmatrix}\dot{p}_1\\ \dot{p}_2\end{pmatrix} = \underbrace{\begin{pmatrix}U_{1;p_1p_1} & U_{1;p_1p_2}\\ U_{2;p_1p_2} & U_{2;p_2p_2}\end{pmatrix}}_{\mathcal{A}}\begin{pmatrix}\tilde{p}_1 - p_1^e\\ \tilde{p}_2 - p_2^e\end{pmatrix}.$$

The terms of the Hessian matrix $\mathcal{A}$ are evaluated at the equilibrium values $\{p_1^e, p_2^e\}$. Stability of the equilibrium requires that all of the eigenvalues of $\mathcal{A}$ have negative real parts (Dixit (1986), (Anishchenko, Vadivasova, and Strelkova, 2014, Chapter 2)). The second-order conditions (B3) directly yield that the trace is negative. Stability therefore ensures that

$$\det\mathcal{A} > 0. \quad \text{(B4)}$$

Now consider taking differentials of the first-order conditions in (B3) with respect to ω_2. Using the fact that $U_{1;p_1\omega_2} = 0$, the two first-order conditions yield

$$\begin{aligned}&\begin{pmatrix}U_{1;p_1p_1} & U_{1;p_1p_2}\\ U_{2;p_2p_1} & U_{2;p_2p_2}\end{pmatrix}\begin{pmatrix}dp_1\\ dp_2\end{pmatrix} + \begin{pmatrix}U_{1;p_1\omega_2}\\ U_{2;p_2\omega_2}\end{pmatrix}d\omega_2 = 0\\ &\Rightarrow \begin{pmatrix}dp_1\\ dp_2\end{pmatrix} = \frac{1}{\det\mathcal{A}}\begin{pmatrix}\cdot & -U_{1;p_1p_2}\\ \cdot & U_{1;p_1p_1}\end{pmatrix}\begin{pmatrix}0\\ -U_{2;p_2\omega_2}\end{pmatrix}d\omega_2. \quad \text{(B5)}\end{aligned}$$

We can sign the actions of firm 2:

$$\begin{aligned}\frac{dp_2^e}{d\omega_2} &=_{\text{using (B5)}} -\frac{U_{1;p_1p_1}}{\det\mathcal{A}}U_{2;p_2\omega_2} =_{\text{sign}} U_{2;p_2\omega_2} \text{ using (B3) and (B4)}\\ &=_{\text{using (B2)}} -\frac{\partial q_2}{\partial p_2}\cdot\alpha \underbrace{y_2^*(p_2)}_{\text{simplifying using (B1)}} + \frac{\alpha}{2}q_2 > 0. \quad \text{(B6)}\end{aligned}$$

It then follows from (B1) that $\frac{dy_2^*}{d\omega_2} < 0$.

For firm 1's behavior in response, we begin with the first-order condition (B3),

$$U_{1;p_1} = 0 \;\Rightarrow\; \frac{1}{4\varphi\delta}\big(1 - \omega_1\alpha - \varphi\delta(p_1 - c)\big)^2 + p_1 - c$$
$$= \frac{q_1}{-\partial q_1/\partial p_1}\frac{1}{2}\big[1 + \omega_1\alpha + \varphi\delta(p_1 - c)\big].$$

Therefore,

$$U_{1;p_1p_2} = \left[\frac{\partial^2 q_1}{\partial p_1 \partial p_2}\frac{q_1}{-\partial q_1/\partial p_1} + \frac{\partial q_1}{\partial p_2}\right]\frac{1}{2}\big[1 + \omega_1\alpha + \varphi\delta(p_1 - c)\big]. \tag{B7}$$

From (B2), $U_1 > 0$ in a misconduct equilibrium requires that $p_1^e - c > -(\frac{1+\omega_1\alpha}{\varphi\delta})$. Noting that

$$\frac{\partial^2 \ln q_1}{\partial p_1 \partial p_2} = \frac{1}{q_1^2}\left(q_1\frac{\partial^2 q_1}{\partial p_1 \partial p_2} - \frac{\partial q_1}{\partial p_1}\frac{\partial q_1}{\partial p_2}\right),$$

we have

$$U_{1;p_1p_2} =_{\text{sign}} \frac{\partial^2 \ln q_1}{\partial p_1 \partial p_2}.$$

It therefore follows that

$$\frac{dp_1^e}{d\omega_2} =_{\text{using (B5)}} \frac{U_{2;p_2\omega_2}}{\det \mathcal{A}}U_{1;p_1p_2} =_{\text{sign and using (B6)}} U_{1;p_1p_2} =_{\text{sign}} \frac{\partial^2 \ln q_1}{\partial p_1 \partial p_2},$$
$$\frac{dy_1^*(p_1^e)}{d\omega_2} =_{\text{sign and using (B1)}} -\frac{dp_1^e}{d\omega_2} = -\frac{\partial^2 \ln q_1}{\partial p_1 \partial p_2}.$$

If the market is characterized by mass-market competition, so the reliability function is log-concave, then we appeal to Quint (2014), Theorem 1, to establish that the log of each firm's realized demand has increasing differences in prices: $\frac{\partial^2 \ln q_1}{\partial p_1 \partial p_2} > 0$. □

Appendix C: Proofs from Section V

PROOF OF PROPOSITION 6: In the second stage, the owner-manager optimizes her misconduct. The first-order condition implicitly defines optimal misconduct as a function of first-period price, $y_1^*(p_1)$:

$$\frac{\partial U_1}{\partial y_1}(p_1, y_1^*(p_1); p^e) = 0. \tag{C1}$$

Implicitly differentiating (C1), we can establish that the dependence of misconduct on the first-period price is given by

$$\frac{dy_1^*}{dp_1} = -\frac{\partial^2 U_1/\partial y_1 \partial p_1}{\partial^2 U_1/\partial y_1^2} =_{\text{sign}} \partial^2 U_1/\partial y_1 \partial p_1, \tag{C2}$$

where we use the concavity of the second-stage misconduct choice problem.

It will be helpful to demonstrate that (C2) is negative. To do so note from (5) that

$$\frac{\partial U_1}{\partial p_1} = q_1(1-\delta\varphi(y_1)) + \frac{\partial q_1}{\partial p_1}\big[(p_1 - c + y_1)(1-\delta\varphi(y_1)) - \omega\alpha(y_1)\big] \tag{C3}$$

$$\frac{\partial^2 U_1}{\partial p_1 \partial y_1} = -q_1\delta\varphi'(y_1) + \frac{\partial q_1}{\partial p_1}\frac{1}{q_1}\frac{\partial U_1}{\partial y_1}.$$

Therefore, evaluating at equilibrium prices, and using the first-order condition (C1), we have

$$\left.\frac{\partial^2 U_1}{\partial p_1 \partial y_1}\right|_e = -q_1(p^e, p^e)\cdot\delta\varphi'(y_1^*) < 0 \;\Rightarrow\; \left.\frac{dy_1^*}{dp_1}\right|_e < 0. \tag{C4}$$

Let us now consider the first-stage price-setting problem,

$$\left.\frac{dU_1}{dp_1}\right|_e = \left.\frac{\partial U_1}{\partial p_1}\right|_e + \underbrace{\frac{\partial U_1}{\partial y_1}}_{=0 \text{ by (C1)}}\frac{dy_1}{dp_1} = 0. \tag{C5}$$

Taking differentials of (C5), we have

$$\underbrace{\frac{d}{dp^e}\left(\left.\frac{\partial U_1}{\partial p_1}\right|_e\right)}_{(\dagger)}dp^e + \frac{\partial}{\partial n}\left(\left.\frac{\partial U_1}{\partial p_1}\right|_e\right)dn = 0. \tag{C6}$$

Note that the term labeled (†) in (C6) is the total derivative of $\partial U_1/\partial p_1$ with respect to the equilibrium price p^e. This expression captures the change in the first-order condition for firm 1 when both firm 1 and all other firms all change their prices in unison. Stability requires that

$$\frac{\partial U_1}{\partial p_1}(p^e - \tilde{\varepsilon}, y_1^*(p^e - \tilde{\varepsilon}); p^e - \tilde{\varepsilon}) > 0 > \frac{\partial U_1}{\partial p_1}(p^e + \tilde{\varepsilon}, y_1^*(p^e + \tilde{\varepsilon}); p^e + \tilde{\varepsilon}),$$

which yields that (†) < 0. It therefore follows from (C6) that

$$\frac{dp^e}{dn} =_{\text{sign}} \frac{\partial}{\partial n}\left(\left.\frac{\partial U_1}{\partial p_1}\right|_e\right). \tag{C7}$$

We now use (C3) and the observation that only demand is a function of n and $q_1(p^e; p^e) = 1/n$ to establish that

$$\frac{\partial}{\partial n}\left(\frac{\partial U_1}{\partial p_1}\bigg|_e\right) = -\frac{1}{n^2}(1-\delta\varphi(y_1^*(p^e))) \tag{C8}$$
$$+\frac{\partial}{\partial n}\left(\frac{\partial q_1}{\partial p_1}(p^e;p^e)\right)\left[(p_e - c + y_1^*(p^e))(1-\delta\varphi(y_1^*(p^e))) - \omega\alpha(y_1^*(p^e))\right].$$

But the first-order condition (C5) applied to (C3) gives

$$(p^e - c + y_1^*(p^e))(1-\delta\varphi(y_1^*(p^e))) - \omega\alpha(y_1^*(p^e)) = \big(1-\delta\varphi(y_1^*(p^e))\big)\left[\frac{1}{-n\frac{\partial q_1}{\partial p_1}(p^e,p^e)}\right]. \tag{C9}$$

This in turn allows us to simplify (C8) to

$$\frac{\partial}{\partial n}\left(\frac{\partial U_1}{\partial p_1}\bigg|_e\right) = \left[-\frac{1}{n^2} + \frac{\partial}{\partial n}\left(\frac{\partial q_1}{\partial p_1}(p^e,p^e)\right)\frac{1}{-n\frac{\partial q_1}{\partial p_1}}\right]\big(1-\delta\varphi(y_1^*(p^e))\big). \tag{C10}$$

Note that (C10) can be simplified as demand is downward-sloping and in equilibrium the final bracket must be positive as otherwise the owner-manager would have negative utility. We can therefore write

$$\frac{\partial}{\partial n}\left(\frac{\partial U_1}{\partial p_1}\bigg|_e\right) =_{\text{sign}} \frac{\partial}{\partial n}\left[n\frac{\partial q_1}{\partial p_1}(p^e,p^e)\right]. \tag{C11}$$

Using (C4), and then (C7) with (C11), we have

$$\frac{dy_1^*(p^e)}{dn} = \frac{\partial y_1^*}{\partial p_1}(p^e)\cdot\frac{dp^e}{dn} =_{\text{sign}} -\frac{dp^e}{dn} =_{\text{sign}} -\frac{\partial}{\partial n}\left[n\frac{\partial q_1}{\partial p_1}(p^e,p^e)\right].$$

We can now use Lemma A.1 with $r = 0$ and the techniques of Proposition 1 to link the direction of misconduct to the log-concavity and log-convexity of the reliability function $1 - F(x)$.

Finally, note that the result applies also to the interior of a misconduct equilibrium for an emotional moral dilemma (thinking-fast) by setting $\omega = 0$. □

PROOF OF COROLLARY 1: The modified objective function (7) causes minor changes in the proof of Proposition 6 at equation (C3) and above equation (C10). However, these changes leave unaffected the subsequent analysis at equations (C4), (C10), and (C11). The proof then follows. □

PROOF OF PROPOSITION 7: We initially follow the steps used in the proof of Proposition 1. Optimizing misconduct in the second stage we have that

$$y_1^*(p_1) = \begin{cases} \frac{1-\omega\alpha}{2\delta\varphi(1+\epsilon q_1)} - \frac{1}{2}(p_1 - c) & \text{if } p_1 - c < \frac{1-\omega\alpha}{\delta\varphi(1+\epsilon q_1)}, \\ 0 & \text{otherwise.}\end{cases} \tag{C12}$$

Note that if $q_1 \to 0$, then this expression remains bounded. First-stage utility is in turn given by

$$U_1(p_1, y_1^*(p_1); p^e)$$
$$= \begin{cases} \frac{q_1(p_1;p^e)}{4\varphi\delta}\Big[\frac{(1-\omega\alpha)^2}{1+\epsilon q_1} + \big(\delta\varphi(p_1-c)\big)^2(1+\epsilon q) + 2\delta\varphi(1+\omega\alpha)(p_1-c)\Big], & \text{if } p_1 - c < \frac{1-\omega\alpha}{\delta\varphi(1+\epsilon q_1)}, \\ q_1(p_1; p^e)(p_1-c), & \text{otherwise.} \end{cases}$$

Consider now a positive-misconduct equilibrium. Applying the first-order condition and evaluating at equilibrium determines the analog of (A12), which allows us to characterize a symmetric misconduct equilibrium as the solution in p^e of

$$\frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} = \frac{\left(\frac{1-\omega\alpha}{1+\frac{\epsilon}{n}}\right)^2 + 2\varphi\delta(1+\omega\alpha)(p^e-c) + \big(\varphi\delta(p^e-c)\big)^2(1+2\frac{\epsilon}{n})}{2\varphi\delta(1+\omega\alpha+\varphi\delta(p^e-c)(1+\frac{\epsilon}{n}))}, \tag{C13}$$

where we use Lemma A.1 with $r = 0$ to focus on passive expectations. Further simplification allows us to write

$$\frac{2\varphi\delta}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} = \delta\varphi(p^e-c)\left(\frac{1+2\frac{\epsilon}{n}}{1+\frac{\epsilon}{n}}\right) + \frac{(1+\omega\alpha)}{(1+\frac{\epsilon}{n})^2} - \frac{\frac{4\omega\alpha}{(1+\frac{\epsilon}{n})^2}}{1+\omega\alpha+\delta\varphi(p^e-c)\big(1+\frac{\epsilon}{n}\big)}. \tag{C14}$$

Note that (C14) is the analog of (A13) and collapses to it if $\epsilon = 0$. Also note that the right-hand side of (C14) is increasing in p^e.

We now define the candidate critical threshold number of firms as any solution $\tilde{N}$ to the condition

$$\frac{1}{\int_x g_{(\tilde{N}-1)}(x)\frac{f(x)}{1-F(x)}dx} = \frac{1}{\varphi\delta}\frac{1-\omega\alpha}{1+\frac{\epsilon}{\tilde{N}}}. \tag{C15}$$

Mass Market

The result that any equilibrium must be clean for $n < \tilde{N}$ and one of misconduct for $n > \tilde{N}$ follows as in Proposition 1.

Niche Market

If the reliability function is log-convex, then both the right- and left-hand sides of (C15) are increasing in $\tilde{N}$. Note that the right-hand side of (C15) can be arbitrarily flat for $\tilde{N} \geq 2$ by choosing ϵ small enough. Therefore, there exists an open region around $\epsilon = 0$ such that (C15) has a unique solution and in this region

$$\frac{1}{\int_x g_{(n-1)}(x)\frac{f(x)}{1-F(x)}dx} \begin{cases} > \frac{1}{\varphi\delta}\left(\frac{1-\omega\alpha}{1+\frac{\epsilon}{n}}\right) & \forall n > \tilde{N}, \\ < \frac{1}{\varphi\delta}\left(\frac{1-\omega\alpha}{1+\frac{\epsilon}{n}}\right) & \forall n \in [2, \tilde{N}). \end{cases} \tag{C16}$$

The proof now uses the same argument as in the log-concave case to deliver the threshold result in part 2.

Mass-Market Comparative Static

In the interior of a misconduct equilibrium, the level of misconduct is given by (C12). Therefore, the rate of change of misconduct with respect to the number of firms is given by

$$\frac{dy_1^*(p^e(n))}{dn} = \frac{d}{dn}\left(-\frac{1}{2}(p^e(n)-c)+\frac{1-\omega\alpha}{2\varphi\delta\left(1+\frac{\epsilon}{n}\right)}\right) = -\frac{1}{2}\frac{dp^e(n)}{dn}+\frac{1-\omega\alpha}{2\varphi\delta\left(1+\frac{\epsilon}{n}\right)^2}\frac{\epsilon}{n^2}$$
$$> -\frac{1}{2}\frac{dp^e(n)}{dn}. \tag{C17}$$

The inequality follows as $\omega\alpha < 1$ is required to hold in (C15), which is required in a misconduct equilibrium. In turn, the equilibrium price $p^e(n)$ is given by the solution to (C13), which we can write as $Q(n) = W(p^e, n)$, where $Q(n)$ is defined in (A26) and $W(p^e, n)$ is the right-hand side of (C13). Note that as the reliability function is log-concave, standard arguments yield that $\partial Q(n)/\partial n < 0$, and by inspection of (C14), $\partial W(p^e, n)/\partial p^e > 0$. Hence,

$$\underbrace{\frac{\partial Q(n)}{\partial n}}_{<0} dn = \underbrace{\frac{\partial W}{\partial p^e}}_{>0} dp^e + \frac{\partial W}{\partial n} dn. \tag{C18}$$

The key final step in the proof is to demonstrate that in a misconduct equilibrium, $\partial W(p^e, n)/\partial n > 0$. If this can be established, then for the mass-market setting (C18) implies $dp^e/dn < 0$, and therefore (C17) implies $dy_1^*(p^e)/dn > 0$ as claimed.

To establish the sign of $\partial W(p^e, n)/\partial n$, differentiate (C13) to establish

$$\frac{\partial W}{\partial n} =_{\text{sign}} \begin{array}{l} \left(1+\omega\alpha+\delta\varphi(p^e-c)\left(1+\frac{\epsilon}{n}\right)\right)\left[\left(\frac{1-\omega\alpha}{1+\frac{\epsilon}{n}}\right)^2\frac{2\epsilon}{n^2\left(1+\frac{\epsilon}{n}\right)} - \left(\varphi\delta(p^e-c)\right)^2\frac{2\epsilon}{n^2}\right] \\ +\frac{\epsilon}{n^2}\varphi\delta(p^e-c)\left[\left(\frac{1-\omega\alpha}{1+\frac{\epsilon}{n}}\right)^2 + 2\varphi\delta(1+\omega\alpha)(p^e-c) + \left(\varphi\delta(p^e-c)\right)^2\left(1+2\frac{\epsilon}{n}\right)\right]. \end{array}$$

In a misconduct equilibrium, we now have from (C12) that $\frac{1-\omega\alpha}{1+\frac{\epsilon}{n}} > \delta\varphi(p^e-c)$. Substituting this in and simplifying yields

$$\text{sign}\left(\frac{\partial W}{\partial n}\right) > \left(\delta\varphi(p^e-c)\right)^2\frac{2\epsilon}{n^2}\frac{1}{1+\frac{\epsilon}{n}}\left[\delta\varphi(p^e-c)\left(1+\frac{\epsilon}{n}\right)+1+\omega\alpha\right] > 0.$$

The final inequality follows from (C13). □

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