Amusing Ourselves to Death? Education and Work Under Digital Influence*

Lin William Cong[†] Siguang Li[§]

First version: July 2023; this version: March 2024.

Abstract

We study individual decisions about educational pursuit, influence acquisition, and economic production, in the presence of increasingly ubiquitous digital (social) media that are purely entertaining. Education traditionally not only imparts knowledge, but also determines initial labor market placements. The rise of the influencer economy via digital platforms alters individual attention and effort allocation, and consequently the relative returns across occupations and overall resource allocation in the society. Technologies that augment entertainment surplus (e.g., improved matching and amplified outreach) can discourage or even break down education. Education pursuits exhibit complementarity in the presence of a sizable influencer economy, resulting in multiple equilibria including one featuring inefficiently low education. Education and occupational choices exhibit generally non-monotonic dependence on labor market search frictions and digital influence technologies. Digital influence becomes "anti-intellectual" because it crowds out not only people's attention but also education and productive occupational choices, especially when societal decisions and public goods provision rely on an individual's logic and scientific understanding. Surprisingly, regulations directly targeting influencers or reducing search friction in the labor market may backfire, but taxing both influencers and followers helps. Interventions to coordinate equilibria and adjust platform designs can also mitigate inefficiency.

JEL Classification:. M31. M37. L11. L20. L51

Keywords: Creator/Influencer Economy, Digital Addiction, Digital Platforms, Disinformation, Occupation Choice, Returns to Education, Social Media.

*The authors are especially grateful to Jaden Chen, Itay Fainmesser, Qingmin Liu, and Xi Weng for helpful discussions and suggestions. They also thank the conference, lecture, and seminar participants at Jinan University, Lingnan University (HK) Faculty of Business, University of British Columbia Sauder School of Business for comments. Siguang Li acknowledges the generous research support from the Guangzhou-HKUST(GZ) Joint Funding Program (2024A03J0630). All errors are our own.

[†]Cornell University SC Johnson College of Business (Johnson) and NBER. Email: will.cong@cornell.edu

[§]Society Hub, HKUST (Guangzhou). Email: siguangli@hkust-gz.edu.cn

1 Introduction

'Together, this new ensemble of electronic techniques called into being a new world – a peek-a-boo world, where now this event, now that, pops into view for a moment, then vanishes again. It is a world without much coherence or sense; a world that does not ask us, indeed, does not permit us to do anything; a world that is, like the child's game of peek-a-boo, entirely self-contained. But like peek-a-boo, it is also endlessly entertaining."

— Neil Postman

Amusing Ourselves to Death: Public Discourse in the Age of Show Business

What Postman wrote almost four decades ago seems uncanny and prophetic descriptions of today's digital social media and creator/influencer economy that are growing into its largest scale ever: non-stop pushes and autoplays of short videos, livestreaming of influencers' lives and pranks, lectures broken into bite-size game-like clips, and influencer marketing.[1] The common denominator is the entertaining and attention-grabbing nature of digital media and the blurring of the boundary between social and business media. As Postman puts: Orwell feared that the truth would be concealed from us; Huxley feared that the truth would drown in a sea of irrelevance. It is the latter fear of "what we love will ruin us" that is forever more salient today. The flow of distraction we experience is akin to Aldous Huxley's A Brave New World, more so than to the restricted information in George Orwell's 1984.

Online content increasingly shapes public beliefs and behaviors, such as inflation expectations, vaccinations, or actions against climate change. Clearly, misinformation and disinformation—–unintentionally or intentionally false information—abounds (Deryugina and Shurchkov, 2016) and spreads virally (Allcott and Gentzkow, 2017; Osmundsen et al., 2021; Pennycook et al., 2021), especially when it is arousing, emotional or interesting (Berger and Milkman, 2012; Serra-Garcia and Gneezy, 2021; Robertson et al., 2023). Our theory, however, points to a less discussed issue: even without false information, digital media is inundated with irrelevant, fragmented, superficial information, which is entertaining or creates the illusion (and satisfaction) of knowing something. Yet, they not only crowd out our attention as consumers, but also reshape the landscape of education and occupational choices. Digital influence is problematic in our setting not necessarily because it spreads dis-

[1]Digital social media is uniquitous these days, with nearly 4 billion users worldwide, including 70-80% of the industrialized world's population and with an average daily use in excess of two hours as of 2020, according to the Globalwebindex survey (550,000 participants) of online behaviors. Not only does the burgeoning creative economy yield substantial profits, but it also opens up enormous opportunities for job creation. For example, from only US \$1.7 billion in 2016 to \$16.4 billion in 2012, the global influencer marketing industry was predicted to reach \$21 billion by 2023 (Geyser, 2023). According to Goldman-Sachs (2023), the total addressable market value of the creator economy is expected to double in size by 2027, from its current \$250 billion to half a trillion dollars, which is comparable to the total revenue generated by the e-commerce industry. Nonetheless, in terms of employment generation, the United States has over 10.2 million Instagram creators and 10.1 Tiktok creators; Europe and Latin America has 10.2 million and 18.9 million Instagram influencers; and China has 10.1 million influencers with a fan base larger than 10,000 (Influencity, 2023; PJdaren, 2023).

information or misinformation, or causes digital addiction and anxiety (Allcott et al., 2022; The Economist, 2024a); neither is it much about politicians' manipulation and control—we may be amusing ourselves to death as a species long before Tiktok launches a propaganda communist among U.S. users. We emphasize its distortion on the incentives for education and in the labor market, while discussing related policy implications. In this regard, we offer an explanation for how Gen Z indulging in social media seem to be less entrepreneurial and innovation (Park et al., 2023; The Economist, 2024b).

It is not that we are against entertainment—which, in reality and in our model, makes people happy and helps them relax after a tiring day, delivering real utility.[2] Our key insight is that attention is a valuable resource and its monetization has unintended consequences. At a basic level, mass show in the era of digital social media is so scalable and available in varieties that it crowds out alternative information sources and meaningful economic productions. As philosopher and communication theorist Marshall McLuhan sharply observed 60 years ago, the medium over which information is transported is sometimes more important than the information itself. In a way, medium is the message![3] More importantly, given the competition for attention and the elevated role of digital influence in allocating this scarce resource that influencers monetize, agents incentives for education and occupational choices are distorted and the one with voice through digital influence may not be the most educated or responsibility for decisions affecting the overall society and of the human race.

Specifically, we present a theory that involves a continuum of risk-neutral agents interacting in three sequential stages to capture the above features of the era of digital media. First, agents with heterogeneous aptitude for formal education (captured by a cost parameter) decide whether to acquire education and based on the educational outcomes, whether to pay to acquire social influence. Each agent endogenously becomes an educated expert, educated worker, influencer, or uneducated follower. Second, agents decide whether to offer services/entertainments as experts/influencers and whether to follow such experts or influencers, in which case they get endogenously matched. Third, expert-followers pay for experts'

[2] Experts and professionals may well use entertaining digital media to amplify their outreach. What is concerning is that, given our continual immersion in a flux of stimuli from digital social media, our capacity to meaningfully engage with and retain the substance of the spectrum of information—be it religious, political, or educational—has substantially attenuated, as Postman worried. Making learning more entertaining may help students memorize certain concepts, but will unlikely teach them the ability to learn, which is what education should be more about. As Postman pointed out in the example of Sesame Street, sometimes learning and education requires endurance and is a painful process.

[3] See McLuhan (2017) and McLuhan (1994). McLuhan predicted the world wide web 30 years before its invention (McLuhan, 1999). His puns "medium is the massage" "medium is the mass age" "medium is the mess age" are also becoming true given how the mass influencer economy presents fragmented information and chaos. Short videos contain a lot of decontextualized information while social media often deliver harmful or inaccurate content. According to a survey by Common Sense in 2023, an advocacy group, 45% of American teenager girls say they are addicted to TikTok and over one third addicted to instagram. See, e.g., https://www.commonsensemedia.org/press-releases/new-report-reveals-what-teen-girls-think-about-tiktok-instagram

service to engage in productive activities and influencer-followers pay influencers to derive entertainment utility, and then the game ends. In our setting, the proliferation of digital social media and advancements in influencer platforms (i) improve the search and matching of experts with educated workers, (ii) decrease the cost for agents to become influencers, and importantly, (iii) increase the variety of influencer offerings and their matching efficiency with followers, augmenting each follower's entertainment value (influencer following can be viewed as variety goods).

Several modeling innovations are crucial for deriving the core economic insights. First, education serves the dual purpose of (i) imparting knowledge and skills and (ii) determining outcomes in conventional labor markets (earning baseline wages as workers with basic skills versus becoming "experts" with additional payoffs from higher-level services workers cannot offer). Second, only educated agents can appreciate experts' service and benefits from that when engaging in economic production. How an individual processes information depends on the characteristics of both the observer and the observed behavior or event (Malmendier and Veldkamp, 2022). In particular, observers are inclined towards learning from people they identify with and that are similar to themselves in some way. Scientific education and consensus standards make it easier for an educated individual to follow another educated person and benefit from the information/advice/leadership/service she provides.

We are not claiming that in practice all influencers are unscientific ones, evidence from other social media settings in more established markets such as stock markets indicates that social media analysts generally add value (e.g., Farrell et al., 2022; Drake et al., 2022; Jame et al., 2022). The popular crowdsourced forecasting platform, Estimize, even emphasizes prominently on its website that individuals have incentives to contribute as doing so is "beneficial to everyone" and is a "mark of a good citizen." Presumably some analysts here are financial experts with proper training. The type of anti-intellectual influencers in our model are the ones that lead to information cascades rather than effective aggregation, and are the ones that without formal education or scientific training, who offer bad advice or misinformation or disinformation.[4] While the incentive to attract attention by influencers could lead to more knowledge about science through increased engagement (Deryugina and Shurchkov, 2016), this incentive also leads to a focus on arousing emotions at the expense of accuracy. Even with accuracy, Serra-Garcia (2024) document through experiments that attention-grabbing can increase misperception and bias through what is omitted in presentations. Overall, we do not criticize short videos, but even improvements in expert matches can be harmful to social welfare. In the intensive margin, technology affects the expert match; in the extensive

[4]Merkley et al. (2023) examine the returns associated with tweets issued by the most prominent crypto social media influencers covering over 1,600 crypto securities for two years and find significantly negative long-horizon returns following the tweets, and the effects are most pronounced for tweets issued by crypto-influencers proclaiming to be professional financial analysts, especially for for self-described experts with a high number of Twitter followers.

margin, it introduces a competitor for education.

Our theory offers two sets of results. First, equilibrium multiplicity can arise due to an increase in amusement utility brought forth by digital technologies. The amusement utility can be micro-founded as a variety good and can be improved by technological advances in social media platforms. When the amusement utility is small, education dominates influence acquisition, which implies that everyone believes in pursuing formal education. However, as entertainment utility increases further, societal beliefs in the aggregated education level come into play. There still exists an equilibrium in which when everyone believes that almost all others believe in science, acquiring education is therefore optimal for most agents. But another equilibrium may exist due to the fact that increased education create fiercer competition for initial job placement. This is because when everyone believes that not many believe in science and formal knowledge, then experts cannot receive enough audience, which hurts the endeavors they lead and the expertise market, resulting in an inevitable self-fulfilling inefficient equilibrium. Intuitively, this complementarity result comes from a form of information resonance: Only people who speak the same language and have similar basic domain knowledge can understand and appreciate each other.

Second, education and occupational choices exhibit generally non-monotonic dependence on digital technology. For example, as the search and matching technology in the expert labor market improves, aggregate education and the expert market first increase and then decrease. (A large search friction reduces labor-market matching efficiency, while a small friction leads to a winner-takes-all phenomenon for the top expert.) While education and labor market never break down absent digital influence, sufficiently high entertainment utilities cause education and a market breakdown in "investment" (a generic reference to expert-led productive economic activities), significantly reducing total welfare. Even without a collapse in investment, a rise in entertainment utility can diminish overall education if the educational resonance effect is weak. In a sense, digital influence becomes "anti-intellectual," not so much because they offer misinformation or disinformation, or "conspiracy theories" and "fake news" (Khan et al., 2021; Lazer et al., 2018) that intoxicate academic and political discourses, but through the crowding out of education and conventional occupational choices, as well as of time that could be spent on economically productive and socially beneficial activities.

The bottom line here is that digital influence takes up a large amount of time and attention, leading to two layers of inefficiency that can decrease total welfare. First, an increase in digital amusement, as long as it is not welfare dominant, can induce educated workers or experts, whoever has a relatively lower payoff, to quit productive activities, removing potential "rent" for the other side. This generates a deadweight loss for agents ex ante. Second, welfare losses can arise due to the positive externality related to network effects in productive activities. This is equally true when digital consumption has a negative externality, digital utilities are transient, or digital followers face self-control problems.

Our model generates several counter-intuitive welfare implications. One, total welfare is independent of the entry cost for influencers. Free entry generates identical payoffs between influencers and their followers, which implies a fixed outside option when it comes to education acquisition. Therefore, the entry cost is irrelevant to total welfare. Two, the entertainment utility has a non-monotonic impact on total welfare. At first, when the amusement utility is small, an increase in the entertainment utility improves total welfare because it generates more surplus in influencer follow-up without decreasing education acquisition. However, sufficiently large entertainment utilities discourage education and even cause a market breakdown in investment, significantly reducing total welfare. Three, searching friction also affects total welfare non-monotonically. While a large search friction between experts and educated workers naturally hinders efficiency, a small friction generates a winner-takes-all phenomenon for top experts, leading to fierce price competition without discernible effects on the expected size of educated workers. Therefore, when it approaches perfect matching, a market breakdown in investment occurs, significantly reducing total welfare.

Finally, our theory guides intervention policies, including economic incentives, equilibrium selection and platform design in the influencer and education markets. Specifically, (i) Banning influencers may not be the way to go, while taxing digital consumption and influencers can help. Influencer bans undermine influencers' positive contributions to social and economic wellbeing, such as influencer marketing and entertainment production, raising concerns about stifling the public. Taxing digital use can enhance education acquisition and mitigate anti-intellectual influence without reducing the variety of influencers, whereas taxing influencers can only remove excessive influencer entry and may incur significant welfare costs. (ii) Subsidizing education moderately can help when the anti-intellectual influence problem is not severe. Specifically, a small subsidy has negligible effect on aggregate education and total welfare, but a large subsidy may result in excessive education acquisition, whose benefits are limited by the investment return. Consequently, subsidizing education can only be plausible for a comparatively low level of entertainment utility when anti-intellectual influence arises. (iii) Taxing digital consumptions can help coordinate to the "good" equilibrium, which ensures a more robust total welfare but possibly at a lower level. In contrast, taxing influencers is irrelevant to equilibrium selection, and the plausibility of a large educational subsidy is restricted by welfare concerns and budget constraint issues. (iv) Altering the surplus-sharing rule, analogous to taxing or subsidizing digital consumption, is more likely to be effective than raising the entry barrier for influencers or decreasing the entertainment utility since it does not generate a dead weight loss. (v) Maintaining some randomness in the matching between experts and educated workers can be beneficial because it helps avoid fierce price competition among experts and sustain the return on educational investment.

Literature. Our study adds foremost to the emerging literature on digital platforms and the influencer or creator economy. Previous studies have focused on the relationship between influencers, platforms and consumers, especially the revenue sharing rules (Bhargava, 2022; Jain and Qian, 2021), AI and platform design (Liu and Liu, 2023; Yang et al., 2023), disclosure by internet influencers (Mitchell, 2021), search technology and advice transparency (Fainmesser and Galeotti, 2021), influencer cartels (Hinnosaar and Hinnosaar, 2021), firms' optimal affiliation with influencers (Pei and Mayzlin, 2019), firms' competition strategy for influencers in social networks (Katona, 2020), the information value of followers' comments on influencers' optimal endorsement policy (Nistor and Selove, 2023), and the industrial organization implications of product competition and influencer marketing (Cong and Li, 2023). We instead join studies to reveal the dark side of digital influence. Among them, Postman criticizes the shift from word-centered typography to image-centered social media in "the age of exposition", causing us to lose seriousness, clarity, and value within public discourse. Khan et al. (2022) and Lazer et al. (2018) discuss misinformation and fake news in digital media. These platforms have come under scrutiny for a variety of reasons, including negatively impacting our health, contributing to social anxiety Berryman et al. (2018), and promoting a culture of "famous for being famous" (McMullan et al., 2022). We shed light no new channels that digital influence can become anti-intellectual and show how it interacts with education and career choices, with aggregate welfare consequences.

Our study also contributes to the theory of information processing and media communications. Malmendier and Veldkamp (2022) point out that the prior emphasis on "access" to information, or lack thereof, is unlikely to be first order in the digital age when abundant information is accessible. The social context of information processing (Bandura, 1977)—Information resonates with recipients when they identify with the person who communicates it or whose personal experience it reflects— is more important and yet under-studied. While race, language, ethnicity, religion, location, etc., could all make one "identify" more or less with another person, we highlight the role of education in information resonance, which is one of the most endogenous and prominent among these social characteristics (McPherson et al., 2001).[5] We are the first to study how formal education interacts with new digital media and the implications of information resonance in such a context. We highlight that similarity in educational background and common scientific language captures a broader notion of social homophily, which is shown to be crucial in social networks and information diffusion

[5]The concept of homophily was introduced in Lazarsfeld and Merton (1954) to refer to the inclination of individuals to associate disproportionally with others who are similar to themselves. While DeMarzo et al. (2003) and Golub and Jackson (2012) discuss netwok and segregation that affect updating processes, theoretical studies on how these pervasive and robust social patterns affect behavior are underdeveloped. Our focus is on a fully connected digital network with an application in the influencer economy and education.

(McPherson et al., 2001; Federman et al., 2006; De Choudhury et al., 2010).

Our study is broadly related to the extensive literature on education and labor market, which has analyzed how education affects returns at both microeconomic and macroeconomic levels (e.g., Schultz, 1988; Harmon et al., 2003; Sianesi and Reenen, 2003), development and growth (e.g. Psacharopoulos, 1988; Griliches, 1997), social returns to education (Lange and Topel, 2006), etc. We postulate that education separates people with differential abilities and earning potentials, but remains agonastic on whether this is coming through informational channels such as signaling Spence (1978) or screening Lazear (1977), or heterogeneity under a human capital channel Card (1999). Instead, like Weiss (1983) we assume that individuals are symmetrically informed about their post-education ability which is revealed through completion of education. While Mincer (1962) empirically examines the effects on-the-job training, to our knowledge we offer the first theory of how technology affects endogenous education choices and labor outcomes, with an emphasis on technology-enabled competition from digital social media and influencers against education and subject experts or leaders.

Our paper is also broadly related to the literature on leisure consumption and individuals' time allocation (e.g., Becker, 1965; Gronau, 1977), especially concerning the role of technology. Aguiar and Hurst (2007) document increased time allocation to leisure from 1965 to 2003 using five decades of linked time use surveys. Aguiar and Hurst (2007) and Gentzkow (2006) study how the introduction of television in the United States in the 1950s and 1960s and the internet in Germany in the 2000s led to a drop in newspaper consumption, political knowledge, and voter turnout. Aguiar et al. (2021) develop a leisure demand system to empirically assess how improvements in leisure technologies have heterogeneous effects on individuals' opportunity cost of labor and, therefore, affect labor supply. Rachel (2024) venture beyond the labor supply aspect to also explore the macroeconomic implications for total factor productivity, measurement, and welfare, emphasizing the adverse impact of leisure-enhancing innovations on long run economic growth.

Our paper is innovative in several aspects. First, most of the literature is empirical and focuses on leisure consumption and its effects on labor supply, except that Rachel (2024) develops a theoretical framework to endogenize leisure-enhancing technological change, but does not model the labor supply for producing leisure goods (other than the attention input of consumers). We take leisure and entertainment technology as given, but endogenize both consumers' consumption of entertainment/leisure and the supply of leisure as influencers/creators. In other words, our model endogenizes both the production and consumption of leisure/entertainment by individual agents, which fits the influencer economy.

Second, we model a new externality of entertainment/leisure coming from the complementarity of education/skill acquisition/job preparation and non-leisure productive activities, as well as the static network effects present in these activities. Rachel (2024) also emphasizes the negative externality of leisure consumption, but does so in a dynamic setting and emphasizes the channel of endogenous growth: More leisure today drives down future growth in wages. In his setting, productivity-enhancing improvements and discoveries rely on human input, making time and attention important determinants of long-run growth. We have a different focus.

Third, unlike previous studies, we introduce a stage of formal education before occupational choices. We are saying that entertainment not only crowds out labor hours ex post, but also discourages skill acquisition and general education ex ante, causing more people to become entertainment producers. For all these reasons, none of our main results (multiplicity and non-monotonicity) were discovered or discussed in the prior literature. We also offer a theoretical foundation for the empirical pattern documented in Aguiar and Hurst (2007) that least educated households experienced the largest increase in leisure because they lack the skills necessary for non-leisure productive economic activities.

2 Model Setup

A unit measure of risk-neutral agents indexed by $i \in \mathcal{I} = [0, 1]$ populate the economy. They interact in three stages. The first stage involves individual's decisions on whether to pursue formal education and/or acquire social influence. The second stage involves individual decisions on whether to follow educated experts for productive activities ("investments") or to follow influencers for pure entertainment, as well as the matching between these followers and the experts/influencers. In the third stage, payoffs are realized for all agents, including those from investments and entertainment, and the game ends.

2.1 Education and Influence Acquisition

In this stage, agents face two non-mutually-exclusive decisions sequentially: whether to pursue education ($a_i = E$), and then whether to attempt to become an influencer ($a_i = I$).

Education decision. Each agent is endowed with an aptitude for formal education (e.g., IQ, cognitive ability, family support, etc.), which is reflected in a personal cost of pursuing formal education $c_i \sim U[0, 1]$ uniformly distributed. Formal education can be broadly interpreted as trainings whose outcomes can be evaluated with a scientific basis or objective standards (e.g., college degrees, skill levels, and certificates for playing musical instruments).

Education serves dual purposes here: general learning and preparation for labor market placement. After incurring the education cost, an agent succeeds and becomes an expert, or graduates as an educated worker, or fails and remains uneducated. Both experts and educated investors represent educated labor, and can earn positive labor income captured by a regular salary $b \geq 0$. Furthermore, because educated workers and experts speak the same "scientific language," they can interact in a market for economic production that we introduce shortly. Experts here can be broadly interpreted as innovators, entrepreneurs, professors, political leaders, artists, etc. In reality, some experts are also social media influencers. For clarification, our notion of influencers refers to the residual influencers that are entertaining but are not experts in any scientific matter related to productive economic activities.

Who become experts and how? The ith agent, by incurring cost c_i, becomes educated with probability η. Let μ_e denote the measure of educated agents. We further stipulate that with probability $p(\mu_e)$, an educated person becomes an expert. Correspondingly, with probability $\eta * (1 - p(\mu_e))$, an agent seeking education becomes an educated worker, but not an expert. In addition to the baseline salary, an expert receives a signal whose precision is randomly drawn from a uniform distribution $\rho_i \sim U([\underline{\rho}, \bar{\rho}])$, where $\bar{\rho} \geq \underline{\rho} \geq \frac{1}{2}$. This captures expertise and "know-hows" such as mastery of painting, leadership skills, creativity for innovations, etc., which allows the experts to earn additional income in an "investment advising" market that we introduce shortly. In a sense, resources and earning opportunities are allocated based on educational outcomes.

Now, we can express the measure of (potential) experts and educated workers as follows:

$$\widehat{\mu}_{ex} = \eta * p(\mu_e) * \mu_e, \quad \widehat{\mu}_{ew} = \eta(1 - p(\mu_e))\mu_e, \quad \text{with} \quad \frac{\widehat{\mu}_{ew}}{\widehat{\mu}_{ex}} = \frac{1}{p(\mu_e)} - 1 \tag{1}$$

Here, we let $\widehat{\mu}_{ex}$ and $\widehat{\mu}_{ew}$ denote the populations of experts and educated workers after the realization of the educational outcome but before the production activities, and save the notation μ_{ex} and μ_{ew} for the populations that actually participate in the productive activities. We assume that $p(\mu_e)$ is continuous (for non-material technical convenience) and weakly decreases in μ_e, reflecting the scarcity of expert positions. After all, there is typically one president of a country despite an increase in the population receiving higher education. The ratio $\frac{\widehat{\mu}_{ew}}{\widehat{\mu}_{ex}}$ then increases in μ_e. To make it finite, we assume that $p(1) > 0$. This monotonicity is consistent with that when pursuing education exhibits strategic complementarity (because each expert can receive more support from educated workers when more agents pursue education), equilibrium multiplicity ensues.

Influence acquisition. After the realization of educational outcomes, the ith agent, by incurring a cost $c_I > 0$, can further acquire influence and become an influencer with probability $\gamma \in (0, 1]$. An influencer can generate a total amusement surplus $u_0 = H(k, \mu_{in})$ for each follower (which could include the net benefit gain with influencer marketing), with $\frac{\partial H}{\partial k} \geq 0$ and $\frac{\partial H}{\partial \mu_{in}} \geq 0$. Here, k is a technology parameter governing influencer productivity and outreach, and μ_{in} is the measure of influencers that provides purely entertainment utility, who essentially offer horizontally differentiated products and compete for followers. For example, a large k may correspond to the advancement of live streaming and short video platforms that increase the number of enjoyable videos that we browse and improve the matching of the videos with our entertainment taste; k could also indicate how influencers can utilize generative AI to produce content. In appendix A.1, we provide a micro-foundation of the entertainment utility, endogenizing the time followers spend on entertainment and incorporating considerations of variety of goods.[6]

It is important not to make the sweeping statement that influencers do not have any educational value or do not contribute to other economic productions. If a piano virtuoso or a physics professor use TikTok videos to impart knowledge about piano performance or the principles of quantum mechanics to future musicians and engineers, that would be beneficial for the society. In our setting, they are labeled as experts who offer education services through new digital media. So there is not so much irony that to point out the detrimental effects, one has to become an influencer to get their voice heard. Again, what we refer to influncers and anti-intellectual influence are the ones that provide pure entertainment value orthogonal to these. We also need to keep in mind that the medium shapes what can be delivered. With influencers fighting for attention through short videos and livestreaming, influencers' appearance and attention grabbing exaggerations naturally dominate the accuracy of content. Writing, in contract, requires careful thinking and reasoning, and much greater rigor than a podcast conversation or a tweet. Why are short-videos so entertaining? Because they distract us from the mentally intensive serious topics.

Technology and digital platforms. Technological advancements, especially those related to digital platforms for social media, influencer videos/livestreaming, and paying for knowledge online, are exogenous in our model. They can alter the model parameters in four important ways. First, they can decrease the "entry cost" of becoming an influencer, c_I, which makes the influencer market rather competitive. Second, they can increase the joint entertainment surplus u_0 generated between influencers and their followers through better matching and scaling. Third, they can improve the search and matching between experts and educated followers by increasing α. We later consider comparative statics with respect to each of these dimensions.[7]

Although we analyze background technology for a continuum of values, we emphasize that digital social media is fundamentally a disruptive technology in at least two ways. First, the reduction in entry costs and improvements in matching and entertainment values

[6]For educational externality, digital technology generally makes u_0 smaller because entertainment has a diminishing return to scale and more influencers means a lower utility per video. However, the influencer video matching might improve, so people find what they really like. We argue that the second effect dominates with powerful algorithms and big data. In our setting each follower only chooses one influencer, so that is another reason why we don't get diminishing returns to scale.

[7]Section A.1 provides a micro-foudation for the entertainment utility and discusses the policy implications.

are significant. Second, unlike traditional sports, music, and the arts, digital entertainment has a horizontal dimension due to improvements in matching algorithms related to digital platforms. For example, NBA games are entertaining, and improvements in broadcasting technology can similarly augment the outreach of the games. However, different basketball leagues are not pushed to viewers through a matching algorithm. Therefore, most of the audience still converges to watch the best games available in the vertical dimension. However, in live-streaming and short videos, it is not always true that there is consensus on the best videos or livestreamers. The algorithm in the background may match a minor sports league to an audience whose hometown is in the same region. This, in turn, implies that entertainment production becomes more inclusive. Influencers do not have to produce the best videos in order to get an audience. They also do not need professional basketball training to attract basketball fans if they are talented at discussing basketball shoe brands, etc.

2.2 Service Choices and Expert/Influncer Matching

Experts offer services so that educated workers can engage in "productive activities." One example is investment advice or fund management service, which allows educated workers to effectively allocate financial resources that improve aggregate economic output. But the services here can be rather broad, including leading a startup, supervising a research lab, etc. Meanwhile, influencers also offer entertainment, such as live streaming their dining experience, luxurious lifestyles, or eye-catching pranks and dares. For simplicity, we normalize agents' outside options to yield zero utility. Therefore, all educated workers and uneducated agents who are not experts or influencers themselves choose to follow either an expert or an influencer. Overall, the following accounting identity holds after matching:

$$\mu_{ex} + \mu_{in} + \mu_{ew} + \mu_{if} = 1.$$

where μ_{if} is the measure of influencer followers. Once all agents have chosen the service market, the matches with experts and influencers ensue. Note that μ_{ex} and μ_{ew} can differ from $\widehat{\mu}_{ex}$ and $\widehat{\mu}_{ew}$.

Expert-led productive activities. Educated workers, by paying a fee to get leadership or consulting service from experts, can observe and understand the signal (i.e., the know-hows, inspirations, or advice) provided by experts to carry out productive activities, such as investments. Uneducated agents cannot process advice or appreciate leadership, reflecting a manifestation of informational resonance — one can only digest the vision or piece of information from someone they trust or share the same beliefs and speak the same languages (e.g., Malmendier and Veldkamp, 2022). This informational resonance is also well-motivated by the literature on the economics of homophily.

When an educated agent is paired with an expert with signal precision ρ_i, the total direct investment surplus (or more generally, productive output) is given by $M * (2\rho_i - 1)$.[8] Here, we use a fixed investment scale $M > 0$ to capture the return and thus the importance of educational expertise.[9] Furthermore, given ρ_i and M, when the ith expert charges a consulting fee f_i, then the jth educated worker, net of the independent labor benefit b, gets a utility from interacting with the ith expert as:

$$u_j(f_i, \rho_i) = M * (2\rho_i - 1) - f_i$$

In contrast, an uneducated follower, when following an expert, lacks the training to understand the expert's signal. This leads to a zero joint surplus.

Given the total measure of expert followers, the probability density that an educated worker matches with the ith expert with signal precision ρ_i and consulting fee f_i is

$$n_i(f) = \frac{u(f_i, \rho_i)^\alpha}{u(\mathbf{f})} = \frac{u(f_i, \rho_i)^\alpha}{\int_m [u(f_m, \rho_m)]^\alpha dm}. \tag{2}$$

Our reduced-form matching function follows from Fainmesser and Galeotti (2021). The matching probability only depends on the service quality (skill, expertise, and in our specification, the precision of their signal), which can be extended to accommodate two-sided heterogeneity.[10]

In addition, we assume that economic productions generate a match-independent payoff $A(\theta, \mu_{ex}, \mu_{ew})$ for each individual participant, which is related to the measure of experts and their educated followers, and is parametrized by θ.[11] It can capture both the competition and complementarity of the productive activities. For stock investing, if experts are all advocating value investing, the capital allocation is more efficient in the society, and welfare

[8]The specific form is not crucial, as long as the investment surplus is strictly increasing in ρ_i.

[9]This reduced-form investment return is given by solving the investment matching problem that $u_j^{ef}(d_j|\rho_i, s) = M * \left(\mathbb{1}_{\{d_j=\omega\}} - \mathbb{1}_{\{d_j\neq\omega\}}\right)$, where $d_j \in \{-1, 1\}$. Here, "$d_j = -1$" means "shorting the asset" and "$d_j = 1$" means "longing the asset". Furthermore, $\Pr(s_i = G|\omega = 1) = \Pr(s_i = B|\omega = -1) = \rho_i \geq \frac{1}{2}$. A correct investment yields one unit payoff and a wrong investment pays nothing.

[10]To build the worker heterogeneity into the matching function, we let experts draw a type, say a_i, and workers draw a type, say b_j. We let a_i and b_j be drawn from a joint distribution and only the best agents become experts with probability $\eta p(\mu_e)$. Agent j gets an utility of $q_{i,j}(f_i, a_i, b_j) = a_i b_j - f_i$ from following expert i. There are two possibilities for modeling the search technology, $n_{i,j}(\mathbf{f})$, the probability density that the jth follower matches the ith expert. A natural idea is to specify $n_{i,j}(\mathbf{f}) = \frac{q_{i,j}^\alpha(f_i, a_i, b_j)}{q_j(\mathbf{f})}$, where $q_j(\mathbf{f}) = \int_i q_{i,j}^\alpha(f_i, a_i, b_j) di$. We can then integrate the follower index j to get the total demand for the ith influencer, that is, $n_i(\mathbf{f}) = \int_j n_{i,j}(\mathbf{f}) dj$. This approach is quite natural but intractable due to integration in the denominator $q_j(\mathbf{f})$. Alternatively, we can specify $n_{i,j}(\mathbf{f}) = \frac{q_{i,j}^\alpha(f_i, a_i, b_j)}{q(\mathbf{f})}$, where $q(\mathbf{f}) = \int_i \int_j q_{i,j}^\alpha(f_i, a_i, b_j) dj di$. Unlike the first approach, it contains a double integral in the denominator, and thus an index $q_{i,j}^\alpha$, which is based on the follower's utility, is imposed to reflect the search friction. Note that this formulation makes algebra simpler. We then integrate the follower index j to get the total demand, that is, $n_i(\mathbf{f}) = \int_j n_{i,j}(\mathbf{f}) dj$. The authors thank Itay Fainmesser for the helpful discussions here.

[11]The results remain when the network effect is proportional to the number of educated workers.

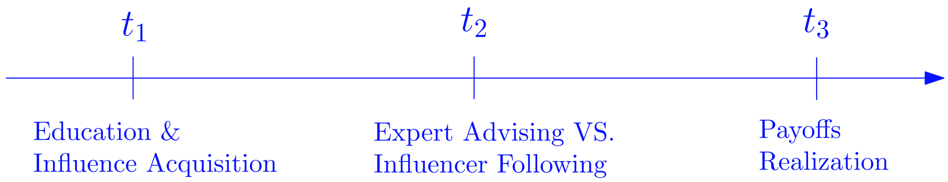


Figure 1: Timeline

improves in addition to personal gains, relative to a situation where everyone is randomly speculating. For environmental conservation, network effect is present and a critical mass of agents who take biodiversity-perserving actions can collectively improve biodiversity.

Amusement and influencer-follower matching. Let β denote the fraction of surplus an influencer can extract from a matched follower, which includes fees or income from influencer marketing, and $(1-\beta)$ for the matched follower. The parameter β reflects the competitiveness of the influencer market and is dependent on platform design and the monopolistic competition between influencers. We take β as exogenous and perform a comparative static analysis. Note that the amusement of influencers is limited by the number of hours in the day and is therefore bounded above. Let κ denote this upper bound. Random matching of influencers and followers is independent of the educational type, and thus

$$u^{if}(\varnothing|c_i) = (1-\beta)u_0$$

Potential influencer followers include those agents who choose not to acquire education/influence, who fail in education/influence training, and who voluntarily switch to following influencers ex post. Influencers' followers, educated or uneducated, are randomly matched with influencers when they decide to do so. Consequently, random matching leads to an identical number of followers for each influencer.

Given the (anticipated) measure of influencers μ_{in} and their followers μ_{if} and , the ith agent receives an expected payoff from acquiring influence :

$$u^{in}(I|c_i) = \gamma * \frac{\mu_{if}}{\mu_{in}} * \beta * u_0 + (1-\gamma)(1-\beta)u_0 - c_I. \tag{3}$$

2.3 Equilibrium Concept

We use backward induction to solve this game. The correct equilibrium concept is the Rational Expectation Equilibrium. Specifically, it requires:

(1) (Service Choices & Expert/Influencer Matching). In stage t_2, the ith expert, after drawing the signal s_i, chooses the optimal pricing strategy f_i^*, given the precision of the signal ρ_i and the probability matching function $n_i(f)$. Agents optimally choose whether to

pay the consulting fee to the matched expert and invest afterward. Furthermore, given the common belief about $(\mu^*_{ex}, \mu^*_{ew}, \mu^*_{in}, \mu^*_{if})$ and the pricing strategies $\tilde{f}_i$ for experts, all agents optimally select which markets to participate in.

(2) (Education & Influence Acquisition). In stage t_1, given the learning cost c_i, the ith agent, fully anticipating future actions of all agents, optimally chooses $a^*_i \in \{\varnothing, E\}$ to maximize the expected payoff. Then, after observing the educational outcome realized, she optimally chooses $a^*_i \in \{I, \varnothing\}$.

(3) (Consistency). In equilibrium, the expectation is consistent, that is, $\tilde{f}_i = f^*_i$ for all experts i. At the aggregate level, the populations of experts, educated workers, influencers, and their followers are consistent with the equilibrium belief $(\mu^*_{ex}, \mu^*_{ew}, \mu^*_{in}, \mu^*_{if})$.

In the baseline model, we focus on the symmetric pure-strategy equilibrium in which all agents hold a common belief and all experts use an identical pure strategy before knowing the signal precision. We consider mixed strategies in Section 6.1 and show that the results remain robust.

3 Equilibrium Characterization

We solve the model backward.

3.1 The Matching and Payoff Stage

First, expert i's optimal pricing strategy considers the demand elasticity of educated workers and maximizes the expected profit given by $u^{ex}_i(\rho_i, f_i) = \frac{\mu_{ew}}{\mu_{ex}} * n_i(f) * f_i$, which yields $f^*_i = \frac{1}{\alpha+1} M(2\rho_i - 1)$. We then compute the payoffs for each group, including:

(i) Influencer followers. They each receive $u^{if} = (1-\beta)u_0 + b * \mathbb{1}_{\{\text{educated}\}}$. Here, the indicator function equals one if the agent is educated and zero otherwise.

(ii) Educated workers. By the formula of f^*_i, the jth educated worker receives a utility of $u(f^*_i, \rho_i) = \frac{\alpha}{\alpha+1} M(2\rho_i - 1)$. Thus, we can compute the expected interim payoff for an educated follower as: $\mathbb{E}[u^{ew}_j | a_j = E, c_j] = \frac{\alpha}{\alpha+1} * R(\alpha) + b + A(\theta, \mu_{ex}, \mu_{ew})$, where $R(\alpha) = M * \frac{(\alpha+1)}{(\alpha+2)} * \frac{(2\bar{\rho}-1)^{\alpha+2} - (2\underline{\rho}-1)^{\alpha+2}}{(2\bar{\rho}-1)^{\alpha+1} - (2\underline{\rho}-1)^{\alpha+1}}$ is the expected investment surplus.[12] Since the educational cost c_j becomes sunk and thus irrelevant for matching, educated workers choose to consult experts only when

$$\frac{\alpha}{\alpha+1} R(\alpha) + A(\theta, \mu_{ex}, \mu_{ew}) \geq (1-\beta)u_0 \tag{4}$$

[12]The derivation is as follows. Note that $\mathbb{E}[u^{ew}_j | a_j = E, c_j] = \int_{\underline{\rho}}^{\bar{\rho}} \frac{1}{\bar{\rho}-\underline{\rho}} u(f^*_i, \rho_i) n_i(f) d\rho_i + b + A(\theta, \mu_{ex}, \mu_{ew})$ $= \frac{\int_{\underline{\rho}}^{\bar{\rho}} u(f^*_i, \rho_i)^{\alpha+1} d\rho_i}{\int_j u(\mathbf{f}^*) dj} + b + A(\theta, \mu_{ex}, \mu_{ew}) = \frac{\alpha}{\alpha+1} * R(\alpha) + b + A(\theta, \mu_{ex}, \mu_{ew})$.

where $\frac{\alpha}{\alpha+1}$ is the surplus share for educated workers. Note that whether to consult experts is independent of the labor market benefit b. Furthermore, the education market collapses when it approaches random matching (that is, α small).

(iii) Experts. After matching, the expert's payoff is given by

$$u_i^{ex}(\rho_i, f_i | a_i = E, c_i) = \frac{\mu_{ew}}{\mu_{ex}} * n_i(f) * f_i + b + A(\theta, \mu_{ex}, \mu_{ew})$$

Thus, the interim expected payoff for each expert is given by:

$$\mathbb{E}[u_i^{ex} | a_i = E, c_i] = \frac{\mu_{ew}}{\mu_{ex}} * \frac{R(\alpha)}{\alpha + 1} + b + A(\theta, \mu_{ex}, \mu_{ew})$$

Again, the educational cost c_i is sunk and thus irrelevant. Note that experts are willing to provide consulting service only when:

$$\frac{\mu_{ew}}{\mu_{ex}} * \frac{R(\alpha)}{\alpha + 1} + A(\theta, \mu_{ex}, \mu_{ew}) \geq (1 - \beta) u_0 \tag{5}$$

where $\frac{\mu_{ew}}{\mu_{ex}}$ is the size of educated workers per expert and $\frac{1}{\alpha+1}$ is the surplus share for experts.

(iv) Influencers. Successful live-streaming influencers are homogeneous and random matching implies that followers are equally distributed so that

$$\mathbb{E}[u^{in} | I, c_i] = \gamma * \frac{\mu_{if}}{\mu_{in}} * \beta * u_0 + (1 - \gamma)(1 - \beta) u_0$$

Again, the influencer entry cost c_I becomes a sunk cost and thus irrelevant.

3.2 Education and Influence Acquisition Stage

Next, we consider the decision to pursue education or influence. Let U_i denote the expected utility of agent i in the stage t_1. Now, there are three choices, including:

(i) Doing nothing. It generates a payoff of $U_i(\varnothing | c_i) = (1 - \beta) u_0$.

(ii) Acquiring influence. We only need to add back the influence training cost c_I, that is,

$$U_i(I | c_i) = \gamma * \frac{\mu_{if}}{\mu_{in}} * \beta * u_0 + (1 - \gamma)(1 - \beta) u_0 - c_I \tag{6}$$

(iii) Acquiring education. It leads to an expected payoff of:

$$\begin{aligned} U_i(E | c_i) = {} & -c_i + \eta b + \mathbb{1}_{\{\text{Breakdown}\}} \times (1 - \beta) u_0 + \mathbb{1}_{\{\text{No breakdown}\}} \\ & \times \left(\eta p * \frac{\mu_{ew}}{\mu_{ex}} \frac{R(\alpha)}{\alpha + 1} + (1 - p)\eta * \frac{\alpha * R(\alpha)}{\alpha + 1} + (1 - \eta)(1 - \beta) u_0 + \eta A(\theta, \mu_{ex}, \mu_{ew}) \right) \end{aligned} \tag{7}$$

The first term is the cost of education, then followed by the labor benefit in the second term, while the third and fourth terms correspond to the utility with and without a breakdown of the investment market. In particular, when there is no breakdown for investment, it includes the payoff of becoming an expert, serving as an educated worker, following influencers, and the network effect surplus, multiplied by the corresponding probabilities.

Denote $a \wedge b = \min\{a, b\}$. Then, a breakdown occurs for investment when:

$$\left(\frac{\mu_{ew}}{\mu_{ex}} \wedge \alpha\right) * \frac{R(\alpha)}{\alpha+1} + A(\theta, \mu_{ex}, \mu_{ew}) < (1-\beta)u_0.$$

In equilibrium, there are three cases for the education level, including:

(1) Interior solution: $\mu_e \in (\eta b, 1)$, when

$$U_i(I|c_i) = U_i(\varnothing|c_i) \leq U_i(E|c_i) \tag{8}$$

holds if and only if $c_i \leq \mu_e$;

(2) Maximum education: $\mu_e = 1$, when $U_i(I|c_i) = U_i(\varnothing|c_i) \leq U_i(E|c_i)$ for all $c_i \in [0, 1]$;[13]

(3) Minimum education: $\mu_e = \eta b$, when $U_i(I|c_i) = U_i(\varnothing|c_i) \geq U_i(E|c_i)$ for all $c_i > \eta b$.

Endogenous free entry leads to identical payoffs between influencers and their followers. Specifically, $\gamma * \frac{\mu_{if}}{\mu_{in}} * \beta * u_0 + (1-\gamma)(1-\beta)u_0 - c_I = (1-\beta)u_0$, or equivalently,

$$\frac{\mu_{if}}{\mu_{in}} = \frac{c_I/(\gamma u_0) + (1-\beta)}{\beta}. \tag{9}$$

Lemma 1. *In equilibrium, the number of followers for each influencer, μ_{if}/μ_{in}, is negatively associated with the bargaining power of influencers β, the entertainment utility u_0, the success rate of becoming an influencer γ and positively associated with the entry cost c_I.*

3.3 Self-Fulfilling Education Levels

Next, we analyze the equilibrium aggregate education. In a symmetric pure strategy equilibrium, all experts use an identical pure strategy: given $\mu_e \in [0, 1]$, all experts offer services only when $\frac{1-p(\mu_e)}{p(\mu_e)} * \frac{R(\alpha)}{\alpha+1} + \theta\eta\mu_e \geq (1-\beta)u_0$; otherwise, all quit.[14] We start with Equation (8), the necessary condition for an interior solution. When there is no market

[13] Note that sequential education plays a role here, which removes the potential market monopoly power and the abnormal profits in payoff for influencers. Instead, if education and influence acquisition occur simultaneously, a missing market can arise if no agent acquires influence. Anticipating this, some agents always switch to acquiring influence and thus the aggregated level of education $\mu_e^* < 1$. More discussions can be found in Section A.3.

[14] The main results extend to asymmetric and mixed strategies in Section 6.1.

breakdown for investment, by Equation (1), $\eta p * \frac{\mu_{ew}}{\mu_{ex}} = \eta p \left(\frac{1}{p} - 1\right) = \eta(1-p)$ and thus:

$$U_i(E|c_i) = -c_i + \eta b + \eta(1-p(\mu_e))R(\alpha) + (1-\eta)(1-\beta)u_0 + \theta\eta^2\mu_e \tag{10}$$

Thus, the indifference type $c_i = \bar{c}$ is pinned down by $U_i(E|\bar{c}) = U_i(\varnothing|\bar{c})$, that is,

$$-\bar{c} + \eta b + \eta(1-p(\mu_e))R(\alpha) + (1-\eta)(1-\beta)u_0 + \theta\eta^2\mu_e = (1-\beta)u_0$$

By imposing the consistency condition that $\bar{c} = \mu_e$, we get:[15]

$$\eta(1-\beta)u_0 + (1-\eta^2\theta)\mu_e = \eta(1-p(\mu_e^*))R(\alpha) + \eta b \tag{11}$$

$$U_i(E|c_i) = -c_i + \eta b + \eta(1-p(\mu_e))R(\alpha) + (1-\eta)(1-\beta)u_0 + \theta\eta^2\mu_e \tag{12}$$

Meanwhile, free entry implies identical utility between acquiring influence and following influencer ex ante, that is, $U_i(I|c_i) = U_i(\varnothing|c_i)$ for $c_i > \bar{c}$,

$$\gamma * \frac{\mu_{if}}{\mu_{in}} * \beta u_0 + (1-\gamma)(1-\beta)u_0 - c_I = (1-\beta)u_0 \tag{13}$$

In equilibrium, equation (13) determines the ratio of μ_{if}/μ_{in}, the measure of followers for each influencer. Furthermore, note that the following identity always hold, that is,

$$\mu_{if} + \mu_{in} = 1 - \eta\mu_e \tag{14}$$

In light of equation (11), we define:

$$\begin{aligned} G(\mu_e): &= \underbrace{\eta b + \eta(1-p(\mu_e))R(\alpha) + (1-\eta)(1-\beta)u_0 + \eta\theta*(\eta\mu_e)}_{\text{Education Benefits}} - \underbrace{((1-\beta)u_0 + \mu_e)}_{\text{Opportunity costs}} \\ &= \underbrace{\eta b + \eta(1-p(\mu_e))R(\alpha)}_{B(\mu_e)} - \underbrace{(\eta(1-\beta)u_0 + (1-\eta^2\theta)\mu_e)}_{C(\mu_e)} \end{aligned} \tag{15}$$

The first term in $G(\mu_e)$ corresponds to educational benefits, when no breakdown of investment occurs, while the second term in parentheses corresponds to the total cost of acquiring education, including the foregone utility from influencers and the educational cost.

Proposition 1 fully characterizes all symmetric pure strategy equilibriums.

[15] If we deal with any continuous probability density with a CDF $F(\cdot)$ for education cost c, the consistency condition reduces to the following fixed point problem given by: $\eta(1-\beta)u_0 + F^{-1}(\mu_e) - \eta^2\theta\mu_e = \eta(1-p(\mu_e^*))R(\alpha) + \eta b$, where $F^{-1}(\cdot)$ is the inverse function of the CDF.

Proposition 1 (Symmetric Pure Strategy Equilibrium).

- *First, agents with $c_i \leq \mu_e^*$ acquire education, and accept their roles assigned only when education succeeds. Agents with $c_i > \mu_e^*$ or with failed educational outcomes acquire influence or do nothing, among which the populations of influencers and followers are given by $\mu_{in}^* = \frac{\beta(1-\eta\mu_e^*)}{1+c_I/(\gamma u_0)}$ and $\mu_{if}^* = \frac{(1-\beta+c_I/(\gamma u_0))*(1-\eta\mu_e^*)}{1+c_I/(\gamma u_0)}$, respectively.*

- *Second, in equilibrium, aggregate education μ_e^* is determined as follows:*

  (i) when $(\alpha \wedge (1/p(1) - 1)) * \frac{R(\alpha)}{\alpha+1} + \theta\eta < (1-\beta)u_0$, $\mu_e^* = \eta b$ is the unique equilibrium;

  (ii) when $(\alpha \wedge (1/p(1) - 1)) * \frac{R(\alpha)}{\alpha+1} + \theta\eta \geq (1-\beta)u_0$, any $\mu_e^* \in [\eta b, 1]$ that satisfies $G(\mu_e^*) = 0$ and $(1/p(\mu_e^*) - 1) * \frac{R(\alpha)}{\alpha+1} + \theta\eta\mu_e^* \geq (1-\beta)u_0$ forms an equilibrium. Furthermore, if $G(1) \geq 0$, then $\mu_e^* = 1$ also forms an equilibrium. Last, if $(\alpha \wedge (1/p(\eta b) - 1)) * \frac{R(\alpha)}{\alpha+1} + \theta\eta b < (1-\beta)u_0$, $\mu_e^* = \eta b$ also forms an equilibrium.

Proposition 1 characterizes the education/influence acquisition decision and occupational choices in equilibrium. Only agents with relatively low learning costs acquire education and accept their roles assigned when education succeeds, while those with high learning costs or failed education acquire influence or do nothing. To understand Proposition 1, we first observe that when the investment market cannot attract educated workers or experts under the most optimistic belief, the investment market collapses, and thus the incentive to acquire education is only driven by the benefits related to the labor market. Second, multiple equilibrium can arise even when both experts and educated workers find it optimal to stay in the investment with a sufficiently optimistic belief. Due to positive externality, a more optimistic belief in aggregate education strengthens the incentive for experts to offer services. Indeed, it is possible that both the most optimistic and most pessimistic beliefs (that is, $\mu_e^* \in \{\eta b, 1\}$) can be supported in equilibrium. Furthermore, for an intermediate case in which the benefits and opportunity costs are not strictly ranked, Equation (11) fully characterizes the equilibrium(s), as long as the participation conditions for both experts and educated workers are satisfied. To achieve a high-education outcome, it is useful to boost morale and make agents aware that others are getting education. The individual's choice of education exhibits complementarity.

4 Model Implications for the Education-Occupation-Technology Nexus

We identify three key themes in the economic consequences of digital influencers on education and social welfare. First, education serves two purposes: professional training and anchoring to labor market competition. This alone means that the occurrence of investment breakdown can depend on search friction and match effectiveness in the expert-advising market. Second, education can have an externality related to education resonance. The expert-follower market is a two-sided market, and resonance means ex ante educational choice has externality that is not fully internalized. As such, we face inefficient coordination and multiple equilibria. Furthermore, when it comes to societal decisions, an individual's investment decision and thus ex ante education could have externality because if others receive education, it improves societal decision, which benefits a particular individual. Third, anti-intellectual influence manifests itself in the breakdown of investment and suboptimal society decision-making, so how to regulate that becomes important. Taxing influencer entry alone might generate a costly reduction in influencer variety, while taxing both followers and digital consumption would help.

For simplicity and transparency, we set $\gamma = 1$ and $A = 0$. 6.3 discusses the case of $A > 0$.

4.1 Self-Fulfilling Education and Technology-Induced Multiplicity

Now, we come to investigate how an increase in entertainment utility, due to technological advances in digital platforms, generates equilibrium multiplicity and leads to destructive anti-intellectual influence. Initially, increasing the utility of digital amusement is always beneficial when it is small because, without discouraging education acquisition, it increases the utility of influencer follow-up. However, when it exceeds a certain threshold, equilibrium multiplicity arises. Depending on the belief selected, both high and low education are plausible. If everyone believes that all others believe in science, then they are also willing to acquire education. On the contrary, when everyone believes that not many people believe in science, the resonance of education comes into play, and experts might not receive enough audience. This discourages education acquisition, and now a self-fulfilling inefficient equilibrium arises. Lastly, when entertainment utility is sufficiently large, all agents quit the investment market, and again, a unique equilibrium with minimum aggregate education ensues.

Define $A = \frac{1-p(\eta b)}{p(\eta b)} * \frac{R(\alpha)}{(\alpha+1)(1-\beta)}$, $B = \min\{(\alpha \wedge \frac{1-p(1)}{p(1)}) * \frac{R(\alpha)}{(\alpha+1)(1-\beta)}, \frac{(b-1/\eta)+(1-p(1))R(\alpha)}{(1-\beta)}\}$, $\underline{L} = \inf_{\mu_e \in [\eta b, 1]} \eta(1-p(\mu_e))R(\alpha) - \mu_e + \eta b$, and $\bar{L} = \sup_{\mu_e \in [\eta b, 1]} \eta(1-p(\mu_e))R(\alpha) - \mu_e + \eta b$.

Proposition 2 (Equilibrium Multiplicity)**.** *Assume $\underline{L} > 0$. Then: (i) there are at least two equilibria such that $\mu_e^* = \eta b$ and $\mu_e^* = 1$ for any $A < u_0 < B$; and (ii) there is only one equilibrium for u_0 sufficiently large or small (that is, $\mu_e^* = 1$ when $u_0 < \min\{\frac{\underline{L}}{(1-\beta)}, \frac{\alpha R(\alpha)}{(1-\beta)(\alpha+1)}, A\}$, and $\mu_e^* = \eta b$ when $u_0 > \bar{L}/(1-\beta)$).*[16]

[16] Note that: (1) $0 < A < B$ when both $p(1) < \frac{1}{\alpha+1} < p(\eta b)$ and $\left(\frac{1}{(\alpha+1)} - p(1)\right) * R(\alpha) > 1/\eta - b$ hold; and (2) $\bar{L} \geq B$. Furthermore, we can prove a more general version of equilibrium multiplicity. Specifically, we first define $\hat{\mu}_e$ to satisfy $\frac{1-p(\hat{\mu}_e)}{p(\hat{\mu}_e)} * \frac{R(\alpha)}{\alpha+1} = (1-\beta)u_0$. Because $p(\cdot)$ is decreasing, $\hat{\mu}_e$ is unique and increases in u_0 whenever it exists. We further define $\hat{\mu}_e = 1$ when $\frac{1-p(1)}{p(1)} * \frac{R(\alpha)}{\alpha+1} > (1-\beta)u_0$. Next, we assume that: (1) $\frac{\alpha}{\alpha+1} R(\alpha) \geq (1-\beta)u_0$; (2) $\hat{\mu}_e \in (\eta b, 1)$; and (3) $\sup_{\mu_e \in [\hat{\mu}_e, 1]} G(\mu_e) \geq 0$. Then, there exist at least two

u_0	$[0, \frac{7}{5}]$	$(\frac{7}{5}, \frac{9}{5})$	$[\frac{9}{5}, 2]$	$[2, \frac{14}{5})$	$\{\frac{14}{5}\}$	$(\frac{14}{5}, \infty)$
μ_e^*	$\{1\}$	$\{\mu_e^2\}$	$\{0, \mu_e^2\}$	$\{0, \mu_e^1, \mu_e^2\}$	$\{0, \frac{1}{2}\}$	$\{0\}$
$\#\mu_e^*$	1	1	2	3	2	1

Table 1: Equilibrium Characterization in Example 1

Parameters: $b = 0, \eta = \frac{3}{4}$, $\alpha = 1$, $R(\alpha) = 2$ and $(1-\beta) = \frac{1}{3}$, $p(\mu_e) = \frac{7}{10} - \mu_e$ when $\mu_e \le \frac{1}{2}$, and $p(\mu_e) = \frac{3}{10} - \frac{\mu_e}{5}$ when $\mu_e > \frac{1}{2}$. Furthermore, $\mu_e^1 = \frac{(5u_0-9)}{10}$ and $\mu_e^2 = \frac{(21-5u_0)}{14}$.

To echo Proposition 2, we construct a numerical example.

Example 1. *We use a weakly convex piecewise linear function $p(\mu_e)$ given by:*

$$p(\mu_e) = \begin{cases} \frac{7}{10} - \mu_e, & \text{if} \quad \mu_e \le \frac{1}{2} \\ \frac{3}{10} - \frac{\mu_e}{5}, & \text{if} \quad \mu_e > \frac{1}{2} \end{cases}$$

Furthermore, we take $b = 0, \eta = \frac{3}{4}$, $\alpha = 1$, $R(\alpha) = 2$ and $(1-\beta) = \frac{1}{3}$. The function $G(\mu_e)$ can be further expressed as

$$G(\mu_e) = \begin{cases} \frac{9}{20} + \frac{1}{2}\mu_e - \frac{1}{4}u_0, & \text{if} \quad \mu_e \le \frac{1}{2} \\ \frac{21}{20} - \frac{7}{10}\mu_e - \frac{1}{4}u_0, & \text{if} \quad \mu_e > \frac{1}{2} \end{cases}$$

Obviously, given u_0, $G(\mu_e)$ is maximized at $\mu_e = \frac{1}{2}$. Denote $\mu_e^1 = \frac{(5u_0-9)}{10}$ and $\mu_e^2 = \frac{(21-5u_0)}{14}$. Depending on the value of u_0:

(i) $u_0 \le \frac{7}{5}$. Then, $G(\mu_e) > 0$ for all $\mu_e < 1$ and $G(1) \ge 0$. Thus, $\mu_e^* = 1$ is the unique equilibrium education level.

(ii) $\frac{7}{5} < u_0 < 2$. There exist two interior solutions such that $0 < \mu_e^1 < \frac{1}{2} < \mu_e^2 < 1$. But, at $\mu_e = \mu_e^1$, educational resonance is too weak and thus experts find it sub-optimal to provide consulting services and the incentive compatibility condition is violated ex post for experts.[17] *Note that we also have $G(0) < 0$, and thus $\mu_e^* = 0$ is another equilibrium education level. In this case, there are two equilibriums, that is, $\mu_e^* \in \{0, \mu_e^2\}$.*

(iii) $2 \le u_0 < \frac{14}{5}$. There exists two interior solutions such that $0 < \mu_e^1 < \frac{1}{2} < \mu_e^2 < 1$.[18] *Again, $\mu_e^* = 0$ is also an equilibrium education level. Thus, there are three equilibriums, that is, $\mu_e^* \in \{0, \mu_e^1, \mu_e^2\}$. An interesting observation is that even with higher entertainment utility, more equilibriums with higher aggregate education can be supported, which is mainly driven by education resonance.*

equilibria: $\mu_e^* = \eta b$ and $\mu_e^* \ge \hat{\mu}_e$. Essentially, Proposition 2 follows from this general result by replacing condition (3) with $G(1) \ge 0$.

[17] The upper bound 2 is derived from the incentive compatibility condition for experts $\frac{1}{p(\mu_e^1)} \ge (1-\beta)u_0 + 1$.

[18] When the amusement utility $u_0 = \frac{14}{5}$, the two interior solutions coincide, that is, $\mu_e^1 = \mu_e^2 = \frac{1}{2}$.

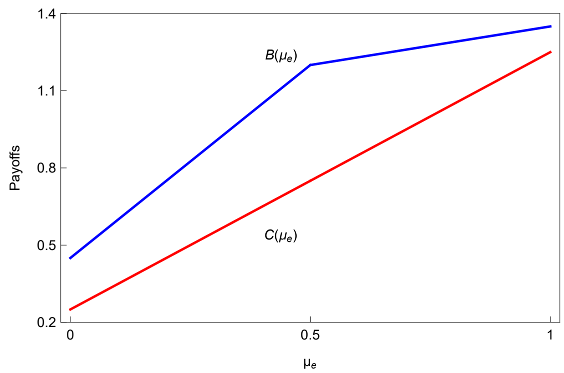


Figure 2: A unique equilibrium $\mu_e^* = 1$

Small amusement utility $u_0 = 1$

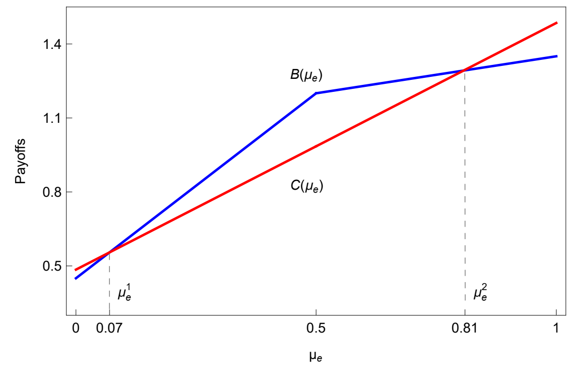


Figure 3: Two equilibrium $\mu_e^* \in \{0, \mu_e^2\}$

Intermediate amusement utility $u_0 = \frac{19}{11}$

(iv) $u_0 > \frac{14}{5}$. *Then,* $\sup_{\mu_e \in [0,1]} G(\mu_e) < 0$. *Thus,* $\mu_e^* = 0$ *is the unique equilibrium and the education market always breaks down.*

The equilibrium characterization is summarized in Table 1.

Example 1 can be further illustrated with Figures 2, 3, and 4, which correspond to three cases where the entertainment utility is small, intermediate, and large.

Small entertainment utility. Figure 2 corresponds to the case with a small entertainment utility. The blue and red lines correspond to the net benefits and opportunity costs of acquiring education in equation (15). Specifically, the blue line represents how the net education benefits $B(\mu_e)$ depends on the aggregate education μ_e, while the red line represents the cost term $C(\mu_e)$. Any intersection of these two lines forms an interior solution equilibrium, as long as the incentive compatibility conditions hold for experts and educated workers. Here, there is a unique equilibrium $\mu_e^* = 1$ because the blue line always lies above the blue line, and thus all agents choose to acquire education.

Intermediate entertainment utility. Figure 3 depicts the case with an intermediate entertainment utility u_0, which can result from technological advances in digital media platforms. First, $\mu_e^* = 0$ is an equilibrium since the opportunity costs $C(\mu_e)$ (the red line) always dominate the net benefits $B(\mu_e)$ (the blue line). Second, we also have two interior solutions μ_e^1 and μ_e^2. However, μ_e^1 is not an equilibrium because the incentive compatibility condition for experts is violated. Thus, we have two equilibria $\mu_e^* \in \{0, \mu_e^2\}$.

An increase in entertainment utility u_0 has two effects. First, it decreases the maximum aggregate education from $\mu_e^* = 1$ to $\mu_e^* = \mu_e^2 < 1$. Second, it creates equilibrium multiplicity, which can also lead to low aggregate education, primarily as a result of ineffective coordination.

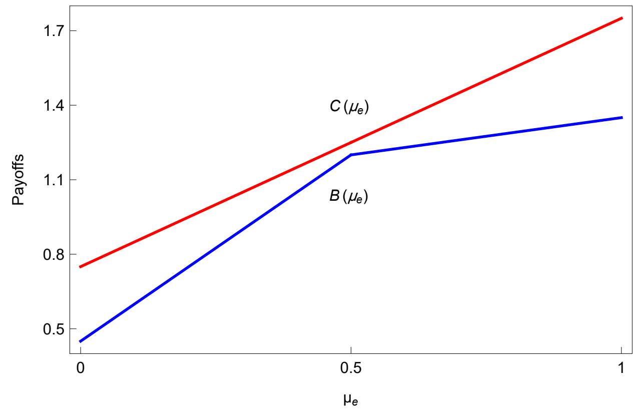


Figure 4: A Unique equilibrium with minimal education $\mu_e^* = 0$

Large amusement utility: $u_0 = 3$.

Large entertainment utility. Figure 4 represents the equilibrium with a large entertainment utility. The red line, which still captures the opportunity cost of education acquisition, lies above the blue line, which captures the net benefits of education. Therefore, the unique equilibrium features minimal aggregate education, that is, $\mu_e^* = 0$. In other words, the market for investment collapses when the entertainment utility is large enough. The rise of digital media platforms increases the intrinsic amusement value of interacting with online influencers, which leads to a higher amusement utility u_0, although this value is more controversial from a healthy societal development.

4.2 Technology and Anti-Intellectual Influence

Digital influence crowding out education and conventional jobs. For a chosen equilibrium, what is the effect of digital social media and search technology in general on education and occupational choices? Under very mild conditions, Proposition 3 shows that amusement-oriented influence invites anti-intellectualism by crowding out education.

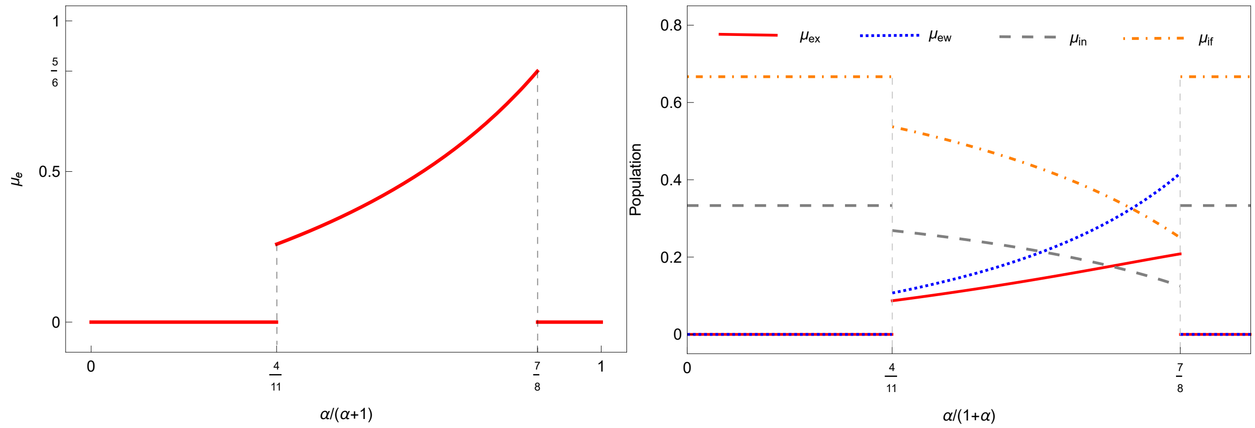
Recall that $\bar{L} = \sup_{\mu_e \in [\eta b, 1]} \{\eta b + \eta(1 - p(\mu_e))R(\alpha) - \mu_e\}$.

Proposition 3 (Anti-Intellectual Influence)**.**

(i) Given any $u_0 > 0$, a market breakdown for investment occurs when the search friction α is too small or too large. In contrast, when $u_0 = 0$, there is no market breakdown.

(ii) For any $u_0 \geq \frac{\bar{L}}{\eta(1-\beta)}$, a market breakdown in investment always occurs. Furthermore, when a breakdown occurs, the aggregate education is minimal (that is, $\mu_e^* = \eta b$).

First, for any positive entertainment utility u_0, a market breakdown in investment occurs when search friction is too large or too tiny, compared to the economy without influencers. Specifically, when α is small, the matching probabilities are insensitive to the prices charged by experts, which are now set at the highest level of $M*(2\rho_i - 1)$. Anticipating this, educated



(a) Aggregate education (b) Occupational shifts

Figure 5: Search friction, aggregate education and occupational shifts
Parameters: $p(\mu_e) = \frac{1}{2} - \frac{\mu_e}{5}$, $b = 0, \theta = 0$, $u_0 = 2$, $\eta = \frac{3}{4}$, $R = \frac{3(\alpha+1)}{(\alpha+2)}$, $c_I = 2$ and $\beta = \frac{2}{3}$.
When $\alpha \in [\frac{4}{7}, 7]$, there is no market breakdown and $\mu_e^* = \frac{5(1+5\alpha)}{2(31+11\alpha)}$.

workers quit the investment market ex ante.[19] For centuries, we have believed that α is too small and technology has improved over time so that we have intermediate α that leads to an increase in formal education, leading to more educated agents and experts. However, when α is large, almost perfect matching generates a winner-takes-all phenomenon for top experts, but has no discernible effect on the expected size of educated workers. Note that the best experts, when they win, receive minimal payoffs because of fierce price competition from those likewise competent peer experts. This wipes out profits and disrupts the incentive for experts to participate in investment. [20]

Second, when the entertainment utility is large, a market breakdown occurs for investment, and a minimal level of aggregate education ensues. This creates a welfare concern, and in general we do not anticipate that entertainment utility dominates the value of investing.

Next, Lemma 2 establishes conditions under which an increase in entertainment utility decreases aggregate education in the intensive margin.

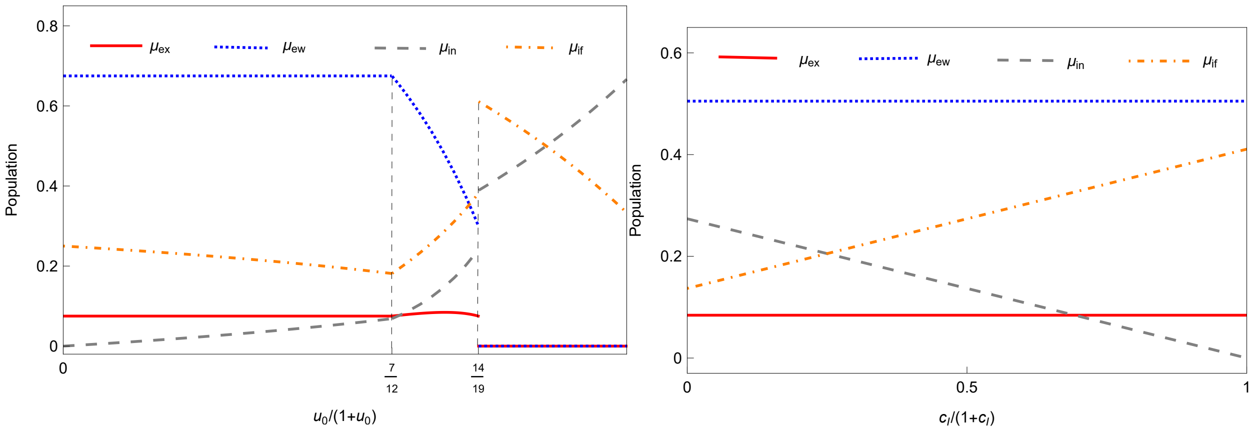
Lemma 2. *Assume that no market breakdown for investment. Then: (i) When $G'(\cdot) < 0$, $\frac{d\mu_e^*}{du_0} < 0$, that is, an increase in entertainment utility crowds out education; and (ii) The highest equilibrium aggregate education $\sup\{\mu_e^*\}$ satisfies $\frac{d \sup \mu_e^*}{du_0} \leq 0$ when $p(\cdot)$ is continuously differentiable and $p''(\cdot) > 0$.*[21]

First, $G'(\cdot) < 0$ in case (i) is valid only when $|p'(\cdot)|$ is not very large, which intuitively means a weak effect of educational resonance. Indeed, weak education resonance implies that the return from acquiring education is insensitive to the belief change in aggregate education,

[19] because $\mathbb{E}[u_j^{ew}] = \frac{\alpha R(\underline{\rho}, \bar{\rho})}{(\alpha+2)} < (1-\beta)u_0 + b$.

[20] Formally, $\lim_{\alpha\to\infty} f_i^* = \lim_{\alpha\to\infty} \frac{M*(2\rho_i - 1)}{(\alpha+1)} = 0$ and that $\lim_{\alpha\to\infty} \frac{\mu_{ew}}{\mu_{ex}} * \frac{R(\alpha)}{\alpha+1} \leq \frac{1-p(1)}{p(1)} * 0 * M(2\overline{\rho} - 1) = 0$.

[21] This also holds when $p(\cdot)$ is weakly convex and piecewise linear.



(a) Entertainment utility

(b) Entry cost

Figure 6: Occupational shifts

(Left) Example 1 with parameters: $b = \theta = 0, \eta = \frac{3}{4}$, $\alpha = 1$, $R(\alpha) = 2$, $c_I = 2$ and $\beta = \frac{2}{3}$. We focus on the highest aggregate education supported $\mu_e^* = \mu_e^2 = \frac{(21-5u_0)}{14}$ for $u_0 \in [\frac{7}{5}, \frac{14}{5}]$.

(Right) Example 1 with parameters: $b = \theta = 0, \eta = \frac{3}{4}$, $\alpha = 1$, $R(\alpha) = 2$, $u_0 = 1$ and $\beta = \frac{2}{3}$.

and thus more agents switch to influencer follow-up as entertainment utility increases. This is illustrated in Figure 5a. Second, case (ii) extends case (i) by focusing on the highest aggregate education in the presence of multiple equilibria. Since $p(\cdot)$ is decreasing, a convex function $p(\cdot)$ means that $|p'(\mu_e)|$ is relatively small for a large μ_e.[22]

Occupational shifts. Advances in digital social networks and search technology can generate variations in entertainment utility, search friction, and entry cost, leading to dynamic occupational shifts. These effects are shown in Figures 6a, 5b, and 6b.

First, increasing entertainment utility can generate dynamic occupational shifts and interesting welfare effects by changing the incentive to acquire education. Specifically, in Figure 6a, the solid red, loosely dashed gray, densely dashed blue, and dot-dashed orange lines represent the populations of experts, educated workers, influencers, and their followers, respectively. Initially, when $u_0 < \frac{7}{5}$, an increase in entertainment utility is insufficient to induce experts and educated workers to leave the investment market, and thus their populations, as well as the incentive to acquire education, remain unchanged. Meanwhile, more agents acquire influence and become influencers, mainly because a larger share of the surplus flows to influencers in this example. However, when $u_0 > 7/5$, as the entertainment utility further increases, the population of educated workers decreases, although the size of experts increases before it decreases. Consequently, there are fewer educated workers per expert,

[22]When $p(\cdot)$ is convex, then the net pay-off function $G(\cdot)$ is concave. There are three cases. One, there are two solutions such that $G(\mu_e^1) = G(\mu_e^2) = 0$. Since $G''(\cdot) < 0$, we have $G'(\mu_e^2) < 0$ by the Mean Value Theorem. Two, there exists only one solution such that $G(\mu_e^*) = 0$ and $G'(\mu_e^*) < 0$. Third, there exists only one solution such that $G(\mu_e^*) = 0$ and $G'(\mu_e^*) > 0$. Three, $\mu_e^* = 1$ also forms an equilibrium because $G(\mu_e) > 0$ for some $\mu_e > \mu_e^*$ and thus $G(1) \geq 0$. In summary, in the first two cases, we have $G'(\sup \mu_e^*) < 0$ and thus $\frac{d \sup \mu_e^*}{du_0} < 0$, while in the third case, $\sup \mu_e^* = 1$ and thus $\frac{d \sup \mu_e^*}{du_0} = 0$.

which lowers the value of formal education. In contrast, an increasing number of agents start to acquire influence or do influencer follow-up, and only agents with extremely small learning costs continue to pursue education. Lastly, when $u_0 > \frac{14}{5}$, agents with successful educational outcomes leave the investment market. This results in large declines in the number of experts and educated workers, which in turn destroys the incentive to acquire education.

Second, increasing search efficiency and decreasing entry costs can lead to dynamic occupational changes. In Figure 5b, when $\alpha > 7$ or $\alpha < \frac{4}{7}$, all agents, even with successful educational outcomes, leave the investment. However, for an intermediate level of search friction, a reduction in search friction motivates more agents to become experts and educated workers and discourages more people from acquiring influence or following influencers.

Third, removing the entry cost barrier for influencers does not change the incentive to acquire education, and thus the populations of both experts and educated workers remain unchanged. However, when the entry cost decreases, fewer followers are required per influencer, leading to a proliferation of influencers.

5 Welfare and Policy Intervention

We examine welfare and policy interventions that better harness digital (social) media and the influencer economy. Regulating influencers and subsidizing education appear to be obvious interventions to avoid amusing ourselves to death. But malignant digital media content, such as trash streaming, is hard to monitor.[23] Platforms have limited means and are usually not liable. While platforms like Twitch and YouTube pledge to remove thrash-streaming and violent videos, they only implement for the time being a nominal age restriction. Banning or taxing streamers often pushes them to find alternative arrangements or move to less restrictive spaces. The key is to realize that nothing happens in isolation: Creators create content to meet demand. As much as we criticize trash streamers for producing repulsive content, people who enjoy them should take blame, too. We thus touch upon the alternative policy approach to tax consumers of entertainment. Finally, we discuss equilibrium coordination and regulations related to platform designs.

[23] Anecdotes abound. See, e.g., https://aninjusticemag.com/the-alarming-rise-in-content-creators-who-profit-from-cruelty-da9401045210, https://ruj.uj.edu.pl/xmlui/handle/item/305781, https://www.insider.com/russian-man-dies-death-thrash-stream-livestream-drinking-vodka-2021-2, and https://news.ifeng.com/c/8PwesZ3Urjt.

5.1 Welfare and Technology

Lemma 3 (Total welfare). *Assume that $p(\cdot)$ is continuous. The total welfare W is given by*

$$W = \begin{cases} \eta b + \eta(1 - p(1)) * R(\alpha) + (1 - \eta)(1 - \beta)u_0 - \frac{1}{2}, & \textit{if } \mu_e^* = 1 \\ (1 - \beta)u_0 + \frac{1}{2}(\mu_e^*)^2, & \textit{if } \mu_e^* \in [\eta b, 1) \end{cases}$$

Let $\underline{u}_0$ denote the largest lower bound of u_0 below which $\mu_e^* = 1$ forms an equilibrium, and $\bar{u}_0$ denote the least upper bound of u_0 above which $\mu_e^* = \eta b$ is the unique equilibrium.[24]

Furthermore, we can introduce Assumption 1 to ensure that $\underline{u}_0 > 0$.

Assumption 1. $\eta b + \eta(1 - p(1))R(\alpha) - 1 > 0$.

With Assumption 1, we can further rewrite:

$$W(u_0) = \begin{cases} \eta b + \eta(1 - p(1)) * R(\alpha) + (1 - \eta)(1 - \beta)u_0 - \frac{1}{2}, & \text{if } u_0 \leq \underline{u}_0 \\ (1 - \beta)u_0 + \frac{1}{2}(\mu_e^*)^2, & \text{if } \underline{u}_0 < u_0 \leq \bar{u}_0 \\ (1 - \beta)u_0 + \frac{1}{2}(\eta b)^2, & \text{if } u_0 > \bar{u}_0 \end{cases}$$

When a market collapse occurs, the total welfare exhibits a downward leap at $u_0 = \bar{u}_0$, that is, $W(u_0-) - W(u_0+) = \frac{(\mu_e^*)^2}{2} - \frac{(\eta b)^2}{2} > 0$ provided $\mu_e^* \neq \eta b$. This abrupt change is driven by the reduction of the consumer surplus for those individuals with minimal educational expenses. When u_0 reaches $\bar{u}_0$, even a small increase in u_0 can trigger a market collapse, eliminating all positive investment surplus for those agents who alter their follow-up choices.

We next examine the welfare consequences of technology advancements.[25]

Proposition 4 (Digital Technology and Welfare). *Suppose that Assumption 1 holds.*

(i) Total welfare is non-monotonic in the entertainment utility u_0, given that $\mu_e^* \neq \eta b$ at $u_0 = \bar{u}_0$;

(ii) Total welfare is independent of the entry cost c_I;

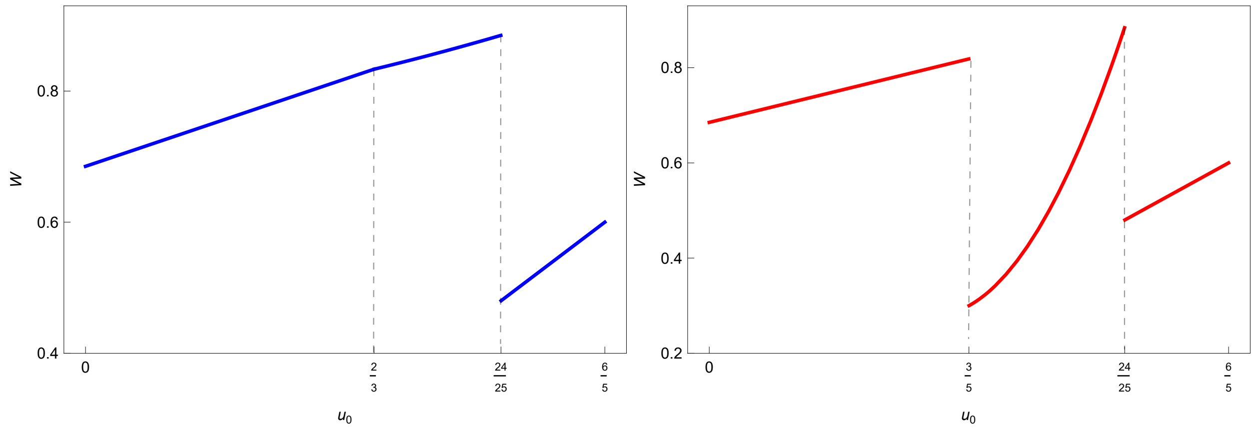
(iii) Total welfare is non-monotonic in the search friction parameter α;

(iv) Total welfare is increaseing in the labor market benefit b whenever $\frac{d \sup\{\mu_e^*\}}{du_0} < 0$.

Advancements in technology related to digital platforms can initiate a variety of changes in the markets of live streaming and education. First, it has the potential to reduce expenses related to gaining influence and help expand its reach to followers on digital media platforms. Second, it can enhance the utility of entertainment and the mutual surplus shared between influencers and their followers. Third, it can refine search technology and increase the effectiveness of matches in the educational market. Proposition 4 shows very interesting welfare implications, which are illustrated in the figures 7, 8 and 9.

[24] Obviously, $\bar{u}_0 < \infty$ by Proposition 3 and $\mu_e^* \geq \eta b$.

[25] We focus on the highest equilibrium belief $\sup\{\mu_e^*\}$ when multiple equilibria exist.



(a) High belief

(b) Low belief

Figure 7: Entertainment utility u_0 and total welfare W

We use the following numerical example: $p(\mu_e) = \frac{9}{10} - \frac{2}{3}\mu_e$ for $\mu_e \leq \frac{9}{10}$ and $p(\mu_e) = \frac{2}{5} - \frac{1}{9}\mu_e$ for $\mu_e > \frac{9}{10}$. Parameters: $\eta = \frac{5}{9}$, $b = 0$, $R(\alpha) = 3$, $\alpha = 1$, $\kappa = \frac{6}{5}$ and $(1-\beta) = \frac{1}{2}$. For $u_0 < \frac{3}{5}$, $\mu_e^* = 1$; for $u_0 \in [\frac{3}{5}, \frac{2}{3}]$, there are three equilibriums such that $\mu_e^* \in \{0, \mu_e^1, 1\}$, where $\mu_e^1 = \frac{5}{2}u_0 - \frac{3}{2}$; and for $u_0 \in (\frac{2}{3}, \frac{24}{25})$, there are three equilibriums $\mu_e^* \in \{0, \mu_e^1, \mu_e^2\}$ where $\mu_e^2 = \frac{27}{22} - \frac{15}{44}u_0$; for $u_0 = \frac{24}{25}$, $\mu_e^* = \frac{9}{10}$; for $u_0 > \frac{24}{25}$, $\mu_e^* = 0$.

Entertainment utility u_0. Figure 7 illustrates the impact of the entertainment utility u_0 on total welfare. Initially, when $u_0 \leq \frac{2}{3}$, $\mu_e^* = 1$, and the total welfare increases in entertainment utility because it increases the surplus for those with failed educational outcomes. Then, for $\frac{2}{3} < u_0 \leq \frac{24}{25}$, an increase in entertainment utility can increase the surplus of influencers' followers and reduce aggregate education. In Figure 7a, the welfare gains in the entertainment surplus dominate. Finally, for $u_0 > \frac{24}{25}$, there is a market breakdown for investment. In our numerical example, this leads to a 45.8% welfare loss when u_0 slightly exceeds $\frac{24}{25}$. However, when u_0 increases further, total welfare increases again, as aggregate education has reached its minimum level at $\mu_e^* = \eta b$. In addition, the equilibrium multiplicity can make the anti-intellectual influence more destructive. Specifically, for $u_0 \geq \frac{3}{5}$, $\mu_e^* \in \{0, \mu_e^1, \mu_e^2\}$. In Figure 7b, when the selected equilibrium belief is μ_e^1, not μ_e^2, it causes an even larger welfare loss of 63.3% when u_0 slightly exceeds $\frac{3}{5}$.

Influencer entry cost c_I. Surprisingly, the cost of entry for influencers does not impact social welfare. Figure 8 illustrates the irrelevance of the entry cost to total welfare, which is driven mainly by the free (endogenous) entry of influencers. Specifically, a lower entry cost invites more entry, which implies fewer followers per influencer, and thus a lower return on influence acquisition. There are two observations behind this result. First, due to ex-post free entry, all influencers and their followers receive identical expected utility $(1-\beta)u_0$. Second, when acquiring education, agents compare it with the outside option of influencer follow-up, which implies that the incentive to acquire education is independent of the entry cost. Therefore, the entry cost does not affect total welfare through education acquisition. Combining these two facts implies the irrelevance of the entry cost c_I for the total welfare.

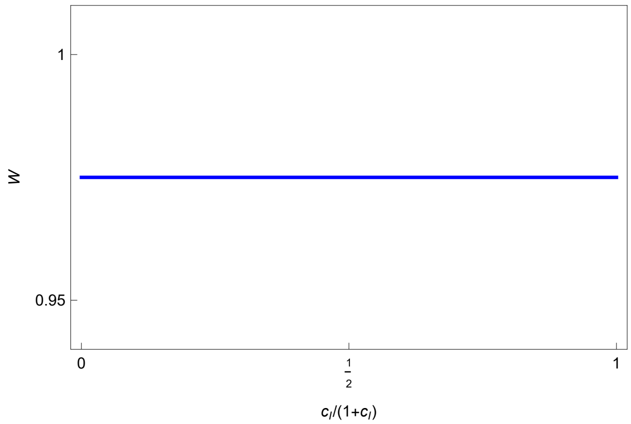


Figure 8: Entry cost

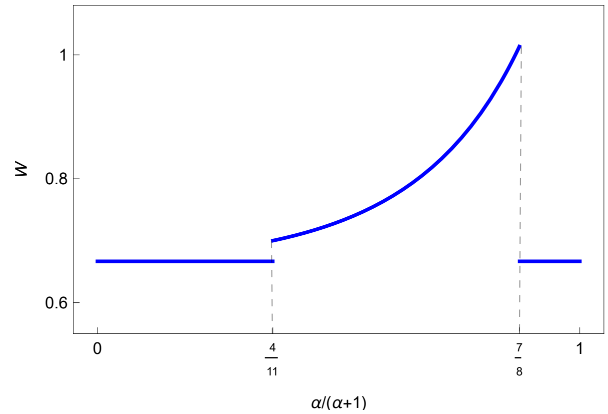


Figure 9: Search friction

(Left) Example 1 with parameters: $u_0 = 2, b = 0, \alpha = 1, \eta = \frac{3}{4}, A = 0; R(\alpha) = 2$ and $\beta = \frac{2}{3}$.
(Right) Parameters: Parameters: $p(\mu_e) = \frac{1}{2} - \frac{\mu_e}{5}$, $b = 0$, $u_0 = 2$, $\underline{\rho} = \frac{1}{2}$, $\eta = \frac{3}{4}$, $R = \frac{3(\alpha+1)}{(\alpha+2)}$ and $(1-\beta) = \frac{1}{3}$. When $\alpha \in [\frac{4}{7}, 7]$, there is no market breakdown and $\mu_e^* = \frac{5(1+5\alpha)}{2(31+11\alpha)}$.

Search friction α. Figure 9 demonstrates the non-monotonic impact of search friction on total welfare. There are two discontinuity points at $\alpha \in \{\frac{4}{7}, 7\}$. In particular, for $\alpha < \frac{4}{7}$, educated workers quit the investment market, while for $\alpha > 7$, experts quit the investment market due to fierce competition between themselves. Then, minimal aggregate education ensues. For $\alpha \in [4/7, 7]$, a reduction in search friction ($\alpha \uparrow$) improves investment efficiency, which, in turn, increases aggregate education and total welfare.

Labor market benefits b. As shown in Proposition 4, labor market benefits increase total welfare. It can both directly improve the return on education, as captured by the term ηb, and indirectly improve aggregate education acquisition, which in turn benefits individual education.[26] Total welfare increases since $\frac{\partial W}{\partial \mu_e^*} \geq 0$.

5.2 Policy Interventions

Now, we turn to policy interventions on how to regulate influencers and education markets, starting with direct economic incentives to influencers and influence consumers. This subsection considers economic incentives to discipline influencers, including taxing influencers, taxing digital consumption, and subsidizing education. We focus on total welfare and use a (negative) lump sum transfer to achieve a balanced budget if necessary.[27]

[26] Indeed, an increase in b is similar to decreasing the entertainment utility u_0. When combined with $\frac{d\mu_e^*}{du_0} \leq 0$, this increases aggregate education.

[27] We show that large subsidies are typically sub-optimal.

5.2.1 Taxing influencers

Proposition 4 provides important insights on taxing influencers. First, regulatory actions targeting live streaming influencers could partially backfire. Specifically, taxing influencers increases the entry cost barrier. As shown in our previous welfare analysis, this does not affect total welfare due to endogenous entry. However, due to ex-post free entry, this does not affect the incentive to acquire education, which is compared with the outside option of influencer follow-up and thus independent of influencer tax. Therefore, welfare losses due to inefficient education acquisition cannot be harnessed by taxing influencers alone. However, it does discourage excessive (endogenous) influencer entry and thus improves total welfare by saving entry costs. When influencers are taxed, each influencer receives more followers to offset the tax imposed so that the expected payoffs remain fixed. This increases total welfare because it saves entry costs as transferred through the government tax. In short, taxing influencers can mitigate the problem of excessive influencer entry when it exists, but cannot fix the disincentive in education acquisition.

More formally, let T_{in} denote the tax levied on influencers. Then, the total welfare after imposing T_{in} is given by: $\widetilde{W} = W(c_I+T_{in})+\mu^*_{in}(c_I+T_{in})T_{in} = W(c_I)+\mu^*_{in}(c_I+T_{in})T_{in}$, where $\mu^*_{in} = \frac{\beta(1-\eta\mu^*_e)}{1+(c_I+T_{in})/(\gamma u_0)}$. Note that the tax collected comes from the extra surplus generated and the entry cost saved when influencers switch their roles to followers. This implies that $\mu^*_{in}(c_I+T_{in})T_{in} < \mu^*_{in}(c_I)(u_0+c_I)$ and the upper bound can only be approximately achieved by letting $T_{in} \to \infty$.[28]

Remark 1. *In general, regulatory measures targeting live streaming influencers could have unintended consequences because they might boost education acquisition by limiting the variety of influencers, although they might curb the excessive influx of influencers and alleviate the impact of anti-intellectual influence. Section A.2 documents an inherent dilemma between curbing anti-intellectual influence and preserving influencer variety, which can lead to undesirable welfare loss and go against the initial goal of corrective regulatory policy. In short, taxing influencers can remedy influencer over-entry but can generate welfare loss and even backfire by reducing influencer variety.*

Taxing digital consumption. Now, we explore regulatory measures aimed at taxing digital consumption. Let $T_{if} > 0$ denote the amount taxed on digital consumption. This reduces the utility of influencer follow-up from $(1-\beta)u_0$ to $(1-\beta)u_0 - T_{if}$. Define $\tilde{u}_0 := u_0 - \frac{T_{if}}{1-\beta}$. Then $(1-\beta)u_0 - T_{if} = (1-\beta)\tilde{u}_0$. Thus, it generates a total welfare: $\widetilde{W} = W(\tilde{u}_0) + \mu^*_{if} * T_{if}$. When is taxing digital consumption desirable and why? This is generally true because it encourages education acquisition without compromising entertainment utility.

[28] If there is a minimum requirement on μ_{in}, say $\tilde{\mu}$, to keep the influencer industry alive, the tax revenue is bounded by $(\mu^*_{in}(c_I) - \tilde{\mu}) * (u_0 + c_I)$. The undesirable feature $T_{in} \to \infty$ is removed in Section A.2.

Lemma 4. *Suppose that $W(u) > W(u_0)$ for some $u < u_0$. Then, $T_{if} > 0$.*

Denote $T_{if} = (1-\beta)(u_0 - u) > 0$. Then, Lemma 4 holds because $W(u) + \mu_{if} T_{if} > W(u_0)$ by the assumed condition that $W(u) > W(u_0)$. Furthermore, Lemma 4 implies that when $W(\bar{u}_0) > W(u_0)$ for $u_0 > \bar{u}_0$, then we need to tax digital consumption. For example, $T^*_{if} > 0$ for $u_0 \in (\bar{u}_0, \bar{u}_0 + \varepsilon)$ with $\varepsilon > 0$ small, since the total welfare exhibits a downward jump at $u_0 = \bar{u}_0$ whenever $\mu^*_e \neq \eta b$. Unlike taxing influencer, taxing digital consumption can mitigate the issue of anti-intellectual influence.

Optimal tax scheme. Digital platforms are two-sided. Does it help further if both influencers and their followers are taxed? Corollary 1 below shows that taxing both sides generally dominates taxing one side alone.

Corollary 1. *Suppose that $W(u) + \mu^*_{in}(u)(u_0 + c_I) > W(u_0) + \mu^*_{in}(u_0)(u_0 + c_I)$ holds for some $u < u_0$. Then, it is strictly optimal to tax both influeners and digital consumption, that is, $T_{if} > 0$ and $T_{in} > 0$.*

Corollary 1 provides a simple and robust rule for policy intervention, that is, when anti-intellectual influence hurts total welfare, taxing both sides becomes essential, especially taxing digital consumption. Furthermore, inefficiency related to the disincentive in education acquisition can only be remedied by taxing digital consumption (or subsidizing education), while inefficiency related to excess entry can be fixed by taxing influencers.

5.2.2 Subsidizing education.

Now, we explore when and to what extent it helps by subsidizing education. Let S denote the education subsidy. Mimicking Equation (16), we obtain:

$$W(u_0|S) = \begin{cases} \eta b + \eta(1-p(1)) * R(\alpha) + (1-\eta)(1-\beta)u_0 - \frac{1}{2}, & \text{if } u_0 \leq \underline{u}_0(S) \\ (1-\beta)u_0 + \frac{1}{2}(\mu^*_e(v(S)))^2 - \mu^*_e(v(S)) * S, & \text{if } \underline{u}_0(S) < u_0 \leq \bar{u}_0(S) \\ (1-\beta)u_0 + \frac{1}{2}(\eta b)^2, & \text{if } u_0 > \bar{u}_0(S) \end{cases}$$

where $v(S) = u_0 - \frac{S}{\eta(1-\beta)}$, $\bar{u}_0(S) = \bar{u}_0 + \frac{S}{\eta(1-\beta)}$ and $\underline{u}_0(S) = \underline{u}_0 + \frac{S}{\eta(1-\beta)}$.

Start with $u_0 > \bar{u}_0$. First, when $u_0 > \bar{u}_0(S)$, say $S \leq \eta(1-\beta) * (u_0 - \bar{u}_0)$, a subsidy S cannot affect aggregate education and total welfare, although it has a distributive effect on the surplus of individuals.

Second, introducing a subsidy S generates a welfare change given by:

$$W(u_0|S) - W(u_0) = \frac{1}{2}\left(\mu^*_e(v(S))\right)^2 - \frac{1}{2}(\eta b)^2 - \mu^*_e(v(S)) * S$$

This term is positive if and only if: $S < \frac{(\mu_e^*(v(S))^2-(\eta b)^2}{2\mu_e^*(v(S))}$. Meanwhile, to avoid a breakdown in production, we need $S \geq \eta(1-\beta)(u_0 - \bar{u}_0)$, because it cannot change aggregate education and becomes irrelevant to welfare when it is too small. Then, we get:

$$\eta(1-\beta)(u_0 - \bar{u}_0) \leq S < \frac{(\mu_e^*(v(S))^2 - (\eta b)^2}{2\mu_e^*(v(S))}$$

Thus, an intermediate level of subsidy can increase total welfare when $(u_0 - \bar{u}_0)$ is small.

Third, when $\mu_e^* > \eta b$, we can compute: $\frac{dW(u_0|S)}{dS} = (\mu_e^* - S) * \frac{d\mu_e^*}{du_0} * \frac{dv(S)}{dS} - \mu_e^*(v(S))$. By Equation (15), $\frac{d\mu_e^*}{du_0} = -\frac{\eta(1-\beta)}{1+\eta R(\alpha)p'(\mu^*)}$. Together, it implies that

$$\frac{dW(u_0|S)}{dS} = \frac{-S - \eta R(\alpha) * \mu_e^* * p'(\mu_e^*)}{1 + \eta R(\alpha) p'(\mu^*)} \tag{16}$$

Thus, $\frac{dW(u_0|S)}{dS} \geq 0$ holds only when $S \leq -\eta R(\alpha) * \mu_e^* * p'(\mu_e^*)$. In particular, Equation (16) says that a small (large) subsidy can increase (decrease) total welfare.

We summarize all these discussions in Proposition 5 below.

Proposition 5. *Given the presence of anti-intellectual influence (that is, $u_0 > \bar{u}_0$ and $W(u_0) < W(\bar{u}_0)$), we have the following policy insights, including:*

(i) Taxing digital consumption can fix anti-intellectual influence, regardless of the size of $u_0 - \bar{u}_0$, without decreasing the influencer variety.

(ii) Taxing influencers alone cannot mitigate the issue of anti-intellectual influence. However, it helps remove over-entry of (homogeneous) influencers.

(iii) Subsidizing education can mitigate the anti-intellectual influence when $u_0 - \bar{u}_0$ is small, and a large subsidy may reduce total welfare.

5.2.3 Regulating labor market (including search on digital platforms)

Proposition 4 illustrates that a decrease in search friction does not necessarily improve overall welfare. Indeed, excessive search friction can obstruct the pairing of educated workers with top-tier experts, deterring their involvement in investment. However, perfect searching can dampen the incentive for experts to participate because the "winner-takes-all" phenomenon leads to little surplus left for experts. Specifically, the incentive compatibility condition for experts requires $\frac{1}{(\alpha+1)} R(\alpha) * (\frac{1}{p(\mu_e^*)} - 1) \geq (1-\beta)u_0$. By claim (ii) in Lemma B.1, $\frac{1}{(\alpha+1)} R(\alpha)$ strictly decreases in α and vanishes as $\alpha \to \infty$. Actually, when there is no market breakdown for investment, more efficient matching always improves total welfare. This has further implications for information design. For example, a platform should not release too much or too little information.

5.2.4 Equilibrium coordination

Previous analysis has ignored this issue by studying the highest belief when multiple equilibria exist. Here, we briefly discuss policy interventions aimed at coordinating to the "good" equilibrium, the one with higher total welfare. The following discussions are based on the local stability in Section A.6, which requires that $G'(\mu_e^*) < 0$. Intuitively, we say that an equilibrium is (locally) stable when, under a small belief perturbation, agents select the right action so that the equilibrium belief μ_e^* can be restored.

We offer three insights related to equilibrium selection. A caveat is that equilibrium selection requires precise knowledge about the model structure. First, taxing influencers is irrelevant for equilibrium selection because it cannot remedy the disincentive in education acquisition. Second, taxing digital consumption can be quite effective. For example, consider Example 1 where $u_0 = 3$. Focusing on the highest belief, we may choose a tax so that the effective entertainment utility $\tilde{u}_0 = u_0 - \frac{T_{if}}{(1-\beta)} \in [2, 14/5)$. However, there are now three equilibria, that is, $\mu_e^* \in \{0, \mu_e^1, \mu_e^2\}$, among which μ_e^1 is not locally stable, "zero" is a bad equilibrium, and μ_e^2 is a good equilibrium.[29] To rule out $\mu_e^* = 0$, we can tax digital consumption by $T_{if} = (1-\beta)(u_0 - \frac{9}{5} + \varepsilon)$, where $\varepsilon > 0$ is small. Thus, equilibrium selection does not contradict interventions aimed at governing anti-intellectual influence. Instead, it leads to a smaller but more robust prediction of total welfare. Third, subsidizing education can be socially costly and even generate inefficient education acquisition. From the discussion in Section 5.2, an intermediate level of subsidy is more likely to improve total welfare, given that the anti-intellectual influence issue is not severe (that is, $u_0 - \bar{u}_0$ is relatively small). However, a large subsidy might be needed for the purpose of equilibrium selection, which may both decrease total welfare and generate budget constraint issues. In summary, taxing digital consumption is the most plausible method for equilibrium selection.

5.2.5 Regulating platform designs

This section explores policy interventions related to platform design. Note that in our model, we have abstracted away from the underlying platform designs, which includes how matching and recommendations are done.

Entry cost c_I. Modifying the organizational framework of influencer platforms by increasing the entry cost, akin to imposing a tax on influencers, might not yield effective results. More generally, as documented in Section A.2, it could lead to a welfare-costly decrease in influencer diversity. With free entry of influencers, a higher entry cost suggests a larger number of followers per influencer, thereby hurting the diversity of influencers.

[29] Local instability means that when we start with a belief at $\mu_e^1 - \varepsilon$, it converges to 0; while with $\mu_e^1 + \varepsilon$, it converges to μ_e^2, where $\varepsilon > 0$ is small.

Entertainment utility u_0. Scaling back entertainment utility u_0 can alleviate the issue of anti-intellectual influence. However, this approach has several limitations. First, this requires prior knowledge of the precise model structure and may cause dead weight loss. First, unlike taxing digital consumption, a reduction in entertainment utility invariably results in a dead weight loss. Second, it requires knowing the precise mapping between the matching algorithm and the entertainment utility. If not, we may have excessively reduced the entertainment utility. Third, it cannot fix the problem of excess entry of influencers, which can only be fixed by taxing influencers, increasing the entry cost c_I, or licensing permits.

Surplus sharing rule β. Adjusting the surplus share parameter β is equivalent to taxing/subsidizing digital consumption. Thus, we can borrow regulatory insights related to digital consumption taxation. Specifically, if we change β to $\tilde{\beta} > \beta$, we can define $T_{if} = (\tilde{\beta} - \beta)u_0$ such that $(1-\beta)u_0 - T_{if} = (1-\tilde{\beta})u_0$. Similarly, given T_{if}, we can define $\tilde{\beta} = \beta - \frac{T_{if}}{u_0}$. Then, the policy insights are just reminiscent of taxing digital consumption. Similarly, adjusting β cannot fix the problem of over-entry of influencers. However, two observations are pertinent. First, reducing β equates to subsidizing digital consumption. Second, it should be noted that $(1-\tilde{\beta})$ could be negative if T_{if} is considerably large and β is already high.

Content categorization and license permit. The last point in platform design is to categorize content and license permits based on the value of the content. One possible policy suggestion is that the platform can broadly categorize content into purely horizontal entertainment versus vertically standardized educational content. Meanwhile, to remove redundant content and remedy over-entry of homogeneous influencer, the platform can license permits to increase the quality of content.

6 Extensions and Robustness

6.1 Mixed Strategy Equilibrium

Unlike the baseline model, we now explore the mixed strategy equilibrium in which a fraction of experts transition to following influencers when there is a lack of educated workers in investment. Specifically, given $\mu_e \in [0,1]$, consider the conjectured strategy as follows: (i) when $\frac{1-p(\mu_e)}{p(\mu_e)} * \frac{R(\alpha)}{\alpha+1} \geq (1-\beta)u_0$ holds, all experts remain in the investment; and (ii) when $\frac{1-p(\mu_e)}{p(\mu_e)} * \frac{R(\alpha)}{\alpha+1} < (1-\beta)u_0$, a fraction of experts, $(1-\delta)$, switch to following influencers until:

$$\frac{1-p(\mu_e)}{\delta p(\mu_e)} * \frac{R(\alpha)}{\alpha+1} = (1-\beta)u_0 \tag{17}$$

A notable distinction is that a market breakdown in investment is never triggered because experts are under-compensated. Now, we define $\hat{\mu}_e$ so that $\frac{1-p(\hat{\mu}_e)}{p(\hat{\mu}_e)} * \frac{R(\alpha)}{\alpha+1} = (1-\beta)u_0$, and focus on $\hat{\mu}_e > \eta b$ (lest experts' incentive compatibility is trivially satisfied). Furthermore, when $\frac{1-p(1)}{p(1)} * \frac{R(\alpha)}{\alpha+1} < (1-\beta)u_0$ holds, we define $\hat{\mu}_e = 1$. Obviously, when $\mu_e \geq \hat{\mu}_e$, $U_i(E|c_i)$ is unchanged, and thus $G(\mu_e)$ is given by Equation (15). However, when $\mu_e < \hat{\mu}_e$, $U_i(E|c_i) = -c_i + \eta b + \eta(1-p)R(\alpha) + (1-\eta+\eta p)(1-\beta)u_0$. Then, we can further define $\widetilde{G}(\mu_e) := U_i(E|c_i = \mu_e) - U_i(\varnothing|c_i = \mu_e)$ and get:

$$\widetilde{G}(\mu_e) = \eta b + \eta(1-p(\mu_e))\left(\frac{\alpha R(\alpha)}{(\alpha+1)} - (1-\beta)u_0\right) - \mu_e, \text{ if } \mu_e < \hat{\mu}_e \tag{18}$$

Correspondingly, similar to Equation (14), the following identity always hold

$$\mu_{if} + \mu_{in} = (1-\delta)\eta p(\mu_e)\mu_e + (1-\eta)\mu_e + (1-\mu_e) \tag{19}$$

Lemma 5 (Mixed Strategy Equilibrium)**.** *Assume that $\eta b \ll 1$ and that $p(\cdot)$ is continuous.*

(i) When $\alpha R(\alpha)/(\alpha+1) < (1-\beta)u_0$, $\mu_e^* = \eta b$;

(ii) When $\alpha R(\alpha)/(\alpha+1) \geq (1-\beta)u_0$ and $\hat{\mu}_e = 1$: (1) any μ_e^* such that $\widetilde{G}(\mu_e^*) = 0$ with $\mu_e^* < 1$ forms an equilibrium; and (2) when $\widetilde{G}(1) \geq 0$, $\mu_e^* = 1$ also forms an equilibrium;

(iii) When $\alpha R(\alpha)/(\alpha+1) \geq (1-\beta)u_0$ and $\hat{\mu}_e < 1$: (1) any μ_e^* such that $\widetilde{G}(\mu_e^*) = 0$ with $\mu_e^* < \hat{\mu}_e$ forms an equilibrium; (2) any $\mu_e^\dagger$ such that $G(\mu_e^\dagger) = 0$ with $\mu_e^\dagger \geq \hat{\mu}_e$ forms an equilibrium; and (3) when $G(1) \geq 0$, $\mu_e^\dagger = 1$ also forms an equilibrium.

Furthermore, δ, μ_{if}^* and μ_{in}^* are jointly determined by Equations (17), (13) and (19).

Lastly, all asymmetric equilibria are outcome equivalent to the mixed-strategy equilibria.

Analogous to Proposition 1, Lemma 5 characterizes the mixed strategy equilibrium, as well as all asymmetric equilibria. Furthermore, equilibrium multiplicity ensues.

Corollary 2. *Assume: (1) $p(\cdot)$ is continuous; (2) $\alpha R(\alpha)/(\alpha+1) \geq (1-\beta)u_0$; (3) $\hat{\mu}_e \in (\eta b, 1)$; (4) $\inf_{\mu_e \in (\eta b, \hat{\mu}_e)} \widetilde{G}(\mu_e) < 0$; and (5) $\sup_{\mu_e > \hat{\mu}_e} G(\mu_e) > 0$. Then, there exist at least two equilibria: $\mu_e^* \in (\eta b, \hat{\mu}_e)$ and $\mu_e^\dagger > \hat{\mu}_e$.*

Condition (4) says that agents with $c_i > \eta b$ abstain from acquiring education when the belief is pessimistic $\mu_e \in (\eta b, \hat{\mu}_e)$, knowing that some experts will quit the investment market.

6.2 Endogenous Labor Wages

This section considers endogenous labor payoff for experts, and it turns out that our main insights, including technology-induced equilibrium multiplicity and welfare-reducing digital influence, still hold. Specifically, educated workers and experts receive salaries w_1 and w_2, which are further determined by market clearing conditions in an external labor market.

Note that the baseline model reduces to $w_1 = w_2 = b$. Here, let $w_1 = b_1 > 0$ and

$$w_2(\rho_i, \mu_{ex}) = \frac{b_2}{\mu_{ex}} * \frac{\rho_i}{\mathbb{E}[\rho_i]} \tag{20}$$

Therefore, educated workers receive a homogeneous wage, while experts' wages are strictly increasing in their own ability parameter ρ_i and decreasing in the size of experts μ_{ex}. Again, as in the baseline model, experts decide whether to enter the investment market before learning about their own ability.

Introducing endogenous labor salaries changes the incentive to acquire education, although it does not affect the participation constraints for experts to engage in investment. Now, experts receive an expected wage of $\mathbb{E}[w_2(\rho_i, \mu_{ex})|\mu_{ex}] = \frac{b_2}{\mu_{ex}}$, which is independent of the decision to participate in the investment. Thus, we only need to replace the term ηb in Equation (12) with

$$\eta p(\mu_e) * \mathbb{E}[w_2(\rho_i, \mu_{ex})|\mu_{ex}] + \eta(1 - p(\mu_e)) * b_1 = \frac{b_2}{\mu_e} + \eta * (1 - p(\mu_e))b_1$$

Thus, we can define:

$$\widehat{G}(\mu_e) := \frac{b_2}{\mu_e} + \eta(1 - p(\mu_e)) * b_1 + \eta(1 - p(\mu_e))R(\alpha) - (\eta(1 - \beta)u_0 + \mu_e) \tag{21}$$

where we assume away the network effect (that is, $\theta = 0$).

Define $\underline{\mu} := \sup\{\mu_e \in [0, 1] : \frac{b_2}{\mu_e} + \eta(1 - p(\mu_e)) * b_1 \geq \mu_e\}$. Note that we can interpret $\underline{\mu}$ as the highest level of education when the investment market collapses. We assume that $\underline{\mu} < 1$. Then, we can restate the equilibrium as follows without proofs.

Lemma 6 (Equilibrium Education)**.** *The equilibrium education μ_e^* is determined as follows.*

(i) when $(\alpha \wedge (1/p(1) - 1)) * \frac{R(\alpha)}{\alpha+1} < (1 - \beta)u_0$, $\mu_e^* = \underline{\mu}$ is the unique equilibrium;

(ii) when $(\alpha \wedge (1/p(1) - 1)) * \frac{R(\alpha)}{\alpha+1} \geq (1 - \beta)u_0$, any $\mu_e^* \in [\underline{\mu}, 1]$ that satisfies $\widehat{G}(\mu_e^*) = 0$ and $(1/p(\mu_e^*) - 1) * \frac{R(\alpha)}{\alpha+1} \geq (1 - \beta)u_0$ forms an equilibrium. Furthermore, if $G(1) \geq 0$, then $\mu_e^* = 1$ also forms an equilibrium. Lastly, if $\big(\alpha \wedge \big(1/p(\underline{\mu}) - 1\big)\big) * \frac{R(\alpha)}{\alpha+1} < (1 - \beta)u_0$, $\mu_e^* = \underline{\mu}$ also forms an equilibrium.

Furthermore, equilibrium multiplicity ensues.

Define $\widehat{\mu}_e := \inf\{\mu_e \in [0, 1] : (\alpha \wedge (1/p(\mu_e) - 1)) * \frac{R(\alpha)}{\alpha+1} \geq (1 - \beta)u_0\}$

Corollary 3. *Assume: $\underline{\mu} < 1$, $\widehat{\mu}_e < 1$ and $(\alpha \wedge (1/p(1) - 1)) * \frac{R(\alpha)}{\alpha+1} \geq (1 - \beta)u_0$. There are at least two equilibria with $\mu_e^* = \underline{\mu}$ and $\mu_e^* > \underline{\mu}$ if: (i) $\widehat{G}(\mu_e) \geq 0$ for all $\mu_e \geq \underline{\mu}$ and $\widehat{\mu}_e > \underline{\mu}$; or (ii) $\widehat{G}(\underline{\mu}) < 0$ and $\widehat{G}(\mu_e) \geq 0$ for some $\mu_e \in [\widehat{\mu}_e, 1]$.*

Corollary 3 is almost self-evident, and thus the proof is skipped. Case (i) says that if the search friction is too tiny, then experts choose to quit investment under a pessimistically low belief and choose not to quit under a high social belief, although the expected return to education are large in both case had there been no market breakdown. Meanwhile, case (ii) says that when complementarity is sufficiently large (that is, the change in $p(\mu_e)$ is large when we increase μ_e from $\underline{\mu}$ to some $\mu_e > \widehat{\mu}_e$), equilibrium multiplicity can also arise.

Two comments require further clarification. First, more attractive outside wages (that is, $b_1 \uparrow$ and $b_2 \uparrow$) make it more difficult for equilibrium multiplicity to arise by inducing a higher level of education in the absence of expert-led investment activities. Note that this effect also exists in the fixed labor income case when we increase b in the baseline model. Second, we are agnostic about total welfare in the external labor market, and thus our welfare analysis is a partial equilibrium analysis.

6.3 Network Effects & Externality

In sustainability, network economics refers to multiple professionals (architects, designers, or related businesses) all working together to develop sustainable products and technologies. The more companies that participate in environmentally friendly production, the easier and cheaper it will be to produce new sustainable products. For example, if no one produces sustainable products, it is difficult and expensive to design a sustainable house with custom materials and technology. But due to network economics, the more industries are involved in creating such products, the easier it is to design an environmentally sustainable building. Here, we consider a positive network effect by specifying $A(\theta, \mu_{ex}, \mu_{ew}) = \theta * (\mu_{ex} + \mu_{ew})$ with $\theta > 0$. Since agents are infinitesimal, they cannot internalize these positive externalities.

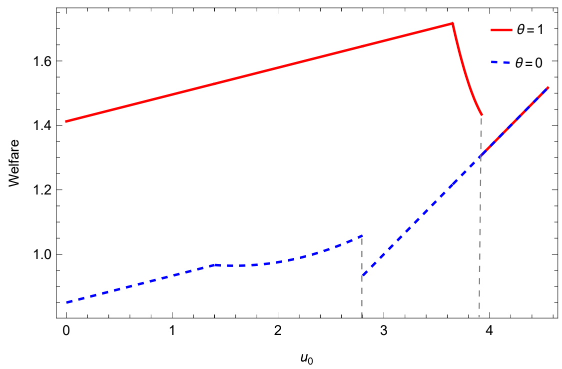
Incorporating network effects affects equilibrium characterization in several ways. First, the belief directly affects the interim incentive to participate in the investment.Furthermore, a higher belief strengthens the ex ante incentive to acquire education.

However, note that adding the network effect does not rule out equilibrium multiplicity. For example, consider $b = 0$. Then, if $\mu_e^* = 0$ can be supported as an equilibrium without network effects, it also forms an equilibrium with network effects, since the network surplus disappears when all people anticipate $\mu_e^* = 0$. Furthermore, the presence of network effects may have ambiguous welfare effects. To see this, we can compute total welfare as:

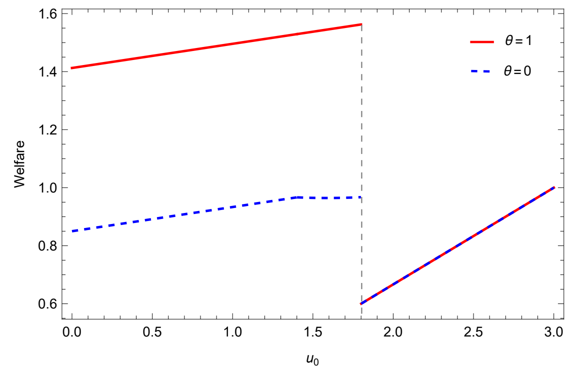
$$W^E = \begin{cases} \eta b + \eta(1 - p(1))R(\alpha) + (1 - \eta)(1 - \beta)u_0 - \frac{1}{2} + \eta^2\theta, & \text{if } u_0 \leq \underline{u}_0^E \\ (1 - \beta)u_0 + \frac{1}{2}(\mu_e^*)^2, & \text{if } \underline{u}_0^E < u_0 \leq \bar{u}_0^E \\ (1 - \beta)u_0 + \frac{1}{2}(\eta b)^2, & \text{if } u_0 > \bar{u}_0^E \end{cases} \tag{22}$$

where $\underline{u}_0^E$ (when exists) is the largest lower bound such that $\mu_e^* = 1$ forms an equilibrium, and $\bar{u}_0^E$ is the least upper bound of u_0 above which $\mu_e^* = \eta b$ is the unique equilibrium.

On the one hand, it can improve welfare by generating network surplus and, even more



(a) High Belief



(b) Low Belief

Figure 10: Welfare Analysis with Network Effects

Example 1 modified by specifying $A(\theta, \mu_{ex}, \mu_{ew}) = \mu_{ex} + \mu_{ew}$, that is, $\theta = 1$.
For reference, "$\theta = 0$" indicates the absence of the network effect.

importantly, by encouraging education acquisition. However, it can also lead to more destructive welfare effects when a market breakdown for investment occurs. Figure 10 illustrates this with Example 1 modified by specifying $A(\theta, \mu_{ex}, \mu_{ew}) = \theta(\mu_{ex} + \mu_{ew})$ and $\theta = 1$. Specifically, Figure 10a illustrates the positive impact on welfare when the most optimistic belief is selected. In this case, adding network effects stimulates more aggregate education, and full education (that is, $\mu_e^* = 1$) can be supported as an equilibrium for $u_0 \leq \frac{73}{20}$, but only for $u_0 \leq \frac{7}{5}$ without the network effect. On the contrary, Figure 10b illustrates the negative welfare impact of network externality under a more pessimistic belief, where the red line and the blue dashed line correspond to total welfare with and without the network effect. When the entertainment utility exceeds $u_0 = \frac{9}{5}$ from below, the welfare loss extends from 38.1% to 61.5% when we add network effects. Thus, with network effects, anti-intellectual influence is more destructive.

6.4 Alternative Game Specifications

We introduce three alternative models and compare them with our benchmark model. First, we consider a sequential education game in which agents initially choose to acquire education VS. influence and then decide whether to acquire influence after learning the educational outcome in stage t_1. In other words, we allow for influence training both before and after the educational outcome is revealed. This setup is equivalent to our baseline model.

Second, in Section A.3 we consider a one-round education game where agents can choose between three mutually exclusive actions, including acquiring education, acquiring influence and doing nothing in stage t_1, which is then followed by the choice of service in stage t_2. Note that agents can no longer acquire influence after as the educational outcome is revealed, making the influencer market less competitive. Basic insights are robust, although it affects the market in several ways. First, $\mu_e^* = 1$ is never an equilibrium because the return of becoming an influencer is unbounded if no one acquires influence. Second, without ex-post free entry, influencers can enjoy market power. This generates interesting welfare effects. When both the return on investment and the cost of influence training are large, an increase in the cost of influencer training always benefits total welfare because it mitigates excessive entry and encourages education acquisition.

Third, in Section A.4, we consider a two-round education game in which agents can choose to acquire influence or education (or do nothing) for two rounds, although the same agent is not allowed to acquire education twice. For example, an agent can choose to acquire education after acquiring influence. We show that any equilibrium in the baseline model still constitutes an equilibrium, although more equilibrium may arise because some agents may delay acquiring education due to coordination issues.

7 Conclusion

We study individual decisions about educational pursuit, occupational choice, influence acquisition, and economic production, in the presence of increasingly ubiquitous digital (social) media that offer sheer entertainment. Education not only imparts knowledge, but also determines initial labor market placements; thus, either high or low search frictions in the market for educated experts may reduce endogenous education. More importantly, the rise of the influencer economy via digital platforms then alters the allocation of attention and effort, and thus resources in the society. Technologies that augment entertainment surplus (e.g., improved matching and amplified outreach) can discourage or even break down education. Education pursuits exhibit complementarity in the presence of a sizable influencer economy, resulting in multiple equilibria including one featuring inefficiently low education. Education and occupational choices exhibit generally non-monotonic dependence on labor market search frictions and digital influence technologies. Digital influence becomes "anti-intellectual" because it crowds out not only people's attention but also education and productive occupational choices, especially when societal decisions and public goods provision rely on an individual's logic and scientific understanding. Regulations directly targeting influencers or reducing search friction in the labor market may backfire, but taxing both influencers and followers helps. Interventions to coordinate equilibria and adjust platform designs can also mitigate inefficiency.

'When a population becomes distracted by trivia, when cultural life is redefined as a perpetual round of entertainments, when serious public conversation becomes a form of baby-talk, when, in short, a people become an audience and their public business a vaudeville act, then a nation finds itself at risk; a culture-death is a clear possibility"

— Neil Postman, *Amusing Ourselves to Death: Public Discourse in the Age of Show Business (p.155-56, New York: Penguin, 2005)*

Acknowledgement Siguang Li acknowledges the generous research support from the Guangzhou-HKUST(GZ) Joint Funding Program (2024A03J0630).

References

Aguiar, Mark and Erik Hurst, "Measuring trends in leisure: The allocation of time over five decades," *The quarterly journal of economics*, 2007, *122* (3), 969–1006.

_ , Mark Bils, Kerwin Kofi Charles, and Erik Hurst, "Leisure luxuries and the labor supply of young men," *Journal of Political Economy*, 2021, *129* (2), 337–382.

Allcott, Hunt and Matthew Gentzkow, "Social media and fake news in the 2016 election," *Journal of economic perspectives*, 2017, *31* (2), 211–236.

_ , _ , and Lena Song, "Digital addiction," *American Economic Review*, 2022, *112* (7), 2424–2463.

Becker, Gary S, "A Theory of the Allocation of Time," *The economic journal*, 1965, *75* (299), 493–517.

Berger, Jonah and Katherine L Milkman, "What makes online content viral?," *Journal of marketing research*, 2012, *49* (2), 192–205.

Berryman, Chloe, Christopher J Ferguson, and Charles Negy, "Social media use and mental health among young adults," *Psychiatric quarterly*, 2018, *89*, 307–314.

Bhargava, Hemant K, "The creator economy: Managing ecosystem supply, revenue sharing, and platform design," *Management Science*, 2022, *68* (7), 5233–5251.

Card, David, "The causal effect of education on earnings," *Handbook of labor economics*, 1999, *3*, 1801–1863.

Choudhury, Munmun De, Hari Sundaram, Ajita John, Doree Duncan Seligmann, and Aisling Kelliher, "" Birds of a Feather": Does User Homophily Impact Information Diffusion in Social Media?," *arXiv preprint arXiv:1006.1702*, 2010.

Cong, Lin William and Siguang Li, "Influencer marketing and product competition," 2023. Working paper, Available at SSRN: `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3975727`.

DeMarzo, Peter M., Dimitri Vayanos, and Jeffrey Zwiebel, "Persuasion Bias, Social Influence, and Unidimensional Opinions," *Quarterly Journal of Economics*, 2003, *118* (3), 909–968.

Deryugina, Tatyana and Olga Shurchkov, "The effect of information provision on public consensus about climate change," *PloS one*, 2016, *11* (4), e0151469.

Drake, Michael S, James R Moon Jr, Brady J Twedt, and James D Warren, "Social media analysts and sell-side analyst research," *Review of Accounting Studies*, 2022, pp. 1–36.

Fainmesser, Itay P and Andrea Galeotti, "The market for online influence," *American Economic Journal: Microeconomics*, 2021, *13* (4), 332–72.

Farrell, Michael, T Clifton Green, Russell Jame, and Stanimir Markov, "The democratization of investment research and the informativeness of retail investor trading," *Journal of Financial Economics*, 2022, *145* (2), 616–641.

Federman, Maya N, David E Harrington, and Kathy J Krynski, "The impact of state licensing regulations on low-skilled immigrants: The case of Vietnamese manicurists," *American Economic Review*, 2006, *96* (2), 237–241.

Gentzkow, Matthew, "Television and voter turnout," *The Quarterly Journal of Economics*, 2006, *121* (3), 931–972.

Geyser, Werner, "The state of influencer marketing 2023: Benchmark report," *Influencer marketing hub*, 2023. `https://influencermarketinghub.com/influencer-marketing-benchmark-report/`.

Goldman-Sachs, "The creator economy could approach half-a-trillion dollars by 2027," *Industry Report*, 2023, *April 19.* `https://www.goldmansachs.com/intelligence/pages/the-creator-economy-could-approach-half-a-trillion-dollars-by-2027.html`.

Golub, Benjamin and Matthew O. Jackson, "How Homophily Affects the Speed of Learning and Best-Response Dynamics," *Quarterly Journal of Economics*, 2012, *127* (3), 1287–1338.

Griliches, Zvi, "Education, human capital, and growth: a personal perspective," *Journal of Labor Economics*, 1997, *15* (1, Part 2), S330–S344.

Gronau, Reuben, "Leisure, home production, and work–the theory of the allocation of time revisited," *Journal of political economy*, 1977, *85* (6), 1099–1123.

Harmon, Colm, Hessel Oosterbeek, and Ian Walker, "The returns to education: Microeconomics," *Journal of economic surveys*, 2003, *17* (2), 115–156.

Hinnosaar, Marit and Toomas Hinnosaar, "Influencer Cartels," *Available at SSRN*, 2021.

Influencity, "The Largest Influencer Study in the US in 2023," *Industry Report*, 2023. `https://influencity.com/resources/studies/the-largest-influencer-study-of-the-united-states-2023/`.

Jain, Sanjay and Kun Qian, "Compensating online content producers: A theoretical analysis," *Management Science*, 2021, *67* (11), 7075–7090.

Jame, Russell, Stanimir Markov, and Michael C Wolfe, "Can FinTech competition improve sell-side research quality?," *The Accounting Review*, 2022, *97* (4), 287–316.

Katona, Zsolt, "Competing for influencers in a social network," *Available at SSRN 2335679*, 2020.

Khan, Ali, Kathryn Brohman, and Shamel Addas, "The anatomy of 'fake news': Studying false messages as digital objects," *Journal of Information Technology*, 2022, *37* (2), 122–143.

Lange, Fabian and Robert Topel, "The social value of education and human capital," *Handbook of the Economics of Education*, 2006, *1*, 459–509.

Lazarsfeld, P. and R. Merton, "Friendship as a Social Process: A Substantive and Methodological Analysis," *Freedom and Control in Modern Society, ed. by M. Berger*, 1954.

Lazear, Edward, "Academic achievement and job performance: Note," *The American Economic Review*, 1977, *67* (2), 252–254.

Lazer, David MJ, Matthew A Baum, Yochai Benkler, Adam J Berinsky, Kelly M Greenhill, Filippo Menczer, Miriam J Metzger, Brendan Nyhan, Gordon Pennycook, David Rothschild et al., "The science of fake news," *Science*, 2018, *359* (6380), 1094–1096.

Liu, Z Jessie and Yi Liu, "Asymmetric Impact of AI Matching on Influencer Marketing: Implications for Platform Revenue," 2023. Working paper, Available at SSRN: `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3801991`.

Malmendier, Ulrike. and Laura Veldkamp, "Information Resonance," 2022. Working paper, Available at SSRN: `https://www0.gsb.columbia.edu/faculty/lveldkamp/papers/CommunityScarring_MV_v4.pdf`.

McLuhan, Marshall, *Understanding media: The extensions of man*, MIT press, 1994.

_ , *Digital McLuhan: a guide to the information millennium*, Routledge, 1999.

_ , "The medium is the message," in "Communication theory," Routledge, 2017, pp. 390–402.

McMullan, Kylie, Christofer Laurell, and Leyland Pitt, "Managing the tensions in marketer-influencer relationships," *Business Horizons*, 2022, *65* (5), 559–566.

McPherson, Miller, Lynn Smith-Lovin, and James M Cook, "Birds of a feather: Homophily in social networks," *Annual review of sociology*, 2001, *27* (1), 415–444.

Merkley, Kenneth J, Joseph Pacelli, Mark Piorkowski, and Brian Williams, "Crypto-Influencers," *Available at SSRN*, 2023.

Mincer, Jacob, "On-the-job training: Costs, returns, and some implications," *Journal of political Economy*, 1962, *70* (5, Part 2), 50–79.

Mitchell, Matthew, "Free ad (vice): internet influencers and disclosure regulation," *The RAND Journal of Economics*, 2021, *52* (1), 3–21.

Nistor, Cristina and Matthew Selove, "Influencers: The power of comments," 2023. Available at SSRN: `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4118010`.

Osmundsen, Mathias, Alexander Bor, Peter Bjerregaard Vahlstrup, Anja Bechmann, and Michael Bang Petersen, "Partisan polarization is the primary psychological motivation behind political fake news sharing on Twitter," *American Political Science Review*, 2021, *115* (3), 999–1015.

Park, Michael, Erin Leahey, and Russell J Funk, "Papers and patents are becoming less disruptive over time," *Nature*, 2023, *613* (7942), 138–144.

Pei, Amy and Dina Mayzlin, "Influencing the influencers," *Available at SSRN 3376904*, 2019.

Pennycook, Gordon, Ziv Epstein, Mohsen Mosleh, Antonio A Arechar, Dean Eckles, and David G Rand, "Shifting attention to accuracy can reduce misinformation online," *Nature*, 2021, *592* (7855), 590–595.

PJdaren, "The State of the Influencers—China 2023," *PJdaren Research Report*, 2023. `https://mpost.io/wp-content/uploads/China-State-of-Influencers-2023.pdf`.

Psacharopoulos, George, "Education and development: A review," *The World Bank Research Observer*, 1988, *3* (1), 99–116.

Rachel, Lukasz, "Leisure-enhancing technological change," *Working Paper*, 2024.

Robertson, Claire E, Nicolas Pröllochs, Kaoru Schwarzenegger, Philip Pärnamets, Jay J Van Bavel, and Stefan Feuerriegel, "Negativity drives online news consumption," *Nature Human Behaviour*, 2023, *7* (5), 812–822.

Schultz, T Paul, "Education investments and returns," *Handbook of development economics*, 1988, *1*, 543–630.

Serra-Garcia, Marta, "he Attention-Information Tradeoff," 2024. Working paper.

_ **and Uri Gneezy**, "Mistakes, overconfidence, and the effect of sharing on detecting lies," *American Economic Review*, 2021, *111* (10), 3160–3183.

Sianesi, Barbara and John Van Reenen, "The returns to education: Macroeconomics," *Journal of economic surveys*, 2003, *17* (2), 157–200.

Spence, Michael, "Job market signaling," in "Uncertainty in economics," Elsevier, 1978, pp. 281–306.

The Economist, "Time for a digital detox?," *Science and Technology*, 2024, *April 20th-26th*, 67.

— , "Winning the generation game," *Kalamta and New York*, 2024, *April 20th-26th*, 57–59.

Weiss, Andrew, "A sorting-cum-learning model of education," *Journal of Political Economy*, 1983, *91* (3), 420–442.

Yang, Jeremy, Juanjuan Zhang, and Yuhan Zhang, "Engagement that Sells: Influencer Video Advertising on TikTok," 2023. Working paper, Available at SSRN: `https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3815124`.

Appendix

A Micro-foundation and Robustness

A.1 A Micro-Foundation of Entertainment Utility u_0

Consistent with the baseline model, we still assume random matching between influencers and their followers on live-streaming platforms. However, we now allow each follower to be matched with multiple influencers of different types, rather than only one. Alternatively, a data-driven algorithm can improve the quality of recommended videos, although the total time spent on live streaming apps such as Tiktok does not necessarily change. Here, we follow the first approach and view the practice of influencer follow-up as a variety good.

Specifically, we first fix the total time $t \in [0, 1]$ spent on live streaming platforms, which will be endogenized shortly. We also assume that the entertainment utility exhibits decreasing marginal return, that is, there exists an entertainment utility index $h(t)$ with $h(0) \geq 0$, $h'(t) > 0$ and $h''(t) < 0$ for all $t \in (0, 1)$. The impact of advances in live streaming and digital platform technology is modeled as an increase in the effective number of influencers paired with a follower. For example, if the digital platform matches two influencers with a follower, the time the follower spends interacting with each influencer is simply $\frac{t}{2}$. Although the total number of followers remains unchanged and the matching protocol still features random matching, the total amusement value u_0 increases from $h(t)$ to $2 * h(\frac{t}{2})$ if the entertainment utility is additive for the same follower when interacted with different influencers.

In general, when matched with k influencers, each follower receives an entertainment utility given by $u_0 = k * h(t/k) =: H(k)$. Then we show that $H(k)$ strictly increases in k, the number of influencers matched for each follower on live streaming platforms. Consider two successive integers, say k and $k+1$. This monotonicity reduces to $(k+1)h\left(\frac{t}{k+1}\right) > kh\left(\frac{t}{k}\right)$. In fact, this follows from the concavity and Jensen's inequality because

$$h\left(\frac{t}{k+1}\right) = h\left(\frac{k}{k+1}\frac{t}{k} + \frac{1}{k+1} * 0\right) > \frac{k}{k+1}h\left(\frac{t}{k}\right) + \frac{1}{k+1}h(0) > \frac{k}{k+1}h\left(\frac{t}{k}\right)$$

Next, we endogenize the total time t^* spent on live streaming platforms by followers. Assume that there exists a leisure cost $L(t)$ such that $L'(0) = 0$, $L'(1) = \infty$ and $L''(t) > 0, \forall t \in (0, 1)$. Here, the maximum leisure time is normalized as one. Given k, the index of digital platform technology, the follower solves: $t^*(k) \in \text{argmax}_{t\in[0,1]}\, kh\left(\frac{t}{k}\right) - L(t)$. Obviously, the follower's problem is strictly concave and thus the first order conditions fully characterize the optimum, that is,

$$h'(t^*/k) = L'(t^*) \tag{A.1}$$

We can verify the comparative statics with respect to k by examining Equation (A.1), which implicitly defines $t^*(k)$. When k increases, the LHS of Equation (A.1) increases because $h''(\cdot) < 0$. Thus, t^* needs to increase so that the RHS increases and the LHS decreases to make two sides equal. In summary, $t^*(k)$ increases strictly in k. Thus

$$H(k+1) = (k+1) * h\left(\frac{t^*(k+1)}{(k+1)}\right) > k * h\left(\frac{t^*(k+1)}{k}\right) > k * h\left(\frac{t^*(k)}{k}\right) = H(k).$$

Lastly, the maximum total number of types of influencer variety, denoted Ξ, is exogenous and fixed, reflecting all potential influencer styles and topics such as cooking, clothing, games, etc. However, a minimum size of influencers, say δ, is needed to form an influencer type and be accessed by followers. Once an influencer type is established, there is no size limit on followers who can access influencers within this type. We impose this restriction to reflect two facts. First, the influencer type is limited by topics, and influencer over-entry can no longer increase variety and lead to homogeneous content production within each type. Second, insufficient entry of influencers can decrease the number of influencer types accessible on digital social networks. In other words, the number of influencer types realized is given by $\min\{[\mu_{in}/\delta], \Xi\}$, where $[x] := \{z \in \mathbb{Z} : q \leq x\}$ returns the maximum integer less than x. Thus, with slight abuse of notation, the entertainment utility $u_0 = H(\min\{k, [\mu_{in}/\delta], \Xi\})$ is a function of the scaling efficiency parameter k, the number of influencer types realized $[\mu_{in}/\delta]$ and the maximum number of topics Ξ.

A.2 Entry cost, Influencer Variety and Policy Implications

Technological advances, including matching, scaling, and entry cost barrier, play a more fundamental role in shaping the influencer section than entertainment utility. Surprisingly, the welfare analysis in Section 5 yields the conclusion that entry costs have no bearing on overall welfare and that raising taxes on influencers is always preferable. Now, we use the micro-foundation for entertainment utility above to establish a linkage between the entry cost and total welfare through overall influencer variety. The main insight claims that the entry cost affects total welfare non-monotonically by changing the overall influencer variety.

Intuitively, when the entry cost c_I is large, the influencer population decreases, reducing the overall variety of influencers. To fix the idea, we denote $u_0 = H(\bar{k}, \mu_{in}) =: H(\mu_{in})$ where the matching efficacy parameter is set to $k = \bar{k}$. Define $c_I^\dagger := \bar{u}_0 * \big(\beta(1-\eta^2 b)/H^{-1}(\bar{u}_0) - 1\big)$. Let $\mu_{in}^*(c_I^\dagger)$ denote the largest solution such that: $\big(1 - \eta \sup \mu_e^*(H(\mu_{in}))\big) = \frac{\mu_{in}}{\beta} * \left(1 + \frac{c_I^\dagger}{H(\mu_{in})}\right)$. Furthermore, define $u_0^\dagger = H(\mu_{in}^*(c_I^\dagger))$.[30]

Lemma A.1. *(i) Total welfare is nonmonotonic in the cost of influencer entry c_I when: (1) $H(\mu_{in})$ is continuous, strictly increasing and satisfies $H(\beta(1-\eta^2 b)) > \bar{u}_0$; (2) $\frac{1}{2}(\sup \mu_e^*(u_0^\dagger))^2 - \frac{1}{2}(\eta b)^2 > (1-\beta) * (u_0^\dagger - \bar{u}_0)$; and (3) $\frac{\mu_{in}}{H(\mu_{in})}$ increases weakly in μ_{in}.*

Lemma A.1 is illustrated in Figure 11, which shows the non-monotonic impact of the entry cost on total welfare. Specifically, we use $u_0 = H(k, [\mu_{in}/\delta], \Xi)$ from Appendix A.1, and specify $\Xi = k = 4$, $\delta = 0.05$, and $H(k, [\mu_{in}/\delta], \Xi) = \frac{3}{2}\sqrt{[\mu_{in}/\delta]}$. There are five regions, including: (1) for $c_I \in (0, 3.07]$, $\mu_{in}^* + \mu_{if}^* = 1$, $\mu_{in}^* \geq 0.2$, $u_0 = 3$ and $W = 1$; (2) for $c_I \in (3.07, 3.86]$, $\mu_e^* = 0.88$, $\mu_{in}^* + \mu_{if}^* = 0.56$, $\mu_{in}^* \in [0.15, 0.2)$, $u_0 = 2.60$ and $W = 1.25$; (3) for $c_I \in (3.86, 4.99)$, $\mu_e^* = 0.99$,

[30] Intuitively, $c_I^\dagger$ is the cost threshold such that u_0 goes below $\bar{u}_0$, and $\mu_{in}^*(c_I^\dagger)$ is the equilibrium size of influencers. When c_I is adjusted, $\bar{u}_0$ may never be reached because μ_{in} is discontinuous at $c_I^\dagger$.

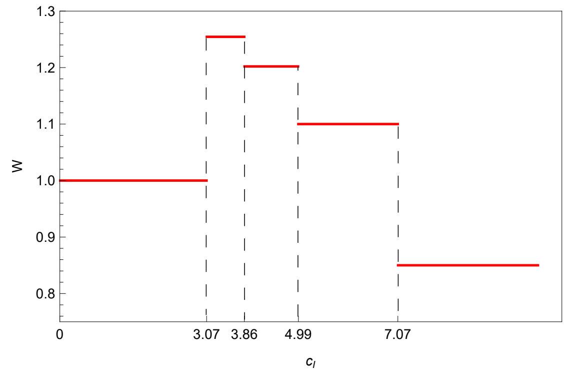


Figure 11: Entry cost c_I and total welfare W

We use Example 1 with parameters: $b = 0$, $\alpha = 1, \eta = \frac{1}{2}, R(\alpha) = 3$ and $(1-\beta) = \frac{1}{3}$.
We use a discrete function $u(k, [\mu_{in}/\delta], \Xi)$ as micro-founded in Appendix A.1.

$\mu_{in}^* + \mu_{if}^* = 0.51$, $\mu_{in}^* \in [0.1, 0.15)$, $u_0 = 2.12$ and $W = 1.20$; (4) for $c_I \in (4.99, 7.07]$, $\mu_e^* = 1$, $\mu_{in}^* + \mu_{if}^* = 0.50$, $\mu_{in}^* \in [0.05, 0.1)$, $u_0 = 1.50$ and $W = 1.1$; and (5) for $c_I \in (7.07, \infty)$, $\mu_e^* = 1$, $\mu_{in}^* + \mu_{if}^* = 0.50$, $\mu_{in}^* < 0.05$, $u_0 = 0$ and $W = 0.85$.

Considering the influencer variety as more primitive, we gain three important insights. First, it affects welfare non-monotonically. In Figure 11, an increase in the entry cost initially increases and then decreases the total welfare. Initially, when the entry cost is small, it generates a large influencer variety, leading to a large entertainment utility and anti-intellectual influence. Thus, raising the entry barrier can help decrease the entertainment utility and reduce welfare losses related to a collapse in the investment market. However, as the entry cost continues to increase, the variety of influencers decreases and overall welfare declines.[31]

Second , increasing entry costs can generate dead weight loss. Essentially, we decrease the variety of influencers to promote education, making it less desirable for policy intervention.

Third, total welfare does not depend on the entry cost in a certain range, mainly due to the free entry of influencers. This echoes the result in the baseline model. For example, the total welfare is set at $W = 1$ for $c_I \leq 3.07$ in Figure 11. Another interesting fact is that the entry and exit of homogeneous influencers do not affect the overall variety, leading to the insensitivity of welfare in certain regions.

Policy Implications Considering the micro-foundation of entertainment utility, the general lesson is that taxing influencers can remedy excessive entry, but can generate welfare loss and even backfire by reducing influencer variety.

Let T_{in} denote the tax levied on influencers. Then, the total welfare after imposing T_{in} is given by: $\widetilde{W} = W(c_I + T_{in}) + \mu_{in}^*(c_I + T_{in})T_{in}$. When $W(c)$ and $\mu_{in}^*(c)$ are continuously differentiable near c_I, we can further obtain: $\frac{d\widetilde{W}}{dT_{in}} = W'(c_I + T_{in}) + \mu_{in}^*(c_I + T_{in}) + \frac{d\mu_{in}^*}{dT_{in}} * T_{in}$. Furthermore, when $W'(c_I) + \mu_{in}^*(c_I) > 0$, the optimal tax for influencers satisfies $T_{in}^* > 0$. In Figure 11, for any $c_I < 7.07$ and $c_I \notin \{3.07, 3.86, 4.99\}$, $T_{in}^* > 0$ because $W'(c_I) = 0$ and $\mu_{in}^*(c_I) > 0$ as $T_{in} \to 0$. Therefore, taxing influencers is desirable, provided that it does not diminish the diversity of influencers.

[31] Note that entertainment utility can help increase the consumer surplus for those who exit the production sector, thereby enhancing welfare when it does not discourage education acquisition.

Furthermore, the negative welfare impacts of taxing influencers can be conveyed by the following hypothetical scenario. Suppose that the investment market initially collapses and total welfare, represented as a function of u_0, peaks at $u_0 = \bar{u}_0$. Also, assume that an optimal strategy would be to employ a regulatory policy $T_{in} > 0$ to set $u_0 = \bar{u}_0$. However, this may not be feasible due to the unexpected decrease in the diversity of influencers. This reduction comes not only from regulatory attempts to lower u_0 to $\bar{u}_0$, but also from an increase in the average number of followers required per influencer $\frac{\mu_{if}}{\mu_{in}}$, and an upward jump in aggregate education μ_e^*.[32] This inherent dilemma between curbing anti-intellectual influence and preserving influencer variety can lead to undesirable welfare loss and go against the initial goal of corrective regulatory policy.

Corollary A.1 shows that taxing both sides is optimal. Recall that $\underline{\mu}$ is the influencer size threshold at which the overall influencer variety stops increasing.

Corollary A.1. *Suppose that: (i) $u_0 > \bar{u}_0$; (ii) $W(\bar{u}_0) > W(u_0) + (\mu_{in}^*(u_0) - H^{-1}(\bar{u}_0))u_0$; (iii) $(1-\eta-\underline{\mu})u_0 > (1-\eta^2 b)u_0^{\dagger}$.[33]; and (iv) $\frac{\beta(1-\eta)}{1+c/u_0} \geq \underline{\mu} := \Xi\delta$. Then, it is strictly optimal to tax both influeners and digital consumption, that is, $T_{if} > 0$ and $T_{in} > 0$.*

Corollary A.1 establishes conditions when taxing both sides is optimal. First, conditions (i) and (ii) imply the existence of welfare loss related to anti-intellectual influence. Second, condition (iii) implies that taxing influencers alone can generate costly reduction in influencer variety. Third, condition (iv) means that there exist homogeneous influencers.

A.3 Simultaneous Education & Influence Choices

This section considers a robustness exercise in which agents simultaneously choose among "acquiring education" (E), "acquiring influence" (I) and "doing nothing" ($\varnothing$), that is, $a_i \in \{E, I, \varnothing\}$. Compared to the baseline setup, we do not allow ex-post switching, that is, agents cannot acquire influence after educational outcomes are revealed.

Observe first that $\mu_e^* < 1$. Assume that $\mu_e^* = 1$ if this were not the case. Then, as long as $\beta u_0 \neq 0$, there exists a measure of $(1-\eta)\mu_e^* > 0$ of uneducated followers, resulting in an unbounded return for becoming an influencer. Given this observation, there are three possible cases, including: (i) $\mu_e^* > \eta b$ and $U_i(I|c_i) = U_i(\varnothing|c_i) = U_i(E|c_i)$; (ii) $\mu_e^* > \eta b$ and $U_i(I|c_i) = U_i(E|c_i) > U_i(\varnothing|c_i)$; and (iii) $\mu_e^* = \eta b$ and $U_i(I|c_i) = U_i(\varnothing|c_i) > U_i(E|c_i)$. Note that cases (i) and (iii) coincide with those of the baseline model.

Next, we characterize the equilibrium. For simplicity, we assume that $b = 0$ and $A = 0$.

Lemma A.2. *Assume that $p(\cdot)$ is continuous. Then:*

(i) If $\sup_{\mu_e \in [0,1]} G(\mu_e) < 0$, $\mu_e^* = 0$ is the unique equilibrium, and μ_{in}^* and μ_{if}^* satisfy equation (13) and (14);

(ii) If $\inf_{\mu_e \in [0,1]} G(\mu_e) > 0$, all potential equilibrium μ_e^* satisfy that

$$G(\mu_e^*) + (1-\beta)u_0 = \frac{(1-\eta) * \mu_e^*}{(1-\mu_e^*)} * \beta u_0 - c_I \tag{A.2}$$

[32] By Equation (13), $\frac{\mu_{if}}{\mu_{in}} = \frac{(c_I + T_{in})/(\gamma u_0) + (1-\beta)}{\beta}$. Meanwhile, $\mu_{in} + \mu_{if} = 1 - \eta\mu_e^*$ and thus $\mu_{in} = \frac{1-\eta\mu_e^*}{1+\mu_{if}/\mu_{in}}$. The discontinuous change in μ_e^* for $u_0 \downarrow \bar{u}_0$ implies that $\bar{u}_0$ cannot be implemented.

[33] In our micro-founded example, $\underline{\mu}$. Furthermore, this condition reduces to $(1-\eta-\Xi\delta)u_0 > (1-\eta\mu_e^*(u_0^{\dagger}))u_0^{\dagger}$, when aggregate education is minimized at $\bar{u}_0$ for $u_0 \leq \bar{u}_0$.

and $\mu_{in}^* = (1-\mu_e^*)$ and $\mu_{if}^* = (1-\eta) * \mu_e^*$.

(iii) If $\sup_{\mu_e \in [0,1]} G(\mu_e) \geq 0 \geq \inf_{\mu_e \in [0,1]} G(\mu_e)$, all $\mu_e^* < 1$ satisfying $G(\mu_e^*) = 0$ and $\frac{(1-\eta)\mu_e^*}{(1-\mu_e^*)} * \beta u_0 - c_I \leq (1-\beta)u_0$, together with μ_{in}^* and μ_{if}^* satisfying equations (13) and (14), forms a potential equilibrium.

Furthermore, for all $\mu_e^* < 1$ such that $G(\mu_e^*) > 0$, any μ_e^* that satisfies Equation (A.2) also forms a potential equilibrium. If $G(0) < 0$, $\mu_e^* = 0$, together with Equation (13), also constitutes an equilibrium. Lastly, a potential equilibrium $\mu_e^* > 0$ forms an equilibrium when $(\alpha \wedge (1/p(\mu_e^*) - 1) * \frac{R(\alpha)}{\alpha+1} \geq (1-\beta)u_0$ holds; otherwise, if this is violated for all potential equilibrium $\mu_e^* > 0$, $\mu_e^* = 0$.

An interesting observation is that a high entry cost c_I may increase total welfare. To see this, by Equation (A.2), we can compute total welfare $\tilde{W}$ as: $\widetilde{W} = G(\mu_e^*) + (1-\beta)u_0 + \frac{1}{2}(\mu_e^*)^2$.[34] With Equation (15), we can further compute the effect of c_I on the total welfare as:

$$\frac{d\widetilde{W}}{dc_I} = \frac{d\widetilde{W}}{d\mu_e^*}\frac{d\mu_e^*}{dc_I} = (\mu_e^* + G'(\mu_e^*)) * \frac{d\mu_e^*}{dc_I} = \big((\mu_e^* - 1) - \eta R(\alpha)p'(\mu_e^*)\big)\frac{d\mu_e^*}{dc_I} \tag{A.3}$$

Furthermore, by differentiating over Equation (A.2), we get

$$\frac{d\mu_e^*}{dc_I} = \frac{1}{-G'(\mu_e^*) + \frac{(1-\eta)}{(1-\mu_e^*)^2}} \tag{A.4}$$

To understand the implication of Lemma A.2 , we first consider a large c_I such that $\mu_e^* \to 1$. Then, by Equation (A.4), we have $\frac{d\mu_e^*}{dc_I} > 0$, and thus $\frac{d\widetilde{W}}{dc_I} \to -\eta R(\alpha)p'(1)\frac{d\mu_e^*}{dc_I} > 0$, that is, total welfare strictly increases in influencer training cost c_I.[35] The intuition is as follows. If ex post switching is allowed, it is best for all agents to obtain education when $G(\mu_e) > 0$ for all $\mu_e \in [0,1]$. Rather, when ex post switching is prohibited, a positive proportion of agents always opt to gain influence in the simultaneous game in anticipation of a missing market. However,when the return on investment is high, it is costly to acquire influence ex ante. Therefore, the higher the influencer entry cost, the higher the total welfare. In summary, this extension gives two insights. First, equilibrium multiplicity and thus anti-intellectualism influence still ensue.[36] Second, a sufficiently large influencer training cost may improve total welfare.

A.4 Two Rounds of Education

Here, we allow for two rounds of education, in which agents can choose to acquire education, acquire influence, or do nothing. It turns out that every equilibrium in our baseline model is also an equilibrium in this extended setup with two rounds of education.

[34] Note that $U_i(E|c_i = \mu_e^*) = G(\mu_e^*) + (1-\beta)u_0$, which also equals $U_i(I|c_i = \mu_e^*) = \frac{(1-\eta)*\mu_e^*}{(1-\mu_e^*)} * \beta u_0 - c_I$. All agents who acquire influence get a payoff of $U_i(I|c_i = \mu_e^*)$, and an agent of type $c_i \leq \mu_e^*$ gets a payoff of $U_i(E|c_i) = U_i(E|c_i = \mu_e^*) + (\mu_e^* - c_i)$ from acquiring education. By integrating over c_i and utilizing the equilibrium property that all agents with $c_i \leq \mu_e^*$ acquires education and those with $c_i > \mu_e^*$ acquire influence, we get the total welfare formula $\widetilde{W}$.

[35] Note that when c_I is relatively small, the relation between the influencer training cost and the total welfare can still be non-monotonic.

[36] This holds whenever $G(\mu_e^*) = 0$ admits multiple solutions, or there exists $\mu_e^* > 0$ such that $G(\mu_e^*) = 0$ and $G(0) < 0$, with a proper upper bound condition imposed on β.

Lemma A.3. *Every equilibrium in the baseline model is also a SPNE in the extended setup with two rounds of education.*

This suggests that our baseline model holds in more general setups, and the key reasons behind this include the complementarity in education acquisition among agents and the ex post free entry in the influencer market. However, there might also be other equilibrium(s) in this game with two rounds of education. For example, there might exist an equilibrium in which $\mu_{e,1} = \mu_{e,2}$ because agents are infinitesimal and their price-taking behavior means that they are indifferent between acquiring education in either rounds.

A.5 Vertical Labor Sorting

In this section, we consider vertical labor sorting, that is, agents with more successful educational outcomes have stronger labor skills, and thus can always switch to other jobs requiring less successful outcomes. In particular, experts can switch to investing as educated followers or following influencers, but not vice versa. This differs greatly from horizontal labor sorting in our baseline model, in which experts cannot invest as educated followers. This has two important implications. First, agents with better education outcomes endogenously have higher payoffs due to vertical labor classification. Second, the market breakdown does not occur due to the participation constraint of experts, who can always switch to investing.

Again, we assume $b = 0$ and $A(\theta, \mu_{ex}, \mu_{ew}) = 0$. First, educated followers do not switch to following influencers when $\frac{\alpha}{\alpha+1}R(\alpha) \geq (1-\beta)u_0$. Similarly, experts would not mimic educated followers when

$$\frac{\mu_{ew}}{\mu_{ex}} * \frac{R(\alpha)}{\alpha+1} \geq \frac{\alpha}{\alpha+1}R(\alpha) \tag{A.5}$$

When no expert mimics educated followers, $\frac{\mu_{ew}}{\mu_{ex}} = \frac{1-p(\mu_e)}{p(\mu_e)}$, implying that $p(\mu_e) \leq \frac{1}{\alpha+1}$.

On the other hand, if $p(\mu_e) > \frac{1}{\alpha+1}$, then some experts switch to work as educated followers. Denote by $(1-\delta)$ the fraction of experts who switch to investing. Then, the size of the experts who do not switch roles is $\delta * \eta p(\mu_e)\mu_e$. Now,

$$\frac{\mu_{ew}}{\mu_{ex}} = \frac{(1-\delta) * \eta p(\mu_e)\mu_e + \eta(1-p(\mu_e))\mu_e}{\delta * \eta p(\mu_e)\mu_e} = \frac{1}{\delta}\left(\frac{1}{p(\mu_e)} - 1\right) + \frac{(1-\delta)}{\delta}$$

By varying δ, switching between experts and educated followers ceases until Equation (A.5) holds, or equivalently,

$$\frac{1}{\delta}\left(\frac{1}{p(\mu_e)} - 1\right) + \frac{(1-\delta)}{\delta} = \alpha \tag{A.6}$$

For any μ_e such that $p(\mu_e) > \frac{1}{\alpha+1}$, we can choose δ small so that Equation (A.6) holds.

Now, we can compute the expected payoff when a positive measure of experts switches to investing as educated investors, that is, $U_i(E|c_i) = \eta * \frac{\alpha}{\alpha+1}R(\alpha) + (1-\eta)(1-\beta)u_0 - c_i$. By imposing the consistency requirement $c_i = \mu_e$, we can further compute the payoff gap $\tilde{G}(\mu_e) = U_i(E|c_i =$

$\mu_e) - U_i(\varnothing|c_i = \mu_e)$ as below

$$\tilde{G}(\mu_e) = \eta R(\alpha)\left((1-p(\mu_e)) \vee \frac{\alpha}{\alpha+1}\right) - (\eta * (1-\beta)u_0 + \mu_e) \tag{A.7}$$

where the notation "$\vee$" means that $x \vee y = \max\{x, y\}$.

Thus, when $p(0) \leq \frac{1}{\alpha+1}$, $p(\mu_e) < \frac{1}{\alpha+1}$ holds, implying $\left((1-p(\mu_e)) \vee \frac{\alpha}{\alpha+1}\right) = 1 - p(\mu_e)$ and thus $\tilde{G}(\mu_e) = \eta R(\alpha)(1-p(\mu_e)) - \eta(1-\beta)u_0 - \mu_e = G(\mu_e)$. Furthermore, we denote $\hat{\mu}_e = \eta * \left(\frac{\alpha}{\alpha+1}R(\alpha) - (1-\beta)u_0\right) \wedge 1$. When $p(\hat{\mu}_e) > \frac{1}{\alpha+1}$, this indeed forms an equilibrium with a positive measure of experts switching to the side of educated investors. We can now characterize the equilibrium with vertical labor sorting as below.

Lemma A.4 (Vertical Labor Sorting)**.** *Assume that $p(\cdot)$ is continuous on $[0,1]$. Then:*

(i) If $\frac{\alpha}{\alpha+1}R(\alpha) < (1-\beta)u_0$, $\mu_e^* = 0$ is the unique equilibrium;

(ii) If $\frac{\alpha}{\alpha+1}R(\alpha) \geq (1-\beta)u_0$ and $\inf_{\mu_e \in [0,1]} \tilde{G}(\mu_e) > 0$, then $\mu_e^* = 1$.

(iii) If $\frac{\alpha}{\alpha+1}R(\alpha) \geq (1-\beta)u_0$ and $p(\hat{\mu}_e) > \frac{1}{\alpha+1}$, then $\hat{\mu}_e$ forms an equilibrium in which a positive measure of experts switch to investing;

(iv) If $\frac{\alpha}{\alpha+1}R(\alpha) \geq (1-\beta)u_0$, then any solution μ_e^* satisfying $\tilde{G}(\mu_e^*) = 0$ with $p(\mu_e^*) \leq \frac{1}{\alpha+1}$ also forms an equilibrium;

Furthermore, given μ_e^*, μ_{in}^* and μ_{if}^* satisfy equation (13) and (14).

Lemma A.4 fully characterizes the equilibrium with vertically sorted skills. Specifically, (i) when the entertainment utility is large enough, the market breaks down on the educated follower side, making it impossible to motivate agents to acquire education; (ii) when the expected payoff from acquiring education is large, all agents choose to acquire education as long as the entertainment utility is relatively small; (iii) when the probability of becoming experts is too large such that $p(\hat{\mu}_e) > \frac{1}{\alpha+1}$, a positive measure of experts switches to the side of educated followers until experts get an utility to match those of educated followers; and (iv) when the probability of becoming experts is small, experts never switch and prefer staying in the expert market. A key feature is that the education market does not break down under perfect search, since experts, by switching their roles to become educated investors, can always get well compensated.

Furthermore, if $\tilde{G}'(\cdot) < 0$ holds, then we have monotonicity in the intensive margin, that is, $\frac{d\mu_e^*}{du_0} \leq 0$. Similarly, we can define $\underline{u}_0 = \inf\{u_0 : \inf_{\mu_e \in [0,1]} \tilde{G}(\mu_e) \leq 0\}$ and $\bar{u}_0 = \frac{\alpha R(\alpha)}{(\alpha+1)(1-\beta)}$. Lemma A.5 can be modified slightly from Lemma 3.

Lemma A.5 (Total Welfare)**.** *Assume that* $\inf_{\mu_e \in [0,1]} \tilde{G}(\mu_e) > 0$ *at* $u_0 = 0$*. Then, the total welfare W is given by*

$$W = \begin{cases} \eta\left((1-p(1)) \vee \frac{\alpha}{\alpha+1}\right) R(\alpha) + (1-\eta)(1-\beta)u_0 - \frac{1}{2}, & \textit{if } u_0 \leq \underline{u}_0 \\ \frac{1}{2}(\mu_e^*)^2 + (1-\beta)u_0, & \textit{if } \underline{u}_0 < u_0 \leq \bar{u}_0 \\ (1-\beta)u_0, & \textit{if } u_0 > \bar{u}_0 \end{cases} \tag{A.8}$$

From Lemma A.5, we get the following welfare implications. Specifically, the first two claims in Proposition 4 still hold, that is, total welfare is independent of the influence training cost because we allow ex post free entry after educational outcomes are realized. Meanwhile, total welfare depends on entertainment utility in a nonmonotonic way when we impose $p(0) \leq \frac{1}{\alpha+1}$. However, we have a result different from the baseline model.

Proposition A.1. *Assume that* $\frac{d\mu_e^*}{d\alpha} \geq 0$. *Then, the total welfare increases strictly in the search friction parameter* α.

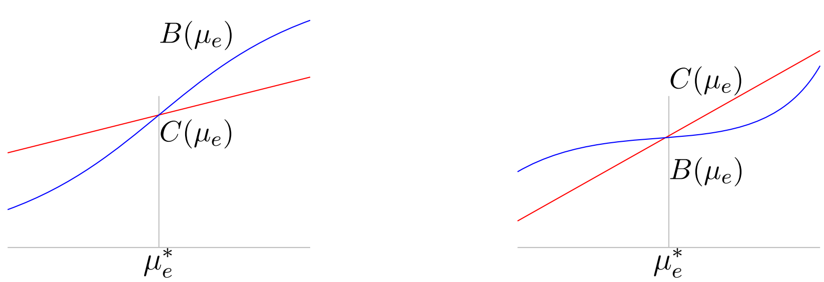
Proposition A.1 verifies the monotonicity between search friction and total welfare under the monotonicity property that aggregate education weakly increases in search friction. If we focus on the most optimistic equilibrium belief, this result also holds when the function $p(\cdot)$ is convex and decreasing. This differs from Proposition 4 in that reducing search friction always helps improve total welfare. Recall that the nonmonotonic relationship between welfare and search friction is driven by market breakdown on the expert side, since less search friction can lead to more intensified competition among experts. Allowing experts to invest imposes a lower bound on their payoff and eliminates market breakdown related to the participation constraint of experts.

A.6 Equilibrium Stability

Here, we discuss equilibrium (local) stability under small perturbations in beliefs.

Definition 1 (Stability)**.** *An equilibrium* μ_e^* *is locally stable if* $G(\mu_e) < 0$ *for* $\mu_e \in (\mu_e^*, \mu_e^* + \delta)$ *and* $G(\mu_e) > 0$ *for* $\mu_e \in (\mu_e^* - \delta, \mu_e^*)$.

Intuitively, if we perturb the equilibrium belief slightly and agents still have incentives to choose "right" actions, then the equilibrium belief (locally) exhibits a mean-reverting property. Furthermore, when $p(\cdot)$ is continuously differentiable, it reduces to $G'(\mu_e^*) < 0$.



(a) Unstable Equilibrium (b) Stable Equilibrium

Figure 12: Equilibrium Refinement

We illustrate both a stable equilibrium (see Figure 12b) and an unstable one (see Figure 12a). Specifically, Figure 12a on the left illustrates an unstable equilibrium. The blue line is the expected payoff benefits of acquiring education for the cutoff type $c_i = \mu_e$,[37] and exceeds the red line when $\mu_e > \mu_e^*$ around a neighborhood, which corresponds to the opportunity cost of forgoing the outside option (including the cost of acquiring education). When the perturbed belief in aggregated education moves slightly above the equilibrium level μ_e^*, all agents with $c_i \in (\mu_e, \mu_e + \delta)$ will acquire

[37]Note that the cutoff type $c_i = \mu_e$ is implied by the consistency requirement.

education for a small $\delta > 0$, and thus the belief is driven even higher. Similarly, for $\mu_e < \mu_e^*$ around a neighborhood, $B(\mu_e) < C(\mu_e)$, implying that the benefits of acquiring education are dominated by the opportunity cost for those agents with $c_i \in (\mu_e - \delta, \mu_e)$. This in turn induces these agents to abstain from acquiring education and further pushes the belief even lower. In short, any deviation from the target equilibrium belief induces an even more divergent aggregated education belief.

In contrast, Figure 12b shows a mean-reverting pattern in which any deviation from the equilibrium belief induces a correction. In particular, for any belief $\mu_e > \mu_e^*$, the ith agent with type $c_i \in (\mu_e, \mu + \varepsilon)$ finds it suboptimal to acquire education since the opportunity costs dominate the net benefits. This leads to a downward revision of beliefs about aggregated education. Similar arguments apply to a belief $\mu_e < \mu_e^*$.

By imposing local stability, we can get the following insights. First, the equilibrium multiplicity can still arise due to anti-intellectual influence. The refinement removes all equilibria such that $G'(\mu_e^*) \geq 0$, which, for example, corresponds to μ_e^1 in Example 1 when $u_0 \in (2, \frac{14}{5})$. Second, it also means that on the intensive margin, the monotonicity result holds more generally because all equilibria with $G'(\mu_e^*) \geq 0$ are killed.[38]

B Proofs of Lemmas and Propositions

We first present a lemma concerning how search friction affects various payoffs. The lemma turns out to be useful in several proofs.

Lemma B.1. *(i) Both $R(\alpha)$ and $\frac{\alpha}{(\alpha+1)}R(\alpha)$ strictly increase in α; and (ii) $\frac{1}{(\alpha+1)}R(\alpha)$ strictly decreases in α.*

Proof. First, we come to show that for all $\alpha \geq 0$ and $x > 1$,

$$(x^{\alpha+1} - 1)(x^{\alpha+2} - 1) > (\alpha + 1)(\alpha + 2)x^{\alpha+1}(x - 1)\log(x) \tag{B.1}$$

To show this inequality, we first prove the following inequality

$$x^{\alpha+2} - 1 > (\alpha + 2) * x^{\frac{\alpha+1}{2}}(x - 1) \tag{B.2}$$

To see this, we define $J_1(x) = (x^{\alpha+2} - 1) - (\alpha + 2)x^{\frac{\alpha+1}{2}}(x - 1)$. Obviously, $J_1(1) = 0$ and $J_1'(x) = (\alpha + 2)x^{\frac{\alpha+1}{2}}J_2(x)$, where $J_2(x) = x^{\frac{\alpha+1}{2}} - 1 - \frac{(x-1)}{x} * \frac{\alpha+1}{2}$. Then, note that $J_2(1) = 0$ and for all $x > 1$, $J_2'(x) = \frac{\alpha+1}{2}x^{-2} * (x^{\frac{\alpha+1}{2}+1} - 1) > 0$, which implies that $J_2(x) > 0$ and $J_1'(x) > 0$ for all $x > 1$. Combined with $J_1(1) = 0$, we have $J_1(x) > 0$ for all $x > 1$. Similarly, we can show that $(x^{\alpha+1} - 1) > (\alpha + 1) * x^{\frac{\alpha}{2}}(x - 1)$.

Define $J_3(x) = (x - 1) - \log(x)\sqrt{x}$. Then, using Equation (B.2), we get

$$(x^{\alpha+1} - 1)(x^{\alpha+2} - 1) - (\alpha + 1)(\alpha + 2)x^{\alpha+1}(x - 1)\log(x) = (\alpha + 1)(\alpha + 2)(x - 1)x^{\alpha}J_3(x)$$

[38] Note that a general property to ensure monotonicity on the intensive margin is $G'(\cdot) < 0$. For example, the monotonicity result holds when $p''(\cdot) < 0$ or $p''(\cdot) > 0$. More details are available upon request.

We can show that $J_3(x) > 0$ for all $x > 1$. To see it, note that $J_3(1) = 0$, and that

$$J_3'(x) = \frac{\sqrt{x} - 1 - \log(x)/2}{\sqrt{x}} \overset{x=t^2}{=} \frac{t - 1 - \log(t)}{t} > 0$$

because it is easy to verify that $(t-1) - \log(t) > 0$ for all $t > 1$.

Second, by definition, $R(\alpha) = M * \frac{(\alpha+1)}{(\alpha+2)} * \frac{p^{\alpha+2} - q^{\alpha+2}}{p^{\alpha+1} - q^{\alpha+1}}$, where $p = 2\bar{\rho} - 1 > 2\underline{\rho} - 1 = q \geq \frac{1}{2}$. Furthermore, $\frac{dR(\alpha)}{d\alpha} \propto (x^{\alpha+1} - 1)(x^{\alpha+2} - 1) - (\alpha+1)(\alpha+2)x^{\alpha+1}(x-1)\log(x)$, where $x = p/q$. By equation (B.1), we have $\frac{dR(\alpha)}{d\alpha} > 0$ for all α.

Third, $\frac{\alpha}{(\alpha+1)} R(\alpha)$ increases strictly in α because $\frac{\alpha}{(\alpha+1)}$ is positive and increases in α.

Fourth, we can directly differentiate $R(\alpha)/(\alpha+1)$ to get:

$$\frac{d}{d\alpha}\left(\frac{R(\alpha)}{\alpha+1}\right) \propto -\Big\{(p^{\alpha+1} - q^{\alpha+1})(p^{\alpha+2} - q^{\alpha+2}) + (2+\alpha)p^{\alpha+1}q^{\alpha+1}(p-q)(\log(p) - \log(q))\Big\}$$

and thus $\frac{d}{d\alpha}\left(\frac{R(\alpha)}{\alpha+1}\right) < 0$ because $p > q > 0$. □

B.1 Proof of Proposition 1

Proof. **Case (i).** Given that $(\alpha \wedge (1/p(1) - 1)) * \frac{R(\alpha)}{\alpha+1} + \theta\eta < (1-\beta)u_0$, either educated followers or experts leave the investment market, even with the most optimistic belief $\mu_e = 1$. Given this, $U_i(E|c_i) = \eta b + (1-\beta)u_0 - c_i$ and $U_i(\varnothing|c_i) = (1-\beta)u_0$, which implies that agents with $c_i \leq \eta b$ choose to acquire education, and thus $\mu_e^* = \eta b$.

Case (ii). The condition that $\frac{\alpha R(\alpha)}{\alpha+1} + \theta\eta\mu_e^* \geq (1-\beta)u_0$ implies that educated followers will stay in the investment market if experts do not quit. First, note that $\mu_e^* \geq \eta b$. This holds because all agents with $c_i \leq \eta b$ will always acquire education due to the labor market related benefits. Therefore, if $(1/p(\eta b) - 1) * \frac{R(\alpha)}{\alpha+1} + \theta\eta b < (1-\beta)u_0$, the investment market collapses because experts stop offering investment advice, and thus $\mu_e^* = \eta b$ forms an equilibrium.

Furthermore, if $\left(\frac{1}{p(1)} - 1\right) * \frac{R(\alpha)}{\alpha+1} + \theta\eta \geq (1-\beta)u_0$ and $\frac{\alpha R(\alpha)}{\alpha+1} + \theta\eta \geq (1-\beta)u_0$, both experts and educated followers remain in the investment market if the counterparty chooses to do so. Furthermore, $G(1) \geq 0$ means that $\eta b + \eta(1-p(1))R(\alpha) - \eta(1-\beta)u_0 - (1-\eta^2\theta) \geq 0$, which implies that, given the belief that $\mu_e = 1$, an agent with c_i finds it optimal to acquire education because $\eta b + \eta(1-p(1))R(\alpha) - \eta(1-\beta)u_0 - c_i + \eta^2\theta \geq 0$, or equivalently, $U_i(E|c_i) \geq U_i(\varnothing|c_i)$ for all $c_i \leq 1$.

Lastly, note that $G(\mu_e^*) = 0$ implies that for any μ_e^*, the agent with $c_i = \mu_e^*$ is indifferent between acquiring education and doing nothing, that is, $U_i(E|c_i = \mu_e^*) = U_i(\varnothing|c_i = \mu_e^*)$. Therefore, $U_i(E|c_i) \geq U_i(\varnothing|c_i)$ for all $c_i \leq \mu_e^*$ and $U_i(E|c_i) < U_i(\varnothing|c_i)$ for all $c_i > \mu_e^*$. Meanwhile, $(1/p(\mu_e^*) - 1) * \frac{R(\alpha)}{\alpha+1} + \theta * (\eta\mu_e^*) \geq (1-\beta)u_0$ implies that experts have incentives to stay in the investment market. Thus, the aggregate education equals μ_e^*. The other two equations, Equation (13) and (15), combined with Equation (11), fully characterize the equilibrium. □

B.2 Proof of Proposition 2

Proof. **Case (i).** When $u_0 > A$, $\frac{1-p(\eta b)}{p(\eta b)} * \frac{R(\alpha)}{(\alpha+1)} < (1-\beta)u_0$ holds, implying that experts quit the investment market and thus $\mu_e^* = \eta b$ is an equilibrium. Furthermore, $u_0 < B$ implies that:

(1) $\left(\alpha \wedge \frac{1-p(1)}{p(1)}\right) * \frac{R(\alpha)}{(\alpha+1)(1-\beta)} > u_0$, which further implies that both experts and educated workers participate in investment; (2) $u_0 < \frac{(b-1/\eta)+(1-p(1))R(\alpha)}{(1-\beta)}$ holds, or equivalently, $G(1) > 0$. Thus, $\mu_e^* = 1$ is an equilibrium.

Case (ii). First, note that $u_0 < A$ and $u_0 < \frac{\alpha R(\alpha)}{(1-\beta)(\alpha+1)}$ imply that experts and educated workers participate in investment, respectively. Also note that when $u_0 < \underline{L}/(1-\beta)$ holds, $G(\mu_e) > 0$ for all $\mu_e \in [\eta b, 1]$, and thus $\mu_e^* = 1$ forms an equilibrium. Second, $u_0 > L$ implies that $G(\mu_e) < 0$ for $\mu_e \geq \eta b$, and thus $\mu_e^* = \eta b$. □

B.3 Proof of Proposition 3

Proof. **Case (i).** First, we consider the incentive for educated followers to participate in investment, which requires $\frac{\alpha}{\alpha+1} R(\alpha) \geq (1-\beta)u_0$. From Lemma B.1, both $\frac{\alpha}{\alpha+1} R(\alpha)$ and $R(\alpha)$ strictly increase in α. Note that $|R(\alpha)| \leq M(2\overline{\rho}-1)$. Thus, if $M(2\overline{\rho}-1) \leq (1-\beta)u_0$, educated followers always quit the investment market for any α. Similarly, when $M(2\overline{\rho}-1) > (1-\beta)u_0$, educated followers quit for $\alpha < \frac{(1-\beta)u_0}{M-(1-\beta)u_0}$. In summary, educated followers quit investing for α sufficiently small.

Second, we consider the incentive for experts when α is large (that is, $\alpha \to \infty$), which requires $\frac{\mu_{ew}}{\mu_{ex}} * \frac{R(\alpha)}{\alpha+1} \geq (1-\beta)u_0$. Note that $\lim_{\alpha\to\infty} \frac{\mu_{ew}}{\mu_{ex}} * \frac{R(\alpha)}{\alpha+1} \leq \sup_{\mu_e} \left\{\frac{\mu_{ew}}{\mu_{ex}}\right\} * \lim_{\alpha\to\infty} \frac{R(\alpha)}{\alpha+1} = 0$, where $\frac{\mu_{ew}}{\mu_{ex}} = \frac{1}{p(\mu_e)} - 1 \leq \frac{1}{p(1)} - 1 < \infty$. Therefore, by Lemma B.1, $\frac{R(\alpha)}{(\alpha+1)}$ strictly decreases in α, and thus the participation constraint for experts is violated for $\bar{\alpha}$ sufficiently large.

Case (ii). By the definition of $\bar{L}$, when $u_0 \geq \frac{\bar{L}}{\eta(1-\beta)}$, we have $G(\mu_0) < 0$. Therefore, by Proposition 1, $\mu_e^* = \eta b$ is the unique equilibrium, which further implies a market breakdown for production. □

B.4 Proof of Lemma 2

Proof. For ease of reference, define $G(x+) = \lim_{\delta>0,\delta\to 0} G(x+\delta)$.

Case (i). The condition that $G'(\mu_e) < 0, \forall \mu_e \in (\eta b, 1)$ implies that there exists at most one solution to $G(\mu_e^*) = 0$. Note that if $G(\eta b+) \leq 0$, then $\mu_e^* = \eta b$; and if $G(1) \geq 0$, then $\mu_e^* = 1$. When $G(\eta b+) > 0 > G(1)$, by the Intermediate Value Theorem, there exists a solution to $G(\mu_e^*) = 0$. Then, we can use the chain rule for implicit functions to differentiate $G(\mu_e)$ over u_0 to get the derivative of $\frac{d\mu_e^*}{du_0}$, that is, $G'(\mu_e^*)\frac{d\mu_e^*}{du_0} - \eta * (1-\beta) = 0$, and thus $\frac{d\mu_e^*}{du_0} = \frac{\eta*(1-\beta)}{G'(\mu_e^*)} < 0$.

Case (ii). That $p''(\cdot) > 0$ implies that $G''(\cdot) < 0$ is strictly concave, and thus there are at most two interior solutions to equation (15).[39] There are three cases: (1) $G'(\eta b) \leq 0$. Then, we have $G'(\mu_e) < 0$ for all $\mu_e > \eta b$, and then we can apply case (i); (2) $G'(1) \geq 0$. In this case, $G'(\mu_e) > 0, \forall \mu_e < 1$, and thus $G(\mu_e)$ strictly increases in μ_e. Then, for $u_0 \leq \underline{u}_0$, then $\mu_e^* = 1$, where $\underline{u}_0 = \sup\{u_0 : \inf_{\mu_e\in[0,1]} G(\mu_e) > 0 \text{ \& } (\alpha \wedge (1/p(\eta b) - 1)) * \frac{R(\alpha)}{\alpha+1} \geq (1-\beta)u_0\}$; for any $\bar{u}_0 \geq u_0 > \underline{u}_0$, $\mu_e^* \in \{\eta b, 1\}$, and then $\mu_e^* = \eta b$ when $u_0 > \bar{u}_0$. Thus, $\sup\{\mu_e^*\}$ weakly decreases in u_0. (3) $G'(\eta b) > 0$ and $G'(1) < 0$. Define $\check{u}_0 = \sup\{u_0 : G(1) \geq 0 \text{ \& } (\alpha \wedge (1/p(1) - 1)) * \frac{R(\alpha)}{\alpha+1} \geq (1-\beta)u_0\}$. Now, we prove the case that $\underline{u}_0 \leq \check{u}_0$ and the other case is similar. First, when $u_0 \leq \underline{u}_0$, $G(\mu_e) > 0$

[39]If there are three or more solutions, we can use the Mean Value Theorem twice to get two solutions such that $G'(\mu_e^1) = G'(\mu_e^2) = 0$, and then applying the Mean value theorem again to show that there exists $G''(\hat{\mu}_e) = 0$, which contradicts with the fact that $G''(\cdot) < 0$.

and thus $\sup\{\mu_e^*\} = 1$. Second, for $u_0 \in (\underline{u}_0, \check{u}_0]$, we have $G(\eta b) < 0$ and $G(1) \geq 0$ with the participation constraints for both experts and educated followers are satisfied, which implies that $\sup\{\mu_e^*\} = 1$. Third, for $u_0 \in (\check{u}_0, \bar{u}_0)$, there exist two solutions $0 < \mu_e^1 < \mu_e^2 \leq 1$ and we can infer that $G'(\mu_e^2) < 0 < G'(\mu_e^1)$ (by using the Mean Value Theorem). Again, we can apply case (i) if we focus on $\sup\{\mu_e^*\} = \mu_e^2$.

Case (iii). In this case, $G(\mu_e)$ is weakly concave and piece-wise linear in μ_e. Thus, given u_0, $G(\mu_e)$ is maximized at $\sup\{\mu_e : G'(\mu_e) > 0\}$. Define $u_0^\natural = \{u_0 : \sup G(\mu_e) = 0\}$. Obviously, $u_0^\natural \geq \bar{u}_0$. Now, we recycle the notation $\underline{u}_0$ and $\check{u}_0$ in case (ii), and only prove the case that $\underline{u}_0 \leq \check{u}_0$ and the other case is similar. First, when $u_0 < \underline{u}_0$, $G(\mu_e) > 0$ for $\mu_e \geq \eta b$ and thus $\mu_e^* = 1$. Second, for $u_0 \in [\underline{u}_0, \check{u}_0]$, we have $G(\eta b) \leq 0$ and $G(\sup\{\mu_e : G'(\mu_e) > 0\}) > G(1) \geq 0$. Thus, there exists $\mu_e^1 < \sup\{\mu_e : G'(\mu_e) > 0\}$ such that $G'(\mu_e^1) > 0$. Then, we have at least three equilibrium $\mu_e^* \in \{\eta b, \mu_e^1, 1\}$ and thus $\sup\{\mu_e^*\} = 1$. Third, for $u_0 \in (\check{u}_0, \bar{u}_0) \subset (\check{u}_0, u_0^\natural)$, there exist two solutions $0 < \mu_e^1 < \sup\{\mu_e : G'(\mu_e) > 0\} < \mu_e^2 \leq 1$ such that $G'(\mu_e^1) > 0$ and $G'(\mu_e^2) < 0$. Thus, $\mu_e^* \in \{\eta b, \mu_e^1, \mu_e^2\}$ and $\sup\{\mu_e^*\} = \mu_e^2$. By case (i), $\frac{d\mu_e^2}{du_0} < 0$. The proof concludes. $\square$

B.5 Proof of Lemma 3

Proof. First, when $\mu_e^* = 1$, we can integrate over $U_i(E|c_i)$, equation (12), to get W

$$\begin{aligned} W = \int_0^1 U_i(E|c_i)dc_i &= \int_0^1 (\eta b + \eta(1-p(1))R(\alpha) + (1-\eta)(1-\beta)u_0 - c_i)\, dc_i \\ &= \eta b + \eta(1-p(1))R(\alpha) + (1-\eta)(1-\beta)u_0 - \frac{1}{2} \end{aligned}$$

Second, when $\mu_e^* \in (\eta b, 1)$, by the continuity of $p(\cdot)$ and thus the continuity of $G(\cdot)$, we have $G(\mu_e^*) = 0$ or equivalently $U_i(E|c_i = \mu_e^*) = U_i(\varnothing|c_i = \mu_e^*) = (1-\beta)u_0$. This further implies that all agents with $c_i > \mu_e^*$ abstain from acquiring education and get a utility of $(1-\beta)u_0$, and all agents with $c_i \leq \mu_e^*$ acquire education and receive an expected utility of $U_i(E|c_i) = U_i(E|c_i = \mu_e^*) + (U_i(E|c_i) - U_i(E|c_i = \mu_e^*)) = (1-\beta)u_0 + (\mu_e^* - c_i)$. Thus,

$$\begin{aligned} W &= \int_0^1 U_i(a_i^*|c_i)dc_i = \int_0^{\mu_e^*} U_i(E|c_i)dc_i + \int_{\mu_e^*}^1 U_i(I|c_i)dc_i \\ &= \int_0^{\mu_e^*} ((1-\beta)u_0 + (\mu_e^* - c_i))\, dc_i + \int_{\mu_e^*}^1 (1-\beta)u_0 dc_i = \frac{1}{2}(\mu_e^*)^2 + (1-\beta)u_0 \end{aligned}$$

Third, when $\mu_e^* = \eta b$, there are two cases. In the first case, $G(\eta b) = 0$ and we can apply the same argument above. Meanwhile, in the second case, $G(\eta b) \neq 0$ and the investment market collapses. Now, only agents with $c_i \leq \eta b$ acquire education and receive $(1-\beta)u_0 + \eta b - c_i$ and agents with $c_i > \eta b$ abstain from acquiring education and thus receive $(1-\beta)u_0$. Again, we can integrate their type c_i to obtain the total welfare. $\square$

B.6 Proof of Proposition 4

Proof. **Case (i).** By the definition of $\bar{u}_0$ and that $\mu_e^* \neq \eta b$, we have a downward jump at $\mu_e = \mu_e^*$, since $W(\bar{u}_0+) - W(\bar{u}_0) = \frac{1}{2}(\mu_e^*)^2 - \frac{1}{2}(\eta b)^2 > 0$, where $W(u_0+) := \lim_{x \downarrow u_0} W(x)$. Furthermore,

$G(1) > 0$ at $u_0 = 0$ and, by continuity, $G(1) > 0$ at u_0 sufficiently small, and thus $\sup \mu_e^* = 1$ for $u_0 \to 0$. From Lemma 3, W increases strictly in u_0 when $u_0 \to 0$. This establishes the non-monotonicity of total welfare in u_0.

Case (ii). First, note that in equilibrium, the entry cost does not affect the decision to acquire education, which depends only on $U_i(E|c_i)$ and $U_i(\varnothing|c_i)$. Thus, μ_e^* is independent of the influencer entry cost c_I, and so is the total welfare of educated agents, including experts and educated followers. Second, given μ_e^*, the indifference condition $U_i(I|c_i) = U_i(\varnothing|c_i) = (1-\beta)u_0$ implies that both uneducated followers and influencers get the same utility $(1-\beta)u_0$, and thus the total surplus for influencers and their followers is given by $((1-\mu_e^*) + (1-\eta)\mu_e^*) * (1-\beta)u_0$, which is also independent of the entry cost c_I.

Case (iii). This follows from the observation below. A small α means a small surplus for educated followers, forcing them to switch to following influencers. Meanwhile, a large α generates fierce competition among experts, forcing them to leave the investment market. In both cases, total welfare is minimal.

Claim (iv). First, we show that both $\underline{u}_0$ and $\bar{u}_0$ increase weakly in b. Note that

$$\inf_{\mu_e \in [0,1]} G(\mu_e) = \eta b - \eta(1-\beta)u_0 + \inf_{\mu_e \in [0,1]} (\eta(1-p(\mu_e))R(\alpha) - \mu_e)$$

increases strictly in b. Similarly, $G(1) = \eta b - \eta(1-\beta)u_0 + \eta(1-p(1))R(\alpha) - 1$ increases strictly in b. Thus, $\underline{u}_0$ is weakly increasing in b.

The argument for $\bar{u}_0$ is more involved. Note that $\inf\{u_0 : \sup_{\mu_e \in (\eta b, 1]} G(\mu_e) < 0\}$ increases strictly in b. The term $\inf\{u_0 : \alpha R(\alpha)/(\alpha+1) < (1-\beta)u_0\}$ is independent of b. Furthermore, when b increases, $G(1)$ increases, and thus $\mu_e^* = 1$ still forms any equilibrium. Similarly, $G(\mu_e)$ increases for any fixed μ_e. Thus, for $G(\mu_e^*) = 0$, increasing b is equivalent to reducing u_0. Thus, by the fact that $\frac{d \sup\{\mu_e^*\}}{du_0} < 0$, $\sup\{\mu_e^*\}$ increases, which implies that $\inf\{u_0 : R(\alpha)\,(1/p(\sup\{\mu_e^*\}) - 1)/(\alpha+1) < (1-\beta)u_0 \; s.t. \; G(\mu_e^*) = 0 \text{ or } G(1) \geq 0 \text{ if } \mu_e^* = 1\}$ increases. Together, these show that $\bar{u}_0$ increases weakly in b.

Second, consider $0 \leq b_1 < b_2$. Denote by $\tilde{G}(\mu_e, u_0) = G(\mu_e, u_0 | b = b_1)$. Then, $G(\mu_e, u_0 | b = b_2) = \tilde{G}(\mu_e, \tilde{u}_0)$ where $\tilde{u}_0 = u_0 - \frac{b_2 - b_1}{1-\beta}$. Under the assumed condition that $\frac{d \sup\{\mu_e^*\}}{du_0} \leq 0$, we have $\sup\{\mu_e^*(b_2)\} = \sup\{\mu_e^*(\tilde{u}_0)\} \geq \sup\{\mu_e^*(u_0)\} = \sup\{\mu_e^*(b_1)\}$.

Third, when $u_0 \leq \underline{u}_0(b_1)$, then $u_0 \leq \underline{u}_0(b_2)$. By the first row in Equation (16), $W(b_2) > W(b_1)$. Similarly, when $u_0 \in (\underline{u}_0(b_1), \bar{u}_0(b_1)]$, we have $u_0 \leq \bar{u}_0(b_2)$. Again, since W increases in μ_e^* and is continuous in $u_0 = \underline{u}_0(b_2)$, and μ_e^* weakly increases in b, we find that W increases in b. Last, when $u_0 > \bar{u}_0(b_1)$, $W(b_1) = (1-\beta)u_0 + \frac{1}{2}(\eta b_1)^2 \leq W(b_2)$. The proof concludes. □

B.7 Proof of Corollary 1

Proof. By assumption, $W(u) + \mu_{in}^*(u)(u_0 + c_I) > W(u_0) + \mu_{in}^*(u_0)(u_0 + c_I)$. Thus, the government can set $T_{if} = (1-\beta)(u - u_0) > 0$ and set $T_{in} > 0$ large enough to improve total welfare, including all participants' utility and the tax revenue. □

B.8 Proof of Lemma 5

Proof. **Case (i).** All educated followers quit the investment market. Thus, $\mu_e^* = \eta b$.

Case (ii). First, note that $U_i(E|c_i)-U_i(\varnothing|c_i) = \widetilde{G}(\mu_e)+(\mu_e-c_i)$. Then, $\widetilde{G}(\mu_e^*) = 0$ implies that for all agents with $c_i \le \mu_e^*$, $U_i(E|c_i) \ge U_i(\varnothing|c_i)$ and vice versa. The condition that $\hat{\mu}_e = 1$ guarantees that $U_i(E|c_i)$ is correctly specified. Furthermore, $\widetilde{G}(1) \ge 0$ implies that $U_i(E|c_i) - U_i(\varnothing|c_i) = \widetilde{G}(1) + (1 - c_i) > 0$ for all $c_i \le 1$, so $\mu_e^* = 1$.

Case (iii). First, statement (1) follows from case (ii). Second, when $\mu_e \ge \hat{\mu}_e$, we have $U_i(E|c_i) - U_i(\varnothing|c_i) = G(\mu_e) + (\mu_e - c_i)$, and thus any $\mu_e^\dagger$ such that $G(\mu_e^\dagger) = 0$ forms an equilibrium because $U_i(E|c_i) - U_i(\varnothing|c_i) \ge 0$ only for $c_i \le \mu_e^\dagger$. The condition that $\mu_e^\dagger \ge \hat{\mu}_e$ guarantees that $U_i(E|c_i)$ is correctly specified as in the baseline model. Third, when $G(1) > 0$ and $\hat{\mu}_e < 1$, this case is already proved in the baseline model. □

B.9 Proof of Corollary 2

Proof. Since $p(\cdot)$ is continuous, both $\widetilde{G}(\cdot)$ and $G(\cdot)$ are continuous in their own domains.

First, note that by Equation (18) and $\alpha R(\alpha)/(\alpha + 1) \ge (1 - \beta)u_0$, $\widetilde{G}(\eta b) \ge 0$. Furthermore, $\inf_{\mu_e \in (\eta b, \hat{\mu}_e)} \widetilde{G}(\mu_e) \ge 0$ means that $\widetilde{G}(\mu_e) < 0$ for some $\mu_e \in (\eta b, \hat{\mu}_e)$, and thus there exists some $\mu_e^* \in (\eta b, \hat{\mu}_e)$ such that $\widetilde{G}(\mu_e^*) = 0$. By Lemma 5, this forms an equilibrium.

Second, by the assumed condition that $\sup_{\mu_e > \hat{\mu}_e} G(\mu_e) > 0$, there are two cases: (1) $\exists \mu_e^1, \mu_e^2 \in (\hat{\mu}_e, 1)$ such that $G(\mu_e^1)G(\mu_e^2) \le 0$, implying the existence of $\mu_e^\dagger$ such that $G(\mu_e^\dagger) = 0$; or (2) $G(\mu_e) \ge 0$ for $\mu_e > \hat{\mu}_e$, implying that $G(1) \ge 0$. Thus, we can take $\mu_e^\dagger = 1$. Again, by lemma 5, this forms an equilibrium. □

B.10 Proof of Lemma A.1

Proof. Assumption 1 implies that $\underline{u}_0 > 0$. By condition (1), we consider the case that $H(\cdot)$ is continuous and strictly increasing. Note that when $u_0 > \bar{u}_0$, $\mu_e^* = \eta b$ and thus

$$\frac{\mu_{if}}{\mu_{in}} = \frac{c_I/u_0(\mu_{in}) + 1 - \beta}{\beta} \quad \text{and} \quad \mu_{in} + \mu_{if} = 1 - \eta^2 * (\eta b)$$

Hence, when $c_I = 0$, $\mu_{in}^* = \beta(1 - \eta^2 b)$. This verifies the equilibrium at $c_I = 0$.

Furthermore, using condition (3), μ_{in}^* strictly decreases in c_I when $c_I \le c_I^\dagger$. Meanwhile, when $\mu_{in} \le H^{-1}(\underline{u}_0)$, $u_0(\mu_{in}) \le \underline{u}_0$, $\mu_e^* = 1$ is the unique equilibrium, and thus $\frac{\mu_{if}}{\mu_{in}} = \frac{c_I/H(\mu_{in})+1-\beta}{\beta}$ and $\mu_{in} + \mu_{if} = 1 - \eta$, that is, $\beta(1 - \eta) = \mu_{in} + \frac{c_I \mu_{in}}{H(\mu_{in})}$. Then, by condition (3), μ_{in}^* strictly decreases in c_I, and thus both u_0 and total welfare, by the first row in Equation (16), strictly decreases in c_I.

Lastly, note that $\lim_{c_I \uparrow c_I^\dagger} H(c_I) = \bar{u}_0$ but $u_0(c_I^\dagger) < \bar{u}_0$. Meanwhile, $\mu_{in}^*(c_I^\dagger)$ is the maximum variety of influencers that can be supported when $c_I = c_I^\dagger$. Then, condition (2) guarantees that $\lim_{c_I \uparrow c_I^\dagger} W(c_I) < W(c_I^\dagger)$, which means that total welfare increases when c_I increases. □

B.11 Proof of Corollary A.1

Proof. Since $W(\bar{u}_0) > W(u_0)$, it is optimal to tax influencers by Lemma 4.

First, we show that it is sub-optimal to tax influencers alone. Condition (ii) implies that it is sub-optimal to tax influencers "slightly" such that the entertainment utility ex post exceeds $\bar{u}_0$ (that is, $H(\mu_{in}) > \bar{u}_0$). To see this, note that the RHS bounds the total welfare gain when we only tax influencer "slightly" because $W(u_0) > W(u)$ for $\bar{u}_0 < u \leq u_0$ and that the increase in entertainment utility is bounded by u_0 multiplied by $(\mu^*_{in}(u_0) - H^{-1}(\bar{u}_0))$, the size of agents switching roles from influencers to social media followers. Again, we can apply Lemma 4 to show that $T_{if} = (1-\beta)(u_0 - \bar{u}_0)$ is strictly dominant.

Second, condition (iii) implies that it is sub-optimal to tax influencers such that $H(\mu_{in}) \leq \bar{u}_0$. To see this, consider any tax plan on influencers such that the entertainment utility after taxation is less than or equal to $\bar{u}_0$. Then, we can choose a tax imposed on digital consumption such that they both generates an identical level of aggregate education, say $\mu^*_e > \eta b$. Under these two tax plans, the welfare gains for agents acquiring education are identical, and thus the welfare gap is determined by the size of social media followers. If we only tax influencers, this part is bounded above by two facts, including the size of followers as bounded by $(1 - \eta * (\eta b))$ and their (total) utility surplus generated as bound by $u^\dagger_0$ because $H(\mu_{in}) \leq \bar{u}_0$. In contrast, if we tax digital consumptions, it is bounded below by $(1 - \eta - \Xi\delta)u_0$ because $\mu_{in} + \mu_{if} \geq 1 - \eta$ and we can always tax influencers to reach the minimum influencer variety to maintain entertainment utility u_0 (that is, $\Xi * \delta = H^{-1}(u_0)$). Thus, condition (iii) implies the sub-optimality of taxing influencers alone to fix anti-intellectual influence.

Third, combining the two points above, $T_{if} > 0$. Condition (iv) implies that there exists redundant influencer and thus $T_{in} > 0$. □

B.12 Proof of Lemma A.2

Proof. **Case (i).** When $\sup_{\mu_e \in [0,1]} G(\mu_e) < 0$, then $U_i(E|c_i) < U_i(\varnothing|c_i) = (1-\beta)u_0$ for all $c_i \in [0,1]$. Thus, $\mu^*_e = 0$. Furthermore, $\mu^*_{in} = \frac{\beta u_0}{c_I + u_0}$ and $\mu^*_{if} = 1 - \mu^*_{if}$.

Case (ii). When $\inf_{\mu_e \in [0,1]} G(\mu_e) > 0$, then $U_i(E|c_i) > U_i(\varnothing|c_i)$ for all $c_i \in [0,1]$, and thus no agent chooses $a_i = \varnothing$. Furthermore, since $\mu^*_e < 1$, agents acquire only influence or education, and the indifference condition is given by Equation (A.2). Thus, $\mu^*_{in} = 1 - \mu^*_e$ and $\mu^*_{if} = (1-\eta)\mu^*_e$.

Case (iii). By Proposition 1, a potential equilibrium must first satisfy $G(\mu^*_e) = 0$. The condition $\frac{\mu^*_e(1-\eta)}{(1-\mu^*_e)} * \beta u_0 - c_I \leq (1-\beta)u_0$ ensures that we can find $\mu^*_{in} \leq (1 - \mu^*_e)$ such that

$$\frac{\mu^*_e(1-\eta) + (1 - \mu^*_{in})}{\mu_{in}} * \beta u_0 - c_I = (1-\beta)u_0$$

Otherwise, $U_i(I|c_i = \mu^*_e) = \frac{\mu^*_{if}}{\mu^*_{in}} * \beta u_0 - c_I > (1-\beta)u_0$. However, this contradicts $G(\mu^*_e) = 0$, that is, $U_i(\varnothing|c_i = \mu^*_e) = U_i(E|c_i = \mu^*_e)$.

Furthermore, by case (ii), any solution μ^*_e to Equation (A.2) forms an equilibrium, as long as $G(\mu^*_e) > 0$. If $G(0) < 0$, then $U_i(\varnothing|c_i = \mu^*_e) > U_i(E|c_i = \mu^*_e)$ at $\mu^*_e = 0$ and no agent acquires education. Thus, $\mu^*_{in} = 1 - \mu^*_{if}$ satisfies Equation (13).

Finally, to support $\mu^*_e > 0$, the condition $(\alpha \wedge (1/p(\mu^*_e) - 1) * \frac{R(\alpha)}{\alpha+1} \geq (1-\beta)u_0$ guarantees that both experts and educated investors remain in the investment market. □

B.13 Proof of Lemma A.3

Proof. We show that if $\mu_e^* > 0$ in the sequential game, it is also an equilibrium in the game with two rounds of education. To see this, construct an equilibrium in which $\tilde{\mu}_{e,1}^* = \mu_e^*$, $\tilde{\mu}_{e,2}^* = 0$, $\tilde{\mu}_{in,2} = \mu_{in}^*$ and $\tilde{\mu}_{in,1} = 0$. We specify that experts in round 1 are matched with educated investors in that round and leave the matching before the round 2 education starts. Under this specification, we can verify that for all $c_i \leq \mu_e^*$, it is optimal to acquire education in round 1 and delaying education acquisition to round 2 does not help and decreases the payoff by $G(\mu_{e,1}^*) - G(\mu_{e,2}^*) = \eta(p(0) - p(\mu_{e,1}^*))R(\alpha) > 0$. Furthermore, acquiring influence always leads to a payoff of $(1 - \beta)u_0$ in both round 1 and round 2. All the remaining parts for equilibrium construction follow from the baseline model. $\square$

B.14 Proof of Lemma A.4

Proof. **Case (i).** All educated followers leave the investment market. Thus, $\mu_e^* = \eta b$.

Case (ii). If $\frac{\alpha}{\alpha+1}R(\alpha) \geq (1 - \beta)u_0$ and $\inf_{\mu_e \in [0,1]} \tilde{G}(\mu_e) > 0$, then for any $\mu_e \leq 1$, it is always optimal for all agents to acquire education and thus $\mu_e^* = 1$.

Case (iii). If $\frac{\alpha}{\alpha+1}R(\alpha) \geq (1-\beta)u_0$ and $p(\hat{\mu}_e) > \frac{1}{\alpha+1}$, then $\frac{1}{p(\mu_e)} - 1 < \alpha$ at $\mu_e = \hat{\mu}_e$. Therefore, some experts will switch to follow influencers. By choosing an appropriate δ that satisfies Equation (17), all agents with $c_i \leq \hat{\mu}_e$ acquire education with a fraction of $(1 - \delta)$ of experts switching to investing.

Case (iv). By Equation (A.7), any solution such that $\tilde{G}(\mu_e^*) = 0$ and $p(\mu_e^*) \leq \frac{1}{\alpha+1}$ forms an equilibrium without experts switching to investing. $\square$

B.15 Proof of Proposition A.1

Proof. First, note that both $\underline{u}_0$ and $\bar{u}_0$ increase strictly in α because $R(\alpha)$ and $\frac{\alpha}{\alpha+1}$ increase strictly in α. Meanwhile, W is continuous at $u_0 = \underline{u}_0$, strictly increasing in μ_e^* for $\mu_e^* < 1$ and also strictly increasing in α when $\mu_e^* = 1$.

Then, consider any $\alpha_1 < \alpha_2$ and fix u_0. For $u_0 \leq \bar{u}_0(\alpha_1)$, then $u_0 \leq \bar{u}_0(\alpha_1) < \bar{u}_0(\alpha_2)$. By the observation stated above, we have $W(\alpha_2) \geq W(\alpha_1)$ since $\frac{d\mu_e^*}{d\alpha} \geq 0$.

For $\bar{u}_0(\alpha_1) < u_0 \leq \bar{u}_0(\alpha_2)$, $W(\alpha_2) = \frac{1}{2}(\mu_e^*(\alpha_2))^2 + (1 - \beta)u_0 \geq (1 - \beta)u_0 = W(\alpha_1)$.

Last, for $u_0 > \bar{u}_0(\alpha_2)$, $W(\alpha_2) = W(\alpha_1) = (1 - \beta)u_0$. The proof concludes. $\square$