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Media Trust: Official versus Commercial Outlets

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Abstract: This paper presents a simple formal theoretical model to explain why citizens in authoritarian regimes trust the illiberal official media more than the commercial media. Media trust is defined as changes in the citizen's belief based on good or bad news from the media. Using this definition, the model evaluates the independent and interaction effect of media bias, censorship, media quality, the citizen's prior belief of the situation, and the citizen's ideology on media trust. The findings reconcile some controversies in the literature, and, more importantly, reveal new and subtle explanations the literature did not identify and probably needs to pay attention to.

Keywords: media trust; censorship; media quality; authoritarian regimes

1. Introduction

In most authoritarian regimes, and even some newly established democracies, the official media often serves as a propaganda machine and tends to feed citizens with positive news about the state. The commercial media, in contrast, is relatively more independent and has more leeway to report neutrally or to reveal governmental malpractice and social injustice, at least when state censorship is not excessively severe. Given this distinction, it is not unreasonable to expect citizens in authoritarian regimes to place more trust in the commercial media rather than the official media. However, recent empirical studies found mixed evidence of this expectation and no formal theoretical work has yet tried to explore and reconcile the controversies.

This paper aims to partially fill the gap by presenting a simple model to systematically explain why and when citizens perceive the official media as more trustworthy than the commercial media in authoritarian regimes. Controversies in the literature at least partly arise from the lack of a clear definition of "media trust" that is comparable across diverse contexts. This paper tries to provide such a definition—media trust is defined as changes in the citizen's belief about the situation based on good or bad news from the media. Good/bad news is defined as news favorable/unfavorable to the state. The official media is assumed to be biased towards good news. The puzzle is, knowing that bias, why would citizens view the official media as more trustworthy than alternatives? To address this puzzle, the model posits two alternative commercial media. One is a neutral media, which has no biases at all. The other is a liberal media, which has the opposite biases to the illiberal official media. The model evaluates independent and interaction effect of media bias, censorship, media quality, the citizen's prior belief, and ideology on media trust. The findings reconcile some controversies in the literature and, more importantly, reveal new and subtle explanations that the literature did not identify and probably needs to pay attention to.

Especially in recent years, media trust has become a relevant and current issue. Media trust impacts how citizens use the media (e.g., [1–3]). Exposure to the selected media, in turn, affects citizens' political opinion and behavior and their confidence in the regime. For example, the Chinese media was found to be contributing to regime legitimacy by propagandizing citizens' experiences in the legal system [4]. In addition, citizens who watched a TV channel independent from the government were more likely to vote for opposition

parties and less likely to turn out in the 1999 parliamentary elections in Russia [5]. Media trust, to some extent, is related to regime stability and even regime transition.

In the past decade, the number of democratic governments has been decreasing and authoritarian regimes have grown (Democracy Index; IDEA). The repercussions of the COVID-19 pandemic probably have exacerbated the global trend of democratic backsliding, at least in countries that are already experiencing democratic erosion (e.g., [6,7]). The media plays an important role in this process. In Poland, the state media was transformed into a propaganda tube and the incumbents' media presence was greatly increased amid the pandemic, while the opposition struggled to stay visible [8]. The emergency measures enacted in electoral autocracies such as Hungary and Russia have involved harsh media restrictions, which in effect suppressed any criticism of the government [6]. To better understand the reasons and implications of these changes, it is critical to examine why people trust authoritarian media campaigns.

Literature Review

Empirical studies of media trust in authoritarian regimes have found contradictory results—citizens may perceive the official or the commercial media as more trustworthy, or see no difference between the two. In large-N studies, [9] analyzed Afrobarometer data from 16 postauthoritarian African democracies and found that citizen ideology played a critical role: low political sophistication, illiberal attitudes, and support for incumbents are all associated with greater relative trust in government media. Ref. [10] utilized World Values Survey data from 44 countries and demonstrated that state ownership of the media did not have a major effect on media trust after controlling for other factors. In both studies, citizens displayed more trust in public broadcasters in more democratic societies, which indicated that they were aware of censorship and propaganda in authoritarian regimes.

Other scholars have conducted more in-depth regional research. Based on a natural experiment during the anti-Japanese protests in Beijing in 2005, [11] showed that urban residents found more strongly commercialized newspapers more persuasive. With surveys and experiments, [12] also found that Beijingers displayed much higher trust in the commercial media than the official media. Moreover, it was not the media's style—the way in which a story was packaged with certain words, phrases, images, and sources, but the media's label—whether it is official or non-official—that mattered. Ref. [13] designed online surveys to investigate the level of trust that Chinese Internet users placed on news from social media versus official media. In one survey, traditional/non-traditional respondents trusted the official/commercial media outlet more and had higher confidence in news that affirmed/criticized the government perspective. In another survey, respondents had higher trust in the official media. Ref. [14] found that an increase in political bias of a newspaper in China was associated with a decrease in this newspaper's advertising revenues, largely determined by readership, which indicates that the citizens could discern, and disliked, media bias. Ref. [15] used smartphone–social media communication and news reports collected in real time during the Kunming Railway Station Attack in China in 2014 and found that citizen trust in the official media diminished with increasing government effort at disseminating information. This result implies citizens' distrust in the official media.

Ref. [16] used detailed browsing data that trace individual level consumption to investigate consumer demand for government-controlled online news outlets in Russia. They showed that the average consumer disliked pro-government ideology but had a strong persistent taste for state-owned outlets, driven by third-party referrals, non-sensitive news content, and high media quality. Ref. [17] examined who trusted state-run media in Russia using two large-scale surveys, in which over 47,000 respondents evaluated 82 true and false news headlines. He found that regime-supporters were vulnerable to propaganda-consistent misinformation, whereas critics often fell for propaganda-inconsistent falsehoods, which demonstrates the role of ideology in media trust.

In general, there are many controversies in the literature about whether and why people trust the official media. Besides diverse contexts, the lack of a clear definition of "media

trust" may account for some of the contradictories. In the studies using surveys (e.g., [9–13]), the respondents were asked how much they trusted the official/state-owned/government media and the commercial/privately owned/independent media. Measure of media trust, therefore, is relatively coarse, either as a dichotomous choice or along a single dimension using, for example, a four- or seven-point scale. Yet, as [10] admitted, many studies argue that media trust is multidimensional and context-dependent [18–22]. A respondent may "trust" the official media more because it is more capable despite its bias in favor of the state, or because the respondent shares a similar ideology to the official outlet, etc.

In this paper, media trust is measured by change in the citizen's belief about the situation based on good or bad news of the state, which combines news accuracy and the citizen's subjective perceptions and is implementable and comparable across diverse contexts. Using this definition and based on [23], a baseline model is presented to describe the incentives of the neutral media, the liberal media, and the official media, and to analyze how the citizen ranks the outlets' trustworthiness regarding good or bad news. To address the puzzle raised above, several variant models are considered. A first variant examines how state censorship influences the citizen's perceptions of media trust. Based on the analysis, the other variants explore how, under or free from censorship, media trust is affected by media quality, the citizen's prior belief of the situation, and the citizen's ideology. These variants construct a multidimensional definition of media trust, instead of compressing all relevant factors into a one-dimensional measure.

The model reconciles some controversies in the literature and, more importantly, reveals new and subtle explanations that future studies might want to explore. The new findings are almost all about media trust regarding good news of the state—the citizen never trusts the official outlet less than the alternatives regarding bad news. The model shows that censorship tends to lower/boost the official outlet's ranking when it decreases/increases media bias towards bad/good news. Moreover, censorship and the official outlet's quality complement each other in promoting the official outlet's ranking. High quality of the official outlet gives censorship more leeway to discipline the liberal outlet without hurting the official outlet's ranking. Censorship, in turn, can boost an official outlet's ranking more easily when its quality is high. Another interesting finding is that the citizen's prior belief does not matter in comparison of outlets in the same context, but not so in comparison across contexts. Lastly, media trust also hinges on how ideology affects citizen's judgment—whether ideology affects the citizen's perception of the magnitude of media bias or affects his perception of the outlet based on whether it is official or not.

2. The Model

Nature selects a state $\omega \in \Omega = \{G, B\}$ regarding the outcome of a governmental policy. G and B represent the good and bad states, respectively. The probability of the bad state is denoted as $Pr(\omega = B)$. A media outlet investigates the real state and receives a signal $s \in S = \{\phi, \beta\}$. Assume that in the good state G, the outlet always receives the good signal $s = \phi$; whereas in the bad state B, it receives the bad signal $s = \beta$ with probability q. In this sense, q measures the quality of the media outlet.

The media outlet then writes a news report $r \in R = \{\phi, \beta\}$ about the state, where ϕ and β denote good and bad news, respectively. The outlet is biased towards good/bad news if it does not report a bad/good signal honestly. The biased outlet reports bad news with probability $\sigma_\beta = Pr(r = \beta | s = \beta)$ when it receives a bad signal, and with probability $\sigma_\phi = Pr(r = \beta | s = \phi)$ when it receives a good signal. Assume that the outlet is more likely to report bad news when the signal is bad ($\sigma_\beta > \sigma_\phi$). Table 1 displays relations between the signals and the news reports.

Table 1. Signals and news reports.

	Signal s	
Report r	β	ϕ
β	σ_β	σ_ϕ
ϕ	$1 - \sigma_\beta$	$1 - \sigma_\phi$

Media bias towards good news is measured by $(1 - \sigma_\beta)$, and media bias towards bad news is measured by σ_ϕ. The outlet therefore is less biased when σ_β is larger or when σ_ϕ is smaller.

2.1. Definition of Media Trust

The citizen's prior belief of the bad state is $\rho_o = Pr(\omega = B)$, according to his past experiences and perceptions of the government. Following the Bayes' rule, the citizen's posterior belief of the bad state after reading bad or good news is

$$\rho_\beta = Pr(\omega = B | r = \beta) = \frac{\rho_o q \sigma_\beta + \rho_o (1 - q) \sigma_\phi}{\rho_o q \sigma_\beta + (1 - \rho_o q) \sigma_\phi} \tag{1}$$

and

$$\rho_\phi = Pr(\omega = B | r = \phi) = \frac{\rho_o q (1 - \sigma_\beta) + \rho_o (1 - q)(1 - \sigma_\phi)}{\rho_o q (1 - \sigma_\beta) + (1 - \rho_o q)(1 - \sigma_\phi)} \tag{2}$$

The news is informative in the sense that, compared with the prior, the citizen's posterior belief of the bad state increases for bad news ($\rho_\beta > \rho_o$) and decreases for good news ($\rho_\phi < \rho_o$) (if $\sigma_\beta < \sigma_\phi$, the news is also informative, in an opposite and unreasonable way that the citizen's posterior belief of the bad state decreases for bad news and increases for good news).

Definition 1. *Media trust is measured by increase/decrease in the citizen's belief of the bad state upon receiving bad/good news of the government.*

By this definition, media trust is positively related to news informativeness. The citizen trusts the media more regarding bad news if ρ_β is larger and regarding good news if ρ_ϕ is smaller. It is possible that the citizen trusts the media more regarding both bad and good news, or regarding only bad or good news.

Proposition 1. *(Please see proof in Appendix A). When the media outlet is only biased in one direction, the citizen has higher trust in the media regarding bad/good news when it is less biased towards bad/good news. When the media outlet is biased in both directions, the citizen has higher trust in the media regarding both bad and good news when it is less biased towards bad or good news.*

2.2. Baseline: Perceptions of Media Trustworthiness

This paper considers two types of commercial media outlets—the neutral outlet and the liberal outlet—and the official outlet, of which the reporting strategies are denoted by σ^N, σ^L, and σ^O, respectively. Though this is not a game-theoretical model, to rationalize the media outlet's reporting strategy, its expected payoff is constructed as follows,

$$\pi = v \underbrace{g(\cdot)}_{\text{market}} + \gamma \underbrace{m(\cdot)}_{\text{ideology}} - k \tag{3}$$

where $g(\cdot)$ and $m(\cdot)$ are functions of the outlet's returns from the market and ideology, v and γ are the marginal returns from the market and ideology, and k is a fixed cost of operation. Assume that every outlet's return from the market decreases in media bias in either direction (i.e., $\frac{\partial g(\cdot)}{\partial \sigma_\beta} > 0$, $\frac{\partial g(\cdot)}{\partial \sigma_\phi} < 0$). This assumption is supported by a model

of Bayesian individuals as potential subscribers, which is available upon request. The neutral outlet is non-ideological and gains zero from ideology, and therefore it is unbiased without censorship, i.e., $\sigma_\beta^N = 1, \sigma_\phi^N = 0$. The liberal outlet tends to reveal governmental malpractice and social injustice. Its gains from ideology $m_L(\cdot)$ is a quadratic function of σ_ϕ^L, where $\mathrm{argmax}_{\sigma_\phi^L} \, m_L(\cdot) \in (0,1)$. Assume that γ_L is sufficiently high and the liberal outlet therefore is biased towards bad news for ideology at the expense of the market, i.e., $\sigma_\beta^L = 1$, $\sigma_\phi^L > 0$. The official outlet, to some extent, is the mouthpiece of the government. Its gains from ideology $m_O(\cdot)$ is a quadratic function of σ_β^O, where $\mathrm{argmax}_{(1-\sigma_\beta^O)} \, m_O(\cdot) \in (0,1)$. Assume that γ_O is sufficiently high and the official outlet is biased towards good news, i.e., $\sigma_\beta^O < 1, \sigma_\phi^O = 0$.

Remark 1. *The citizen only trusts the official outlet less than a commercial outlet regarding good news of the government.*

Based on the analyses above, a subscriber of the neutral outlet has posterior beliefs of the bad state of the world:

$$\rho_\beta^N = 1; \qquad \rho_\phi^N = \frac{\rho_o(1-q)}{1 - \rho_o q} \tag{4}$$

The posterior beliefs of a subscriber of the liberal outlet are

$$\rho_\beta^L = \frac{\rho_o q + \rho_o(1-q)\sigma_\phi^L}{\rho_o q + (1-\rho_o q)\sigma_\phi^L}; \qquad \rho_\phi^L = \frac{\rho_o(1-q)}{1 - \rho_o q} \tag{5}$$

and a subscriber of the official outlet has posterior beliefs of the bad state:

$$\rho_\beta^O = 1; \qquad \rho_\phi^O = \frac{\rho_o q(1-\sigma_\beta^O) + \rho_o(1-q)}{\rho_o q(1-\sigma_\beta^O) + (1-\rho_o q)} \tag{6}$$

Regarding bad news, the citizen trusts the official outlet as much as the neutral outlet, and trusts both more than the liberal outlet, which misreports a good signal to produce more bad news ($\rho_\beta^N = \rho_\beta^O > \rho_\beta^L$). In contrast, regarding good news, the citizen trusts the neutral outlet as much as the liberal outlet, and trusts the official outlet that misreports a bad signal to produce more good news the least ($\rho_\phi^N = \rho_\phi^L < \rho_\phi^O$). In sum, the citizen views a media outlet as more trustworthy when it is unbiased at all or when it reports in a way against its own bias. This finding is related to, but different from, the argument that biased information is more valuable than unbiased information to a decision-maker (e.g., [24–28]). In this model, the neutral outlet that is unbiased is not less trustworthy than a biased outlet. The citizen therefore only trusts the official outlet less than a commercial outlet regarding good news of the government. In survey studies that ask the respondents how much they trust the media, this distinction is often ignored, whereas in some experimental studies of richer contexts, it is found that the subjects indeed can discern between sources of information with differing credibility (e.g.,[26,29–31]).

2.3. Effect of Censorship

This part explores how state censorship affects media trust. The government censors to reduce the likelihood of bad news. Specifically, it sets thresholds $\bar{\sigma}_\beta, \bar{\sigma}_\phi \in (0,1)$ (this assumption implies that censorship in either direction does not backfire; otherwise, the government does not censor, which means $\bar{\sigma}_\beta = 1$ or $\bar{\sigma}_\phi = 0$), and imposes penalty on a media outlet if its bias towards good news does not reach the threshold $(1 - \bar{\sigma}_\beta)$, or if its bias towards bad news exceeds the threshold $\bar{\sigma}_\phi$. A lower value of $\bar{\sigma}_\beta$ or $\bar{\sigma}_\phi$ implies more severe censorship. Assume also that the penalty is sufficiently severe to counteract

all the gains a media outlet can obtain, and therefore the outlet does not defy censorship. Denote the neutral outlet, the liberal outlet, and the official outlet's reporting strategies under censorship as $\hat{\sigma}^N$, $\hat{\sigma}^L$, and $\hat{\sigma}^O$, respectively, and denote the citizen's posterior belief of the bad state under censorship as $\hat{\rho}$.

The neutral outlet remains unbiased towards bad news ($\hat{\sigma}_\phi^N = 0$), which automatically satisfies any threshold $\bar{\sigma}_\phi \in (0,1)$. It has to become biased towards good news, as required by the government, to avoid the penalty, i.e., $\hat{\sigma}_\beta^N = \bar{\sigma}_\beta < 1$. The posterior beliefs of a subscriber of the neutral outlet are given by

$$\hat{\rho}_\beta^N = 1; \quad \hat{\rho}_\phi^N = \frac{\rho_o q(1 - \hat{\sigma}_\beta^N) + \rho_o(1-q)}{\rho_o q(1 - \hat{\sigma}_\beta^N) + (1 - \rho_o q)} \tag{7}$$

The liberal outlet, in contrast, needs to become not only biased towards good news but also less biased towards bad news to meet the thresholds, i.e., $\hat{\sigma}_\beta^L = \bar{\sigma}_\beta < 1$, $\hat{\sigma}_\phi^L = \bar{\sigma}_\phi > 0$. Its subscriber's posterior beliefs of the bad state are

$$\hat{\rho}_\beta^L = \frac{\rho_o q \hat{\sigma}_\beta^L + \rho_o(1-q)\hat{\sigma}_\phi^L}{\rho_o q \hat{\sigma}_\beta^L + (1 - \rho_o q)\hat{\sigma}_\phi^L}; \quad \hat{\rho}_\phi^L = \frac{\rho_o q(1 - \hat{\sigma}_\beta^L) + \rho_o(1-q)(1 - \hat{\sigma}_\phi^L)}{\rho_o q(1 - \hat{\sigma}_\beta^L) + (1 - \rho_o q)(1 - \hat{\sigma}_\phi^L)} \tag{8}$$

Regarding the official outlet, its subscriber's posterior beliefs of the bad state are

$$\hat{\rho}_\beta^O = 1; \quad \hat{\rho}_\phi^O = \frac{\rho_o q(1 - \hat{\sigma}_\beta^O) + \rho_o(1-q)}{\rho_o q(1 - \hat{\sigma}_\beta^O) + (1 - \rho_o q)} \tag{9}$$

where $\hat{\sigma}_\beta^O \leq \bar{\sigma}_\beta < 1$. If the official outlet's bias towards good news exceeds the threshold ($\sigma_\beta^L < \bar{\sigma}_\beta$), it is more biased towards good news than the other two outlets under censorship, i.e., $\hat{\sigma}_\beta^O < \bar{\sigma}_\beta$. Otherwise, it becomes as biased as required by the threshold, i.e., $\hat{\sigma}_\beta^O = \bar{\sigma}_\beta$.

Censorship does not affect how the citizen ranks the three outlets regarding bad news—she trusts the neutral outlet and the official outlet more than the liberal outlet ($\hat{\rho}_\beta^N = \hat{\rho}_\beta^O > \hat{\rho}_\beta^L$).

Remark 2. *Censorship tends to boost/lower the official outlet's ranking regarding good news when it increases/decreases media bias towards good/bad news.*

Regarding good news, first consider the case where the official outlet becomes as biased as the commercial outlets ($\hat{\sigma}_\beta^O = \bar{\sigma}_\beta$). The citizen trusts the official outlet as much as the neutral outlet, and trusts the liberal outlet the least due to its bias towards bad news ($\hat{\rho}_\phi^L > \hat{\rho}_\phi^N = \hat{\rho}_\phi^O$). In contrast, if the official outlet is more biased towards good news than the commercial outlets ($\hat{\sigma}_\beta^O < \bar{\sigma}_\beta$), the citizen trusts the neutral outlet more than the official outlet or the liberal outlet ($\hat{\rho}_\phi^N < \hat{\rho}_\phi^O$, $\hat{\rho}_\phi^N < \hat{\rho}_\phi^L$), and she trusts the official outlet less than the liberal outlet ($\hat{\rho}_\phi^O > \hat{\rho}_\phi^L$) when censorship brings the liberal outlet's bias towards bad news to a level that is sufficiently low,

$$1 - \frac{1 - \hat{\sigma}_\beta^L}{1 - \hat{\sigma}_\beta^O} > \hat{\sigma}_\phi^L \tag{10}$$

When Condition (10) does not hold, the ranking of the citizen's trust of the outlets regarding good news is $\hat{\rho}_\phi^N < \hat{\rho}_\phi^O < \hat{\rho}_\phi^L$; otherwise, the ranking is $\hat{\rho}_\phi^N < \hat{\rho}_\phi^L < \hat{\rho}_\phi^O$.

The effect of censorship on media trust regarding good news, therefore, is conditional. Censorship that increases media bias towards good news mitigates the official outlet's disadvantage and often boosts the citizen's relative trust in it. Recall that without censorship, the citizen trusts the official outlet the least. Yet, when $\bar{\sigma}_\beta$ is imposed and if $\hat{\sigma}_\beta^O = \bar{\sigma}_\beta$, the cit-

izen trusts the official outlet no less than either commercial outlet. In contrast, censorship that decreases media bias towards bad news makes the liberal outlet more trustworthy and tends to lower the official outlet's ranking—if $\hat{\sigma}_\phi^L$ is sufficiently low, the citizen trusts the official outlet the least. In this sense, the government faces a trade-off—whether to discipline the liberal outlet and make the official outlet seem relatively less trustworthy in the eyes of the citizen.

2.4. Effect of Media Quality

This part explores how media quality affects media trust, without or with censorship. Denote the neutral outlet, the liberal outlet, and the official outlet's quality as q^N, q^L, and q^O, respectively. Free from or under censorship, media quality does not affect how the citizen ranks the three outlets regarding bad news ($\rho_\beta^N = \rho_\beta^O > \rho_\beta^L$; $\hat{\rho}_\beta^N = \hat{\rho}_\beta^O > \hat{\rho}_\beta^L$).

Regarding good news, first consider the scenario without censorship. Between the neutral outlet and the liberal outlet, the citizen has more trust in whichever is more capable ($\rho_\phi^N = \rho_\phi^L$; $\frac{\partial \rho_\phi^N}{\partial q^N} < 0$, $\frac{\partial \rho_\phi^L}{\partial q^L} < 0$). The citizen trusts the official outlet more than the neutral outlet or the liberal outlet if $\rho_\phi^O < \rho_\phi^N$ or $\rho_\phi^O < \rho_\phi^L$, which are equal to

$$q^O > \frac{q^N}{\sigma_\beta^O}; \quad or \ \ q^O > \frac{q^L}{\sigma_\beta^O} \tag{11}$$

Namely, the citizen trusts the official outlet more if, compared with the neutral outlet or the liberal outlet, its quality is sufficiently high to compensate for its bias towards good news. The more biased the official outlet is, the higher quality it needs to have to become relatively more trusted.

With censorship, if the official outlet is as biased towards good news as a commercial outlet ($\hat{\sigma}_\beta^O = \bar{\sigma}_\beta$), then when the quality of the official outlet is higher, the citizen trusts it more than the neutral outlet ($\hat{\rho}_\phi^N = \hat{\rho}_\phi^O$; $\frac{\partial \hat{\rho}_\phi^N}{\partial q^N} < 0$, $\frac{\partial \hat{\rho}_\phi^O}{\partial q^O} < 0$), let alone the liberal outlet that is also biased towards bad news. Even if the official outlet is the most biased towards good news ($\hat{\sigma}_\beta^O < \bar{\sigma}_\beta$), the citizen trusts it more than the neutral outlet ($\hat{\rho}_\phi^O < \hat{\rho}_\phi^N$) or the liberal outlet ($\hat{\rho}_\phi^O < \hat{\rho}_\phi^L$) when its quality is sufficiently high,

$$q^O > \frac{q^N \hat{\sigma}_\beta^N}{\hat{\sigma}_\beta^O}; \quad or \ \ q^O > \frac{q^L(\hat{\sigma}_\beta^L - \hat{\sigma}_\phi^L)}{\hat{\sigma}_\beta^O(1 - \hat{\sigma}_\phi^L)} \tag{12}$$

The conditions are easier to satisfy if the quality of the official/commercial outlet is higher/lower, and if censorship is more effective in increasing/decreasing media bias towards good/bad news.

Remark 3. *When the official outlet has high quality, the government has more leeway to discipline the liberal outlet, and can use censorship to promote the official outlet's ranking more easily.*

When the official outlet is of high quality, on one hand, the government can discipline the liberal outlet without making the official outlet a less trusted one, which relieves the government's dilemma of choosing between censorship and protecting the official outlet's ranking; and on the other hand, it is easier for the government to force all outlets to be more biased towards good news to promote the official outlet's ranking.

To illustrate these points, Figure 1 visualizes two numerical examples. Quality of the liberal outlet, the high-quality official outlet, and the low-quality official outlet is $q^L = 0.8$, $q^O = 0.8$, and $q^O = 0.6$, respectively. The citizen's prior belief of a bad state is $\rho_o = 0.3$. In case 1, the liberal outlet's bias towards bad news under censorship is $\hat{\sigma}_\phi^L = 0.2$, and the official outlet's bias towards good news without censorship is $\sigma_\beta^O = 0.8$. In case 2, censorship threshold $\bar{\sigma}_\beta = 0.8$. In either case, the y axis represents how much the citizen trusts

the official outlet more than the liberal outlet. The red and blue curves capture comparisons between the liberal outlet and a high- or low-quality official outlet, respectively.
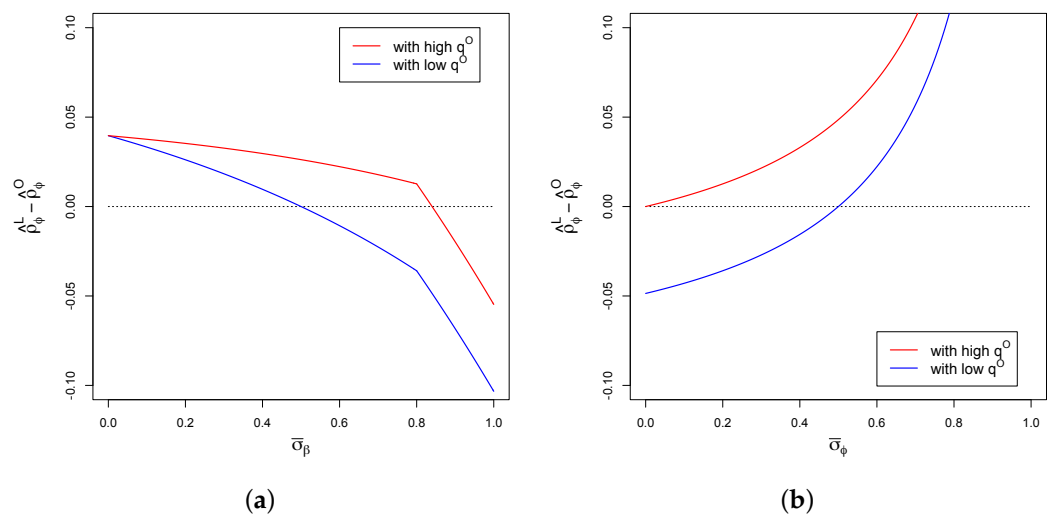

Figure 1. Complementary effect of media quality and censorship. (**a**) Case 1. (**b**) Case 2.

In case 1, the x axis represents censorship threshold $\bar{\sigma}_\beta$. When $\bar{\sigma}_\beta$ is relatively high, which means censorship is not severe, there is $\hat{\rho}_\phi^L - \hat{\rho}_\phi^O < 0$, which means the citizen trusts the official outlet less than the liberal outlet. As the government imposes more severe censorship, i.e., a lower $\bar{\sigma}_\beta$, the official outlet's disadvantage gradually disappears and becomes the more trusted one. The threshold $\bar{\sigma}_\beta$ needs to be lower for this shift to happen when the official outlet's quality is low.

In case 2, the x axis represents censorship threshold $\bar{\sigma}_\phi$. If the official outlet has low quality, there is $\hat{\rho}_\phi^L - \hat{\rho}_\phi^O > 0$ only if $\bar{\sigma}_\phi$ is not too low. In other words, the citizen trusts the official outlet less when severe censorship is imposed to decrease media bias towards bad news. In contrast, a high-quality official outlet gives the government more leeway to impose a low $\bar{\sigma}_\phi$ to discipline the liberal outlet without hurting its ranking—the red line is above zero even when $\bar{\sigma}_\phi$ is very small.

These results well explain the situation in Russia—when the quality of the official media is sufficiently high, people are willing to use and trust the official outlet even if they are well aware that it is seriously biased toward the government (e.g., [16]). Moreover, in authoritarian regimes such as Russia and China, by investing in controlled outlets' quality and non-sensitive content, governments can exercise censorship in relatively competitive online news markets (e.g., [16,32,33]), which exemplifies the complementary effect of censorship and the official media's quality as shown in the model.

2.5. Effect of Citizen's Prior Belief

This part examines whether a citizen's prior belief of the bad state affects how he ranks the outlets regarding their trustworthiness. Denote a citizen's prior belief of the bad state by $\rho_o + \epsilon \in [0,1]$. When $\epsilon > / < 0$, the citizen is more pessimistic/optimistic and has a higher/lower prior belief of the bad state of the world.

Remark 4. *In comparison of different outlets in the same context, the citizen's prior belief of the bad state does not affect how she ranks the three outlets, without or with censorship. In comparison across contexts, regarding good news, the citizen may have higher trust in an outlet that is more biased, simply because the outlet is in a context where the citizen's prior belief is lower.*

In the extreme case where the citizen is so optimistic and has prior belief $\rho_o + \epsilon = 0$, her posterior belief of the bad state is also zero; if the citizen is extremely pessimistic and

has $\rho_o + \epsilon = 1$, then her posterior belief also equals one. In these two cases, all the three outlets are equally trustworthy to the citizen. When $\rho_o + \epsilon \in (0,1)$, no matter whether based on good or bad news of whichever outlet is free from or under censorship, the citizen's posterior belief of the bad state increases in ϵ, except for $\rho_\beta^N = \rho_\beta^O = \hat{\rho}_\beta^N = \hat{\rho}_\beta^O = 1$. Yet, how the citizen ranks the three outlets regarding good or bad news, with or without censorship, is not affected by the sign or the magnitude of ϵ. Namely, the citizen's posterior belief of the bad state increases in her prior belief, which, however, does not affect her ranking of the trustworthiness of the three outlets. The conclusion applies to comparison of different outlets in the same context.

Interestingly, in comparison across contexts, regarding good news, the citizen may have higher trust in a more biased outlet, simply because the outlet is in a context where the citizen's prior belief is lower. Consider the following case: without censorship, the neutral outlet is in a context where the citizen's prior belief is ρ_o, and the biased official outlet in another context where the citizen's prior is $\rho_o + \epsilon$ and $\epsilon < 0$. Given the same media quality, the citizen trusts the official outlet more regarding good news when

$$\epsilon < -\frac{\rho_o q(1-\rho_o)(1-\sigma_\beta^O)}{(1-\rho_o q)(1-q) + q(1-\rho_o)(1-\sigma_\beta^O)} \tag{13}$$

This condition applies to comparison between the official outlet and the liberal outlet as well. Moreover, under censorship, the condition is $\epsilon < 0$, which is easier to hold.

The effect of citizen's prior belief on media trust is mostly ignored in the literature. This finding, on one hand, is an assurance that the ignorance does not matter much in comparison of outlets in the same context; and on the other, highlights a potential pitfall when comparison regarding media trust is conducted across contexts.

2.6. Effect of Citizen Ideology

A citizen's ideology may influence her judgment of the magnitude of media bias towards a certain direction, or of a certain media outlet's reporting strategy. This part examines the effect of citizen's ideology on media trust, with either assumption of how ideology plays a role. (Note that if there are many ideological citizens in society, even a neutral outlet can be motivated to become biased without censorship, to earn more ideological subscribers (e.g., [34,35]). Because the major point of this paper is media trust rather than media reporting strategies, the model presented here does not dive into these possibilities).

First, assume that a liberal/illiberal citizen tends to view media bias towards bad/good news as less severe, no matter which outlet produces the news. Denote a liberal citizen's perception of media bias towards bad news as $\frac{\sigma_\phi}{\lambda} \in [0, \frac{1}{\lambda}]$, $\lambda > 1$; and an illiberal citizen's perception of media bias towards good news as $\frac{1-\sigma_\beta}{\lambda} \in [0, \frac{1}{\lambda}]$. The citizen is more ideological when λ is larger. Based on this definition, an ideological citizen has a correct judgment about whether media bias towards either direction exists but evaluates the magnitude of the bias incorrectly.

Remark 5. *If the citizen's ideology affects her judgment of the severity of media bias towards a certain direction, it is possible that, given the same situation, a non-ideological citizen finds the official outlet more trustworthy than the liberal outlet regarding good news, but a liberal citizen finds the opposite.*

Compared with a non-ideological citizen, a liberal citizen perceives the liberal outlet as less biased towards bad news, and therefore has more trust in it regarding bad news without or with censorship ($\frac{\partial \rho_\beta^L}{\partial \lambda} > 0$; $\frac{\partial \hat{\rho}_\beta^L}{\partial \lambda} > 0$), and regarding good news with censorship ($\frac{\partial \hat{\rho}_\phi^L}{\partial \lambda} < 0$) (Proposition 1). Though these changes do not affect how the liberal citizen ranks

the outlets regarding bad news, she trusts the official outlet more than the liberal outlet regarding good news ($\hat{\rho}_\phi^O < \hat{\rho}_\phi^L$) if

$$1 - \frac{1 - \hat{\sigma}_\beta^L}{1 - \hat{\sigma}_\beta^O} < \frac{\hat{\sigma}_\phi^L}{\lambda} \tag{14}$$

When λ is sufficiently large, it is possible that Condition (10) holds but Condition (14) does not hold. The substantial meaning is that, given the same situation, a non-ideological citizen perceives the official outlet as more trustworthy than the liberal outlet regarding good news but the liberal citizen finds the opposite.

An illiberal citizen perceives the liberal outlet under censorship as less biased towards good news and therefore more trustworthy regarding bad news ($\frac{\partial \hat{\rho}_\beta^L}{\partial \lambda} > 0$) (Proposition 1). The illiberal citizen also finds every outlet that is biased towards good news more trustworthy regarding good news, including the official outlet with or without censorship ($\frac{\partial \rho_\phi^O}{\partial \lambda} < 0$; $\frac{\partial \hat{\rho}_\phi^O}{\partial \lambda} < 0$), and the neutral outlet and the liberal outlet under censorship ($\frac{\partial \hat{\rho}_\phi^N}{\partial \lambda} < 0$, $\frac{\partial \hat{\rho}_\phi^L}{\partial \lambda} < 0$). Yet, the illiberal citizen ranks the three outlets exactly the same as a non-ideological citizen.

Hence, when ideology works through the citizen's judgment of the magnitude of media bias, it can only hurt the official outlet in the sense that a liberal citizen ranks it relatively lower while an illiberal citizen does not change its ranking.

Consider the alternative assumption that ideology affects the citizen's evaluation of a media outlet based on its label, namely, whether it is official (e.g., [12]). A liberal citizen only perceives the commercial outlets as less biased towards bad news and an illiberal citizen only perceives the official outlet as less biased towards good news.

Remark 6. *If the citizen's ideology affects his judgment of the outlet based on whether it is official, Remark 5 still holds. In addition, it is possible that, given the same situations, a non-ideological citizen finds the official outlet less trustworthy than the neutral outlet or the liberal outlet regarding good news, but an illiberal citizen finds the opposite.*

The liberal citizen ranks the three outlets exactly the same with either assumption, since only the liberal outlet is biased towards bad news. Therefore, Remark 5 still holds. The illiberal citizen ranks the three outlets regarding bad news exactly the same with either assumption. Regarding good news, the ranking is affected only when censorship is imposed. If the official outlet is as biased as the neutral outlet ($\hat{\sigma}_\beta^O = \bar{\sigma}_\beta$), a non-ideological citizen trusts them the same, but the illiberal citizen trusts the official outlet more ($\hat{\rho}_\phi^O < \hat{\rho}_\phi^N$). When the official outlet is more biased than the neutral outlet ($\hat{\sigma}_\beta^O < \bar{\sigma}_\beta$), a non-ideological citizen finds the neutral outlet more trustworthy, while the illiberal citizen trusts the official outlet more ($\hat{\rho}_\phi^O < \hat{\rho}_\phi^N$) if

$$1 - \frac{\lambda(1 - \hat{\sigma}_\beta^N)}{1 - \hat{\sigma}_\beta^O} < 0 \tag{15}$$

The illiberal citizen also trusts the official outlet more than the liberal outlet ($\hat{\rho}_\phi^O < \hat{\rho}_\phi^L$) if

$$1 - \frac{\lambda(1 - \hat{\sigma}_\beta^L)}{1 - \hat{\sigma}_\beta^O} < \hat{\sigma}_\phi^L \tag{16}$$

When λ is sufficiently large, it is possible that Condition (10) does not hold but Condition (16) holds. Namely, given the same situation, a non-ideological citizen trusts the liberal outlet more than the official outlet but the illiberal citizen finds the opposite. Note also that it is easier to satisfy Condition (16) than to satisfy Condition (15), which

means that as the official outlet becomes more biased, it is possible that the illiberal citizen perceives the official outlet to be less trustworthy than the neutral outlet but still more trustworthy than the liberal outlet.

When ideology works through the citizen's judgment of the media outlet based on its label, it can hurt or help the official outlet—the liberal/illiberal citizen ranks it relatively lower/higher, compared with a non-ideological citizen. Overall, an ideological citizen tends to perceive a media outlet sharing similar ideology to be more trustworthy. These findings reveal that whether ideology affects how the citizen ranks the outlets depends on not only the intensity of her ideology and the severity of media bias, but also how ideology plays a role in the citizen's perceptions.

3. Conclusions

This paper presents a formal theoretical model to systematically explain under what conditions citizens in authoritarian regimes perceive the official media as more trustworthy than the commercial media. The paper posits a nuanced definition of "media trust" that is implementable and comparable across diverse contexts. The model is also sufficiently flexible to incorporate factors critical to media trust in authoritarian regimes—media bias, censorship, media quality, citizen's prior belief of the current situation, and citizen's ideology, and examine independent and interaction effect of these factors.

The model provides several new and subtle explanations of the question of interest. For example, censorship may increase or decrease the official outlet's ranking of trustworthiness. Censorship and the official outlet's quality can complement each other in promoting the official outlet's ranking. The citizen's prior belief only affects the outlets' ranking in comparison across contexts, and media trust hinges on whether ideology affects citizen's judgment of the magnitude of media bias or the outlet based on its label.

These findings enrich our understanding of media trust in authoritarian regimes. They potentially account for some controversies in the literature, where the definition and measure of "media trust" are often coarse due to limitation of data availability or unawareness of the potential pitfalls. In this sense, this paper not only provides a chance to examine media trust from a theoretical perspective, but also contributes to better conceptualization and measurement of media trust in authoritarian regimes in empirical studies.

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Appendix A

Proof. If the media outlet only misreports a good signal ($\sigma_\beta = 1$, $\sigma_\phi > 0$), then the citizen's posterior belief of the bad state increases more for bad news when the outlet is less biased towards bad news ($\frac{\partial \rho_\beta}{\partial \sigma_\phi} < 0$). The citizen's posterior belief of the bad state based on good news is $\rho_\phi = \frac{\rho_o(1-q)}{1-\rho_o q}$, which is not affected by media bias. In contrast, if the outlet only misreports a bad signal ($\sigma_\beta < 1$, $\sigma_\phi = 0$), then the citizen's posterior belief of the bad state decreases more for good news when the outlet is less biased towards good news ($\frac{\partial \rho_\phi}{\partial \sigma_\beta} < 0$). In this case, once the citizen receives bad news, he is sure that the state is bad ($\rho_\beta = 1$). Lastly, if the media outlet is biased in both directions ($\sigma_\beta < 1$, $\sigma_\phi > 0$), the citizen's posterior

belief of the bad state increases/decreases more for bad/good news when the media outlet is less biased in either direction ($\frac{\partial \rho_\beta}{\partial \sigma_\beta} > 0$, $\frac{\partial \rho_\phi}{\partial \sigma_\beta} < 0$; $\frac{\partial \rho_\beta}{\partial \sigma_\phi} < 0$, $\frac{\partial \rho_\phi}{\partial \sigma_\phi} > 0$). $\square$

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