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“HONEY, WE DON’T HATE AI”:

UPHOLD REDDIT COMMUNITY ENGAGEMENT THROUGH

TRANSPARENT AI RULES, A PANEL DATA APPROACH

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Abstract

Artificial Intelligence (AI) and Large Language Models (LLMs) have changed digital communication since ChatGPT debuted at the end of 2022. This study takes a multilevel approach to external, structural, and individual factors to analyze user engagement on Reddit, a social media platform that values social interaction and personal opinion. Using a panel data methodology, the research includes 83 subreddits across 30 categories and spans over 14 months, from November 2022 to December 2023. The research employs one-way fixed-effects and random-effects models simultaneously, adjusted with Driscoll-Kraay standard errors. The results are demonstrated as follows. First, regarding **external factors**, the cumulative number of generative AI models available in the market is correlated with a reduction in posting and commenting behavior. Second, regarding **structural factors**, AI-related regulations deemed vague and lacking explicit guidance trigger community engagement drops. Nonetheless, implementing specific guidelines, either allowing or banning Artificial Intelligence Generated Content (AIGC), stimulates a higher engagement rate, indicating that imposing explicit obligations promotes interpersonal communication. Third, with **individual factors**, there is no evidence that user sentiment towards AI affects the number of posts and comments in subreddits. The study empirically tests for comprehensive influences on social media participation in the AI era. The findings benefit community managers by signifying the need to take a clear stance on AIGC use to maintain healthy online communities.

Keywords: *panel data, Reddit, community guidelines, Artificial Intelligence, AIGC, sentiment, user engagement, AI ethics.*

1. Business Problem: Background

Since the launch of ChatGPT at the end of 2022, artificial intelligence (AI) and Large Language Model (LLM) have changed how online communication manifests. The tech giants, including Google, Microsoft, Meta, and many other IT startups, have promptly entered the market and launched their models¹. On social media platforms, AI is being integrated to automate content creation and customize content recommendations for users (Bashardoust et al., 2024), and therefore, changing online interpersonal engagement dynamics. In this research, both AI and generative AI are simultaneously mentioned several times. There are various specialized AI models, for example, FGN by Google DeepMind forecasts weather, MegaSyn by Collaborations Pharmaceuticals discovers new drugs, and INTELLECT-MATH by Prime Intellect does mathematics. However, generative AI models are the main research topic due to the unique functional relationship between Artificial Intelligence Generated Content (AIGC) and the communicative nature of social media. Within the context of a knowledge-sharing platform like Reddit, there is a pattern in which users change their habits, from joining online participatory platforms to asking generative AI models like ChatGPT, DeepSeek, and Gemini. This phenomenon creates a direct substitution effect as seen on StackOverflow, another social queries site, as found in Burtch et al. (2023). Thus, there is a need to focus on generative AI and isolate the predicted correlation on social media.

Among several social networking sites, Reddit is a platform created to allow users to share their knowledge and experiences, known for its sociable, interactive, and interpersonal characteristics. Because of its numerous subcommunities and substantial number of users, Reddit is chosen for this thesis to examine the link between user behavior and community rules. It contains a vast network of subreddits, namely separate interest-driven communities. Reddit audience may gather within subreddits for a plethora of purposes, from casual conversations about daily tips, relationship advice, to niche content for fandoms or profound discussions about abstract subjects like politics or philosophy (Gonzalez-Bailon et al., 2010). Different from other social media, users could only engage with designated subreddits and content topics, but not with other users (Medvedev et al., 2019). Developing high-quality content is critical as sharing interests and

¹ [AI in 2023: The Timeline](#)

community engagement are the core values of Reddit (Fang et al., 2023). User engagement on Reddit, therefore, varies by users since it is highly dependent on their internal ideas, perception, and how they view the subject (Keller, 1993).

To fully understand variations in engagement, it is essential to surpass individual behaviors and take into account the structural governance of Reddit communities. Moderators typically apply rules to ensure their community runs smoothly, regulate social activity, and prevent unwanted consequences (Seering et al., 2019). These guidelines vary in scope and rigidity, thereby affecting the quality, tone, and volume of user engagement (Fang et al., 2023). The topic of generative AI rules is of interest as AI technology is developing rapidly, simultaneously influencing community interaction on social media platforms.

Even though generative AI technology offers substantial practical benefits in language modeling, it hypothetically brings up ethical concerns, particularly regarding consent, reliability, information transparency, and the manipulation of user behavior in online participatory settings. These technologies can lead to data exploitation or the unintended leakage of personal information. One recent example is the latest controversial experiment by the University of Zurich, as AI bots were used to influence user engagement on Reddit, disguised as a real human. This experiment violates not only the subreddit's policy but also disregards the ethics of research². The Stanford Center for Research on Foundation Models' study in 2021 reveals ongoing issues regarding current AI and Large Language Models³. The accelerated development of generative AI has outpaced our ability to fully mitigate its associated risks. Sociologically, there is a growing concern that these models, trained on massive datasets, potentially amplify social inequality. The ease of producing high-quality content in the digital realm makes deepfakes and misinformation more likely to spread, posing a threat to public opinion and regulation.

Nonetheless, authorities are actively building adaptive legal frameworks alongside the fast pace of technological advancement. Just recently, the European Parliament approved the Artificial Intelligence Act in March 2024 in response to the unprecedented rate of generative AI use among the masses, establishing a complete legal framework for AI to ensure ethical and sustainable

² [‘Unethical’ AI research on Reddit under fire](#)

³ [On the Opportunities and Risks of Foundation Models](#)

adoption of AI⁴. Additionally, Vietnam recently passed the Law on Intellectual Property to allow digital assets to be evaluated for AI and digital technologies research. The law lays out intellectual property protection guidelines for future bills regarding AI-generated material, mentioning that any works with significant human involvement are protected⁵. However, this sparks a heated discussion amongst the artists and lawmakers, as these initial ambiguous regulations create many legal gray areas.

The above examples highlight the necessity for individual viewpoints on any changes. Individual psychological factors play an important role not only in digital involvement but also in releasing systemic governance decisions. Decisions associated with AI ethics draw significant reactions from the masses, showing a variety of subjective views towards AI, despite being heavily influenced by personal beliefs and perspectives (Nickerson, 1998). Enthusiastic adoption or skeptical hostility correlates with distinct behavior patterns; hence, capturing emotional nuances yields significant insights into engagement dynamics. Thereby, understanding the human element in this latest technological advancement era is an essential knowledge gap that needs to be filled.

Thus, a complex interaction exists between the external technological development, the structural community formation, and individual user perception. As a result, there is a demand to tackle the ethical concern of AI, the application of suitable community guidelines, and how these external factors and people's attitudes affect how the community interacts.

One significant academic relevance of this study is that it adopts a multi-level framework. While existing literature often uses an isolated lens to dig deep into the separated impact on engagement, this study simultaneously accounts for the interactional multi-level impacts of external, structural, and individual factors. The objective of this research is to understand the comprehensive effect over time and across several subreddits through a panel data approach, as mentioned later in this paper. This is a niche and emerging academic research topic in technology and community engagement. The result of this research provides empirical evidence on the effect of permissive and restrictive guidelines, considering the concurrent effect of external and individual motives. In addition, this paper discusses ethical pressures that come from rapid AI technological

⁴ [AI Act](#)

⁵ [Vietnam turns intellectual property into bankable assets in new law](#)

development, which eventually drive formal actions of subreddits in governing the communities. From a managerial perspective, community managers or authorities in a broader scene could consult this paper when making AIGC usage policies to avoid unwanted quarrels. There is a need for authorities to consider all-rounded aspects and go beyond ambiguous policies to detailed implementation guidelines in order to maintain positive community dynamics.

2. Problem Statement and Research Questions

Building upon the multi-level framework above, the problem statement is expressed as follows:

“How can the external generative AI models’ availability, the structural community guidelines of each subreddit, and the individual community’s sentiment towards AI influence Reddit users’ engagement behavior, as examined by time series and cross-subreddit?”

This thesis would answer these research questions, corresponding to the three levels of analysis:

1. *External level: How does the emergence of generative AI technologies, presented by the availability and debut of models, affect user engagement?*
2. *Structural level: How do subreddit community guidelines on AI-generated content or AI-related content influence user engagement?*
3. *Individual level: How does community sentiment towards AI, specifically when AI is mentioned in the subreddit with positive or negative views, affect user engagement?*

This study aims to measure how three levels of influence affect user engagement within subreddit, which can be listed as follows: structural level, such as subreddit-level rules and policies on AI-related content should be formulated; external level, including the number of generative AI models are cumulatively available and those that have recently debuted; and the individual level, namely the overall community sentiment toward AI, measured by polarity of mentions in the subreddit. At the same time, the research analyzes the impact over time and across subreddits from different categories, as there is a limited number of studies about this segment.

3. Theoretical background

The first part delves into whether new advancements or specific changes to the AI world lead to vigorous discussion on the platform. The second part looks into whether implementing AI-associated rules of each subreddit triggers a change in user behavior. Lastly, Reddit users' sentiment and behavior related to AI are examined.

External factors – The development of Artificial Intelligence

The debut of ChatGPT, a publicly accessible chatbot based on a large language model, in November 2022, has pioneered in introducing generative AI technology to the masses. AI is utilized in numerous areas to increase productivity, including research, image and sound production, automotive, design, education, and healthcare (Wang et al., 2025). Latest developments in artificial-intelligence-generated content (AIGC) tools make it simple to produce content nearly identical to human-generated content. Recent evidence suggests that AIGC is oftentimes perceived as trustworthy as human-generated content, especially when LLMs can generate undetectable results. This creates problems of ethics since misleading information could spread out of control when AIGC is misused on social media (Bashardoust et al., 2024; Steen et al., 2025).

The Stanford Center for Research on Foundation Models conducts several studies on foundation models. The report shows that these models are versatile and have been the origin of multiple AI models in the market developed in the 2020s. As these models are open-source, foundational research can pave the way for rapid, powerful development of AI technology, hence creating market breakthroughs (Kapoor et al., 2024). Open models are supposed to foster innovations, facilitate in-depth research and development of common knowledge in the community. Large corporations cannot keep a monopoly state; give small businesses spaces for competition and increase overall transparency. However, a vital drawback of sharing the same foundation is that intrinsic biases trained for models without sufficient transparency can cause extrinsic harm downstream, especially to end users. Serious issues such as representational bias, performance disparities, abuse, and stereotypes need to be addressed, even though the widespread emergence

of new models in the market has made this more challenging to control (Kapoor et al., 2024; Rishi Bommasani et al., 2021).

Additionally, behaviors that cause societal harm, such as manipulative content creation and harassment, have been tested. They notice that when these harmful behaviors are intended, content generated with malicious purposes is hard to detect (Antoine Bosselut et al., 2021; Rishi Bommasani et al., 2021). In their article, Teo (2025) examines how the effect of AI systems on user awareness is subtle and overlooked, partly because it is not immediately noticeable. On a wider scope, Teo (2025) continues to examine how countless individuals may not be aware of the ethical norms that are respected when socializing online, including the freedom of speech and privacy. Kapoor and others (2024) further analyze the risks related to cybersecurity and non-consensual intimate imagery. When fraudsters exploit AI technology for profit, they can traumatize the victims mentally and physically. They can also blackmail the victims or spread false information online, causing a significant negative impact on society. The authors emphasize that banning or regulating them is uneasy as the pervasive open models make it difficult to trace back. Deploying automated systems to identify cybersecurity weak points is an early sign that cybersecurity risks are partly under control.

However, a comprehensive analytic framework is still required to better understand the degree of risk associated with AI models. Prior to the rising popularity of ChatGPT in 2023, the majority of users and policymakers had limited knowledge about AI and LLM (Roche et al., 2023; Wang et al., 2025). Governments, policymakers, and people in positions of responsibility need to regularly monitor the actual impacts (Roche et al., 2023). At the state level, flexible policies rather than rigid laws are there to ensure the rights belong to the community⁶. Policies could also be implemented for the social networking sites. At the platform level, community managers are responsible for implementing a regulatory framework that aligns community norms with technological oversight.

Structural factors – Reddit, Subreddit and Community governance

The concepts of fundamental community structure and community governance are essential to the academic inquiry into Reddit's ecosystem. Reddit is organized into numerous subreddits as

⁶ [AI Act by NL Digital Government](#)

communities, each of which covers a topic of interest to subscribers. The platform covers a wide range of topics, including but not limited to economics, culture, society, macro and micro topics, even personal experiences and funny moments. In human-computer interaction (HCI) literature, online community is a topic that could bridge technology and sociology (Lloyd, Reagle, et al., 2025). The fact that the literature analyzes users' behavior, including moderators (i.e., governors of subreddits) and subscribers (i.e., Reddit residents), shows connections with many studies in the field of behavioral science. With a self-moderation mechanism in most subreddits, rules and restrictions are usually enforced, showing the standpoint of the community (Fiesler et al., 2018). Fiesler et al. (2018) study the general rules that are commonly found in many subreddits and classify them into restrictive and prescriptive categories. Moderators' decisions to update community guidelines for their communities might be influenced by external factors or by the fact that some users suddenly decided to misbehave (Seering et al., 2019). Chandrasekharan et al. (2018) emphasize that such regulations are essential as unsuitable behavior must be removed in order to preserve a constructive, high-quality community environment. Without specific regulations, users can be exploited without consent, raising ethical concerns. Only a portion of Reddit users are able to tell which information is accurate and which is human- or AI-generated content. Without solid knowledge of AIGC, people may not be able to distinguish the source (Boutadjine et al., 2025; Huschens et al., 2023); therefore, they can not give critical opinions on content posted on social networking platforms, creating an interactive environment in the community.

This study seeks to develop an understanding of how such structures should adapt to the unique challenges posed by the fast-paced nature of AI-generated content (AIGC). Research by Lloyd, Reagle, et al. (2025) analyzes the motivation for enforcing rules about AIGC, particularly with content quality. In addition, community dynamics and governance issues are also mentioned. Similar to Chandrasekharan et al. (2018), Lloyd, Reagle, and others (2025) confirm the need to clarify norms within the community. Lloyd, Gosciak, et al. (2025) continue analyzing more thoroughly by adding 4 types of rules, namely, quality of content, rules with actions, types of content used, and whether the rule mentions AI Generate/Create or AI Edit/Assist/Enhance. There is an acknowledgement regarding the significance of rules for regulating content, including or utilizing AIGC throughout time. The study by Lloyd, Gosciak, et al. (2025) serves as a premise for this thesis, as it greatly influences the formation of the methodological stance. In that study,

the dataset consists of 331,938 subreddits, in which moderators of 99,969 subreddits apply guidelines in their moderated communities. 4,251 of which, approximately 1,38% of all subreddits, apply the rule related to AIGC.

However, not many studies confirm long-term shifts in subreddit subscriber behavior. Reddit operates using a suggestion algorithm to adjust according to user behavior, at the same time gathering information about users' interactions, interests, and patterns of activity on a regular basis (Rodiloso, 2024). Other studies examine the behavior in the comment section on Reddit (Aragón et al., 2017; Gonzalez-Bailon et al., 2010). The longer the chain of discussion trees can be understood, the longer the "root", the more engaged users are with a specific "root" of a tree, or the more engagement that the comment receives. One distinguishing feature of Reddit is its hierarchical structure for organizing commenting threads, which indicates social interaction. Conversations get placed higher and gain more traction when there are more responses. Despite these findings on community dynamics, there is a lack of a thorough analysis that connects the rigidity of specific AIGC policies to persistent engagement rates. This study addresses this gap by examining how structural AIGC guidelines affect user engagement over time using a panel data approach.

Individual factor – Sentiment towards AI

The concept of user perception is a major area of interest within the field of social psychology. The term "*perception*" or "*brand perception*" is generally understood as descriptive information about a brand, derived from a consumer's awareness of it (Keller, 1993). Given AI as a product, users evaluate and perceive AI either favorably or unfavorably, or both, based on what they are exposed to and what they already know (Nickerson, 1998). Consumers engage with content and could only perceive values if the topic of the conversation corresponds with the value the community treasures (Homburg et al., 2015).

Perception towards generative AI has varied greatly in recent years. A small number of users favor using content-producing assistances like Wall-E, Midjourney, or ChatGPT since their debut dates, so they could contribute to the community (Matatov et al., 2025; Xu & Li, 2015). Because of its ease of access, many users prefer generative AI help for information queries over reaching out on low-engagement social platforms (Burtch et al., 2023). On the other hand, certain groups that are

inherently hostile to generative AI become more skeptical and react adversely to AIGC (Matatov et al., 2025). Users are more likely to participate in arguments to voice their ideas and contribute to community engagement when they encounter content they find controversial (Berman et al., 2019). A lot of subreddits have an adverse view of generative AI, reflected in how the moderators regulate their communities, as calculated in Lloyd, Gosciak, et al. (2025)'s paper. A remarkable 55.23 percent of 4,251 subreddits have AI-related rules in their community guidelines that completely prohibit AIGC use in most circumstances. The following numbers are discussed regarding framing the negative impact of generative AI on their community: 13.19% state AIGC is low quality; 11.93% with another 7.0% say AIGC is not authentic and not original; 11.06% say AIGC is low effort; 3.1% believe AIGC is not relevant to the mainly discussed topics, with another 3.25% claim it is spam; 2.98% disagree with AI's ethic; 1.7% AIGC is deemed as misleading by 1.7% and as inaccurate by 0.83%. These AI-specific insights focus on descriptive attitude; hence, it is needed to find a link between that to actual behavior in an online social media setting.

User engagement

In addition to analyzing the impact of community guidelines on engagement rates, the researchers study sentiment, a psychological individual factor that possibly affects engagement rates. Without accounting for the specific topic, there are different findings regarding the effect of sentiment in text on engagement rates. Positive emotions are found to be more contagious than negative emotions on Twitter (Ferrara & Yang, 2015). Promoting more optimistic content and positive reactions can make users more willing to use the platform (Kramer et al., 2014). Conversely, in some other polemical cases, the topic could lead to heated discussion. Users are prone to be stimulated by negative, controversial subjects, high-arousal emotions, or ragebait, thereby making the posts have high interaction levels (Berger & Milkman, 2012). In other studies, context is a decisive factor in engagement research. If the post is purely text content, sentiment applied in text may not be a significant factor in promoting engagement; instead, visualization, the use of content type, content length, posting time, community interacting culture, or the topic of the post would influence the degree of engagement (Sabate et al., 2014). Although there are many positive conversations about AI, there are numerous philosophical issues brought up (Fast & Horvitz, 2017). The emphasis on AI-related topics has not yet been the center of research; hence, the paper further examines this topic.

User engagement is one of the fundamental areas of interest in several behavioral studies. Social connection plays a major role in keeping online groups active, particularly on the Reddit platform (Burtsch et al., 2023; Kim & Lee, 2019; Liu et al., 2021). The current occurrence is that new users of the community using AIGC to participate in conversations out of their expertise (Matatov et al., 2025). Even though this stems from the sense of belonging and freely contributing in the community (Xu & Li, 2015), it makes the relative quality of the content gradually decrease if more people spread incorrect information (Burtsch et al., 2023). Some governance measures might be employed to prevent the spread of inaccurate and unconfirmed information. According to Fang et al. (2023), the overall community's user interaction volume may increase if the subreddit adopts a rigorous content restriction policy. Even though individual psychological drivers of participation have been the subject of recent research, there persists a significant lack in our understanding of how the occurrence of AIGC and structural governance triggers fluctuations in user engagement.

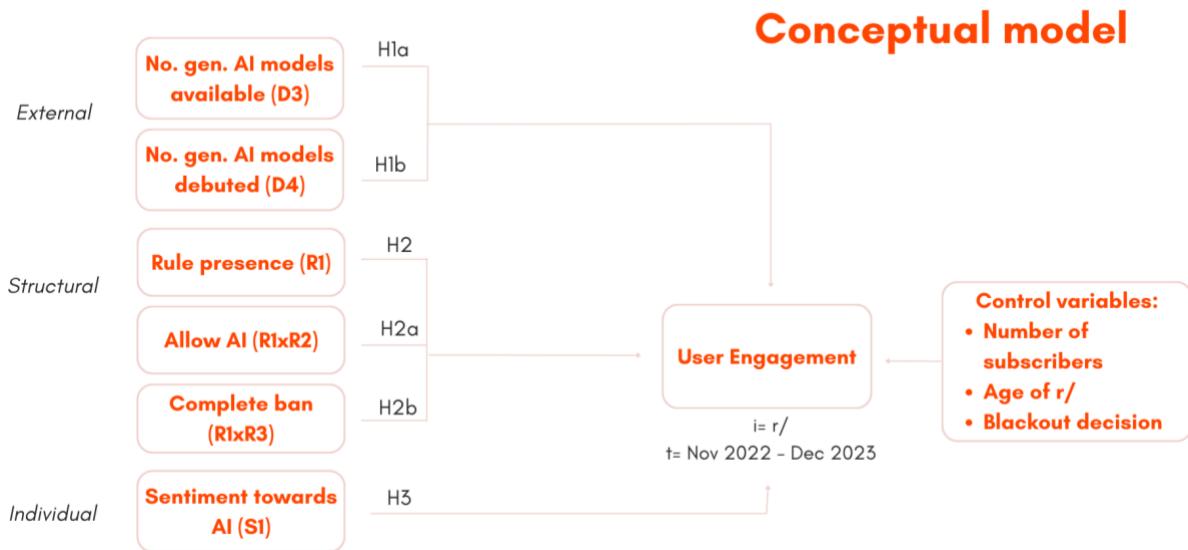
Moreover, the latest report by the Stanford Institute for Human-Centered AI (HAI) has studied the number of models currently available in the market as a quantification metric of AI development. The institute researchers suggest that the rapid rise of models being more cost-effective despite being more computationally demanding is an optimistic indicator of development (Maslej et al., 2025). The increasing accessibility of models to the general public has certain effects on user behavior in recent years. Burtsch et al. (2023) is a notable research regarding the impact of the introduction of generative AI models, such as ChatGPT, on the level of interaction on question-and-answer social platforms like StackOverflow and Reddit. In this study, only StackOverflow shows a decreasing trend in posting behavior four months after ChatGPT debuted. This is due to user behavior changes, from asking on social media to asking ChatGPT instead. However, this effect is not concluded on Reddit; one possible rationale is the nature of Reddit communities, which emphasize social interaction, emotional exchange, and a more engaged community, making the impact of AIGC less obvious or taking longer to become noticeable. Being aware and having access to a broad selection of generative AI models for different purposes can spark conversations on a wide range of subjects outside of their specialty.

Nevertheless, no study has examined whether community guidelines implementing certain generative AI policies, as suggested by Fiesler et al. (2018) or Lloyd, Goscik, et al. (2025) impact community engagement in that subreddit from the viewpoint of ordinary users. This thesis fills the

gap in the literature by adopting a multi-level framework to analyze user engagement changes on Reddit. Additionally, this study makes a major contribution to research on Reddit by extending the measurement period up to 13 months after ChatGPT debuted.⁴

4. Conceptual Model and Hypotheses

This thesis set out to investigate the influence of independent variables, which are the community guidelines, the number of generative AI models, and sentiment towards AI, on the dependent variable, which is user engagement. The conceptual model and hypotheses are formulated as follows:



The debut of ChatGPT at the end of 2022 grabbed the attention of the whole world. As a consequence, more discussion regarding this subject emerges (Wang et al., 2025). Instead of taking only ChatGPT into account, this research follows the report of HAI and Epoch AI to test the influence of all generative AI models in the market. The researcher acknowledge several generative AI models available, and using generative AI models is a direct substitute for many people to ask questions and interact on social networks. From that, a logical hypothesis is:

H1a: *The number of generative AI models available in the market is negatively correlated with user engagement rate on Reddit.*

H1b: *The number of generative AI models debuted during the month is negatively correlated with the user engagement rate on Reddit.*

When applying rules, the moderators need to consider the impact on their community. A newly introduced rule could orient appropriate chains of discussion, at the same time, generate a sense of feeling safe to share in the subreddit (Fiesler et al., 2018; Lloyd, Gosciak, et al., 2025). Hence, the feeling of belonging to a community encourages subscribers to engage in a conversation (Xu & Li, 2015). The first hypothesis is formulated as follows:

H2: *The presence of rules and policies regarding the use of AI-related content leads to higher user engagement on Reddit.*

Some subreddits are open to AIGC and specify this in their set of rules. They encourage newcomers to try AI-generated content, as this stimulates curiosity, creativity, and variety (Matatov et al., 2025). This type of policy is believed to boost engagement from newcomers. Therefore, the next hypothesis is stated as:

H2a: *Allowing the use of AI-related content leads to higher user engagement on Reddit.*

On the other hand, some subreddits have a hostile point of view towards AIGC. They specify that AIGC is completely banned in order to prioritize overall quality of content (Lloyd, Reagle, et al., 2025). As noted by Fang et al. (2023), although strict content restriction rules are usually applied to prevent spam, inappropriate content, or unauthorized content, user engagement does not decrease, but positive reactions are observed. Deep conversations without concerns in pointless, spam posts could facilitate a sense of community. As such, the hypothesis regarding user engagement is:

H2b: *Rules that completely ban the use of AI-generated content lead to higher user engagement on Reddit.*

Users on Reddit have diverse backgrounds and points of view towards AI. Users with negative perceptions towards AIGC have the urge to argue and defend their standpoint (Berman et al., 2019; Matatov et al., 2025). Discussion around conflict opinions is seen with long chains of replies and a substantial reaction rate (Aragón et al., 2017; Medvedev et al., 2019). This researcher suppose

generative AI is a recently heated topic. Moreover, Lloyd, Gosciaik, et al., (2025) reports a huge dataset contains more than 55 percent of subreddits that prohibit the use of AIGC. This proves that many people and communities have an unfavorable perception of exploiting generative AI. From the findings of prior literature, a negative perspective may result in more attention being drawn to that content. Thus, the last hypothesis is expressed as:

H3: A negative perception towards AIGC leads to higher user engagement on Reddit.

5. Data and methods

In this analysis, all hypotheses were tested using panel data across 83 subreddits. These subreddits had more than 100,000 subscribers in December 2023. All 83 subreddits are picked across 30 categories and topics in order to cover a wide range of interests on Reddit. The analysis period covers 14 months from November 2022, when ChatGPT was introduced to the public, to December 2023. The collected data mostly ends in December 2023, as a previous announcement from Reddit stated to start monetizing the access to its API for data collection, which was put into effect at the end of 2023⁷. This leads to numerous difficulties in past data and large-batch data collection. Therefore, the period between November 2022 and December 2023 contains the majority of data eligible for this study.

Controls

Number of subscribers

This is the total number of users who join a subreddit. They contribute to the community by posting content, leaving comments, and reacting to other people's content. The total subscriber count could vary from 2,000 subscribers, due to the early age at the start of the collected period, to 54 million subscribers in the subreddit r/funny. This is chosen to be a control variable as more people could generate a higher number of posts and comments, which are the dependent variable in this study. However, the effect of this is not considered in this study. This variable is demonstrated as a continuous ratio variable *Control_NoSub*.

Age of the subreddits

⁷ [How social media's biggest user protest rocked Reddit](#)

The age is counted by months from the day the subreddit was created. The number goes from as small as 15 months (created in 2022) to 191 months or nearly 16 years at the end of 2023. The age of the subreddit possibly affects the total number of engagements; however, this is also not the main effect this study focuses on. This variable is demonstrated as a continuous ratio variable *Control_Lifetime*.

Go Dark protest

As mentioned briefly above, in 2023, Reddit CEO Steve Huffman publicly announced that Reddit's API and data accessibility would be monetized. However, a huge number of unpaid moderators of Reddit, who have been managing its sub-communities, relied on third-party data-collecting tools to efficiently govern the community. The implication of the announcement tremendously affected the moderators, therefore triggering the anger. Various subreddits' moderators decided to "go dark", which implies they set their subreddits to private, diminishing the number as low as zero posts, particularly from 12 to 14 June 2023, in order to pressure Reddit to withdraw the decision⁷. A lot of subreddits have a substantially decreased engagement rate during that period. However, this is considered the main indicator of this study. A binary variable *Control_Protest* is used to express this effect.

Independent variables

AI development

The number of AI models available is suitable in order to quantify the development pace of AI and LLM technology. This study uses the AI model dataset by Epoch AI that can be found [here](#)⁸. This dataset covers more than 3,200 researched and debuted AI models since the 1950s. This study uses the notable models subset, which includes 951 models that fit into Epoch AI's criteria of notability. In order to be mentioned in the dataset, the models have to be funneled through these criteria: there must be documents regarding its existence, learning component, and experimental results. And to be considered notable, the models need over 5000 citations, considerable training cost, and be actively used by the masses. Initially, all notable AI models are considered, as this number could demonstrate how developed the AI industry has been. However, as generally a Reddit user would not leave a social media platform for a new AI model is found with the ability to discover new

⁸ [AI Models Documentation](#)

drugs, the researcher filter the dataset and leave only generative AI models that have language, images, videos, music, and other content-related generating tasks to be calculated in the model. These generative models could produce content in all texts and other content formats, and they are likely to be a direct substitute for the questioning-answering process on Reddit (Burtch et al., 2023). As a result, this study analyzes based on the number of notable generative AI and LLM models available up to the timestamps from November 2022 to December 2023. Another variable also studied is the number of notable generative models introduced each month during November 2022 – December 2023. It is worth noting that the models are not widely used right away. There is a lagged period between when the product first debuted and when there are adopters who decide to purchase and use the product (Aggarwal et al., 2019). Therefore, the one-month-lag number of notable generative models debuted during each month is calculated in the model ($t-1$). These variables are the same across all subreddits, as it is assumed that all people have the same approachability to all available models. These variables are expressed as:

- How many notable generative AI models are cumulatively available, as a continuous ratio variable ($D3$).
- How many notable generative AI models have debuted, as a continuous ratio variable ($D4$).

Community guidelines

Many subreddits have been developing and implementing a set of community guidelines, gradually becoming more refined in order to cater to the community's wants and needs. In the dataset of this study, all mentioned subreddits have their own set of rules. This study records specifically the timestamp and the characteristics of rules regarding generative AI usage and AI mentions in the community. AI-related rules are either be specified, represented by 1 for having AI-related rules, or not represented by 0. The change from 0 to 1 means that in this month, the moderators newly introduced the rule. Any changes outside of the data collection period from November 2022 to December 2023 are considered as no changes in this study. The timestamp of rules' appearance could be found in this sample link [https://www.reddit.com/mod/\(insert subreddit name here\)/rules/](https://www.reddit.com/mod/(insert subreddit name here)/rules/). For some subreddits, they posted a separate rules page that mentioned their stance on content moderation, such as r/anime's in-depth rules page could be found [here](#)⁹. The updated

⁹ <https://www.reddit.com/r/anime/wiki/rules/>

versions and dates could also be found in the page history. In more detail, this study considers the effect of AI Rule Stance on dependent variables. This part of the dataset is partially collected from Lloyd, Gosciak, et al. (2025)'s dataset that could be found [here](#)¹⁰. However, as some subreddits have edited their new rules, this section is re-evaluated manually to determine whether they allow or completely ban the usage of AI content in the subreddit. The indicators are expressed as:

- Whether the guideline regarding AI exists, as a binary variable (*R1*).
- Whether the guideline allows the use of AI or allows the topic of AI, as a binary variable (*R2*).
- Whether the guideline bans the use of AI or allows the topic of AI, as a binary variable (*R3*).

Sentimental

This variable expresses how AI is positively or negatively perceived by users of each subreddit. For this study, AI-related posts are searched on each subreddit from November 2022 to December 2023 with keywords including AI, A.I., ChatGPT, LLM, and then English texts without emojis are collected. The text is extracted into PDF files by months and then loaded into a text-processing sentiment-coding file to determine the polarity score. All coding is run in R and Python, and the GitHub link is provided in Appendix 1. The range of polarity score is from -1 to 1 (minus one to one). If the text included extremely negative words, such as “awful” and “disgusting”, it would receive a minus 1-polarity score (-1). A -1 could show that users have a pessimistic view or even tend to eradicate the use of AI. On the other hand, extremely positive words, including “best” and “great”, result in a score of 1. This could mean the community is optimistic about the present and future of AI, or advocates for AI usage. The polarity score represents the overall sentiments towards the post; therefore, it shows how users in the subreddit perceive AI topics. The variable is expressed as a continuous interval variable from -1 to 1 (*SI*).

Table 5.1 below summarizes the most important components of the independent variables in this research.

Table 5.1: Components of independent and control variables used in the model.

¹⁰ https://github.com/sTechLab/AIRules/tree/main/ai_rules_set

Type	Code	Description	Measure- ment scale	Range	Applicati- on in the model
Independent	D3	How many notable generative AI models are cumulatively available in month t	continuous ratio	121 to 166	Logged
Independent	D4	How many notable generative AI models have debuted in month t	continuous ratio	1 to 13	Logged, lag 1 month
Independent	R1	Whether the guideline regarding AI exists	binary	0 or 1	Direct calculation
Independent	R2	Whether the guideline allows the use of AI or allows the topic of AI	binary	0 or 1	Interaction with R1
Independent	R3	Whether the guideline bans the use of AI or allows the topic of AI	binary	0 or 1	Interaction with R1
Independent	S1	Overall sentiment polarity score towards AI related posts	continuous interval	-1 to 1	Direct calculation
Control	Control_NoSub	Total number of subreddit subscribers	continuous ratio	1,633 to 54 millions	Logged
Control	Control_Lifetime	Age of subreddits in months	continuous ratio	2 to 191	Logged

Control	Control_Protest	Whether the subreddit joined the Go Dark protest in month t	binary	0 or 1	Direct calculation
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Note: The range of the variables is listed based on the original data.

Dependent variables

This analysis evaluates the impact of the above-mentioned internal and external influences on Reddit's engagement rate. The engagement indicators covered in this study are total post counts and total comment counts of each month from November 2022 to December 2023. These variables are chosen thanks to the availability of the data from this thesis supervisor, Dr. Shrabastee Banerjee, and a further manual collecting process to count posts and comments of 83 subreddits within 14 months. Another potential measure of engagement is the total score of posts, which is the total upvotes minus downvotes of each post, and this could not be estimated due to a lack of data across months. The examination of this measurement is hoped to be executed in future works.

Table 5.2 below shows the descriptive statistics for dependent variables. These variables demonstrate the activity across subreddits in 14 months of data collection. Log-transformed variables preserve significant variation while reducing the skewness present in raw count data.

Table 5.2: Descriptive statistics of y1, y2, and the dependent variables used in the calculation of y1lg and y2lg. Note: M = mean; SD = standard deviation.

Variable	M	SD	Min	Max
y1 (Post count)	4,440.92	5,826.73	0.00	94,586.00
y2 (Comment count)	66,649.83	110,896.82	0.00	1,113,300.00
y1lg (Log post count)	3.40	0.48	1.72	4.98
y2lg (Log comment count)	4.41	0.67	2.12	6.05

One-way model

All the variables are curated into a panel dataset with a total of 1160 observations across 14 months and 83 subreddits. The analysis attempts to examine the impact of introducing community guidelines, either allowing or banning, newly debuted AI and LLM models, and how the community perceives AI on engagement rate across both time and subreddits. There has been no previous study on this topic that used this technique to analyse the impact on engagement rate. Hence, this part of the research references theoretical ideas in Baltagi (2021)'s book "Econometric Analysis of Panel Data" to justify the choice of methodology. Given the rapid pace of generative AI development at the moment, each subreddit has a different lag time when applying a new guideline; hence, using panel data across time is reasonable.

Firstly, when dealing with panel data, it is natural to question whether to pool the data or not. A poolability test is applied to compare if the pooled OLS model or the fixed-effects model is more appropriate. To do this, a pooltest function is used, and with the result of rejecting the null hypothesis ($p\text{-value} < 2.2\text{e-}16$), the pooled OLS is considered not suitable for this dataset. When dealing with a varied set of subreddits with multiple attributes, while a lot of them are not capable of being captured within one study, or in other words, there are potentially too many parameters, it is necessary to determine whether to use either fixed-effect or random-effect. The fixed effects definition is more suitable if the emphasis is restricted to a predetermined number of units, in this case, subreddits, whereas the random effect specification indicates that the involved units are drawn randomly from a larger population. It is suggested that the Hausman tests could be utilized to choose the appropriate specification.

A two-way fixed-effects model is considered as well, as it has the ability to account for both subreddit-specific heterogeneity and time-specific shocks. However, a joint test of monthly time dummies returns a significant Chi-square number; hence, it rejects the null hypothesis that time effects provide additional explanatory power. Additionally, adding time fixed effects creates perfect multicollinearity with the most important independent variables, particularly the cumulative and debut generative AI models counts (D3 and D4); hence, it reduces the forecasting ability of the model. This is expected as the focused independent variables of this study have cross-sectional variation among subreddits rather than notable multiple changes across time. With the

support of the results of the poolability and Hausman tests, the one-way fixed-effects model is selected for calculating post counts and the one-way random-effects model is selected for calculating comment counts in order to be more in line with the goal of this research. For all non-percentage variables, the logarithmic form is used to raise the variance of the variables. Thus, taking into account all pre-described variables, the following model is defined to explain the effect on engagement rate:

$$y_Post_count_{it} = \beta_1 a(D3_{it}) + \beta_1 b(D4_{i(t-1)}) + \beta_2(R1_{it}) + \beta_2 a(R1xR2_{it}) + \beta_2 b(R1xR3_{it}) + \beta_3(SI_{it}) + \beta_4(Control_NoSub_{it}) + \beta_5(Control_Lifetime_{it}) + \beta_6(Control_Protest_{it}) + u_i + \varepsilon_{it}$$

And:

$$y_Comment_count_{it} = \beta_0 + \beta_1 a(D3_{it}) + \beta_1 b(D4_{i(t-1)}) + \beta_2(R1_{it}) + \beta_2 a(R1xR2_{it}) + \beta_2 b(R1xR3_{it}) + \beta_3(SI_{it}) + \beta_4(Control_NoSub_{it}) + \beta_5(Control_Lifetime_{it}) + \beta_6(Control_Protest_{it}) + u_i + \varepsilon_{it}$$

In which:

- $y_Post_count_{it}$ and $y_Comment_count_{it}$ are the engagement indicators of total post counts and total comment counts in subreddit i and month t .
- $D3_{it}$ is the number of generative AI models that are cumulatively available in subreddit i and month t , and $D4_{i(t-1)}$ is the number of generative AI models that have debuted in subreddit i and month $t-1$.
- $R1_{it}$, $R2_{it}$, and $R3_{it}$ are respectively the AI guideline options in subreddit i and month t .
- SI_{it} is the number of overall sentiments towards the posts in subreddit i and month t .
- $Control_NoSub_{it}$, $Control_Lifetime_{it}$, and $Control_Protest_{it}$ are respectively the control variables of the total number of subscribers, total age, and whether the subreddit joins the Go Dark protest of subreddit i in month t .

It is crucial to ensure the dataset's quality before proceeding with the regression analysis. Multicollinearity, heteroskedasticity, serial correlation, and cross-sectional dependence are the primary issues that must be examined in order to follow with panel data methodologies.

Multicollinearity

Multicollinearity is the violation of the assumption that no independent variable is highly correlated with any other independent variable (Baltagi, 2021; Hagenstad, 1999). This needs to be checked as the violation could yield a large standard error. In this case, the dataset is tested for multicollinearity by using the VIF function. A common rule of thumb for the result of this test is that a VIF of 10 or higher should be taken into consideration further. And a VIF number of 5 or lower is acceptable. It is expected in this study that the result of this test to be unfavorable to reject multicollinearity. Given the nature of this dataset, every subreddit must have the AI-related rules in its guidelines (R1=1) for the subsequent rule specification (R2 and R3), either allowing or banning generative AI usage, or both or none, to be applicable. The dataset does not bias any coefficients; however, the standard error of the R variables is larger than expected. Other than that, every other variable has a decent VIF number of around 1, indicating that these variables have no concerning correlations. Thus far, all independent variables show no atrocious threats to model validity and are maintained to theoretically argue for the study.

Heteroskedasticity

Heteroskedasticity violation means that the error terms drawn from a distribution vary over time. (Baltagi, 2021). When heteroskedasticity is present, consistent estimates of the regression coefficients may be unattainable despite being able to assume homoscedastic disturbances. Therefore, it is crucial to determine how severe the heteroskedasticity issue in the model is. In the case of this study, the Breusch-Pagan test is utilized to test for the issue. The result returns the impact of heteroskedasticity in the dataset, y1 and y2 (p-value < 0.001 for both). Thus, it is needed that the issue is held accountable by applying robust estimates of the standard error in the calculation.

Serial correlation

Serial correlation is another breach of the assumption that the error terms are independent of one another (Baltagi, 2021). Pure serial correlation is defined as serial correlation that depends on the error term of the regression equation. Meanwhile, impure serial correlation is from errors in specification, like an omitted variable or incorrect use of a function form. The violation of this assumption may cause serious standard error biases, hence, nullify the results. Serial correlation needs to be taken into account; as such, this study's dataset is tested with the Wooldridge test. The

result of the test demonstrated that the p-value is significant for both of the formulas for total post counts and total comment counts. It is confirmed that the standard errors are biased and may dismiss the t-test result. To resolve the issue, a method called cluster-robust SE is advised to effectively address this under the one-way fixed effect model.

Cross-sectional dependence

Cross-sectional correlation is usually not concerning; however, this study additionally evaluates this assumption due to the fact that the dataset already violates the above assumptions. Cross-sectional dependence implies that units, in this case, subreddits, are dependent on each other and all influenced by a trend or mutual events (Baltagi, 2021). The Pesaran test for identifying cross-sectional dependence indicates that the case exists in this dataset, $y1$ ($z = 15.974$, $p\text{-value} < 0.001$) and $y2$ ($z = 14.285$, $p\text{-value} < 0.001$). The result leads to rejecting the null hypothesis that all subreddits are cross-sectionally independent. Therefore, the initial result of robust inference requires Driscoll–Kraay standard errors as this method is able to maintain validity in the presence of heteroskedasticity, serial correlation, and cross-sectional dependence (Hoechle, 2007).

To conclude this section, it is worthwhile to mention the statistical software to run the regression. With the characteristics of the substantial dataset, R is employed to handle multiple steps of gathering, converting, and accessing the data. The chapter that follows moves on to consider the result of the final model using one-way (individual) fixed-effect panel regression with Driscoll–Kraay standard errors.

6. Results

In the following pages, the empirical results of the one-way fixed-effect panel regression with Driscoll–Kraay robust standard errors are presented after a series of diagnostic tests checking the existence of heteroskedasticity, autocorrelation, and cross-sectional dependence. The Driscoll–Kraay standard errors are able to guarantee the accuracy in the presence of traditional assumption violations. This section demonstrates the results of the following two dependent variables: log-transformed total post counts $y1lg$ and log-transformed total comment counts $y2lg$, both are

influenced by the log-transformed number of AI models (D3 and D4), community guidelines regarding AI (R1, R2, and R3), and the sentiment of subscribers (S1). All calculations account for subreddit-specific control variables. They are also log-transformed numbers of subscribers (Control_NoSub), log-transformed subreddit ages by month (Control_Lifetime), and the GoDark protest situation (Control_Protest).

Model fits

As described on the previous pages, the panel dataset consists of 1,160 observations spanning 14 months from November 2022 until December 2023 across 83 subreddits. It is appropriate to use panel data to express within-unit changes, as each subreddit's guidelines and adoption of AI-related standards are contextual. The detailed statistics of all pre-tests and diagnostic tests can be listed in Table 6.1 as follows:

Table 6.1: Statistics of poolability test, Hausman test, joint test of time dummies, diagnostic tests of Multicollinearity (VIF), Breusch-Pagan test for heteroskedasticity, Wooldridge test for serial correlation, and Pesaran CD test for cross-sectional dependence.

Diagnostic Test	Statistic	p-value	Conclusion
Poolability test	$F(82, 1067) = 79.365$ (y1)	< 0.001	Fixed effects
	$F(82, 1067) = 111.6$ (y2)		
Hausman test	$\chi^2(9) = 34.043$ (y1)	< 0.001	Fixed effects for y1
	$\chi^2(9) = 12.663$ (y2)	0.1785	Random effects for y2
Joint test of time dummies	$\chi^2(11) = 37.72$	< 0.001	One-way FE
Multicollinearity (VIF)	VIF = 1-1.42 for D1, D4, S1, controls 21-37 for R1, interactions	N/A	Keep all variables

Breusch-Pagan test for Heteroskedasticity	BP = 92.107 (y1) BP= 63.712 (y2)	< 0.001	Robust SE required
Wooldridge test for Serial correlation	F(1,1074) = 36.667 (y1) F(1,1073) = 144.2 (y2)	< 0.001	Cluster or DK SE needed
Pesaran CD test for Cross-sectional dependence	z = 15.974 (y1) z = 14.285 (y2)	< 0.001	Driscoll-Kraay required

External factor

The more the percentage of cumulative generative AI model numbers, the considerably lower degree of posting activity, as the cumulative generative AI model number (D3) shows a negative and statistically significant association with posting frequency ($\beta = -1.451$, p-value < 0.001), in support of hypothesis 1a. On the other hand, the number of generative AI models debuted in the last month (D4) is not significant at 5% and we cannot confirm hypothesis 1b, but it could be considered significant at 10% with a small magnitude ($\beta = -0.029$, p-value = 0.084). This could imply that after a lagged time, the cumulative exposure has a significantly more noticeable impact on posting behavior, even though users of Reddit do react quantitatively to the introduction of new generative AI models.

Commenting behavior appears to be affected by the number of generative AI models, similar to posting behavior. The beta of D3 is significantly negative ($\beta = -1.057$, p-value < 0.001), which supports hypothesis 2a, and D4 is not significant ($\beta = -0.029$, p-value = 0.177), which does not support hypothesis 2b, and both of them yield the same direction as the above result. This could mean that users are exposed to new technology influences the decision to share ideas and participate in the conversation.

Structural factor

Subreddits that explicitly state AI-related rules in their community guidelines tend to have lower post frequency over time compared to their own baseline levels, as evidenced by the considerable

negative correlation between rule existence (R1) and y1lg ($\beta_1 = -0.202$, p-value = 0.025). This result is against the theoretical prediction that the existence of AI governance frameworks could higher user involvement. This result does not support hypothesis 2. However, formulating clear guidelines for acceptable and unacceptable conduct yields an opposite result. Positive correlations are found between applying rules regarding allowances or complete bans. The presence of specifically stated generative AI usage reverses the impact of R1. The resulting net impact of R2 is 0.069, and that of R3 is 0.056. The simultaneous presence of all three factors leads to the strongest positive synergistic effect at 0.328, although this occasion rarely happens. These results are significant at the p = 0.05 level, which confirms hypotheses 2a and 2b. This result supports the idea that clear guideline allowances and bans could encourage some types of engagement.

The results regarding comment patterns are somewhat similar to the post patterns. The intercept is a part of a random effect model, and it makes sense when all other variables are 0. However, given the nature of the dataset, this circumstance cannot occur; therefore, the effect of this variable could be neglected. The negative correlation between rule existence (R1) and y2lg indicates that subreddits with written AI-related rules in their community guidelines typically have a lower percentage of having comments ($\beta = -0.366$, p-value = 0.017), so hypothesis 2 is not supported with regard to the number of comments. This outcome contradicts the hypothesis that the presence of AI governance frameworks could increase user participation, like in posting behavior. Meanwhile, establishing precise rules on what behavior is acceptable and undesirable has the opposite effect. Rules about allowances or total bans are proven to have positive connections in support of hypotheses 2a and 2b, despite different significant levels. R2's presence effectively counteracts R1's negative effects. There is a small positive net impact of +0.048 as the positive interaction coefficient (0.414) exceeds the negative baseline effect of R1 (-0.366). In the same way, R3 reverses the detrimental effects of R1. A total increase of +0.095 results from compensating for the baseline decrease with the strong interaction term (0.461). The presence of all three elements results in a significant cumulative benefit of 0.509, which is again a rare occasion. This finding gives evidence to the theory that clear guidelines that permit or prohibit the use of generative AI tools may increase the participation rates.

Individual factor

One anticipated independent variable, the sentiment of users towards AI, is theoretically forecasted to harm the posting pattern, in other words, if they perceived AI more negatively, people would engage more in the subreddit. However, the evidence is only found at the significant level of 10% for associations between sentiment and posting behavior ($\beta = 0.033$, p-value = 0.097). The direction of the coefficient is inconsistent with theoretical research suggesting that emotional tone may affect user engagement, as the effect is not significant enough to draw any correlation conclusions. Hence, hypothesis 3 is not supported. This suggests that, if other variables are taken into account, sentiment in this dataset does not significantly predict posting activity.

Theoretically, user attitude toward AI is expected to negatively impact the commenting pattern; that is, if users had a more unfavorable perception of AI, they would participate more in the subreddit. Yet again, significant correlations between sentiment and commenting activity cannot be identified ($\beta = 0.010$, p-value = 0.680), therefore, hypothesis 3 is not supported regarding the total comment counts. The coefficient in the second formulation is negligible, similar to the result found in the first one. This result reveals no correlation between sentiment and commenting activity when other factors are included in the calculation.

Control variables

The three control variables behave in the calculation as expected. Larger subscriber bases (Control_NoSub) are linked to higher posting activity ($\beta = 0.108$, p-value < 0.001), whereas subreddit age (Control_LifeTime) has a more substantial influence ($\beta = 0.984$, p-value = 0.030). The GoDark protest participation (Control_Protest) also significantly correlates with post frequency, confirming that protests significantly decrease engagement levels due to being completely unavailable ($\beta = -0.127$, p-value < 0.001).

While subreddit age (Control_LifeTime) has a considerable effect on commenting pattern ($\beta = 0.573$, p-value = 0.045), larger subscriber bases (Control_NoSub) are also associated with higher commenting activity ($\beta = 0.170$, p-value = 0.005). Additionally, there is a significant correlation between post frequency and GoDark protest participation (Control_Protest), demonstrating

drastically lower engagement levels since they are entirely inaccessible when the protest happened ($\beta = -0.200$, p-value < 0.001).

Figure 6.1 and Figure 6.2 extract the coefficients after adjusting with Driscoll-Kraay SE with the significant level for any variable that is significant. The full one-way fixed-effect panel regression result with Driscoll-Kraay standard errors for y1lg and y2lg is added in Appendix 2.

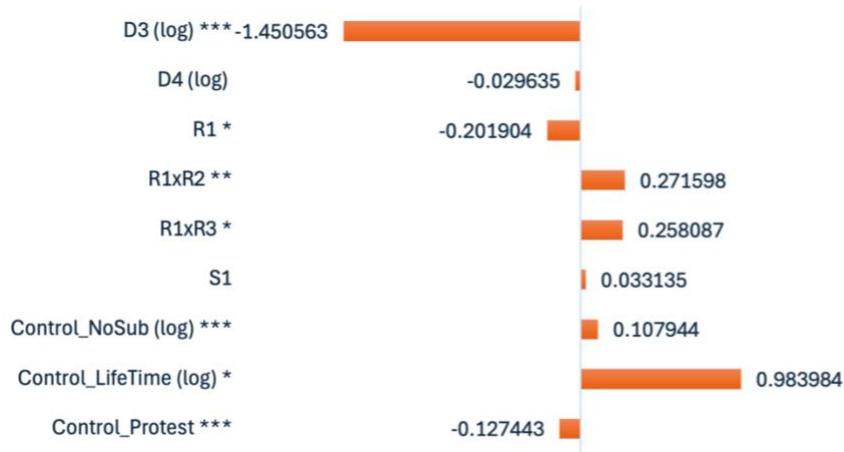


Figure 6.1: Impact of independent variables on log-transformed total post counts (y1lg) after adjusting with Driscoll-Kraay SE

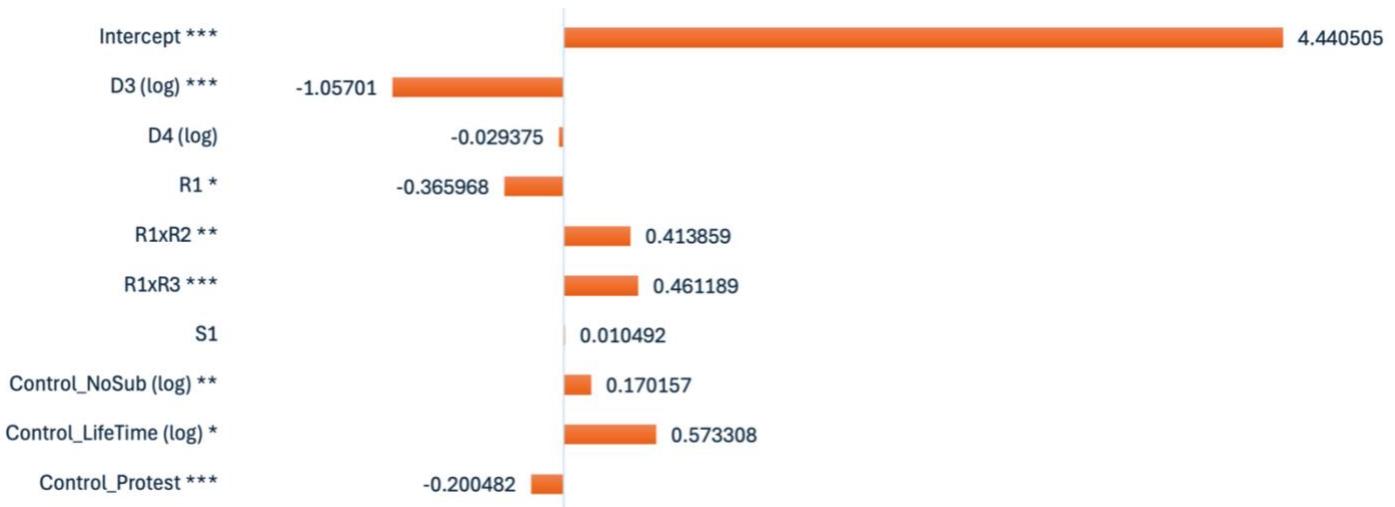


Figure 6.2: Impact of independent variables on log-transformed total comment counts (y2lg) after adjusting with Driscoll-Kraay SE

Table 6.4 below summarizes the findings.

Table 6.4: Summary of Results

Hypothesis	Expected	Total post count	Total comment count
H1a: no. available models	-	Supported	Supported
H1b: no. models debuted	-	Not supported	Not supported
H2: rule presence	+	Not supported	Not supported
H2a: allow	+	Supported	Supported
H2b: ban	+	Supported	Supported
H3: sentiment	-	Not supported	Not supported

7. Discussion and Conclusion

Academic findings

This study analyzes how the development of the AI industry affects the performance of Reddit, which is considered a social network with a variety of self-organized methods, high freedom of speech, promoting social interaction and sharing of knowledge or opinions in the digital environment (Medvedev et al., 2019). On the whole, the thesis contributes some findings. Firstly, this research adds to the literature regarding the multi-level influence of external elements (i.e., the emergence of generative AI), structural elements (i.e., the presence of community guidelines), individual elements (i.e., the sentiment of Reddit users on AI), and engagement rate on Reddit. Previous studies focus on a single factor, for example, Burtch et al. (2023) examines the impact of external aspects, Lloyd, Gosciaik, et al. (2025) analyze the application of structural governance, and personal opinion influence on engagement rate is separately evaluated (Berman et al., 2019; Matatov et al., 2025).

Secondly, this research presents the effort to quantify the multi-level influence with various approaches and carry out an econometric approach. A variety of manual and scraping tools, several versions of sentiment analysis, and countless R scripts and console files have been optimized in order to successfully establish the dataset with more than 1000 observations. The findings of Lloyd, Gosciaak, et al. (2025) take a foundational role in the way this research is developed. Despite data availability limitations, the regression offers interesting results.

This study includes all the necessary pretests in order to run a panel data regression, namely poolability, Hausman test, joint test of time dummies, multicollinearity, heteroskedasticity, serial correlation, and cross-sectional dependence, hence, to be able to find an appropriate analysis method for each dependent variable. The results show that there are differences between the effects of each level. The influence at the external level becomes evident. The decline in engagement rate on Reddit is closely correlated with the explosion of generative AI technology that is deemed a conceivable substitution. This result reconfirms findings of Burtch et al., (2023), and even has a significant result. This might be due to the longer data collection period, which, when combined with the impact of other variables in the model, could make the findings significant. Technology booms should be studied with a certain lag to be able to verify the actual impact, as actual consumers take time to widely adopt new technology and gradually change their habits (Aggarwal et al., 2019). Next, at the structural level, the proposal and implementation of unclear guidelines related to AI and AIGC in the community can lead to a decrease in community activity. Guidelines that specify what is allowed and what is not significantly encourage interaction and sustain a positive community by promoting constructive dialogue. This finding is consistent with the study applying other rules regarding framing endorsed and opposed behavior (Chandrasekharan et al., 2018; Fiesler et al., 2018). Governments need to create an environment for interpersonal interaction and keeping users on the platform. Regarding the individual level, previous researches on social media marketing have different opinions on the effect of individual sentiment on engaging behavior. The influence of sentiment in this study is negligible, which can be concluded that average users' sentiment with AI news in the community does not influence their decision to post or interact with other users. Or another way of looking at it is that sentiment is not clearly expressed in subreddit posts to be significant in the calculation model. This study aligns with previous research that this is a variable that is greatly influenced by different contextual conditions,

from which it is possible to evaluate the influence on the willingness to interact with other users in the community.

Managerial applications

The findings of this paper could be applied to the governance method on social media. Regarding the external changes, the AIGC is emerging and becoming a direct substitute for questioning-and-answering social media platforms. Detailed guidelines for AIGC usage, compared to unclear ones, are proven to return positive results with other external and individual aspects in mind. Users' reactions could vary, but an incorrect decision could trigger widespread disagreement. Community managers should consider having a strong stance on the benefits and drawbacks of generative AI use. Hence, analyzing the people's opinion is a critical step to nudge correct usage for the community. This leads to less negative response in regards of any point of view toward AIGC. Therefore, this researcher advise widely applying a comprehensive governance method on Reddit.

Limitation

Despite the study's methodology, several limitations must be acknowledged. Firstly, the sample size is drawn from 83 subreddits, while there are hundreds of thousands of subreddits, which may not fully capture the breadth of the whole platform. More subreddits with different topics and sizes should leverage potential skewness and biases during calculations. Additionally, reliance on textual data for social media content excludes audiovisual elements, which are key drivers of engagement. Third, the study only captures the period until the end of 2023, and all changes after that period are not part of the study. Meanwhile, the AI industry has continued to boom in the last 3 years. This leaves out a lot of the changes in perception or the effects of the latest innovations on people's behavior. Nonetheless, the overall prediction ability of the model is quite small, even though this is not an important indicator of this methodology. Therefore, it is acknowledged that various unpredictable stimuli affect user engagement rates. Further studies could expand the scope of research and approach more subreddits; therefore, more variation could be measured over a longer period of time. More variables, for example, demographic information, market size indicators, moderation decisions, platform algorithms, content types, number of removed posts, and user backgrounds, could enhance the explanatory ability of the multilevel analysis model. An elemental variable that portrays engagement rate clearly is the post score. This researcher plan to

add this variable to the dataset, as it is believed to yield significant results and provide a reasonable explanation of Reddit's algorithm. However, due to time constraints and API suspension, this dependent variable is left for further studies.

Further discussion

The emergence of new technologies is arguably inevitable for economic development, as they help users reach optimal productivity. However, it is necessary to assess the associated costs, the possible consequences, and whether such development is under control. Research by The Stanford Center for Research on Foundation Models highlights profound, multifaceted concerns regarding current AI and Large Language Models. One sociological concern with regard to the continuous deployment of models that have access to large-scale datasets is the potential to magnify social injustices through bias amplification mechanisms. These models could directly impact end users who subconsciously consume content generated by assistive applications laden with bias, stereotypes, or discrimination. In addition to the issue of equality, the latest innovations raise new issues of security risks and misuse. The ability to generate high-quality content at low cost has lowered the barrier for creating deepfakes and misleading information. Coupled with the general public's limited capacity to identify accurate information, this poses great challenges for those working in the information technology industry, as well as politicians and authorities in governing the use and development of new technology. The current legal framework struggles to keep up with the rapid development of artificial intelligence technology. Many legal gray areas have not been mentioned, such as copyright ownership, legal liability when generative AI is the cause of faulty management decisions. While waiting for the legal regulations to mature, the role of professional ethics becomes vital. All parties need to cooperate to establish appropriate implementation standards, considering the impact on both actual users and indirect societal externalities. Moreover, although the indirect environmental cost of this AI technological boom is not a part of this research, this topic remains a much-needed debate. Power grid and water systems are bearing much stress due to data center implementations¹¹. The accumulated energy consumption associated with training, deploying, and operating to serve millions of people globally will increase exponentially. The question that has to be addressed is what particular

¹¹ [We did the math on AI's energy footprint. Here's the story you haven't heard.](#)

strategies are necessary to take advantage of renewable energy, optimize software, or record energy consumption to minimize the adverse effects and devote to transparency in the unavoidable impact on the environment, and if a model's social advantages outweigh its environmental costs. The author of this research anticipate that artificial intelligence conferences would discuss these issues in the process of building legal frameworks, and in future research on artificial intelligence technology.

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Appendix 1: Data material

Materials for the thesis include:

1. Full dataset
2. Sentimental code
3. R analysis code
4. Console result

They are available on GitHub through this link <https://github.com/mynhieee/master-thesis-plmn-2025.git>

Appendix 2: Regression result

	y1lg				y2lg			
	Estimate	Std. Error	t value	Pr(> t)	Estimate	Std. Error	t value	Pr(> t)
Intercept	-	-	-	-	4.440505	0.601605	7.3811	3.006e-13 ***
R1	-0.201904	0.090245	-2.2373	0.0254731 *	-0.365968	0.153793	-2.3796	0.0174929 *
R1xR2	0.271598	0.103028	2.6362	0.0085067 **	0.413859	0.159175	2.6000	0.0094413 **
R1xR3	0.258087	0.106742	2.4179	0.0157787 *	0.461189	0.134273	3.4347	0.0006144 ***
D3 (log)	-1.450563	0.158629	-9.1444	< 2.2e-16 ***	-1.057010	0.282626	-3.7400	0.0001931 ***
D4 (log)	-0.029635	0.017148	-1.7281	0.0842529 .	-0.029375	0.021738	-1.3513	0.1768583
S1	0.033135	0.020000	1.6568	0.0978578 .	0.010492	0.025468	0.4119	0.6804544
Control_NoSub (log)	0.107944	0.031299	3.4488	0.0005851 ***	0.170157	0.060956	2.7915	0.0053336 **
Control_LifeTime (log)	0.983984	0.453485	2.1698	0.0302401 *	0.573308	0.286038	2.0043	0.0452716 *
Control_Protest	-0.127443	0.032190	-3.9591	8.022e-05 ***	-0.200482	0.040501	-4.9501	8.528e-07 ***

Note: Significant codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Appendix 3: AI tool use logbook for Master thesis Marketing

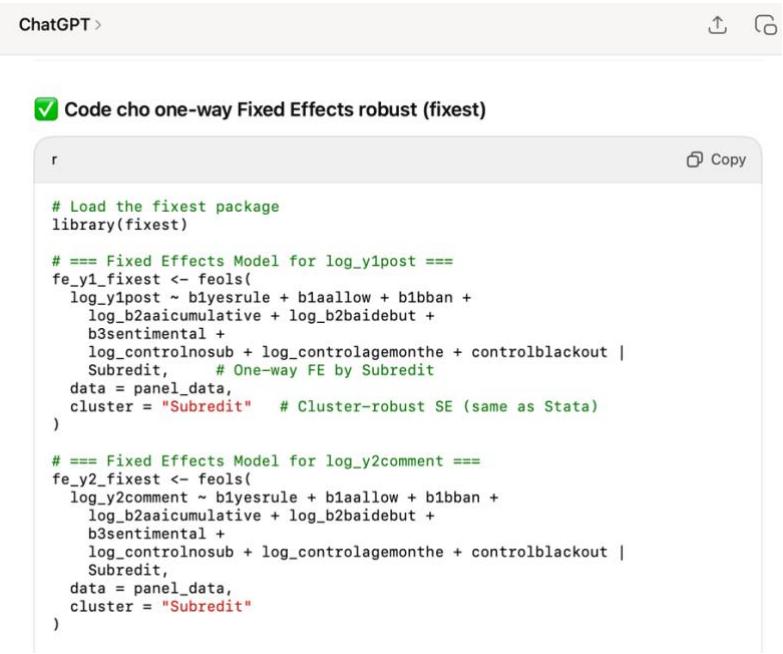
Student Name: Mai Nhi Pham Le

Student SNR: 2142880

Supervisor: Shrabastee Banerjee

Date	AI Tool	Purpose of use
26/09/2025	ChatPDF	Skim the literature
27/09/2025	ChatGPT	Summarize theoretical background to present the hypotheses
29/09/2025	ChatGPT	Write excel codes
10/11/2025	ChatGPT	<p>Find data set for variable regarding AI models available.</p> <p>Q: Are there reports that count the number of AI model available for the mass?</p> <p>A: I found a few relevant reports that touch on metrics related to AI models or consumer-AI tool adoption. They don't all give a clean "number of consumer-facing AI models from 2022 to today", but they are good sources you can use / combine. I can help you dig deeper if you like.</p>
		<p> Relevant reports</p> <ol style="list-style-type: none">1. Artificial Intelligence Index Report 2025 (by Stanford HAI)<ul style="list-style-type: none">o It says "institutions produced 40 notable AI models ..." in its 2025 edition.o So this gives a count of "notable models" but doesn't restrict to consumer-facing models.o Useful as a baseline of model development.

		<p>2. Artificial Intelligence Sector Study 2023 (UK Government / Perspective Economics)</p> <ul style="list-style-type: none"> ○ Shows growth of AI companies and product/service orientation: e.g., in 2022-2023, 329 AI companies registered since January 2022 in the UK dataset. ○ Not specifically “models for consumers” but indicates ecosystem growth. <p>3. 50+ Generative AI Statistics 2024 (via AIPRM compilation)</p> <ul style="list-style-type: none"> ○ Provides data on generative AI market size, user numbers (e.g., one stat: over 100 million monthly users of a major model by early 2023) ○ Again, more about usage and market, not exact count of models. <p>4. Trends in Frontier AI Model Count: A Forecast to 2028 (Kumar & Manning, 2025)</p> <ul style="list-style-type: none"> ○ This paper forecasts the number of “frontier” AI models, i.e., models exceeding compute thresholds ($\\$10^{25}$ FLOP etc). ○ While not strictly “consumer-facing”, it gives a quantified count and trend of model proliferation.
		<p> Gap & Next Step</p> <ul style="list-style-type: none"> • Gap: None of these give exactly “how many consumer-facing AI models (chatbots, image generators, etc.) were made available to the mass market from 2022 to now”. • Next Step: You could combine data: e.g., from “notable models produced” (Stanford), “market size / user uptake” (AIPRM), “forecast of models” (Kumar & Manning) → then estimate or approximate the consumer-model count. <p>If you like, I can search for a more specific dataset / industry report that <i>does</i> list consumer-facing AI models available to the public (and try to find a number or table) and send you direct links & key numbers.</p>

23/10- 12/11/2025	ChatGPT	<p>Write/test R codes. R codes are arranged manually with ChatGPT recommendations in using codes and presenting in text file.</p> <p>Eg: Q: Write R codes for fixed effect robust one way for log_y1post and log_y2comment with package fixest</p> <p>A:</p>  <pre> r # Load the fixest package library(fixest) # === Fixed Effects Model for log_y1post === fe_y1_fixest <- feols(log_y1post ~ b1yesrule + b1aallow + b1bban + log_b2aaicunlative + log_b2baidebut + b3sentimental + log_controlnosub + log_controlagemonthe + controlblackout Subredit, # One-way FE by Subredit data = panel_data, cluster = "Subredit" # Cluster-robust SE (same as Stata)) # === Fixed Effects Model for log_y2comment === fe_y2_fixest <- feols(log_y2comment ~ b1yesrule + b1aallow + b1bban + log_b2aaicunlative + log_b2baidebut + b3sentimental + log_controlnosub + log_controlagemonthe + controlblackout Subredit, data = panel_data, cluster = "Subredit") </pre>
13/11- 31/12/2025	QuillBot, Grammarly, Gemini	Paraphrase and check for grammars of writings

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