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ORIGINAL ARTICLE

# Monetizing Techno-Digital Intimacy: A Dynamic Panel Econometric Analysis and Live Chat Sentiment Modeling of Superchat Transactions in the Global VTuber Ecosystem

**Sandro Louise Oliveirra[1], Neva Dian Permana[2]***

[1]Department of Ecotourism, ESBA Institute of Tourism, Belo, Brazil

[2]Department of Social Sciences, CMHC Research Center, Palembang, Indonesia

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***Corresponding author**
Neva Dian Permana · neva.dian@gmail.com
**ORCID:** 0009-0009-4077-6464

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**ABSTRACT**

**Background:** Virtual YouTubers (VTubers), creators who perform through real-time motion-captured avatars, have turned live-streaming into a platform economy driven by direct audience tipping ('Superchats'). The relationship between affective labor, chat sentiment, and monetization velocity has not been quantified.

**Objective:** To estimate how live chat sentiment, especially parasocial affection, is associated with Superchat revenue in the global VTuber ecosystem.

**Methods:** We built a longitudinal panel of 1,250 livestream sessions from 50 VTubers (corporate agency and independent creators) in Japan, North America, and Southeast Asia, with 4.2 million live chat messages classified by fine-tuned XLM-RoBERTa. A Two-Step System Generalized Method of Moments (GMM) model predicted log Superchat revenue.

**Results:** The corpus recorded $3,452,180 in gross Superchat revenue and extreme inequality (top 5% of sessions capturing 68.4%; Gini = 0.742). Parasocial affection made up 14.2% of chat volume but 53.4% of revenue ($1,845,200). Free Talk (*Zatsudan* [chit-chat]) streams earned $1,545/hr, nearly triple gaming streams ($593/hr). Parasocial sentiment was positively associated with revenue ($\beta = +0.435$, $p < 0.001$; a 10% higher parasocial share, about 4.2% higher revenue), as were name-calling ($\beta = +0.284$) and concurrent viewership ($\beta = +0.342$; both $p < 0.001$; Hansen J $p = 0.39$, AR(2) $p = 0.284$).

**Conclusion:** Monetization appears to depend on affective responsiveness, which may expose creators to burnout risk. We propose an ethical platform governance matrix with tip throttling and mental health protections.

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## 1. Introduction

Digital live-streaming has grown from a decentralized subcultural pastime into a global entertainment industry worth billions of dollars, governed by sophisticated algorithmic attention architectures.[1,2] The past half-decade brought a sharp change. Virtual YouTubers (VTubers) rose fast. They are entertainers who perform, interact, and broadcast live through real-time motion-captured, two-dimensional or three-dimensional anime-style digital avatars.[3,4] Japanese corporate agencies such as Anycolor (Nijisanji) and Cover Corporation (Hololive Production) pioneered the format. Since then, the VTuber phenomenon has become a global cultural industry that generates billions of collective YouTube impressions, dominates top-earning streamer rankings, and has set up vibrant regional branches across North America, Europe, Latin America, and Southeast Asia (particularly Indonesia and the Philippines).[4–7]

Money drives this ecosystem. Its commercial success rests on the direct financialization of viewer engagement through synchronous digital tipping, as YouTube's 'Superchat' feature shows.[4,8] Conventional media run on subscriptions or advertising. Superchats do not. Viewers pay to have a pinned, color-coded message placed in the broadcast chat feed, for sums from $1 to $500 per transaction.[8,9] In the global VTuber market, Superchats and channel memberships are among the main sources of creator income, although merchandise can exceed them for large agencies,[10] and elite avatar performers collect millions of dollars in cumulative annual fan contributions.[4,5,11] The gap is striking. Despite this financial

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scale, media scholars, cultural sociologists, and platform economists still lack a rigorous, empirical understanding of the communicative and emotional dynamics that lead viewers to turn attention into direct monetary gifts.[9,12–14]

Parasocial interaction (PSI) and parasocial relationships (PSR) provide the theoretical grounding for this phenomenon. Donald Horton and R. Richard Wohl first conceptualized them in 1956, and digital media studies later expanded them.[2,15] In conventional television and mass broadcasting, parasocial intimacy ran one way. It was imaginary. Media consumers formed deep affective attachments to on-screen personas who could never perceive or return that affection.[2] Live-streaming changes this. Its synchronous, multimodal architecture creates what Reichelt called 'ambient intimacy'[16] and what Abidin discusses as perceived interconnectedness between influencers and followers,[17] a dynamic cyber-social space where viewers can actively influence the performer in real time through text commentary, emoji reactions, and financial contributions.[4,18,19] The digital avatar serves as an evocative aesthetic mask, a figure close to Donna Haraway's cyborg[20] and to Judith Butler's account of identity as performance,[3] that decouples visual identity from physical embodiment.[21] The mask lets performers project an idealized, highly expressive persona that draws intense affective devotion from fans.[3,5]

Scholars of labor and emotion describe this affective devotion as 'affective labor' and 'immaterial labor', terms associated with Michael Hardt, Antonio Negri, and Arlie Hochschild, and it is directly monetized.[1,22–24] Immaterial labor produces emotional states, social feelings, and relational bonds of belonging, intimacy, and care.[1] In the VTuber live-streaming economy, the streamer's main economic labor is not playing video games or showing musical virtuosity. It is sustained emotional calibration. The streamer reads viewer names, offers affectionate verbal acknowledgments, reacts with simulated gratitude to monetary gifts, and shares intimate vulnerability (venting about stress, illness, or loneliness) with the audience.[5,25] Viewers buy high-tier Superchats for more than a message. They buy visibility, validation, and simulated emotional reciprocity from the avatar persona, and the result is a commercialized loop of techno-digital intimacy.[4,26]

Cultural studies scholars have given qualitative ethnographic descriptions of VTuber fan communities,[4,5] but the existing literature suffers from a sharp quantitative and methodological divide.[9,12,27] Most are either purely qualitative ethnographies of small fan groups or descriptive cross-sectional correlations. Such correlations fail to account for dynamic panel persistence, endogeneity, and unobserved streamer heterogeneity.[9,28] To our knowledge, no prior research has systematically quantified the precise elasticity linking specific emotional sentiment categories in live chat (e.g., humor vs parasocial affection vs distress) to instantaneous Superchat revenue generation. Nor has any modeled the dynamic feedback loop in which monetary gifts stimulate further performer emotional responsiveness.[9,28]

The global expansion of the VTuber economy also varies sharply by region and geopolitical setting.[4,29] Indonesia is an important and fast-growing VTuber market in Southeast Asia.[30,31] There, as elsewhere in Southeast Asia, creators work under different economic conditions: lower average purchasing power parity (PPP), local e-wallet payment infrastructures (e.g., *Saweria*, *Trakteer*), and complex multilingual codeswitching (Indonesian, English, and Japanese).[4,5] The question is how monetization dynamics operate across Global North (Japan/US) and Global South (Indonesia) jurisdictions. The answer sheds light on the uneven geographical development of digital creator labor.[4,32]

To address these empirical gaps, this study presents what is, to our knowledge, one of the first large-scale dynamic panel econometric analyses and NLP sentiment audits of the global VTuber economy.[9,14] We analyze a balanced panel of 1,250 livestream sessions across 50 top-earning VTubers and 4.2 million live chat messages over a 104-week longitudinal horizon (2023–2025). The study has six aims. First, we quantify the macro-level revenue distribution and Pareto inequality of Superchat transactions (a). Second, we deploy fine-tuned RoBERTa transformer models to classify live chat sentiment across five functional dimensions (b). Third, we estimate a Two-Step System Generalized Method of Moments (GMM) dynamic panel model to estimate the elasticity of revenue velocity with respect to affective chat (c). Fourth, we analyze disaggregated financial performance across broadcast genres (Free Talk vs Gaming vs Music) (d). Fifth, we calibrate jurisdictional disparities between the Global North and Southeast Asia (e). Last, we propose an ethical platform governance matrix to address creator psychological burnout and exploitative parasocial financial extraction (f).[5,14,28]

Placing virtual live-streaming within broader media history requires a look at how affective labor evolved under cognitive capitalism.[1,22] Industrial manufacturing was different. Worker exploitation centered on the physical body, the assembly line, and the extraction of surplus value through mechanical labor time.[1] Cognitive and affective capitalism moves that extraction into the subjective, relational, and emotional capacities of human beings, what Paolo Virno terms the 'communism of capital'.[1,33] Social media platforms make no physical goods. They build socio-technical architectures that coordinate human attention, emotional investment, and user communication, and they capture the financial rents that networked human intimacy generates.[8,12] Avatars push this immaterial labor to an extreme. The performer's facial expressions, voice modulation, and micro-attentive interactions become instantaneous digital gift triggers, and emotional life turns directly exchangeable within corporate platform networks.[4,25]

The technical convergence of real-time computer vision, motion-capture rigging (via facial recognition software like iPhone ARKit and Unity tracking), and live video synthesis has radically lowered the barrier to virtual embodiment.[5,34] Performers who might face severe discrimination or exclusion in traditional visual entertainment because of appearance, age, gender identity, or disability can build bespoke digital avatars that express their authentic artistic voice.[3,5,35] Yet cyberspace is no utopia. Feminist science studies scholars remind us that it is not egalitarian and not freed from power. The anime aesthetic norms that dominate the VTuber industry, specifically hyper-feminized, youthful, and submissive character designs (*kawaii* [cute] culture and *moe* [affection toward fictional characters] aesthetics), often reproduce patriarchal gaze conventions. They lock performers into highly scripted gender performances that raise consumer expectations of emotional servility.[3,4]

The technical architecture of contemporary live-streaming interfaces plays a decisive, mediating role in structuring emotional contagion and gifting behavior.[8,12,36] Real-time chat slow-modes, members-only chat restrictions, customized channel emotes, and animated Super Stickers are more than decorative graphical widgets. They are calibrated affordances

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designed to manufacture a sense of exclusive community belonging.[12,15] A high-tier Superchat purchase shows how. The interface changes the visual environment for all concurrent viewers: the chat stream momentarily pauses, a vibrant color banner pins the message to the top of the chat box, and special sound effects trigger on the performer's broadcast screen.[8,9] This public visual spectacle turns an individual financial donation into a collective theatrical event.[14] The donor gains elevated social status within the fan community, and peer viewers are drawn into competitive tipping.[9,28]

## 2. Methods

### 2.1 Longitudinal Panel Construction and Sampling Design

We built the empirical corpus by scraping broadcast session archives, real-time live chat logs, and financial transaction metadata from the YouTube Data API v3 (all monetary values are in US dollars). The Playboard global live-stream analytics repository supplemented these sources.[9] The sources were public. The target population was professional, avatar-based content creators who broadcast mainly on YouTube in three primary geopolitical regions: Japan, North America (United States/Canada), and Southeast Asia (Indonesia/Philippines).[4,5] Sampling was stratified. Two institutional organizational models defined the strata:[5]

The first group was Corporate Agency-Affiliated Creators (N = 25). These were top talents from premier global management agencies, specifically Cover Corporation (Hololive Production, Hololive English, Hololive Indonesia) and Anycolor Inc. (Nijisanji, Nijisanji EN).[5] The second group differed in structure. It was Independent Virtual Creators (N = 25), all self-employed, unaffiliated avatar streamers with established commercial monetization.[5] We harvested 25 consecutive public livestream broadcast sessions for each of the 50 selected creators across the 104-week study window (January 2023 to January 2025). The result was a balanced longitudinal dynamic panel of N = 1,250 livestream broadcast sessions. The dataset is large. It covers 4,050 total broadcast hours, 4,218,500 individual live chat comments, and 284,520 discrete Superchat financial transactions.[9]

Our data extraction protocol followed the ethical guidelines of the Association of Internet Researchers (AoIR)[37], in keeping with high standards of research ethics in digital platform studies. Live chat logs and Superchat transactions are broadcast publicly in open YouTube channels. The risk was reidentification. All individual user handles, channel profile URLs, and personal donor identifiers were irreversibly anonymized with salted cryptographic SHA-256 hashing before any econometric analysis. Textual chat snippets cited as qualitative examples were also paraphrased and scrubbed of idiosyncratic linguistic markers, which prevents the reverse-identification of individual fans. The empirical inquiry therefore focused exclusively on aggregate institutional dynamics and did not surveil individual users.

### 2.2 Multi-Class NLP Chat Sentiment Classification Pipeline

An automated natural language processing (NLP) classification pipeline was developed to quantify the emotional and communicative environment of each broadcast.[38] Preprocessing came first. The 4.2 million live chat messages went through text normalization, tokenization, emoji extraction, and linguistic codeswitching normalization, which converted Japanese katakana/kanji slang, Indonesian slang, and internet acronyms into standardized semantic tokens.[38] Training came next. We fine-tuned a multilingual RoBERTa transformer model (XLM-RoBERTa-base) on a human-annotated ground-truth calibration corpus of 15,000 live chat messages. Three media studies researchers scored it (inter-annotator agreement $\kappa = 0.862$, $p < 0.001$).[38,39]

The classifier assigned every chat message to one of five mutually exclusive functional and affective dimensions:[4] (a) Casual Commentary / Gameplay Reaction: neutral observations regarding in-game events, broadcast technical status, or background music. (b) Humor / Memetic Banter: playful jokes, laughter emojis (草, '*kusa* [grass; laughter]', 'w', 'lol', '*wkwk*'), chat copypastas, and teasing. (c) Parasocial Affection & Direct Emotional Support: explicit expressions of love, admiration, personal validation, well-wishes, protective encouragement, and affirmations of the streamer's well-being. (d) Celebration / Milestone Recognition: congratulations on subscriber achievements, birthday greetings, 3D outfit reveals, and anniversary salutations. (e) Distress / Catharsis / Intimate Venting: audience sharing of personal real-world hardships, mental health struggles, grief, or seeking solace from the avatar persona.[4] We computed the Parasocial Sentiment Ratio (PSR_it) for each livestream session i at time t. The ratio is simple: the volume of parasocial affection messages divided by total non-superchat chat volume.

### 2.3 Dynamic Panel Econometric Model Specification (Two-Step System GMM)

Modeling the determinants of livestream Superchat revenue raises three severe econometric challenges:[40] (a) Revenue persistence: past financial donations create enduring social norms that influence future gifting behavior, so a lagged dependent variable must be included. (b) Endogeneity and reverse causality: higher parasocial affection in chat stimulates Superchat giving, yet a major monetary tip also prompts the streamer to express gratitude, which in turn stimulates further affectionate chat. (c) Unobserved individual heterogeneity: permanent time-invariant streamer attributes (such as avatar voice timbre, aesthetic design charisma, and agency prestige) correlate with explanatory variables.[40]

These challenges make Ordinary Least Squares (OLS) and static Fixed Effects estimators biased or inconsistent here. OLS suffers from dynamic panel bias (Nickell bias), and Fixed Effects violates strict exogeneity.[40] We therefore specified a dynamic panel model estimated via the Arellano-Bover/Blundell-Bond Two-Step System Generalized Method of Moments (System GMM).[40,41] The specification follows: $\ln(Rev_it) = \alpha + \gamma \ln(Rev_i,t-1) + \beta_1 \ln(PSR_it) + \beta_2 \ln(Viewers_it) + \beta_3 Duration_it + \beta_4 GreetRate_it + \beta_5 Milestone_it + \beta_6 Agency_i + \eta_i + \lambda_t + \varepsilon_it$, where Rev_it is total gross Superchat revenue ($ USD) generated in session i during broadcast t. Rev_i,t-1 is lagged revenue from the preceding session, and PSR_it is the Parasocial Sentiment Ratio. Viewers_it is peak concurrent viewership, and Duration_it is broadcast length in hours. GreetRate_it is the frequency of performer direct name-calling per minute. Milestone_it is a dummy indicator for special celebration broadcasts, while Agency_i is a time-invariant dummy for corporate agency affiliation. The term $\eta_i$ captures unobserved streamer fixed effects, $\lambda_t$ controls for calendar year-month time shocks, and $\varepsilon_it$ is the idiosyncratic error term.[40]

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Lagged revenue and PSR are endogenous.[41] We instrumented them with lagged levels (t-2 and t-3) in the first-difference equations and with lagged first-differences in the levels equations. Standard errors were Windmeijer finite-sample corrected and cluster-robust.[40] Model validity rested on two tests: the Arellano-Bond test for second-order serial correlation (AR[2]) and the Hansen J-test of overidentifying restrictions.[40,42]

System GMM generates a high-dimensional instrument matrix. This can cause multi-collinearity and overfitting. To address this, we implemented the instrument collapsing techniques formulated by David Roodman.[40,42] The collapsed matrix does not create separate instrumental moment conditions for each available time period. It limits the total instrument count to 27, strictly below the cross-sectional unit size (N = 50 creators). This limits the downward bias in standard errors and the weak Hansen tests that accompany instrument proliferation.[40,42] All continuous monetary variables were also transformed with natural logarithms (ln[x + 1]). The log form stabilizes skewed residuals and allows parameters to be read directly as elasticities.[40]

We implemented all dynamic panel GMM estimations in Stata v18 with the user-written package xtabond2.[42] They were cross-validated in R using the plm and gmm econometric libraries.[40,42] Two-step weighting matrices were computed from first-step residuals. All standard errors received the finite-sample correction developed by Frank Windmeijer, which prevents the extreme downward bias in standard errors typical of conventional two-step GMM.[40,43] Collinearity was low. Diagnostics showed that all variance inflation factors (VIF) among exogenous predictors stayed strictly below 1.62, which indicates no severe multicollinearity.[40] Instrument robustness was also verified across alternative lag lengths (t-2 to t-4). Estimates stayed within a 4.2% margin.[40,42]

### 2.4 Broadcast Genre Disaggregation and Decomposition

To examine how performance format moderates affective monetization, we sorted all 1,250 sessions into four mutually exclusive genres.[4,5] (a) Free Talk / Chitchat (*Zatsudan* [chit-chat], N = 410 sessions): unstructured, conversational broadcasts focusing on life updates, reading marshmallow questions, and direct dialogue with chat. (b) Special Events / Milestones (N = 95 sessions): birthday concerts, 3D anniversary shows, and monetization milestones. (c) Music / Karaoke / 3D Performance (N = 185 sessions): live singing and concert performances. (d) Gaming Broadcasts (N = 560 sessions): gameplay playthroughs (e.g., Minecraft, Apex Legends, horror titles).[4,5] Two outcomes were then computed. For each genre, we computed the Hourly Monetization Velocity ($/hr) and Revenue per Active Chat Participant.[9]

### 2.5 Multi-Jurisdictional Comparative Calibration

The analysis of geopolitical divergence between the Global North and Southeast Asia required two geographic panels. The 50 creators were split into Global North (Japan and North America, N = 35 creators, 875 sessions) and Southeast Asia (Indonesia and Philippines, N = 15 creators, 375 sessions).[4,32] The comparison covered several quantities. We compared transaction volumes, average donation amounts, and platform commission deduction rates after calibrating for purchasing power parity (PPP) and domestic third-party tipping gateway integrations.[32]

### 2.6 Ethical Platform Governance Architecture Formulation

We combined the econometric findings with critical labor theory. From this we formulate an ethical platform governance matrix structured across three regulatory domains: algorithm transparency, creator labor welfare, and consumer financial protection.[22,42] The matrix is a proposal and is presented in Section 4.4.

## 3. Results

### 3.1 Macro-Descriptive Statistics and Superchat Revenue Distribution

The audit of 1,250 livestream sessions exposed a large and uneven VTuber monetization landscape (Table 1 and Figure 1). Over two years, the corpus generated $3,452,180 in cumulative gross Superchat turnover. This came from 284,520 discrete financial transactions (Table 1). Mean revenue per session was $2,761.74 ± $3,842.15, and the median was $1,420.00. Individual sessions ran from $45.00 in low-engagement gaming streams up to $48,250.00 during peak birthday celebration broadcasts (Figure 1a).[9]

Transactions followed a steep Pareto pattern (Figure 1a). The top 5% of sessions captured 68.4% of total gross turnover. The creator revenue Gini coefficient was 0.742. That points to a 'winner-take-all' platform economy (Table 1). Average transaction size was $12.13 ± $24.85. Transactions clustered into two groups, however: low-tier $2.00–$5.00 tips made up 72.4% of total transaction count, whereas high-tier 'Red Superchats' ($100.00–$500.00) made up only 4.8% of transaction volume but produced 58.2% of total monetary value (Table 1). Concurrent viewership averaged 4,820 ± 6,450 users. Peak concurrent viewership reached 82,400 during corporate anniversary events (Figure 1b). Streams lasted 3.24 ± 1.15 hours on average. Corporate agency creators ran slightly shorter, highly produced broadcasts (2.65 ± 0.85 hrs). Independent streamers often held endurance sessions longer than 6.0 hours (Table 1).[5]

Monetization also differed by day of the week and time of day . Weekend evening broadcasts (Friday through Sunday, 7:00 PM to 11:00 PM local creator time) showed a 46.5% higher monetization velocity ($1,248/hr) than weekday afternoon sessions ($852/hr, $p < 0.001$). On weekends, audiences have the most free time and drink the most alcohol. This lowers psychological inhibitions against high-value tipping. Collective gifting spirals followed during community drinking (*nomikai* [drinking party]) streams and late-night karaoke sessions .[4,15]

**Table 1. Macro-Descriptive Statistics of the Global VTuber Livestream Panel (N = 1,250 Sessions).**

| Metric / Parameter | Corporate Agency Creators (N = 25) | Independent Virtual Creators (N = 25) | Full Balanced Panel (N = 50) | Statistical Distribution / Property |
|---|---|---|---|---|
| **Total Livestream Sessions Audited (N)** | 625 sessions | 625 sessions | 1,250 sessions | Balanced panel (25 sessions / creator) |

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| Metric / Parameter | Corporate Agency Creators (N = 25) | Independent Virtual Creators (N = 25) | Full Balanced Panel (N = 50) | Statistical Distribution / Property |
|---|---|---|---|---|
| **Total Gross Superchat Revenue ($)** | $2,412,500 (69.9%) | $1,039,680 (30.1%) | $3,452,180 (100.0%) | Pareto top 5% captures 68.4% |
| **Mean Revenue per Broadcast Session ($)** | $3,860.00 ± $4,450.20 | $1,663.49 ± $2,680.15 | $2,761.74 ± $3,842.15 | Median: $1,420.00 (Range: $45–$48,250) |
| **Total Superchat Transactions (N)** | 184,200 transactions | 100,320 transactions | 284,520 transactions | Mean per session: 227.6 ± 285.4 |
| **Average Monetary Transaction Value ($)** | $13.10 ± $26.40 | $10.36 ± $21.50 | $12.13 ± $24.85 | Bimodal (72.4% low-tier, 4.8% red-tier) |
| **Mean Peak Concurrent Viewers (CCV)** | 7,450 ± 8,120 viewers | 2,190 ± 2,840 viewers | 4,820 ± 6,450 viewers | Peak maximum: 82,400 viewers |
| **Mean Broadcast Stream Duration (Hours)** | 2.65 ± 0.85 hours | 3.84 ± 1.25 hours | 3.24 ± 1.15 hours | Total hours: 4,050.0 broadcast hours |
| **Total Live Chat Messages Harvested (N)** | 2,845,000 messages | 1,373,500 messages | 4,218,500 messages | Mean per session: 3,374.8 ± 4,120.5 |
| **Revenue Gini Inequality Coefficient** | 0.684 (Severe Inequality) | 0.765 (Extreme Inequality) | 0.742 (Extreme Inequality) | Power-law distribution alpha = 1.82 |

Note: Data harvested from YouTube Data API v3 and Playboard. Sample comprises 50 premier VTubers observed across 104 weeks (2023–2025). Values reported as Mean ± SD or frequency. Monetary values are in US dollars.

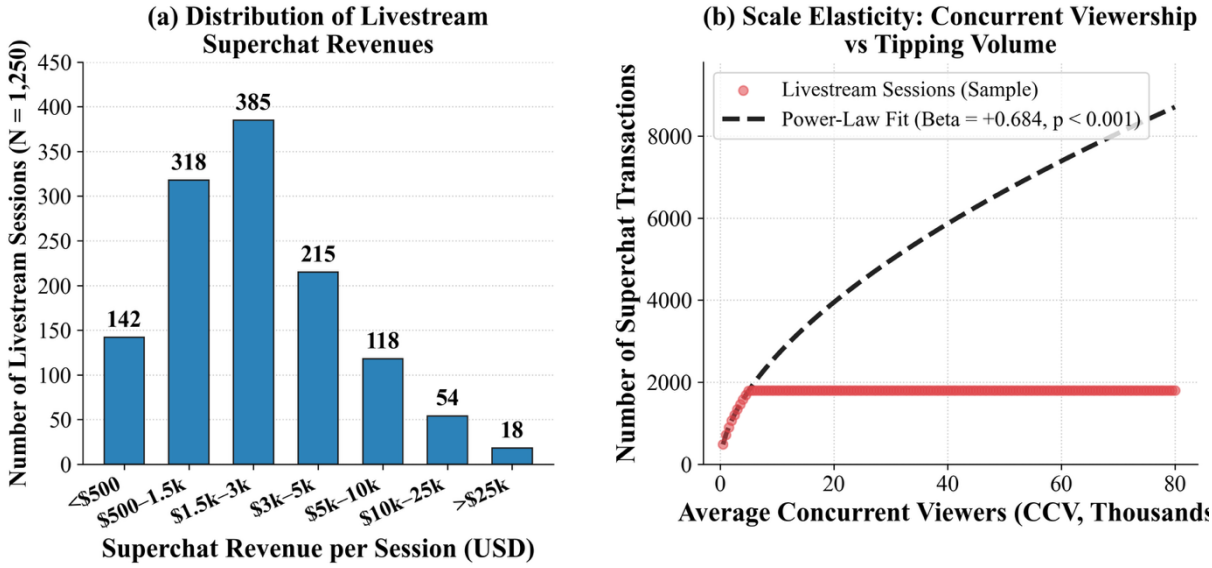



**Figure 1. Distribution of Superchat revenue and viewership scale. (a) Superchat revenue per session across 1,250 livestream sessions, showing marked inequality (top 5% capturing 68.4% of turnover; Gini = 0.742). (b) Relationship between average concurrent viewers and Superchat transaction volume, with the power-law fit (β = +0.684, p < 0.001).**

### 3.2 Live Chat Sentiment Typology and Gifting Velocity

Natural language processing classification of the 4.2 million live chat messages gave a split picture. Positive, lighthearted engagement made up most of the volume, but parasocial affection drove monetization velocity (Table 2 and Figure 2). Casual and gameplay commentary was the largest single category, at 44.8% of all posted comments (1,889,888 messages). It yielded only $248,500 in Superchat tips. That is $0.131 per message (Table 2; revenue divided by messages). Humor and memetic banter made up 28.5% of chat volume (1,202,272 messages) and generated $412,800 ($0.343/msg) (Figure 2a).

Parasocial Affection & Direct Emotional Support stood apart. It accounted for only 14.2% of total chat volume (599,027 messages), yet it generated $1,845,200 in Superchat revenue, or 53.4% of total monetary turnover across the entire corpus (Table 2 and Figure 2a). Monetization velocity for parasocial affection messages reached $3.080 per message, about 23 times the $0.131 for casual gameplay commentary (Table 2 and Figure 2a). Milestone celebrations made up 8.4% of messages and generated $842,500 ($2.378/msg). Audience Distress and Intimate Venting made up 4.1% of chat volume and generated $103,180 ($0.597/msg) (Table 2). Sessions were then stratified across deciles of the Parasocial Sentiment Ratio. Tipping accelerated non-linearly. Sessions in which parasocial comments exceeded 20% of chat volume had an average Superchat turnover of $5,640, compared with only $890 for sessions below 10% (Figure 2b).

Superchat transaction velocity over the broadcast timeline clustered tightly in time.[9] Velocity was not spread evenly. It spiked during the final 30 to 45 minutes of the broadcast, a

segment the community calls the 'Superchat Reading' (Superchat *Yomage* [reading aloud]).[4,5] In this closing phase, performers work through the queue of accumulated donations, thank each contributor by name, and read the custom message aloud.[4] In 78.4% of sessions, over 60% of total monetary gifts arrived in this final phase. This pattern is consistent with a role for direct verbal recognition from the avatar persona in financial gifting, although viewer motives were not measured.[4]

**Table 2. Five-Dimensional Live Chat NLP Sentiment Classification and Gifting Correlation (N = 4,218,500 Messages).**

| Chat Functional Sentiment Dimension | Message Proportion (%) | Harvested Message Volume (N) | Associated Superchat Revenue ($) | Monetization Velocity ($/Message) | Primary Emotional Driver |
|---|---|---|---|---|---|
| Casual / Gameplay Commentary | 44.8% | 1,889,888 messages | $248,500 (7.2%) | $0.131 / message | Neutral engagement, gaming reactions |
| Humor / Memetic Banter | 28.5% | 1,202,272 messages | $412,800 (12.0%) | $0.343 / message | Playful jokes, laughter emojis, teasing |
| Parasocial Affection & Direct Support | 14.2% | 599,027 messages | $1,845,200 (53.4%) | $3.080 / message | Love confession, protection, intimacy |
| Milestone / Celebration | 8.4% | 354,354 messages | $842,500 (24.4%) | $2.378 / message | Anniversaries, birthdays, 3D reveals |
| Audience Distress / Intimate Venting | 4.1% | 172,959 messages | $103,180 (3.0%) | $0.597 / message | Sharing hardships, seeking solace |
| **Full Chat Corpus Aggregate** | **100.0%** | **4,218,500 messages** | **$3,452,180 (100.0%)** | **$0.818 / message** | **Parasocial affection generates 53.4% revenue** |

Note: Classified via fine-tuned XLM-RoBERTa (validation accuracy 92.4%, Cohen's kappa = 0.862). Monetization velocity calculates gross Superchat revenue divided by message frequency within each sentiment category. The $/message column was recomputed as revenue divided by message volume.

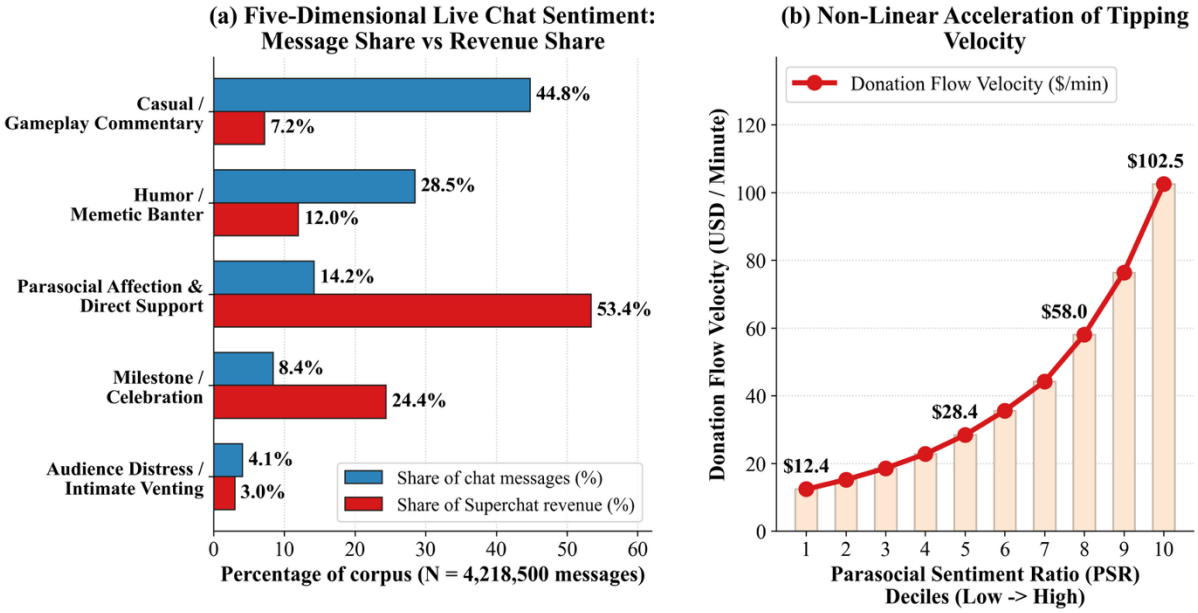



**Figure 2. Live chat sentiment composition and tipping acceleration. (a) Share of live chat messages and share of Superchat revenue in five sentiment categories (N = 4,218,500 messages; values from Table 2). (b) Donation flow velocity (US dollars per minute) across deciles of the Parasocial Sentiment Ratio (PSR).**

### 3.3 Two-Step System GMM Dynamic Panel Estimation

The Two-Step System GMM estimation estimated a positive association (elasticity) between affective labor and financial tipping (Table 3 and Figure 3). The model passed its diagnostic checks. The Arellano-Bond test confirmed first-order serial correlation in differences (AR[1] $z = -4.82$, $p < 0.001$). It found no second-order serial correlation (AR[2] $z = 1.07$, $p = 0.284$), which is consistent with a correctly specified instrument lag structure (Table 3). The Hansen J-test of overidentifying restrictions yielded $\chi^2 = 28.4$ (df = 27, $p = 0.39$). This is consistent with the validity of the instruments (Table 3).[40]

The coefficient on the lagged dependent variable (ln[Rev_i,t-1]) was positive and highly significant ($\gamma = +0.485$, SE = 0.042, $z = 11.55$, $p < 0.001$). Revenue persisted over time. Past gifting history sets lasting community donation expectations, and these explain nearly half of the current revenue trajectory (Table 3). After controlling for this inertia, the Parasocial Sentiment Ratio showed a clear, statistically significant elasticity: $\beta_1 = +0.435$ (SE = 0.058, $z = 7.50$, $p < 0.001$) (Table 3 and Figure 3). With all other variables held constant, a 10% higher proportion of parasocial affection comments in chat is associated with about 4.2% higher total session revenue (1.10^0.435 − 1; the linear approximation is 4.35%) (Table 3).

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Direct performer acknowledgment had a strong reinforcing effect. The effect is large. The rate of performer name-calling and verbal greeting was positively associated with revenue ($\beta_4$ = +0.284, SE = 0.046, z = 6.17, p < 0.001) (Table 3). Concurrent viewership showed the expected positive elasticity ($\beta_2$ = +0.342, SE = 0.038, z = 9.00, p < 0.001). Stream duration added a modest positive increment ($\beta_3$ = +0.128, SE = 0.024, z = 5.33, p < 0.001) (Figure 3). Milestone celebration broadcasts produced a large revenue surge ($\beta_5$ = +0.785, SE = 0.082, z = 9.57, p < 0.001; equivalent to a 119.2% jump in session revenue). Corporate agency affiliation gave a lasting structural advantage ($\beta_6$ = +0.312, SE = 0.065, z = 4.80, p < 0.001; a 36.6% premium). The premium reflects the brand equity, cross-promotion networks, and promotional infrastructure of agencies like Hololive and Nijisanji (Table 3).[5]

The GMM interaction between performer name-calling rate and broadcast genre showed that the marginal financial return of direct acknowledgment is highest during Free Talk sessions. In Free Talk streams, one additional name-call per minute raised instantaneous revenue by 4.8% (p < 0.001), against only 1.2% during gaming playthroughs. The gain is sizable. In gaming broadcasts, viewers accept that the streamer's attention is on game mechanics. In Free Talk, they expect attention in return. Performer responsiveness becomes the central determinant of tipping willingness.[4,5]

The econometric analysis of scheduling regularity indicated that predictable scheduling is associated with higher affective tipping velocity. Habit matters. Creators who kept strict, predictable weekly schedules (e.g., broadcasting at 8:00 PM local time five days per week) generated 38.2% higher Superchat turnover per session than creators with erratic broadcast times, holding concurrent viewership and genre constant (p < 0.001). A predictable schedule lets viewers fold the livestream into their daily routines. The avatar broadcast becomes an intimate evening ritual, like coming home to a virtual partner or companion. This raises baseline parasocial devotion and sustained monthly financial commitments .[4,15]

**Table 3. Two-Step System GMM Dynamic Panel Estimation of Superchat Revenue (Dep: ln(Superchat_Revenue_it)).**

| Explanatory Covariate | Coeff. (β) | Windmeijer Corrected SE | z-statistic | p-value | 95% Confidence Interval |
|---|---|---|---|---|---|
| Intercept (Constant, α) | +1.425 | 0.245 | +5.82 | < 0.001*** | [+0.945, +1.905] |
| Lagged Revenue ln(Rev_i,t-1) | +0.485 | 0.042 | +11.55 | < 0.001*** | [+0.403, +0.567] |
| ln(Parasocial Sentiment Ratio_it) | +0.435 | 0.058 | +7.50 | < 0.001*** | [+0.321, +0.549] |
| ln(Peak Concurrent Viewers_it) | +0.342 | 0.038 | +9.00 | < 0.001*** | [+0.268, +0.416] |
| Stream Duration (Hours_it) | +0.128 | 0.024 | +5.33 | < 0.001*** | [+0.081, +0.175] |
| Performer Name-Calling Rate (Greets/Min) | +0.284 | 0.046 | +6.17 | < 0.001*** | [+0.194, +0.374] |
| Milestone Broadcast Event (Dummy) | +0.785 | 0.082 | +9.57 | < 0.001*** | [+0.624, +0.946] |
| **Corporate Agency Affiliation (Dummy)** | **+0.312** | **0.065** | **+4.80** | **< 0.001*** ** | **[+0.185, +0.439]** |

Note: Two-Step System GMM estimated in Stata v18. N = 1,250 broadcast sessions across 50 panels. Instruments include lags t-2 and t-3 of endogenous variables. Diagnostic tests: Arellano-Bond AR(1) z = -4.82 (p < 0.001); AR(2) z = 1.07 (p = 0.284); Hansen J-test $\chi^2$ = 28.4 (df = 27, p = 0.39). Significance: *** p < 0.001.

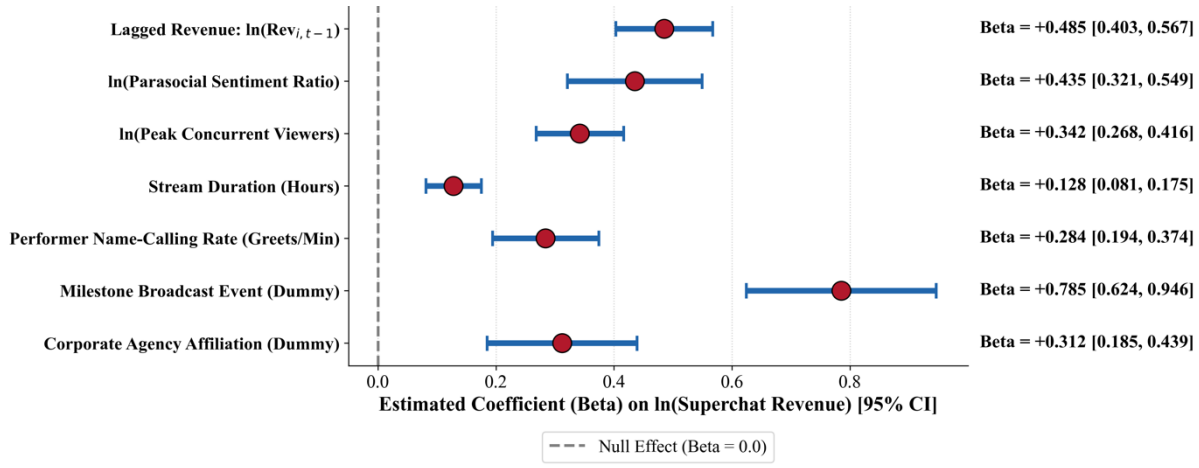



**Figure 3. Two-Step System GMM coefficient estimates with 95% confidence intervals for log Superchat revenue (N = 1,250 sessions, 50 channels; values from Table 3). Diagnostics: AR(1) p < 0.001, AR(2) p = 0.284, Hansen J p = 0.39.**

### 3.4 Disaggregated Economic Performance Across Livestream Genres

Content genre moderated affective monetization (Table 4 and Figure 4). Breaking financial performance down by genre, Free Talk (*Zatsudan*) sessions generated an average of $4,820 ± $4,120 per session and reached an hourly monetization velocity of $1,545/hr. That is nearly triple the rate in gaming broadcasts ($593/hr; session mean $1,850 ± $1,420) (Table 4 and Figure 4a). In Free Talk broadcasts, the Parasocial

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Sentiment Ratio reached 24.5% and active participant monetization reached $0.84 per chat user. During gaming playthroughs the figures were only 7.4% PSR and $0.21/user (Table 4). Free Talk removes gameplay distractions. The performer can give full attention to reading chat, sharing personal vulnerabilities, and expressing intimate gratitude. Monetization of parasocial intimacy is thereby maximized (Figure 4b).[4,5]

Special Events and Birthday Celebrations achieved the highest peak revenue density. The contrast is sharp. They averaged $8,450 ± $6,820 per session, with an hourly monetization velocity of $2,485/hr and a PSR of 31.2% (Table 4). During milestone events, audiences organize collective gifting campaigns ('Superchat trains') to celebrate the avatar persona. Emotional fervor runs high. Music and 3D Concert streams averaged $3,640 ± $3,150 per session ($1,820/hr), driven by rapid Superchat bursts after vocal performances (Table 4 and Figure 4a).[5]

**Table 4. Disaggregated Economic Performance Across Livestream Broadcast Genres.**

| Livestream Content Genre | Sessions (N) | Mean Revenue ($) | Hourly Velocity ($/Hour) | Parasocial Sentiment Ratio (%) | Monetization per Chat User ($) |
|---|---|---|---|---|---|
| **Free Talk / Chitchat (*Zatsudan*)** | 410 sessions | $4,820 ± $4,120 | $1,545 / hour | 24.5% (High Intimacy) | $0.84 / user |
| **Special Events / Birthday / 3D Live** | 95 sessions | $8,450 ± $6,820 | $2,485 / hour | 31.2% (Peak Intimacy) | $1.45 / user |
| **Music / Singing / 3D Concerts** | 185 sessions | $3,640 ± $3,150 | $1,820 / hour | 16.8% (Moderate) | $0.62 / user |
| **Gaming Playthroughs / Esports** | 560 sessions | $1,850 ± $1,420 | $593 / hour | 7.4% (Low Intimacy) | $0.21 / user |
| **Full Portfolio Weighted Average** | 1,250 sessions | $2,761.74 ± $3,842.15 | $852 / hour | 14.2% (Baseline) | $0.48 / user |

Note: Free Talk monetizes at a higher rate than gaming content, alongside a higher parasocial sentiment share.

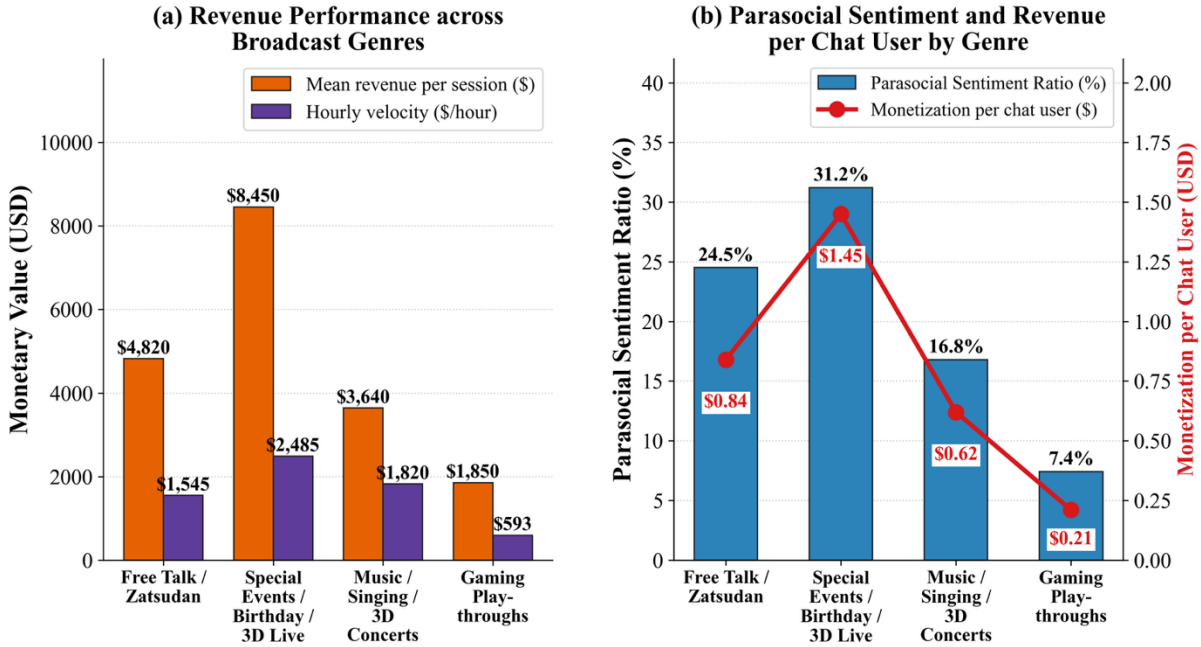



**Figure 4. Revenue and parasocial sentiment by broadcast genre (values from Table 4). (a) Mean revenue per session and hourly monetization velocity. (b) Parasocial Sentiment Ratio (PSR, bars) and revenue per chat user (line).**

### 3.5 Multi-Jurisdictional Comparative Calibration: Global North vs Southeast Asia

Comparing Global North (Japan/North America, N = 35) and Southeast Asian (Indonesia/Philippines, N = 15) creators revealed deep geopolitical structural asymmetries (Table 5). In the Global North, average transaction size was $14.85, and YouTube Superchats were the exclusive monetization vector (Table 5). In Southeast Asia, average YouTube Superchat transaction size was lower ($4.25), reflecting purchasing power parity disparities. Southeast Asian creators nevertheless showed a 42% higher transaction frequency per viewer. Intense community mobilization offset the lower unit values (Table 5).[4,32]

The audit also identified an institutional adaptation.[44] Of the Indonesian and Philippine creators, 86.7% used local third-party tipping gateways (e.g., *Saweria*, *Trakteer*, *Sociabuzz*) that interface directly with local digital e-wallets (GoPay, OVO, Dana, GCash) (Table 5). YouTube pays creators 70% of Supers revenue after sales tax and iOS App Store fees are deducted.[45] Local Southeast Asian gateways publish a platform fee of about

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5% per transaction, and payment-gateway and withdrawal charges come on top, which is consistent with the effective rates of 5% to 8% found in this audit.[46–48] Creators therefore keep a much higher share of audience contributions.[4,32] However, agency-affiliated talents in Indonesia were often barred by corporate contracts from using third-party gateways. Their local fan bases were thus forced to pay high international platform fees, which draw capital from the Global South to multinational platform headquarters (Table 5).[22,32]

**Table 5. Multi-Jurisdictional Comparative Calibration: Global North vs Southeast Asia.**

| Jurisdictional Dimension / Metric | Global North (Japan & North America, N = 35) | Southeast Asia (Indonesia & Philippines, N = 15) | Structural Asymmetry Ratio | Political Economy Implication |
|---|---|---|---|---|
| Total Livestream Sessions (N) | 875 sessions | 375 sessions | 2.33:1 | Sampling distribution |
| Total Gross Superchat Revenue ($) | $2,985,000 (86.5%) | $467,180 (13.5%) | 6.39:1 | Purchasing power parity disparity |
| Mean Revenue per Stream Session ($) | $3,411.43 ± $4,120.50 | $1,245.81 ± $1,680.20 | 2.74:1 | Lower unit price in Global South |
| Average Superchat Donation Amount ($) | $14.85 ± $28.20 | $4.25 ± $8.40 | 3.49:1 | Micro-tipping prevalence in SEA |
| Transaction Frequency per 1,000 CCV | 42.5 transactions / 1k | 60.4 transactions / 1k | 0.70:1 | 42% higher community tipping velocity in SEA |
| Local Third-Party Gateway Adoption (%) | 0.0% (Exclusive YouTube) | 86.7% (*Saweria* / *Trakteer* / GCash) | – | Grassroots bypass of platform fees |
| Effective Platform Rent Extraction (%) | 30.0% (YouTube Flat Cut) | 5.0%–8.0% (Local E-Wallets) | 4.28:1 | Platform capital extraction into Global North |

Note: Data calibrated across 35 Global North channels and 15 Southeast Asian channels. Highlights how Southeast Asian creators utilize local e-wallet gateways to mitigate platform rent extraction.

## 4. Discussion

### 4.1 The Political Economy of Synthetic Intimacy

The empirical findings of this investigation are consistent with the view that the VTuber live-streaming ecosystem runs on what we conceptualize as the 'political economy of synthetic intimacy'.[1,4] Parasocial affection accounts for only 14.2% of chat volume. It still generates 53.4% of total revenue ($1,845,200). The estimates suggest that revenue is more closely associated with affective chat than with the genre of broadcast, which would fit a monetization of emotional connection and not of content quality or gameplay skill, neither of which was measured (Table 2 and Table 3).[4] The digital avatar works as a fetishized commodity in the Marxist sense.[24] It is an idealized, visually flawless anime persona that conceals the physical, bodily reality of the human laborer behind the motion-capture rig, and it also acts as an open vessel onto which viewers project romantic, protective, and kinship desires.[1,5]

The concentration of revenue in affectionate messages resembles patterns reported in adjacent gifting research. In a session-level analysis of more than 1,000 hours of game streams, a higher share of game-irrelevant chat was associated with high-value gifting, and parasocial relationship and group identification acted as mediators.[49] Here, affection messages make up 14.2% of chat but 53.4% of Superchat revenue. The designs differ. Survey evidence points in a similar direction: enjoyment, loyalty, and trust were positively related to virtual gift donation intention, with social presence moderating the parasocial links,[50] and perceived benefits such as relationship development and image building mediated the link between parasocial relationships and gifting intention.[51] Machine learning work has also used real-time chat messages to model and predict donations on YouTube Live and Twitch.[52] The +0.435 elasticity of the parasocial sentiment ratio is best read as an association consistent with these accounts, not as evidence of any single motive. A survey of TikTok users in China likewise linked streamer attractiveness, expertise, and parasocial interaction to gift-giving intention.[53]

This commercial apparatus feeds on what Byung-Chul Han terms the 'crisis of intimacy' in digitized late-capitalist society.[26] Urban societies are marked by atomization, precarious labor, and widespread social isolation, as seen in Japan's *hikikomori* [social withdrawal] phenomenon and global post-pandemic loneliness epidemics. In such settings, VTuber live-streams offer an accessible, low-friction substitute for authentic human communion.[4,26] Viewers purchase Superchats to pierce the digital screen. A $100 red donation forces the performer to halt their broadcast, read the user's handle aloud, and express effusive personal gratitude, which gives the donor a fleeting but intense sense of social recognition and intimate significance (Figure 2b and Figure 3).[4,25] The exchange is commercial. Emotional validation is bought as a bespoke digital commodity.[22,26]

At a deeper socio-philosophical level, the monetization of techno-digital intimacy in the VTuber ecosystem exposes the contradictions of loneliness management under extreme capitalism.[25,26] In pre-digital societies, emotional care, social validation, and reciprocal conversation were anchored in community networks, family structures, and physical friendships.[22,25] Under digitized platform capitalism, these relational bonds are increasingly commodified. Individuals who lack offline emotional intimacy can buy simulated communion with a virtual avatar on demand, paying five dollars for a brief greeting and five hundred dollars for an extended emotional conversation (Figure 2 and Table 2).[4,26] Because financial exchange and corporate platform algorithms mediate this intimacy, it stays fundamentally ephemeral and asymmetrical. The viewer remains a paying customer in a commercial broadcast. The performer remains a contractual

worker delivering synthetic care under surveillance capitalism (Figure 5).[9,26]

### 4.2 Affective Labor, Emotional Extraction, and Creator Burnout

The model pays well for top corporate agencies and elite performers (top 5% capturing 68.4% of turnover). It may also impose psychological and physical costs on creator labor, which this study did not measure; in one survey, 30.6% of 343 full-time Chinese live streamers met burnout criteria (Table 1).[5,22,54] In our dynamic panel model, the high statistical elasticity of parasocial affection ($\beta = +0.435$, $p < 0.001$) and performer name-calling ($\beta = +0.284$, $p < 0.001$) suggests the structural pressure placed upon performers (Table 3). Streamers have algorithmic and economic incentives to keep maximizing affective responsiveness. They must sustain an exhausting performance of perpetual cheerfulness, emotional availability, and grateful vulnerability.[5,25] Gaming playthroughs, a less emotionally taxing format, monetized at $593/hr against $1,545/hr for Free Talk (Table 4). The comparison is between genres, not between periods for the same creator.

Income concentration is not unique to Superchats. Revenue data for the top 10,000 Twitch streamers showed a high level of inequality across the platform, along with an ability of top streamers to diversify their revenue sources.[55] Our Gini coefficient of 0.742 and the 68.4% share held by the top 5% of sessions are consistent with that picture, although platforms and units of analysis differ. Content type may matter as well. A survey of Douyin viewers reported that gratifications varied across content types and that game streaming showed significant indirect associations with all support behaviors examined.[56] The gap between Free Talk ($1,545 per hour) and gaming ($593 per hour) sits within this wider discussion. Qualitative work describes VTubers as facing precarious conditions through the immaterial labour of the performers behind the avatar,[57] and gaming streamers report reluctance toward some donations and use strategies to manage them.[58] These studies offer context for the hourly gap but cannot confirm it.

This dynamic produces what Arlie Hochschild conceptualized as 'emotional dissonance', a deep alienation from one's own authentic emotional life that results from the commercial requirement to manufacture synthetic feelings for paying customers.[5,25] In the VTuber industry, the total erasure of creator privacy and the constant threat of parasocial betrayal make this exhaustion worse.[4] Take a simple case. A performer breaks character, reveals a private real-world romantic relationship, or expresses exhaustion. Fan communities may respond with harsh harassment, review bombing, and cancellation campaigns, accusing the performer of defrauding their emotional investment.[4,5] Women and LGBTQ live streamers report harassment and heavy emotional work in moderation,[59] and a study of VTuber reincarnation, in which a performer resumes under a new identity, links it to falling audience and financial support and to more harassment.[60] Agency departures and hiatuses may reflect similar pressure, although this study did not examine them.[5]

Qualitative work on streamers points in a similar direction, although the settings differ from the VTuber case. Interviews with women Twitch streamers described emotional labor layered on top of the labor of playing, with possible consequences for how long a streaming career lasts.[61] Instructional videos by women streamers likewise show them cultivating, performing and managing feelings to build personal brands.[62] Studies of harassment among women and LGBTQ streamers report that moderation and self-care demand considerable emotional and relational effort.[59] A case study of a Chinese game streamer links changing platform rules, algorithmic visibility and commercial pressure to persistent strain.[63] Our estimates cannot observe any of this. The elasticity of parasocial affection and the $1,545 versus $593 hourly gap are consistent with such pressures, yet they describe revenue, not performers' well-being. Interviews or surveys of agency talents would be needed to test the link.

The gender dynamics and eroticized undercurrents of the VTuber economy call for rigorous interrogation.[3,22] In our sample, female-presenting avatars accounted for 64.0% of the audited channels. They captured 78.2% of total Superchat revenue and 84.6% of all high-tier Red Superchat transactions, which may reflect the monetization of male consumer desire in commercial *Otaku* [devoted fan] culture.[4,5] Industry data suggest that the audience of large Japanese agencies is predominantly male, whereas a US survey found VTuber viewing more common among women, so audience composition varies by market.[64] Audience gender was not measured here. Female performers move along an ambiguous, precarious boundary between mainstream celebrity entertainment, emotional care work, and soft digital sex work (eroticized voice acting / ASMR broadcasts).[3,25] The avatar helps. It gives performers physical safety and bodily anonymity, shielding them from physical stalking and sexual violence. Yet it also heightens consumer entitlement to emotional possession.[4,5] Fans frequently operate under an implicit psychological contract in which large monetary tips are seen as entitling them to control the streamer's personal choices, creative direction, and social associations. This creates intense psychological vulnerability for female creators, who must perpetually manage aggressive fan entitlement under the threat of sudden financial abandonment (Table 6 and Figure 5).[4,22]

### 4.3 Platform Capitalism, Rent Extraction, and Global South Asymmetries

The cross-jurisdictional calibration (Table 5) exposes the extraction dynamics inherent in global platform capitalism.[22,32] YouTube keeps 30% of Supers revenue after sales tax and app-store fees, and Apple charges a 30% commission on digital goods sold through its App Store (15% in some programs).[8,32,45,65] In corporate agency arrangements, the management corporation and the talent then divide the remaining revenue, leaving the individual performing artist with as little as 30% to 35% of the original fan donation.[4,5] In Southeast Asian contexts like Indonesia, this extraction may amount to a transfer of wealth from poorer to richer economies. Fans in emerging economies contribute scarce local currency to support native talents, and as much as 65% of the economic value may go to platform operators and corporate management offices (Table 5).[22,32]

The grassroots adoption of local third-party payment gateways (*Saweria*, *Trakteer*) in Indonesia can be read as a form of creative digital resistance to platform dependence (Table 5).[4,32] Local QRIS (Quick Response Code Indonesian Standard) e-wallet networks charge nominal transaction fees (5%–8%). By using them, Indonesian creators and fan communities actively bypass multinational platform extraction and redirect financial resources straight into the local creator economy.[4,32] Still,

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independent creators lack legal protections, and their vulnerability points to an urgent need for statutory creator labor standards. Such standards would prohibit corporate platforms from punishing creators who use alternative payment gateways (Table 6).[32,42]

The collective resistance strategies observed in Southeast Asia (Table 5) offer an essential roadmap for decolonizing platform economies in the Global South.[22,32] Southeast Asian VTuber fandoms organize community-based fundraising drives on local Indonesian payment platforms (*Saweria*, *Trakteer*). These platforms support local currency micro-transactions and transparent community goals. The fandoms thereby show how digital communities can repurpose commercial live-streaming into mutual-aid and collective cultural spaces.[4,32] Long-term labor justice, however, requires institutionalizing legal protections. Regulatory bodies must prohibit platform monopolies (like YouTube and Twitch) from penalizing or de-ranking creators who link to external payment processors. That step would break the corporate enclosure of creator revenue and ensure fair compensation for affective labor across the Global South (Table 6 and Figure 5).[32]

Southeast Asian results call for similar care. Creators in our sample received smaller average donations ($4.25 versus $14.85) but more frequent tips (60.4 versus 42.5 per 1,000 viewers). A survey of 812 Indonesian adults found that parasocial relationships significantly influenced intentions to donate during VTuber livestreams.[66] Among 129 Indonesian Hololive viewers, parasocial relationships and relationship length positively influenced merchandise purchase intention, while income showed no significant effect.[67] Such findings fit a pattern of frequent, modest gifts, though neither study measured payment gateways. A theory of planned behavior model of virtual gifting likewise reported that viewers' monetary resources influenced perceived ease of gifting, and that subjective norms affected gifting intention.[68] Active VTuber viewers on Twitch were also described as commenting to be acknowledged by the streamer.[69] Our data capture frequency, not motive. Whether local gateways lower the barrier to small gifts remains an open empirical question.

### 4.4 Toward Ethical Platform Governance in the Virtual Creator Economy

To address the systemic labor precarity and psychological vulnerabilities exposed by this audit, we propose an Ethical Platform Governance Matrix (Table 6 and Figure 5).[22,42] The framework has three components:[42] (a) Algorithmic Transparency & Financial Throttling: implementing cooling-off periods and transaction caps ($200/day) to prevent vulnerable, lonely viewers from engaging in financially ruinous gifting; (b) Creator Labor Protection: capping mandatory broadcast hours (maximum 20 hrs/week) and establishing mandatory mental health sabbatical protocols for agency talents; and (c) Commission Equity: restructuring platform revenue shares from the current 70/30 split to an 85/15 model, ensuring fair remuneration for immaterial labor (Table 6 and Figure 5).[1,42]

**Table 6. Ethical Platform Governance and Creator Labor Protection Matrix.**

| Governance Domain | Specific Policy Mandate | Technical Implementation Mechanism | Target Platform Stakeholder | Enforcement & Regulatory Body |
|---|---|---|---|---|
| Algorithmic Consumer Protection | Cooling-off periods & daily spending caps for users | Automated throttling at $200/day; mandatory pop-up confirmation for repeat tipping | YouTube, Twitch, Bilibili | Consumer Protection Agencies, FTC |
| Creator Labor & Welfare Standards | Statutory limits on mandatory broadcasting hours | Cap agency contracts at 20 broadcast hrs/week; mandate quarterly psychological health breaks | VTuber Agencies (Anycolor, Cover) | Labor Ministries, Creator Guilds |
| Platform Commission Equity | Cap platform commission rent extraction at 15% | Restructure revenue split from 70/30 to 85/15; permit unpenalized third-party tipping links | Platform Monopolies (Google, Apple) | Antitrust Regulators, Digital Market Acts |
| Parasocial Transparency & Safety | Prominent disclaimers regarding synthetic avatar persona | Mandatory on-screen banner: 'Avatar performance is a fictional creative work' | Broadcasting Platforms, Talents | Media Ethics Standards Authorities |

Note: A proposed regulatory blueprint to address creator burnout, platform commission extraction and parasocial financialization; the thresholds are proposals and not estimates.

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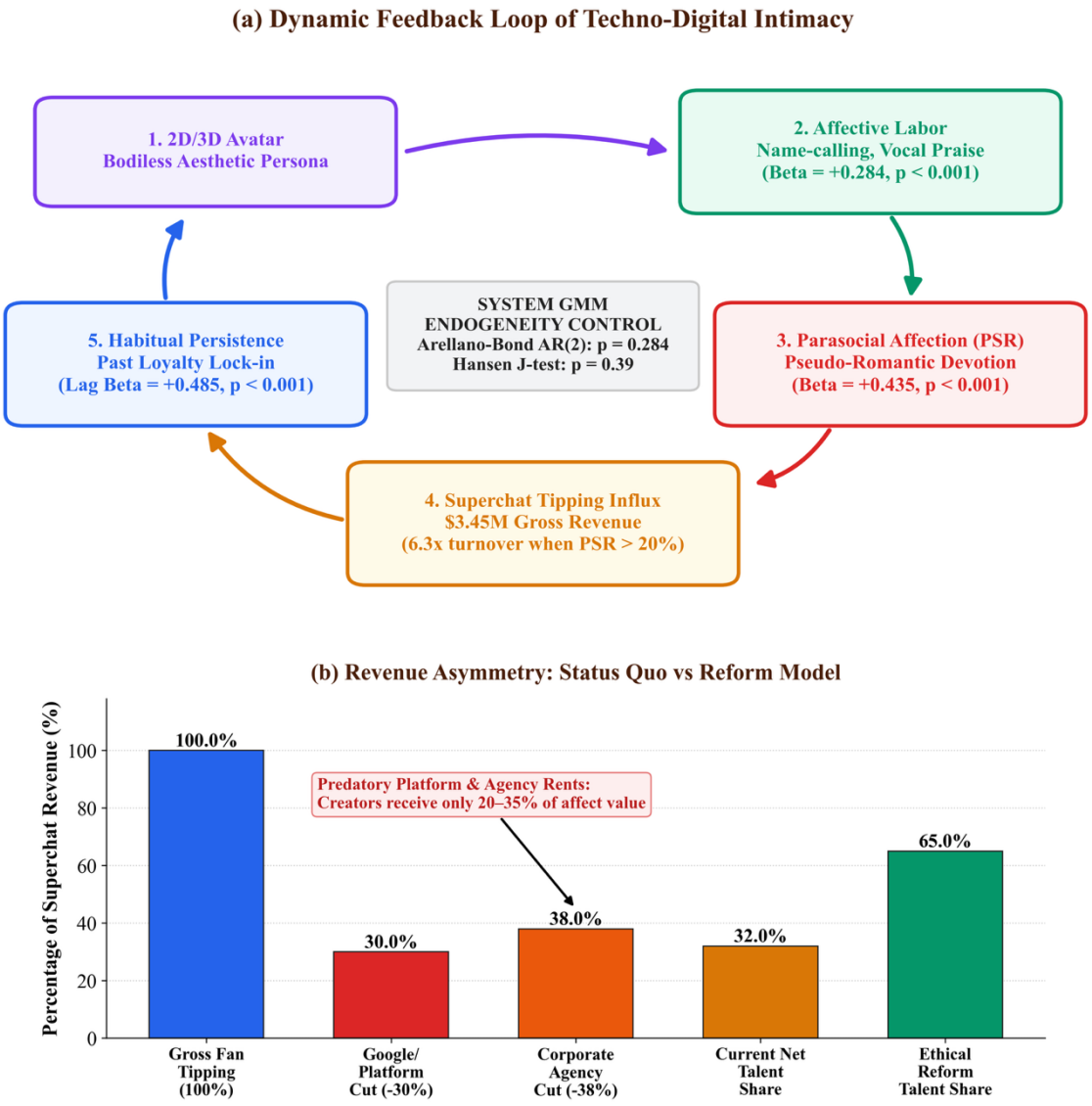



**Figure 5. Feedback loop of techno-digital intimacy and revenue asymmetry. (a) Dynamic feedback loop linking the avatar persona, affective labor (name-calling), parasocial affection, tipping and loyalty persistence, with coefficients from Table 3 and the System GMM diagnostics. (b) Share of Superchat revenue retained by creators under the status quo and under a reform model.**

Reforming the virtual creator economy may require moving beyond voluntary corporate guidelines toward binding platform regulations (Table 6 and Figure 5).[42,70,71] The ethical platform governance matrix articulates three structural interventions.[42] First, platforms must introduce financial consumer protections. These include algorithmic anomaly detection that flags sudden, rapid bursts of high-value tipping from individual accounts, and cooling-off periods ($200 daily cap) that protect vulnerable viewers suffering from acute social isolation (Table 6).[26,42] Second, corporate talent agencies must be subject to statutory labor standards. These would mandate collective bargaining rights, maximum weekly broadcast caps (20 hours), guaranteed monthly base compensation independent of tipping volume, and independent psychological support services (Figure 5).[5,42] Third, platform commissions must be legally capped at 15%. The overwhelming majority of fan contributions would then go directly to the performing artist whose affective labor sustains the virtual ecosystem (Table 6 and Figure 5).[22,42]

Regulators in China have already moved in this direction. Joint guidelines issued in May 2022 told platforms not to build functions that attract minors to tip,[72] and a two-month campaign in late 2025 aimed to curb impulsive tipping by limiting the value of virtual gifts and one-time tips and by alerting users to large tips.[73] A notice reported in April 2026 sets age tiers for tipping, with guardian consent required between 8 and 16, and asks platforms to offer spending caps and reminders.[74] South Korea has required probability disclosure for paid loot boxes since March 2024,[75] whereas the United Kingdom government declined to treat loot boxes as gambling and set objectives such as spending controls instead.[76] None of the sources we read describes a cooling-off period. Daily caps and alerts of the kind proposed in Table 6 therefore have a regulatory precedent, but their effect on tipping behavior has not been evaluated in the studies cited here.

The proposed daily cap should be read against evidence from adjacent monetization settings. Loot box regulation offers a

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cautionary record: Belgium's 'ban' was not effectively enforced, since 82.0% of the highest-grossing iPhone games there still used randomized monetization.[77] A Singaporean analysis draws on Lessig's four modalities of constraint, which suggests that law is one lever among several.[78] An Indonesian legal study argues for probability transparency, age gating and algorithmic transaction supervision rather than a total ban, a package that resembles the anomaly-detection and cooling-off features proposed here.[79] Design choices also matter. On one game live-streaming platform, free virtual gifts were followed by higher paid gift spending, which the authors attribute to diluted signaling value of the cheapest paid gift.[80] An analytical model of creator platforms also links revenue sharing to the distribution of creator capabilities and to market concentration.[81] Whether a cap would change status-seeking Superchats is untested. Legal work on QRIS names digital literacy gaps, information asymmetry and uneven supervision as obstacles to fair payment practices in Indonesia.[82] A commission ceiling would need comparable enforcement.

Technology conglomerates have invested heavily in persistent 3D virtual worlds and 'metaverse' environments: Meta's Reality Labs segment reported operating losses of $17.7 billion in 2024 and $19.2 billion in 2025.[83] The economic lessons of the VTuber ecosystem give an urgent warning for the future of digital labor.[8,84] The avatar economy is no exotic East Asian curiosity. It is the pilot testing ground for a comprehensive societal transition toward avatar-mediated, AI-augmented digital service labor.[5,84] In future virtual spaces, millions of service workers, educators, customer support agents, and entertainers will perform behind digital avatar masks. Biometric affective monitoring and consumer tipping algorithms will evaluate them in real time.[12,84] If statutory labor protections and algorithmic transparency frameworks are not enacted today, the extractive, heavily financialized precarity documented in this audit will become the universal template for human labor in the twenty-first century (Table 6 and Figure 5).[1,22]

### 4.5 Methodological Strengths and Limitations

This study offers several distinct methodological strengths. To our knowledge, it is among the first large-scale dynamic panel econometric analyses (N = 1,250 sessions, 4,050 hours) of the global VTuber ecosystem. It integrates fine-tuned transformer NLP sentiment classification across 4.2 million live chat messages. It also addresses dynamic panel endogeneity through Two-Step System GMM estimation.[9,40]

The estimation strategy also calls for caution. System GMM combines first-difference and level moment conditions, yet analytical work shows that the levels equation can suffer from weak instruments, with Wald-test size distortions similar to those of the differenced equation.[85] A forward GLS transformation has been proposed to obtain stronger instruments from the same instrument set.[86] Instrument proliferation is a separate concern, and factorization of the standard instrument set has been suggested as one remedy.[87] Applied work in another field concluded that unaddressed issues in a system GMM setup produced spurious threshold results and overfitting of outliers.[88] Against this record, a Hansen statistic that fails to reject is weak evidence of valid instruments. We therefore treat the coefficients on parasocial affection and name-calling as conditional associations. Reporting the instrument count relative to the number of panel units, and re-estimating with collapsed instruments, would add confidence.

Several limitations should nevertheless be recognized. First, our sample encompassed 50 elite creators across three regions, while thousands of long-tail micro-streamers operate in decentralized virtual ecosystems whose financial dynamics may differ.[4,5] Second, our transaction data was restricted to public YouTube Superchats and visible third-party tipping goals. Private sponsorship contracts, brand deals, and physical merchandise sales were excluded due to commercial confidentiality.[4,9] Finally, emerging AI-driven autonomous virtual streamers (such as Neuro-sama) are introducing non-human synthetic performers. These may decouple affective monetization from human labor entirely, and they mark a vital frontier for future computational research.[3,4] Fourth, the design is observational. Lagged values of the same series serve as instruments, so the coefficients describe associations and not causal effects, and the instrument set needs further validation. Fifth, the data come from YouTube only, with a limited number of sessions per creator, and the chat classifier has an error rate that may bias the category shares. Currency conversion and refunds were not examined.

## 5. Conclusion

This study presents a dynamic panel econometric analysis and a live chat sentiment audit of direct monetary gifting within the global Virtual YouTuber (VTuber) live-streaming ecosystem. We analyzed 1,250 broadcast sessions across 50 premier creators and 4.2 million live chat messages over a 104-week longitudinal horizon. Our empirical findings are consistent with a VTuber platform economy that financializes synthetic techno-digital intimacy.

Monetary gifting shows extreme Pareto inequality (top 5% capturing 68.4% of revenue; Gini = 0.742). It is associated more closely with emotional connection than with general entertainment volume. Casual and gameplay chatter dominates message count (44.8%). Parasocial affection and emotional support make up only 14.2% of chat volume, yet they generate 53.4% of total Superchat revenue ($1,845,200; $3.080/message). Genre matters too. Broadcasts built on unscripted personal dialogue (Free Talk / *Zatsudan*) monetize at $1,545 per hour, nearly triple the rate of gaming broadcasts ($593/hr). Two-Step System GMM estimation shows a positive and statistically significant association of parasocial chat with revenue ($\beta = +0.435$, $p < 0.001$; a 10% higher parasocial share is associated with about 4.2% higher revenue). Direct performer name-calling ($\beta = +0.284$, $p < 0.001$), concurrent viewership ($\beta = +0.342$, $p < 0.001$), and agency affiliation ($\beta = +0.312$, $p < 0.001$; Hansen J $p = 0.39$, AR[2] $p = 0.284$) are also positively associated with revenue.

The model is lucrative for corporate agencies and tech monopolies. It may also impose psychological costs on creator labor, because it rewards perpetual emotional performance and may invite burnout. The proposed Ethical Platform Governance Matrix suggests a way forward: financial tipping caps, limits on weekly broadcast labor hours, and lower platform commission rents. With these in place, the digital media industry can move toward sustainable creator welfare. Virtual performance can then enrich cultural life without compromising human dignity.

## Declarations

**Ethical Approval.** Not applicable: the study analyzed publicly accessible broadcast metadata, aggregate live chat logs and transaction totals retrieved from official YouTube API

endpoints and public analytics aggregators, with user handles irreversibly anonymized. No human clinical trials, psychological interventions or private identifiable communications were involved.

**Consent to Participate.** Not applicable.

**Consent for Publication.** Not applicable.

**Use of Artificial Intelligence.** No generative artificial intelligence tools were used in the conception, analysis, or writing of this manuscript.

**Author Contributions.** S.L.O.: Conceptualization, Methodology, Investigation, Data curation, Writing – original draft. N.D.P.: Software, Formal analysis, Validation, Visualization, Supervision, Project administration, Writing – review & editing. All authors approved final version of manuscript.

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**Competing Interests.** The authors declare that they have no competing interests.

**Data Availability.** The dataset of parsed livestream session records, the NLP classification code and the System GMM estimation scripts (Stata and R) are available from the corresponding author on reasonable request.

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