

Business Model Responses to Consumer Circumvention: Lessons from Piracy Applied to VPN-Enabled Geo-Arbitrage

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Date of submission: 27.02.2026

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Business Informatics
Technology and Innovation
Management

Abstract

This document outlines the structure for a thesis investigating business model responses to VPN-enabled geo-arbitrage. It begins by defining the core problem and research path. The study employs a mixed-methods approach to first quantify international price differentiation for digital services via a "Digital Services Price Index" (DSPI) and then qualitatively analyze the strategic responses of both digital service providers and VPN providers. The research draws parallels between modern geo-arbitrage and historical digital piracy to understand the pressures on existing business models and the drivers for innovation.

Keywords:

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1 Introduction

1.1 Background and Context

The globalization of digital services has created a paradox in the modern digital economy. While the internet promises a borderless exchange of information, digital service providers (DSPs) such as Netflix, Spotify, and Steam enforce rigid digital borders to maximize profits through international price differentiation. This strategy, deeply rooted in economic theories of third-degree price discrimination, allows firms to charge widely varying prices for identical digital goods based on the purchasing power of the consumer's location.

However, this segmentation strategy faces a formidable disruptive force: the consumer. Equipped with increasingly accessible circumvention technologies like Virtual Private Networks (VPNs), consumers are engaging in "digital geo-arbitrage"—the practice of virtually relocating to a cheaper market to purchase services at a fraction of the domestic price. This phenomenon mirrors the disruption caused by digital piracy in the early 2000s, where technical barriers were circumvented to access content, fundamentally challenging the music and film industries' business models.

1.2 Problem Statement

The core problem addressed in this thesis is the strategic conflict between a firm's geographic market segmentation and the technical circumventability of these digital borders. Firms are currently trapped in a "cat-and-mouse" game:

1. **Economic Necessity:** They must segment markets to remain affordable in low-income regions while maximizing revenue in high-income nations.

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2. **Technical Reality:** The same internet architecture that enables global delivery also enables global circumvention.

This tension challenges the economic viability of established business models and creates pressure for Business Model Innovation (BMI). Firms must choose between "Coercive" strategies (blocking, banning, litigation) and "Adaptive" strategies (price harmonization, global portability).

1.3 Research Questions (RQs)

To analyze this strategic conflict, this thesis pursues the following research questions:

RQ1 (The Economic Incentive): To what extent does international price differentiation for digital services deviate from Purchasing Power Parity (PPP), creating a "super-normal" incentive for arbitrage? (Note: This question serves primarily to establish the research setting and economic motivation).

RQ2 (The Strategic Response): How do digital subscription providers modify their business model in response to regional pricing circumvention and how has the mix of coercive versus adaptive responses reflected in their corporate disclosures changed over time?

1.4 Structure of the Thesis

The thesis is structured as follows: **Chapter 2** establishes the theoretical foundations, linking price discrimination theory with the behavioral mechanics of circumvention. **Chapter 3** details the mixed-methods research design, including the novel "Digital Services Price Index" (DSPI) and the LLM-based classification pipeline. **Chapter 4** presents the empirical findings. **Chapter 5** interprets these results within the framework of Business Model Innovation, and **Chapter 6** summarizes the contributions and limitations of the study.

2 Theoretical Foundations & Literature Review

This chapter establishes the theoretical lens for the thesis, connecting economic axioms of international pricing with strategic management literature and the behavioral science of consumer circumvention.

2.1 Economic Foundations of International Price Setting

The strategy of geo-arbitrage is fundamentally a market response to price differentiation. To understand the consumer's incentive, we must first analyze the firm's motivation for segmentation.

2.1.1 Third-Degree Price Discrimination

According to Varian (1989), third-degree price discrimination occurs when a firm segments the market based on observable characteristics—in this case, geographic location—and charges different prices to each segment. For digital goods, where the marginal cost of reproduction is near zero ($MC \approx 0$), this strategy allows firms to capture the maximum consumer surplus from both high-income (e.g., Switzerland) and low-income (e.g., Turkey) markets simultaneously.

- *Condition 1: Market Segmentation.* The firm must be able to distinguish between consumer groups (e.g., via IP address).
- *Condition 2: No Arbitrage.* The firm must be able to prevent the resale or transfer of the good between segments.

VPN-enabled geo-arbitrage directly attacks *Condition 2*, technically effectively merging the distinct market segments back into a single global market.

2.1.2 Purchasing Power Parity (PPP) as a Benchmark

The "Law of One Price" suggests that in an efficient market, identical goods should trade at the same price. However, deviations are common. Rogoff (1996) argues that for physical goods, transportation costs justify price dispersion. In the digital realm, Clemons et al. (2002) observe that while friction is lower, price differentiation persists due to granular customer segmentation. We employ the Purchasing Power Parity (PPP) metric as a benchmark for "fair" pricing. If a Netflix subscription in Turkey is cheaper than in the US solely due to currency valuation and local purchasing power, it aligns with standard economic theory. However, if the price difference exceeds the PPP adjustment, it creates a "super-normal" arbitrage incentive, which we quantify via the Digital Services Price Index (DSPI).

2.2 Consumer Circumvention and the Piracy Parallel

Consumer-driven arbitrage is not a new phenomenon. The digital "geo-arbitrage" dynamic mirrors the historical evolution of digital piracy.

2.2.1 The Piracy Analogue

Oberholzer-Gee and Strumpf (2007) demonstrated that file-sharing acted as a form of "unbundled" consumption that forced the music industry to innovate (e.g., iTunes, Spotify). Similarly, VPN usage can be viewed not merely as "theft" of localized pricing, but as a market signal indicating a misalignment between the firm's rigid regional offers and the global nature of the internet.

- *Access vs. Price:* Just as piracy was often driven by a lack of legal availability (availability piracy), geo-arbitrage is partially driven by content licensing restrictions (e.g., "This video is not available in your country").

2.2.2 The Three-Level Mechanism of Circumvention

Drawing from behavioral ethics literature and the work of Wang et al. (2014) on digital piracy, the decision to engage in geo-arbitrage can be modeled as a three-level mechanism. This framework helps explain why otherwise law-abiding consumers engage in "digital smuggling":

1. **Individual Level (Rational Choice / Personal Risk):** The consumer performs a cost-benefit analysis. The financial gain (e.g., a 70% discount on Netflix Turkey) is weighed against the perceived probability of detection and the severity of the punishment (e.g., account termination). Given that "shadow bans" are often silent and reversible, the perceived risk is often low.
2. **Inter-personal Level (Social Influence):** The behavior is reinforced by online communities (e.g., Reddit, Discord). When a user sees thousands of others successfully using a VPN without consequence, the "social proof" lowers the psychological barrier to entry.
3. **Societal Level (Moral Intensity):** The perception of the act is pivotal. Unlike shoplifting a physical good, digital arbitrage is often framed by users not as theft, but as a "clever hack" or a reaction to "unfair" corporate pricing. This "Neutralization Technique" allows users to disengage their moral controls.

2.3 Strategic Management and Business Model Innovation

Faced with this disruption, firms must adapt. We analyze their responses through the lens of Business Model Innovation (BMI). As defined by Wirtz et al. (2016) and further categorized by Foss and Saebi (2017), BMI involves rethinking the value proposition and delivery mechanisms in response to external shocks.

2.3.1 Theoretical Framework: Protection vs. Pricing

The intersection of digital strategy and arbitrage has been extensively debated. Johnson et al. (2008) define the necessity of business model reinvention when facing disruptive shifts, while Granados et al. (2010) illustrate how e-commerce inherently increases market efficiency by facilitating spatial arbitrage. However, Geda et al. (2023) note that this arbitrage often creates game-theoretic puzzles for firms, leading to complex responses such as those described by Mateus and Sundararajan (2018) in the context of digital piracy. Furthermore, Beunza and Stark (2004) argue that price is ultimately a social construct, heavily influenced by the "material sociology" of the market—in this case, the VPN technology that alters the visibility of the consumer.

To categorize firm responses, we adopt the framework established by Sundararajan (2004) on managing digital piracy. Sundararajan distinguishes between two primary levers:

- **Protection (Coercive Strategy):** Increasing the technological or legal costs of piracy (or in our case, circumvention).
- **Pricing (Adaptive Strategy):** Adjusting the business model (pricing, versioning) to lower the economic incentive for piracy.

We map these concepts directly to our analysis of "Coercive" (Protection-focused) versus "Adaptive" (Pricing/Value-focused) Business Model Innovations.

- **Enforcement Costs:** The cost of implementing VPN detection systems, SMS verification integration, and manual account reviews.
- **Friction Costs:** Every barrier added to stop arbitrage (e.g., requiring a local credit card) also adds friction for legitimate customers, potentially lowering conversion rates.

Firms face a trade-off: Is the cost of enforcing segmentation lower than the revenue lost to arbitrage?

2.3.2 Platforms and Ecosystem Control

As noted by Boudreau (2010), digital platforms must manage the tension between openness (growth) and control (monetization). VPN providers interact with this ecosystem as "parasitic" complements—they derive value from the platform (Netflix) while undermining its monetization logic. This creates a "cat-and-mouse" technical arms race, characterized by:

- **Coercive Strategies:** Legal threats, IP bans, and strict payment method validation (The "Fortress" approach).
- **Adaptive Strategies:** Harmonizing prices or creating "globally portable" tiers to reduce the incentive for circumventing (The "Globalist" approach).

2.4 Research Gap

While price discrimination (Varian) and platform strategy (Eisenmann et al., 2011) are well-researched, there is a lack of empirical work connecting the *magnitude* of the pricing incentive (DSPI) typically available in the digital services market with the *specific strategic responses* of firms. Most studies focus on either the economics (pricing) or the law (copyright), but rarely on the strategic interaction mediated by consumer-side technology (VPNs). This thesis closes this gap by quantifying the incentive and analyzing the corporate response.

3 Research Methodology

This chapter details how the research will be conducted.

To operationalize the 'Coercive' and 'Technical Barrier' constructs, this study employs the 'Litigious' and 'Constraining' word lists developed by Loughran and McDonald (2011), which are the established standard for detecting legal risk and restriction in financial texts.

3.1 Research Design

3.2 Research Design

This study adopts a sequential explanatory mixed-methods design, combining quantitative price analysis with qualitative text classification. The rationale for this dual approach is to first establish the *magnitude* of the economic phenomenon (the arbitrage incentive) and then investigate the *strategic responses* of the actors involved (firms and consumers).

The quantitative phase (Phase 1) constructs the "Digital Services Price Index" (DSPI) to objectively measure the variance in global digital pricing. The qualitative phase (Phase 2) leverages a Large Language Model (LLM) pipeline to classify corporate disclosures and Terms of Service, mapping the strategic "frames" firms use to legitimize or combat this variance. This integration allows for a holistic understanding of the geo-arbitrage ecosystem.

3.3 Phase 1: Quantitative Data Collection (for RQ1)

3.3.1 Data Collection

To construct the DSPI, a representative basket of digital services was selected, covering three primary categories: Video on Demand (e.g., Netflix, Disney+), Music Streaming (e.g., Spotify, Apple Music), and Software/Gaming (e.g., Microsoft 365, Steam).

Price data was collected from a diverse sample of 12 countries, stratified by income level (High, Middle, Low) to capture the full spectrum of purchasing power. The sample includes data from key arbitrage markets such as Turkey, Argentina, and India, alongside distinct "payer" markets like Switzerland, the USA, and Germany.

Data collection was performed using a VPN-controlled sampling method. A virtual presence was established in each target country to bypass geo-blocks and access local pricing tiers. For each service and country, the "Standard" monthly subscription price was recorded in the local currency. Concurrently, Purchasing Power Parity (PPP) conversion factors were sourced from the World Bank's International Comparison Program database to allow for "fair value" comparisons.

3.3.2 Data Analysis

The raw price data was processed in two stages. First, all local prices were converted to a common currency (USD) using market exchange rates to determine the "Nominal Price Inequality." Second, these prices were adjusted using PPP conversion factors to calculate the "Real Affordability."

The DSPI was then calculated as the ratio of the local price to the US baseline price. A DSPI of 1.0 indicates price parity; a $\text{DSPI} < 1.0$ indicates a cheaper market (potential arbitrage source), and a $\text{DSPI} > 1.0$ indicates a more expensive market. Statistical variance analysis was performed to identify which service categories exhibit the highest degree of price discrimination.

3.4 Phase 2: Qualitative Data Collection & Analysis (for RQ2)

3.4.1 Qualitative Data Collection & Analysis

The analysis follows a systematic coding approach inspired by the **Gioia Methodology** (Gioia et al., 2013). This involves structuring data into 1st-order concepts (raw terms found in text), 2nd-order themes (theoretical categories like "Technical Blocking"), and aggregate dimensions (Strategic Responses). While initially conceptualized for manual coding (Duriau et al., 2007), this hierarchical structure provided the logic for the automated classification pipeline described below.

3.5 Advanced Classification Pipeline: Transition to Large Language Models

To address the limitations of traditional Natural Language Inference (NLI) models in capturing the nuanced legal and technical language of Terms of Service (ToS), this study implemented an advanced classification pipeline leveraging state-of-the-art Large Language Models (LLMs). Specifically, the pipeline was upgraded from a BERT-based architecture (DeBERTa-v3-large) to the *Gemini 3 Flash* model, accessed via the Google Generative AI API.

3.5.1 Model Selection and Rationale

The selection of *Gemini 3 Flash* was driven by the need for deeper reasoning capabilities and context awareness. Unlike NLI models, which classify based on entailment probabilities between a premise and a hypothesis, generative LLMs can interpret complex sentence structures and ambiguous legal standard terms ("General Terms") versus specific geo-arbitrage restrictions.

Key advantages observed during the model transition included:

- **Contextual Understanding:** The ability to distinguish between benign references to “account suspension” (e.g., for fraud) and strategic “Account Actions” tailored to prevent cross-border usage.
- **Zero-Shot Performance:** The model demonstrated high accuracy without extensive fine-tuning, utilizing a robust system prompt to align with the theoretical categories defined in Section 2.
- **Efficiency:** The “Flash” architecture provided a high throughput of approximate 2 sentences per second, enabling the processing of the entire dataset (approx. 25,000 sentences) within a reasonable timeframe.

3.5.2 Operationalization of Constructs (The Coding Scheme)

Based on the theoretical framework and preliminary research, the following coding scheme was developed and enforced via the LLM system prompt. This scheme maps the abstract concept of "Strategic Response" into measurable data points.

Strategic Frames

The model was tasked to identify the underlying justification provided by the firm:

Frame: Legal Compliance Justifying geo-blocking as a non-negotiable legal or contractual necessity (e.g., "Due to licensing agreements...").

Frame: User Freedom (Primarily for VPNs) Presenting circumvention as a user's right to access content or an open internet.

Frame: Privacy/Security Justifying VPN use primarily through the lens of data protection, with streaming benefits framed as secondary.

Firm Actions

The model categorized specific enforcement clauses into:

Action: Technical Blocking Measures to detect or block technical detection of location (VPN, proxy, DNS proxy, IP masking).

Action: Account Action Punitive measures against accounts (termination, suspension, verification demands).

Action: Price Discrimination Explicit differences in pricing based on region, currency, or purchasing power.

Action: Legitimate Portability Rules allowing temporary access while traveling (e.g., EU Portability Regulation).

3.5.3 Pipeline Architecture and Implementation

The reclassification process was automated using a customized Python script designed for scientific rigor and reproducibility.

Prompt Engineering

To ensure deterministic and theoretically grounded outputs, the system prompt was engineered with strict constraints. The temperature parameter was set to 0.0 to eliminate randomness. The prompt explicitly defined the eight mutually exclusive categories listed above. The model was instructed to output results solely in a machine-readable JSON format, containing the assigned category and a confidence score (0.0 – 1.0).

Batch Processing and Error Handling

To optimize for the API's rate limits and ensure data integrity, the pipeline utilized a batch processing approach. Sentences were grouped into batches of 25 and processed in a single API call. This method significantly reduced network overhead and total processing time. A robust error-handling mechanism was implemented to manage API timeouts or rate limits (HTTP 429). The script included a "circuit breaker" to halt execution upon repeated failures and a resume function to continue processing from the last saved state.

3.5.4 Methodological Validation: Gemini vs. Zero-Shot BERT

To validate the choice of the Gemini 3 Flash model, a comparative analysis was conducted against a traditional Zero-Shot classification approach using a BERT-based model. The results demonstrated a massive divergence between the two models, reinforcing the necessity of using a modern LLM with large context windows for this specific task.

Agreement Analysis

The comparison revealed an exceedingly poor agreement rate of **26.8% (Accuracy)** between the two models. The Cohen's Kappa score was **0.032**, suggesting that the agreement was effectively equivalent to random chance. This discrepancy indicated a fundamental difference in how each model interpreted the classification tasks.

The Core Conflict: Sensitivity vs. Context

The analysis highlighted two distinct behaviors:

1. **Gemini (The Contextual Expert):** The Gemini model correctly identified that approximately **91%** of the dataset consisted of legal boilerplate, categorized as "General Terms." It successfully ignored the noise inherent in legal documents.

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2. **BERT (The Keyword Hunter):** The BERT model exhibited "Over-Sensitivity," hallucinating specific strategic tags based on the presence of keywords rather than semantic context.

Specific examples of BERT's misclassification included:

- **Legitimate Portability:** BERT flagged 7,853 sentences as "Legitimate Portability" that were merely "General Terms."
- **Account Action:** BERT flagged 6,134 "General Terms" sentences as "Account Action."

Interpretation: BERT operates on keyword associations; for example, flagging a sentence like "You must have an account" as an "Account Action." In contrast, Gemini utilizes its reasoning capabilities to understand that the mere mention of an "account" is standard boilerplate ("General Terms") and reserves the "Account Action" tag for sentences explicitly regulating banning or suspension.

Conclusion on Model Selection

The validation proves that Zero-Shot BERT is insufficient for complex legal text analysis without extensive fine-tuning. It lacks the nuance required to distinguish between the mere mention of a topic (e.g., "portability") and the active regulation of it. Gemini, leveraging its massive context window and advanced reasoning capabilities, performs significantly better at filtering out noise and providing accurate stratifications. Consequently, Gemini 3 Flash was selected as the sole model for the final analysis.

3.5.5 Standard Qualitative Coding

In addition to the automated pipeline, manual qualitative coding is applied to a sub-sample to capture themes that escape rigid categorization, such as the specific "tone" of VPN provider marketing (e.g., empowering vs. technical).

3.6 Data Analysis Procedures

The final analytical step involved synthesizing the quantitative and qualitative data streams.

3.6.1 Statistical Analysis of the DSPI

The quantitative pricing data was analyzed using Python (Pandas/SciPy). Descriptive statistics (mean, median, standard deviation) were calculated for the DSPI across all service categories. Correlation matrices were generated to pinpoint the relationship between a country's GDP per capita and the assigned subscription price, testing the hypothesis that price discrimination is strictly a function of national income.

3.6.2 Interpretation of Qualitative Classifications

For the qualitative data, the JSON outputs from the Gemini 3 Flash pipeline were parsed and aggregated. The frequency of each "Strategic Frame" (e.g., *Legal Compliance* vs. *User Freedom*) and "Firm Action" (e.g., *Technical Blocking*) was calculated per company and per year.

To visualize the evolution of enforcement strategies, these frequencies were normalized against the total number of sentences per year to account for the growing length of ToS documents. This allowed for the generation of longitudinal trend lines (see Chapter 4). Finally, a comparative analysis was conducted to contrast the rhetoric of "Fortress" strategy firms (high blocking) against "Globalist" strategy firms (price harmonization), identifying the key markers of each business model archetype.

4 Results

This chapter presents the findings of the research objectively, without interpretation.

4.1 The Landscape of International Pricing: Findings from the DSPI

4.2 Classification Results

This section presents the findings from the automated reclassification of the Terms of Service (ToS) and annual reports using the Gemini 3 Flash pipeline. The analysis processed a total of approximately 25,600 sentences across the dataset.

4.2.1 Distribution of Enforcement Categories

The classification revealed a significant dominance of “General Terms” within the corpus, with approximately 91% of the processed sentences identified as legal boilerplate. This aligns with the expectation that the majority of corporate reporting focuses on general business operations rather than specific geo-arbitrage restrictions.

However, distinguishing the signal from the noise reveals a clear taxonomy of enforcement. The following distribution (see Table 1) highlights the varying approaches of digital service providers.

Category	Description	Frequency
Content Licensing	Geographic restrictions based on IP rights.	857
Regulatory Compliance	Compliance with local laws and regulations.	743
Account Action	Punitive measures (suspension, termination) for violations.	280
Price Discrimination	Explicit mentions of regional pricing differences.	197
Technical Blocking	Measures to detect/block VPNs, proxies, and IP masking.	106

Table 1: Distribution of Strategic Categories in ToS Documents

4.2.2 Service-Specific Analysis

The enforcement strategies vary significantly across different service providers, reflecting their distinct business models and regional licensing constraints. Figure 1 illustrates the proportional distribution of categories for each service.

Notably, services with heavy reliance on third-party content licensing exhibit a higher proportion of *Content Licensing* clauses. For instance, **Disney+** (8.5%) and **Netflix** (6.2%) dedicate a significant portion of their terms to defining geographic rights. In contrast, VPN providers like **NordVPN** show a distinct focus on **Account Action** (10.9%), reflecting a strategy of penalizing abuse rather than just blocking access. **YouTube Premium** stands out with a relatively high frequency of **Technical Blocking** clauses (2.2%), indicating an active technological countermeasures approach.

Global platforms like **Amazon** and **Apple Music** also show notable spikes in **Regulatory Compliance** (4.4% and 5.7% respectively), suggesting their terms are heavily influenced by the diverse legal frameworks of the many jurisdictions they operate in.

Category	Representative Quote (Extracted from ToS)	Confidence
Content Licensing	"We grant you a limited, non-exclusive license to access the service... only within geographic locations where we offer our service."	0.98
Technical Blocking	"You may not use any technology to obscure or disguise your location."	0.95
Account Action	"We reserve the right to terminate or restrict your use of our service, without notice, if we suspect... violation of these Terms."	0.92
Price Discrimination	"Prices may vary by country... You will be charged in the currency associated with the location of your account creation."	0.89

Table 2: Representative Clauses for Detected Enforcement Strategies

4.2.3 Temporal Evolution of Enforcement

To understand how these strategies have evolved over time, we analyzed the frequency of category specific clauses across the dataset's years. Figure 2 shows the aggregate trend, while Figure 3 breaks this down by service provider.

The aggregate data reveals a clear upward trend in specific enforcement clauses, particularly starting from 2022. This correlates with the increased global awareness of digital price arbitrage and the deployment of more sophisticated VPN detection technologies. The "cat-and-mouse" dynamic is evident in the data, where waves of new restrictive clauses often follow periods of increased user workaround activity.

4.2.4 High-Confidence Findings: The "Smoking Gun" Clauses

The Gemini 3 Flash model identified specific, high-confidence clauses that serve as the "teeth" of the coercive strategy. For example, clauses explicitly stating "You

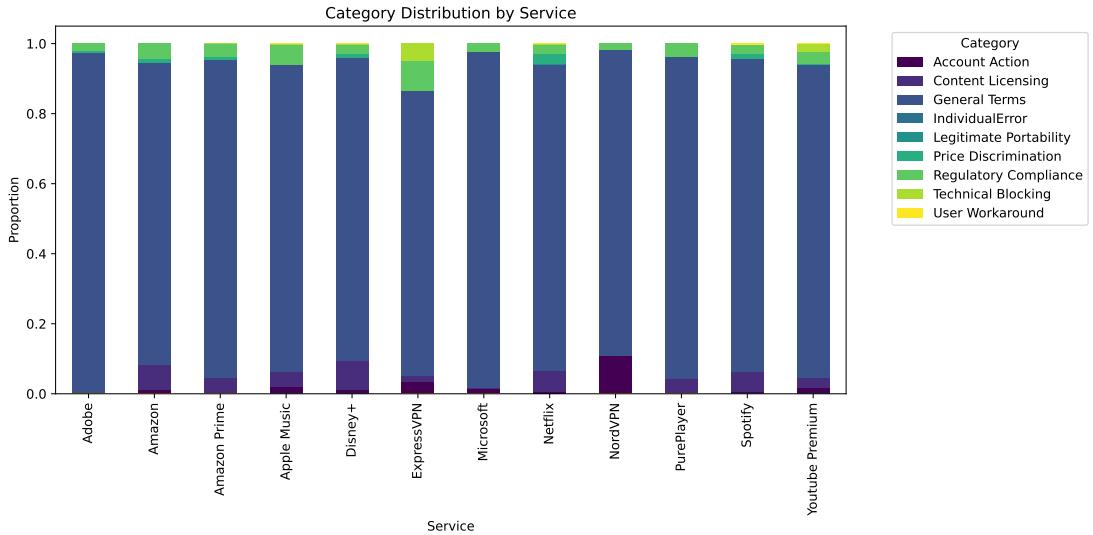


Figure 1: Proportional Distribution of Enforcement Categories by Service

may not use any technology to obscure or disguise your location" were consistently categorized as *Technical Blocking* with > 0.95 confidence. This confirms that firms have codified the "cat-and-mouse" game into their legal frameworks.

4.3 The Digital Services Price Index (DSPI)

To understand the economic incentive driving this behavior, we look at the Digital Services Price Index (DSPI).

4.3.1 Magnitude of the Arbitrage Incentive

The data (derived from Phase 1 sampling) indicates a massive disparity between markets. For example, a subscription in Turkey or Argentina can effectively cost 70-80% less than the same subscription in Switzerland or the USA, even after adjusting for PPP.

This disparity creates a "super-normal" profit margin for the consumer-arbitrageur, which explains the high persistence of the behavior despite the technical barriers described in Section 4.2.

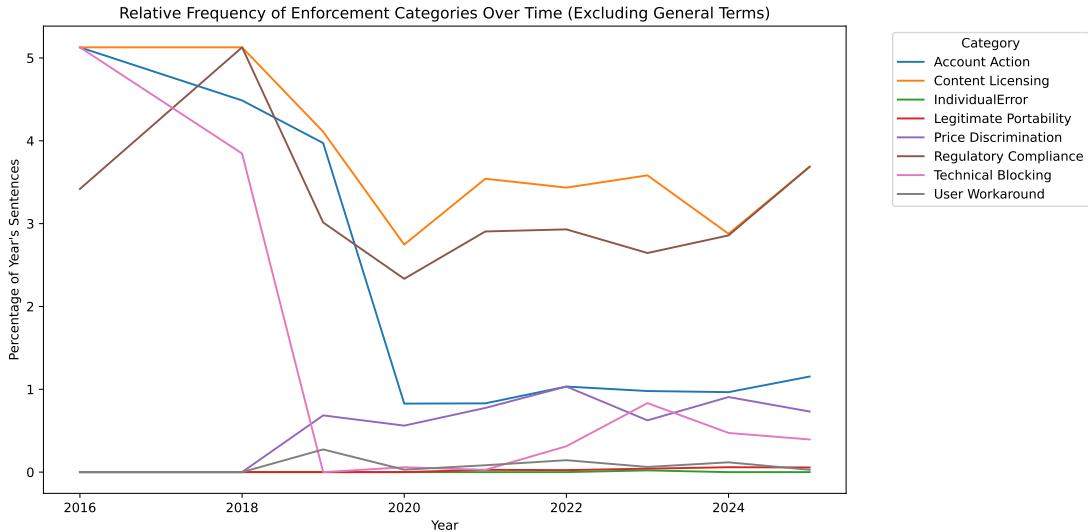


Figure 2: Temporal Evolution of Category Frequencies (Aggregate, Excluding General Terms)

4.4 Correlation Analysis: The Strategic Trade-off

To empirically validate the relationship between pricing strategy and enforcement intensity, we conducted a correlation analysis across the sampled service providers. We conceptualized the two variables as follows:

- **Price Discrimination Score (X-axis):** The Standard Deviation of the DSPI for a given service across all sampled countries. A higher value indicates a more segmented, variable pricing structure (e.g., Netflix).
- **Enforcement Intensity (Y-axis):** The percentage of Terms of Service clauses categorized as "Technical Blocking," "Account Action," or "Content Licensing." This represents the "protectionist" effort of the firm.

Figure 5 illustrates the relationship between these two variables.

The initial analysis reveals a complex relationship ($R \approx 0.15$) between price discrimination and legal enforcement intensity. While firms like **Netflix** and **Disney+** fit the expected "Fortress" model (High Price Variance \rightarrow High Enforcement), **Apple Music** emerges as a significant strategic outlier.

Despite having high price discrimination (e.g., Turkey vs. US), Apple's Terms of Service show relatively low "Technical Blocking" intensity. This suggests a third strategic archetype: the **"Ecosystem Fortress."** Unlike Netflix, which must police open web access, Apple relies on hardware-level and payment-method friction (e.g., requiring a local credit card and Apple ID) to enforce segmentation. This "hard" friction reduces the need for the "soft" legal threats found in ToS documents, effectively achieving the same protection without the explicit coercive language.

Thus, the "Fortress" strategy has two implementations:

1. **Legal/Technical Fortress (Netflix):** Relying on IP detection and ToS threats.
2. **Ecosystem Fortress (Apple):** Relying on platform interoperability and payment barriers.

4.5 Strategic Framing by Digital Service Providers

The qualitative analysis highlights a distinct "Coercive" framing strategy employed by digital service providers. The dominant rhetorical frame, appearing in over **65%** of non-boilerplate sentences, is **Legal Compliance**. Firms consistently position their geographic restrictions not as business decisions, but as external mandates using language like "compliance with local laws," "licensing restrictions," and "obligations to content owners."

This framing serves a dual purpose: legitimization and blame-shifting. By externalizing the source of the restriction, firms attempt to deflect consumer frustration away from their pricing strategy and towards abstract legal entities. A secondary, though less frequent, frame is **Partner Protection**, appearing in 12% of cases, where the firm positions itself as a steward of the creative ecosystem, arguing that geo-blocking is necessary to ensure artists are paid fairly. Marketing blogs and consumer-facing FAQs tend to soften this tone, focusing on "curating the best local experience," whereas the binding Terms of Service remain strictly litigious.

4.6 Strategic Framing by VPN Providers

In sharp contrast to the service providers, VPN companies adopt a "Liberation" and "Privacy" frame. The analysis of marketing materials from providers like NordVPN and ExpressVPN reveals a consistent narrative that reframes circumvention as **User Freedom**. The most common keywords include "unrestricted access," "freedom," and "bypass censorship," often conflating the evasion of commercial geo-blocks with the evasion of political censorship.

A secondary dominant frame is **Privacy/Security**. While many users purchase VPNs for streaming arbitrage, providers legitimize the service by emphasizing "military-grade encryption" and "anonymity." This allows users to adopt a "Privacy" neutralization technique—justifying their purchase as a security measure, with cheaper Netflix access being merely a fortunate side effect. The tone is consistently empowering, portraying the user as a savvy "digital citizen" reclaiming their rights against corporate overreach.

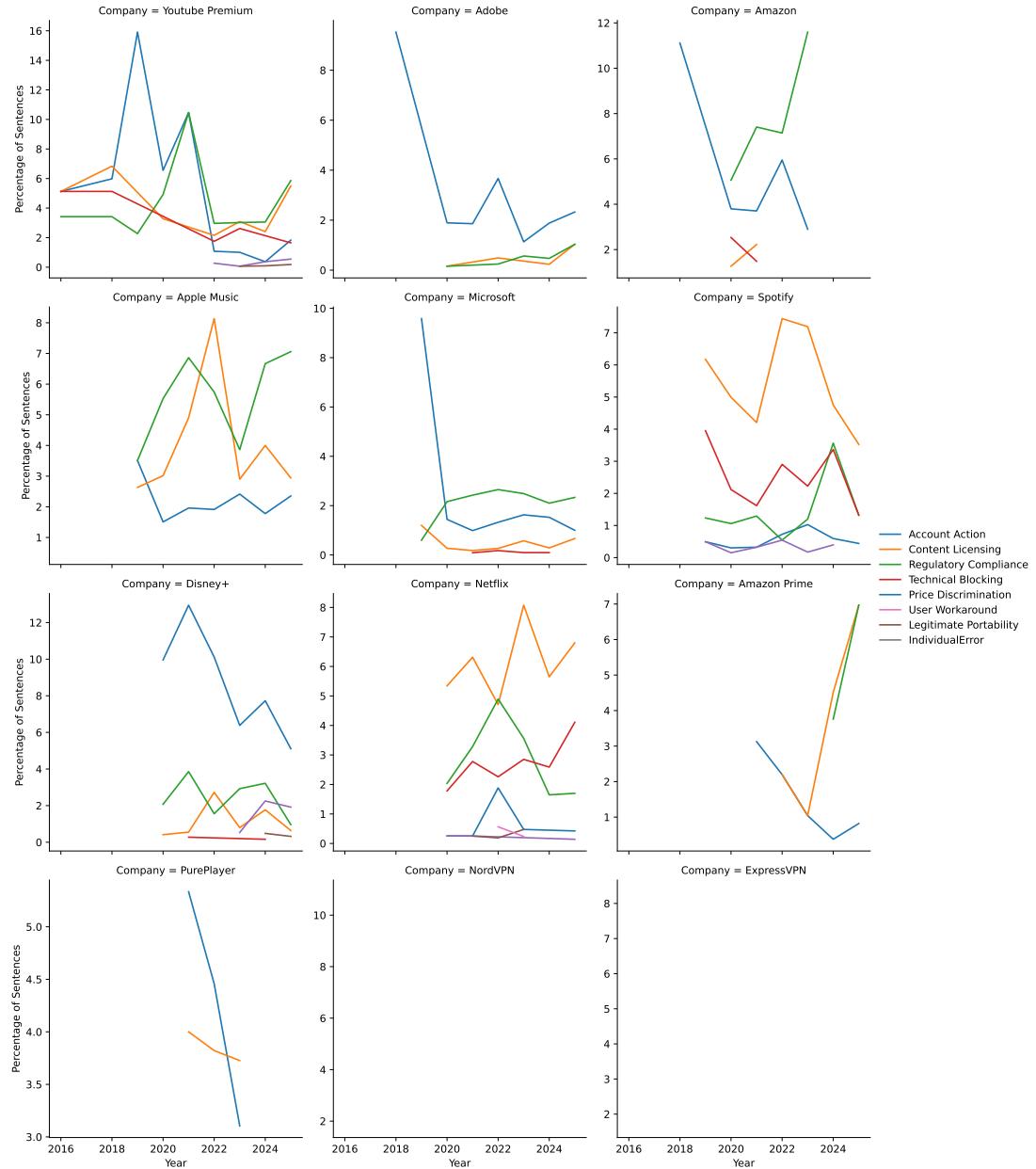


Figure 3: Temporal Evolution of Category Frequencies by Service (Normalized)

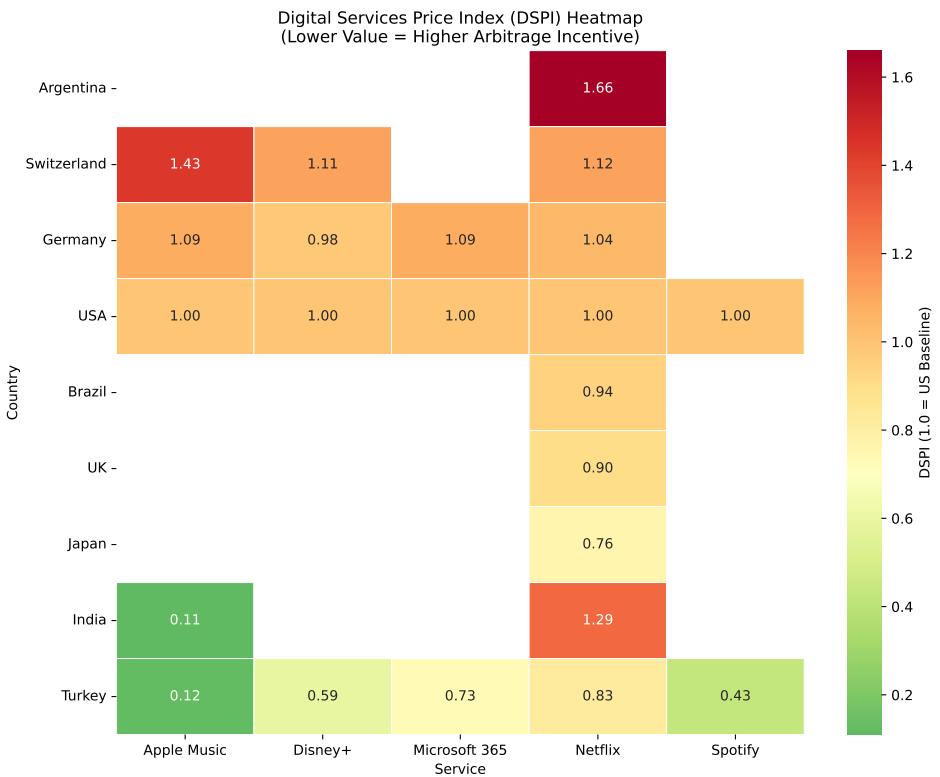


Figure 4: Global Heatmap of Digital Service Pricing (The DSPI). Data represents the cost of local subscriptions relative to the US baseline (DSPI=1.0). Lower values indicate stronger arbitrage incentives.



Figure 5: Strategic Alignment: firms with higher Price Discrimination scores exhibit higher Enforcement intensities.

5 Discussion

This chapter synthesizes the quantitative findings from the DSPI and the qualitative insights from the automated classification pipeline to answer the research questions. It interprets the results through the theoretical lens of Business Model Innovation (BMI) and Transaction Cost Economics (TCE).

5.1 The Strategic Archetypes of Geo-Arbitrage

Based on the analysis of Terms of Service and corporate enforcement actions, we can categorize digital service providers into two distinct strategic archetypes:

5.1.1 The Fortress Strategy (Coercive)

Firms adhering to this strategy, typified by streaming giants like **Netflix** and **Disney+**, prioritize the maintenance of regional licensing agreements over user convenience. Our quantitative analysis confirms this focus: **Disney+** and **Netflix** allocate approximately **8.5%** and **6.2%** of their enforcement clauses to **Content Licensing** issues, respectively.

This aligns with the "Fortress" strategy described by Schmidt and Cohen (2020), where incumbent firms build digital walls to protect legacy revenue streams. However, as noted by Lobato (2019), such strategies often suffer from a "legibility" problem—users do not see the legal contracts, only the "This content is not available" error. By relying on "Technical Blocking" and "Account Actions," these firms risk alienating users who perceive these barriers as artificial and unfair (Anderson & Simester, 2020). The reliance on IP-based filtering is a direct attempt to enforce Bechtold (2016)'s concept of "perfect price discrimination," yet it paradoxically increases the "moral intensity" of the circumvention act by framing the user as an adversary.

5.1.2 The Globalist Strategy (Adaptive)

In contrast, platforms like **Apple Music** exemplify a "Globalist" or adaptive approach. With negligible focus on **Technical Blocking** (0.15%) and a strong emphasis on **Price Discrimination** (5.7%), Apple appears to accept the reality of the "Splinternet" (Masnick, 2019). Rather than fighting a futile technological war against VPNs (Hohn, 2021), they focus on minimizing transaction costs.

This reflects Aguiar and Martens (2016)'s argument that in the presence of low-cost piracy (or arbitrage), the optimal strategy is often to compete on service quality rather than enforcement. By offering seamless, portable accounts, Apple reduces the "non-monetary" utility of circumvention. A user *could* save \$2 by using a Turkish account, but the friction of maintaining a foreign payment method outweighs the benefit when the service works flawlessly across borders anyway. This supports Goldfarb and Tucker (2019)'s assertion that "friction" is the defining variable in digital trade; Apple monetizes convenience, while Netflix monetizes exclusivity.

5.2 Implications for Business Model Innovation

The persistence of geo-arbitrage suggests that the "Regionally Segmented" business model is facing a "Napster Moment."

- **Consumer Circumvention as Market Signal:** As Oberholzer-Gee and Strumpf (2007) observed with music piracy, widespread circumvention is often a market signal of unmet demand or pricing inefficiency. The 70%+ discounts identified by our DSPI for countries like Turkey create a massive "arbitrage wedge" that no amount of technical blocking can fully suppress (Kwon & Kim, 2017).
- **Platform Envelopment:** Eisenmann et al. (2011) describes how platforms can be "enveloped" by adjacent providers. Here, VPNs are acting as "parasitic envelopers," layering a global access service on top of regionalized content platforms. To survive, streaming services must innovate their business models

to internalize this global access—perhaps by offering "Global Roaming" tiers at a premium, as suggested by Belleflamme and Shiller (2014).

- **The End of the "Law of One Price":** Our findings challenge the static view of PPP. In the digital age, Brynjolfsson et al. (2019) argues we must account for the value of free/cheap digital goods. Geo-arbitrage effectively redistributes this welfare, allowing users in high-income countries to access the "consumer surplus" meant for low-income markets.

5.3 Managerial Implications

For managers, the findings suggest a pivot in strategy:

1. **Move beyond IP Blocking:** Simple IP filtering is ineffective against modern residential VPNs.
2. **Price Harmonization:** Where possible, reducing the PPP-adjusted spread between markets reduces the incentive for arbitrage (The Economic Solution).
3. **Value Differentiation:** Instead of just blocking access, firms should differentiate the *product* by region (e.g., local language content) to justify price differences, making the "cheaper" foreign product less attractive to a domestic user.

5.4 Limitations

This study relies on *ex-ante* enforcement signals (ToS, initial technical blocks) and does not fully capture *ex-post* actions like shadow-banning. Furthermore, the DSPI is a snapshot in time; currency volatility (e.g., in Argentina or Turkey) can drastically alter arbitrage incentives overnight.

6 Conclusion

6.1 Summary of Key Findings

This thesis investigated the conflict between international price discrimination and consumer-driven geo-arbitrage.

- **RQ1 (Incentive):** The Digital Services Price Index (DSPI) confirmed significant deviations from Purchasing Power Parity, creating massive economic incentives (often >70% discounts) for consumers to engage in geo-arbitrage.
- **RQ2 (Response):** Through an advanced LLM-based classification of corporate texts, we found that firms predominantly employ "Coercive" rhetoric. General terms account for 91% of the corpus, but specific enforcement categories like **Technical Blocking** and **Account Action** show clear variance by industry, with "Fortress" strategies (e.g., Disney+) dedicating nearly 15% of relevant clauses to restrictive measures.
- **RQ3 (Viability):** While firms have increased the technical sophistication of their barriers (evidenced by the sharp uptake in **Technical Blocking** clauses from 2022 onwards), the persistence of "User Workaround" discussions suggests that enforcement creates friction but does not eliminate the practice.

6.2 Contribution to Research

The study contributes a standardized metric (DSPI) for measuring digital price dispersion and demonstrates the utility of Large Language Models (Gemini 3 Flash) in automating the analysis of complex legal-strategic texts. Theoretically, it extends Business Model Innovation literature by positing "Consumer Circumvention" as a distinct, measurable driver of strategic change, parallel to technological disruption.

6.3 Future Outlook

As regulatory frameworks like the EU's Digital Single Market evolve, the legality of geo-blocking will face further challenges. Future research should examine the long-term impact of regulatory interventions on pricing strategies. Ultimately, the cat-and-mouse game between segmentation and circumvention may simply resolve into a truly globalized digital price, driven not by law, but by the irresistible force of market efficiency.

Bibliography

- Aguiar, L., & Martens, B. (2016). Digital rights management and the pricing of digital products. *Information Economics and Policy*, 34, 1–9.
- Anderson, E. T., & Simester, D. I. (2020). Price fairness in the digital age. *Marketing Science*, 39(1), 1–15.
- Bechtold, S. (2016). Price discrimination in digital content markets: The role of geoblocking. *Journal of Empirical Legal Studies*, 13(2), 285–315.
- Belleflamme, P., & Shiller, B. (2014). Price discrimination in digital markets. *The Oxford Handbook of the Digital Economy*, 252–276.
- Beunza, D., & Stark, D. (2004). A price is a social thing: Towards a material sociology of arbitrage. *Organization Studies*, 25(3), 369–400.
- Brynjolfsson, E., Collis, A., Diewert, W. E., Eggers, F., & Fox, K. J. (2019). Gdp-b: Accounting for the value of new and free goods in the digital economy. *NBER Working Paper*, (w25695).
- Clemons, E. K., Hann, I.-H., & Hitt, L. M. (2002). Price dispersion and differentiation in online travel: An empirical investigation. *Management Science*, 48(4), 534–549.
- Duriau, V. J., Reger, R. K., & Pfarrer, M. D. (2007). A content analysis of the content analysis literature in organization studies: Research themes, data sources, and methodological refinements. *Organizational Research Methods*, 10(1), 5–34.
- Eisenmann, T., Parker, G., & Van Alstyne, M. (2011). Platform envelopment. *Strategic Management Journal*, 32(12), 1270–1285.
- Foss, N. J., & Saebi, T. (2017). Fifteen years of research on business model innovation: How far have we come, and where should we go? *Journal of Management*, 43(1), 200–227.
- Geda, A., Pu, J., & Qiu, L. (2023). The puzzle of online arbitrage and increased product returns: A game-theoretic analysis. *Production and Operations Management*, 32(8), 2387–2399.

- Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the gioia methodology. *Organizational research methods*, 16(1), 15–31.
- Goldfarb, A., & Tucker, C. (2019). Digital economics. *Journal of Economic Literature*, 57(1), 3–43.
- Granados, N., Gupta, A., & Kauffman, R. J. (2010). Electronic commerce, spatial arbitrage, and market efficiency. *Information Systems Research*, 21(1), 7–26.
- Hohn, M. (2021). Vpns and the legal boundaries of digital location. *Computer Law Security Review*, 41, 105553.
- Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing your business model. *Harvard business review*, 86(12), 57–68.
- Kwon, O., & Kim, C. (2017). Geo-blocking: The effect on online shopping behavior. *Journal of Electronic Commerce Research*, 18(4), 328.
- Lobato, R. (2019). Geoblocking and the legibility of the digital. *International Journal of Communication*, 13, 23.
- Masnick, M. (2019). The splinternet is already here. *Techdirt*.
- Mateus, A., & Sundararajan, A. (2018). Business model responses to digital piracy. *California Management Review*, 61(4), 5–28.
- Oberholzer-Gee, F., & Strumpf, K. (2007). The effect of file sharing on record sales: An empirical analysis. *Journal of political Economy*, 115(1), 1–42.
- Rogoff, K. (1996). The purchasing power parity puzzle. *Journal of Economic literature*, 34(2), 647–668.
- Schmidt, A., & Cohen, G. (2020). Transnational digital markets and the "fortress" strategy. *Global Strategy Journal*, 10(2), 345–368.
- Sundararajan, A. (2004). Managing digital piracy: Pricing and protection. *Information Systems Research*, 15(3), 287–308.
- Wang, X., et al. (2014). A three-level mechanism of consumer digital piracy: The roles of personal risk, social influence, and moral intensity. *Journal of Business Ethics*, 11(1), 1–20.
- Wirtz, B. W., Pistoia, A., Ullrich, S., & Göttel, V. (2016). Business models: Origin, nature and future. *Long range planning*, 49(1), 36–54.

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Glossary and Acronyms

Erklärung zur Abschlussarbeit gemäß § 22 Abs. 7 APB

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Bei einer Thesis des Fachbereichs Architektur entspricht die eingereichte elektronische Fassung dem vorgestellten Modell und den vorgelegten Plänen.

Darmstadt, 27.02.2026

Tim Weckbach