Evaluation Matrix: Per-Token Pricing for Online Services

A Multi-Dimensional Framework for Assessing Pricing Model Design

Executive Summary

This matrix provides a **comprehensive evaluation framework** for per-token pricing models in online services (with AI LLMs as the primary case study). The framework assesses pricing models across **three temporal horizons** (immediate, medium-term, long-term) and **four stakeholder perspectives** (consumers, businesses/providers, third-party ecosystems, society/policy).

Key Finding: Per-token pricing exhibits a **paradox**—theoretically superior on fairness and efficiency metrics, but **practically problematic** due to information asymmetries, behavioral effects, and systemic risks. **Hybrid models** combining usage-based components with value-aligned, predictable elements outperform pure token-based approaches across most dimensions.

Matrix Structure

Temporal Dimensions

1. Immediate Effects (0-6 months)

- Initial adoption decisions
- User experience & transparency
- Setup and onboarding friction

2. Medium-Term Effects (6-24 months)

- Behavioral adaptation & learning
- Competitive positioning & pricing power
- Revenue stability & business viability

3. Long-Term Effects (2+ years)

- Market structure & concentration
- Innovation & ecosystem development
- Infrastructure sustainability & access equity

Stakeholder Perspectives

1. Consumer Segments

- Individual/hobbyist users

- SMB/startup users

- Enterprise users

- Non-English/Global South users

2. Business/Provider Perspective

- Revenue predictability & growth

- Margin sustainability

- Operational complexity

3. Third-Party Ecosystem

- Complementor viability (app developers, tool builders)

- Integration costs & lock-in

- Innovation incentives

4. Society & Policy

- Distributional equity & fairness

- Environmental sustainability

- Regulatory & governance challenges

Part 1: IMMEDIATE EFFECTS

1A. Transparency & User Experience

Dimension	Token-Based Pricing	Subscription Pricing	Outcome-Based Pricing	Hybrid Tiered
Price Clarity	⚠ **Moderate**: Per-token rate is clear, but total cost is opaque (tokens-per-task unknown) [1] [2]	✅ **High**: Fixed monthly cost, predictable	⚠ **Moderate**: Price depends on outcome achievement (uncertain ex ante)	✅ **High**: Base + variable components clearly communicated
Cost Forecasting	✖ **Poor**: Users cannot predict consumption accurately [1] [2] [3]	✅ **Excellent**: Exact monthly cost known upfront	⚠ **Moderate**: Depends on outcome definition & measurement	✅ **Good**: Base is fixed, variable has caps/estimates
Cognitive Load	✖ **High**: Must track consumption, optimize usage, monitor spending [4]	✅ **Low**: Pay once, forget	⚠ **Moderate**: Must assess outcome value vs cost	✅ **Medium**: Tiered choice, then predictable

Dimension	Token-Based Pricing	Subscription Pricing	Outcome-Based Pricing	Hybrid Tiered
Fairness Perception	⚠ **Mixed**: Theoretically fair (pay for use), but opacity undermines trust [5] [6]	⚠ **Mixed**: Perceived as unfair if under-utilized	✅ **High**: Direct value-cost linkage	✅ **High**: Combines fairness (usage component) + predictability
Language Equity	✖ **Poor**: Non-English users pay 5-25x more for equivalent value [7] [8]	✅ **Excellent**: Language-neutral pricing	✅ **Excellent**: Outcome-based, language-agnostic	✅ **Good**: If usage measured in outcomes not tokens

Summary: Token-based pricing appears transparent (published per-token rates) but creates **hidden complexity** that undermines user understanding and trust. **Subscription** models offer superior immediate user experience through predictability, while **hybrid approaches** balance transparency with fairness.

1B. Initial Adoption & Onboarding

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
Commitment Friction	✅ **Low**: "Try it, pay only for what you use" [9] [10]	⚠ **Medium**: Monthly commitment feels risky	⚠ **Medium**: Must trust provider to deliver outcomes	✅ **Low**: Base tier is low-commitment
Risk Perception	✅ **Low**: No wasted spend if unused	✖ **High**: Sunk cost if not used enough	⚠ **Medium**: Risk of paying for failed outcomes	✅ **Low**: Base provides safety, usage adds flexibility
Experimentation	⚠ **Mixed**: Low commitment encourages trial, but fear of bill shock inhibits exploration [11] [12]	✅ **High**: Subscription feels "free" to use	⚠ **Medium**: Experimentation must generate measurable outcomes	✅ **High**: Included usage enables experimentation
Onboarding Time	⚠ **Medium**: Must understand tokens, set budgets, configure alerts	✅ **Low**: Simple signup process	✖ **High**: Must define & agree on outcome metrics	⚠ **Medium**: Tier selection + basic setup
Trust Requirement	⚠ **Medium**: Must trust provider's token counting is accurate	✅ **Low**: Fixed price, less trust needed	✖ **High**: Must trust outcome measurement & attribution	✅ **Medium**: Hybrid reduces dependency on any single mechanism

Summary: Token-based pricing has **low initial barriers** (no commitment, low risk), making it **attractive for acquisition**. However, this masks **hidden risks** (bill shock, optimization burden) that emerge post-adoption. **Hybrid models** retain low-friction adoption while providing protective guardrails.

1C. Immediate Cost Comparison (Illustrative)

Scenario: Customer service chatbot processing 10,000 customer queries/month

Pricing Model	Month 1 Cost	Predictability	Notes
Token-Based (GPT-4o @ $2.50/$10 per 1M tokens)	**$125-$750**	✘ **Poor**: 10x variation depending on query complexity	Average 5K tokens/query (250 in, 250 out) = $125. Complex queries (1.5K in, 1.5K out) = $750. **User cannot predict which scenario applies** [1] [2] .
Subscription (Unlimited tier @ $200/mo)	**$200**	✔ **Excellent**: Always $200	Underutilized if simple queries, excellent value if complex queries. **Mental accounting**: feels "free" after payment [13] .
Outcome-Based ($0.05 per resolved query)	**$500**	✔ **Excellent**: Linear with outcomes	Only pay for successful resolutions. **Value-aligned**: cost scales with benefit [14] [11] .
Hybrid (Base $100 + $0.50 per query beyond 5K)	**$350**	✔ **Good**: $100 base + $250 variable (5K overage)	Combines predictability (base) + fairness (usage). **Caps** can prevent runaway costs [15] .

Analysis: Token-based pricing creates **10x cost uncertainty** for identical business outcomes, creating budgeting challenges and bill shock risk [16] [10] .

Part 2: MEDIUM-TERM EFFECTS

2A. Behavioral Adaptation & Learning

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
User Learning Curve	✘ **Steep**: Must learn to optimize token consumption (prompt engineering, model selection, batching) [4]	✔ **Minimal**: Just use the service	⚠ **Moderate**: Must understand outcome metrics	✔ **Low**: Tier selection, then use freely
Optimization Incentives	✘ **Misaligned**: Optimize tokens, not business value [11]	⚠ **Weak**: No incentive to optimize (flat rate)	✔ **Strong**: Optimize for outcomes = optimize for business value	✔ **Balanced**: Some optimization incentive without distraction
Mental Accounting Effects	✘ **Negative**: Continuous loss aversion, "pain of payment" inhibits usage [13] [17]	✔ **Positive**: Sunk cost → consumption feels "free" [13]	⚠ **Neutral**: Payment tied to value delivery	✔ **Positive**: Base is sunk, usage adds value
Bill Shock Incidence	✘ **High**: 31% of users experience unexpected costs [9] [16] [10]	✔ **None**: Cost is always expected	✔ **None**: Cost = value delivered	✔ **Low**: Caps & alerts prevent extreme shocks

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
Trust Evolution	⚠ **Fragile**: Unexpected bills erode trust [5] [6]	✅ **Stable**: Predictability builds trust	✅ **Conditional**: Trust depends on outcome achievement	✅ **Strong**: Transparency + fairness build trust

Summary: Token-based pricing creates a **learning burden** and **continuous psychological friction** that degrade user experience over time. Users who "learn the ropes" can optimize, but this **misaligns effort** (optimizing tokens rather than business value) [11]. **Subscription** models have better behavioral properties, while **hybrid** approaches combine the best elements.

2B. Competitive Positioning & Pricing Power

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
Pricing Comparability	⚠ **Difficult**: Requires comparing (Price × Tokens-per-Task), but tokens-per-task varies and is hidden [1] [2] [7]	✅ **Easy**: Direct $ comparison	⚠ **Difficult**: Outcome definitions vary across providers	✅ **Moderate**: Can compare base + variable structure
Switching Costs	⚠ **Medium**: Prompt optimization, integration, learning curve [18]	✅ **Low**: Just cancel & subscribe elsewhere	✖ **High**: Outcome metrics non-portable	⚠ **Medium**: Integration but less optimization lock-in
Lock-In Effects	⚠ **Moderate**: Usage data, optimizations, fine-tuned models [18] [19]	✅ **Low**: Minimal lock-in	✖ **High**: Outcome measurement systems embedded	⚠ **Moderate**: Base creates stickiness, but portable
Price Discrimination	✖ **Hidden**: Volume discounts, tokenization differences create implicit discrimination [20] [7] [8]	✅ **Transparent**: Different tiers clearly communicated	⚠ **Moderate**: Outcome definitions can vary by segment	✅ **Transparent**: Tiers + usage create segmentation
Margin Sustainability	⚠ **Pressured**: Per-token price competition intense [21]	✅ **Stable**: Subscription provides predictable revenue	⚠ **Variable**: Depends on outcome achievement rates	✅ **Stable**: Base provides margin floor

Summary: Token-based pricing creates **switching costs** through optimization lock-in, but **opacity** prevents providers from fully exploiting this (users don't realize how expensive switching would be until they try) [18]. **Price wars** on per-token rates create margin pressure despite lock-in [21]. **Subscription** and **hybrid** models offer more **stable competitive positioning**.

2C. Revenue Stability & Growth

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
Revenue Predictability	✘ **Poor**: High variance in monthly revenue [10]	✅ **Excellent**: Predictable MRR/ARR	✘ **Poor**: Depends on outcome achievement	✅ **Good**: Base provides predictable floor, usage creates upside
Forecasting Accuracy	✘ **Low**: Cannot predict customer usage [10]	✅ **High**: Churn is only variable	✘ **Low**: Outcome rates uncertain	✅ **Moderate**: Base is predictable, usage estimated from history
Cash Flow Stability	⚠ **Moderate**: Delays between usage & payment [10]	✅ **High**: Monthly recurring billing	⚠ **Moderate**: Pay-on-outcome delays cash flow	✅ **Good**: Base is upfront, usage in arrears
Growth Scalability	✅ **Excellent**: Revenue grows linearly with usage	⚠ **Moderate**: Growth requires subscriber acquisition	⚠ **Moderate**: Growth limited by outcome delivery capacity	✅ **Excellent**: Base grows with customers, usage provides multiplier
Churn Risk	✘ **High**: Bill shock drives cancellations [10]	⚠ **Medium**: Under-utilization drives cancellations	⚠ **Medium**: Unmet outcome expectations drive cancellations	✅ **Low**: Predictability + fairness reduce churn

Summary: Token-based pricing creates **revenue volatility** that undermines business planning [10]. This is **especially problematic for public companies** needing to forecast quarterly results. **Hybrid** models provide the **best balance**—predictable base revenue with usage-driven growth potential [15].

Part 3: LONG-TERM EFFECTS

3A. Market Structure & Concentration

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
Barriers to Entry	⚠ **Moderate**: Opacity & optimization complexity favor incumbents [18] [22]	✅ **Low**: Transparent pricing, easy to compete	✘ **High**: Outcome measurement systems create differentiation barriers	✅ **Low-Moderate**: Transparency + flexibility
Network Effects	✅ **Weak**: Limited direct network effects in AI LLMs [22] [23]	✅ **Weak**: Subscription doesn't create network effects	⚠ **Moderate**: Shared outcome data could create indirect effects	✅ **Weak**: Minimal network effects
Market Concentration	⚠ **Moderate**: Lock-in + opacity → sticky customers → fragmented local monopolies [18] [24] [22]	✅ **Low**: Low switching costs → competitive markets	✘ **High**: Outcome systems non-portable → strong lock-in	✅ **Low-Moderate**: Balance prevents extreme concentration

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
Innovation Incentives	✖ **Misaligned**: Incentive to increase tokens-per-task (more revenue) [1] [11]	✅ **Aligned**: Better service → happier subscribers → lower churn	✅ **Strongly Aligned**: Better outcomes → more revenue	✅ **Aligned**: Improve value → reduce churn + increase usage
Complementor Ecosystem	⚠ **Challenged**: Unpredictable API costs deter third-party development [25] [26]	✅ **Enabled**: Predictable costs allow business planning	⚠ **Moderate**: Shared outcomes could benefit ecosystem	✅ **Strong**: Base predictability + usage flexibility

Summary: Token-based pricing creates **moderate concentration** through lock-in without achieving strong network effects [18] [22]. **Innovation incentives are misaligned**—providers benefit from less-efficient models (more tokens per task) [1] [11]. **Hybrid** and **subscription** models better support competitive markets and ecosystem development.

3B. Infrastructure Investment & Sustainability

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
Capacity Planning	✖ **Difficult**: Demand volatility creates over/under-provisioning risk [27] [28]	✅ **Easy**: Predictable demand enables optimal provisioning	⚠ **Moderate**: Outcome demand more stable than token demand	✅ **Good**: Base provides demand floor, planning easier
Infrastructure ROI	⚠ **Uncertain**: Revenue volatility makes long-term investment risky [10]	✅ **Predictable**: Stable revenue enables infrastructure investment	⚠ **Moderate**: Outcome-based revenue moderately predictable	✅ **Good**: Base revenue supports infrastructure investment
Energy Sustainability	✖ **Poor**: No incentive to use energy-efficient models (costs externalized) [29]	⚠ **Moderate**: Fixed revenue may encourage efficiency	✅ **Good**: Efficiency reduces costs, improves margins	✅ **Good**: Can incorporate carbon pricing in usage component [29]
Green Energy Procurement	⚠ **Challenging**: Unpredictable demand → hard to commit to renewable contracts [28]	✅ **Enabled**: Predictable demand → long-term renewable contracts	⚠ **Moderate**: Moderately predictable demand	✅ **Good**: Base demand enables renewables commitment
Scalability	⚠ **Challenged**: Energy infrastructure constraints create bottlenecks [28]	✅ **Manageable**: Controlled growth through subscriber acquisition	⚠ **Moderate**: Outcome delivery creates natural pacing	✅ **Good**: Hybrid pacing prevents infrastructure overload

Summary: Token-based pricing creates **infrastructure challenges** through demand volatility and misaligned energy incentives [29] [28]. **Subscription** models enable better long-term planning and sustainable infrastructure investment. **Hybrid** approaches combine these benefits.

3C. Access Equity & Social Impact

Dimension	Token-Based	Subscription	Outcome-Based	Hybrid
Income-Based Access	✖ **Highly Inequitable**: Low-income users priced out or severely limited [30] [31]	⚠ **Moderately Inequitable**: Fixed cost creates barrier	✔ **Potentially Equitable**: Pay only for value received	✔ **Good**: Low base tier accessible, pay-as-you-grow
Language Equity	✖ **Discriminatory**: 5-25x cost penalty for non-English [7] [8]	✔ **Equitable**: Language-neutral	✔ **Equitable**: Outcome-based, language-agnostic	✔ **Equitable**: If usage measured in outcomes
Educational Access	✖ **Restricted**: Students/researchers cannot afford extensive usage	⚠ **Restricted**: Subscription cost still a barrier for individuals	⚠ **Moderate**: Depends on outcome pricing for educational use	✔ **Flexible**: Edu tiers with low base + capped usage
Global South Access	✖ **Severely Limited**: Purchasing power disparity + tokenization penalties [30] [31] [7]	✖ **Limited**: Subscription still expensive relative to PPP	⚠ **Moderate**: Outcome value may justify costs	✔ **Best**: PPP-adjusted base + capped usage
Digital Divide Impact	✖ **Exacerbates**: Usage-based pricing widens gap [30] [31] [32]	⚠ **Maintains**: Doesn't worsen, but doesn't improve	⚠ **Neutral**: Depends on outcome accessibility	✔ **Mitigates**: Tiered access can be designed for equity

Summary: Token-based pricing **exacerbates inequality** through language discrimination and income-based barriers [30] [31] [7] [8]. **Subscription** models are more equitable but still create barriers. **Hybrid** models with **tiered structures** and **PPP-adjusted pricing** offer the **best equity outcomes**.

Part 4: STAKEHOLDER-SPECIFIC ANALYSIS

4A. Consumer Segments

Individual/Hobbyist Users

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid	Optimal Choice
Affordability	⚠ Light users pay little, but bill shock risk	✔ Predictable monthly cost	⚠ Depends on outcome pricing	✔ Low base tier accessible	**Hybrid** or **Subscription**
Experimentation	✖ Fear of costs inhibits exploration [11] [12]	✔ Feels "free" to explore [13]	⚠ Must generate measurable outcomes	✔ Included usage enables play	**Subscription** or **Hybrid**
Value Alignment	✖ Pay for tokens, not personal value	⚠ Wasted cost if under-utilized	✔ Pay for results received	✔ Tier matches usage level	**Outcome** or **Hybrid**

Recommendation for Hobbyists: **Subscription** (predictable, enables experimentation) or **Hybrid** (low base + capped usage).

SMB/Startup Users

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid
Budget Predictability	✖ Critical for lean startups, token pricing fails [10]	✅ Enables budgeting	⚠ Moderate predictability	✅ Predictable base + manageable variable
Scalability	✅ Pay only as you grow	⚠ Must upgrade tiers as you scale	⚠ Outcome costs scale with business	✅ Base + usage scales smoothly
Cash Flow	✖ Unpredictable cash out-flows [10]	✅ Predictable monthly payment	⚠ Outcome-based timing varies	✅ Base is regular, usage predictable from history
Competitive Advantage	⚠ Optimization expertise creates differentiation	✅ Simple, focus on core business	⚠ Outcome measurement complexity	✅ Balance of simplicity + optimization opportunity

Recommendation for SMBs: **Hybrid** (budget predictability + scale flexibility) or **Subscription** (simplicity for early stage).

Enterprise Users

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid
Procurement Fit	✖ Annual budgets require predictability [10]	✅ Fits annual budget cycles	⚠ Outcome-based requires new procurement frameworks	✅ Committed-use hybrid fits enterprise procurement
Volume Discounts	✅ Available but create lock-in [15]	⚠ Tiered, but less granular	⚠ Negotiable outcome rates	✅ Committed-use creates discounts + predictability
Value Capture	✖ Undercharged relative to value delivered [14] [33]	⚠ Moderate value capture	✅ Directly tied to business value	✅ Base + outcome-based usage component
Risk Management	✖ Cost volatility creates risk [16] [10]	✅ Predictable cost, low risk	⚠ Outcome risk shared with provider	✅ Predictable base, capped variable

Recommendation for Enterprises: **Hybrid** with **committed-use discounts** and **outcome-based components** for strategic use cases.

Non-English/Global South Users

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid
Language Equity	✖ 5-25x cost penalty [7] [8]	✅ Language-neutral	✅ Outcome-based, language-agnostic	✅ If outcomes, not tokens, measured

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid
Purchasing Power	✘ No PPP adjustment [31]	⚠ Typically no PPP adjustment	⚠ Rare PPP adjustment	✅ Can incorporate PPP in base tiers
Access Barriers	✘ Structural discrimination [7] [8]	⚠ Flat barrier	⚠ Depends on outcome accessibility	✅ Tiered access reduces barriers

Recommendation for Global South: **Hybrid** with **PPP-adjusted base tiers** and **language-normalized outcome measurement**.

4B. Provider/Business Perspective

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid	Optimal for Provider
Revenue Predictability	✘ High volatility [10]	✅ Predictable MRR/ARR	✘ Outcome uncertainty	✅ Base provides floor, usage adds growth	**Hybrid**
Margin Sustainability	⚠ Compressed by price competition [21]	✅ Stable margins	⚠ Variable based on outcome costs	✅ Base margins stable, usage profitable	**Hybrid**
Operational Complexity	✘ High: Token tracking, optimization, billing [4]	✅ Low: Simple billing	✘ High: Outcome measurement, attribution	⚠ Moderate: Tiered + usage tracking	**Subscription** or **Hybrid**
Customer Lifetime Value	⚠ High for optimized users, low for churned users	✅ Predictable based on churn	⚠ Depends on outcome delivery	✅ High due to low churn + growth	**Hybrid**
Competitive Differentiation	⚠ Difficult: Price transparency → commoditization	✅ Features, brand, quality differentiate	✅ Outcome delivery differentiates	✅ Value tiers create differentiation	**Outcome** or **Hybrid**

Provider Recommendation: **Hybrid models** optimize for **revenue predictability**, **margin sustainability**, and **customer lifetime value** while maintaining **manageable complexity**.

4C. Third-Party Ecosystem

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid
API Cost Predictability	✘ Volatile, unpredictable [25] [26]	N/A (APIs typically not subscription-based)	⚠ Outcome-based APIs rare	✅ Committed-use creates predictability
Business Model Viability	⚠ Thin margins due to API cost volatility [25]	N/A	⚠ Depends on outcome API economics	✅ Predictable costs enable sustainable margins

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid
Innovation Incentives	⚠ Focus on token optimization, not features [11]	N/A	✅ Focus on outcome delivery = feature quality	✅ Balanced incentives
Ecosystem Entry Barriers	⚠ High: Must commit volume for discounts [15]	N/A	⚠ Moderate: Outcome measurement complexity	✅ Low: Graduated tiers for small entrants

Ecosystem Recommendation: **Hybrid API pricing** with **graduated tiers** and **outcome-based components** for strategic features enables **healthy complementor ecosystems**.

4D. Society & Policy

Criterion	Token-Based	Subscription	Outcome-Based	Hybrid
Distributional Equity	✖ Regressive: Sophisticated/wealthy benefit [20] [7]	⚠ Neutral: Equal access, but still barriers	⚠ Moderate: Depends on outcome accessibility	✅ Progressive: Tiered access by ability
Environmental Impact	✖ Externalized: No carbon pricing [29]	⚠ Neutral: Fixed revenue doesn't incentivize efficiency	⚠ Moderate: Efficiency reduces outcome costs	✅ Good: Carbon pricing in usage component
Regulatory Complexity	⚠ Moderate: Disclosure, fairness audits needed	✅ Low: Simple to regulate	✖ High: Outcome measurement standards complex	⚠ Moderate: Hybrid requires balanced regulation
Consumer Protection	✖ Weak: Bill shock, information asymmetry [16] [10]	✅ Strong: Predictable, transparent	⚠ Moderate: Outcome disputes possible	✅ Strong: Transparency + caps protect consumers
Innovation & Competition	⚠ Moderate: Lock-in reduces competition [18] [24]	✅ High: Low switching costs encourage competition	⚠ Moderate: Outcome lock-in possible	✅ High: Balance prevents lock-in abuse

Policy Recommendation: **Hybrid models** with **mandated transparency**, **fairness audits**, **PPP adjustments**, and **carbon pricing** achieve **best social outcomes** while enabling innovation and competition.

Part 5: INTEGRATED ASSESSMENT & RECOMMENDATIONS

Overall Model Comparison Scorecard

Scoring: ✅ **Excellent** (9-10), ✅ **Good** (7-8), ⚠ **Moderate** (5-6), ⚠ **Poor** (3-4), ✖ **Failing** (1-2)

Category	Weight	Token-Based	Subscription	Outcome-Based	Hybrid
Immediate User Experience	15%	⚠ 4/10	✅ 8/10	⚠ 6/10	✅ 8/10
Medium-Term Behavioral Effects	20%	⚠ 3/10	✅ 7/10	⚠ 6/10	✅ 8/10
Long-Term Market Health	20%	⚠ 5/10	✅ 7/10	⚠ 6/10	✅ 9/10
Provider Viability	15%	⚠ 4/10	✅ 8/10	⚠ 5/10	✅ 9/10
Ecosystem Development	10%	⚠ 4/10	⚠ 6/10	⚠ 6/10	✅ 8/10
Equity & Social Impact	10%	✖ 2/10	⚠ 6/10	⚠ 6/10	✅ 8/10
Sustainability	10%	⚠ 3/10	✅ 7/10	⚠ 6/10	✅ 8/10
TOTAL WEIGHTED SCORE	100%	**3.85/10**	**7.25/10**	**5.95/10**	**8.25/10**

Key Findings:

1. **Token-Based Pricing (3.85/10)**: **Fails** across most dimensions due to information asymmetry, behavioral challenges, and equity concerns. Theoretically appealing but **practically problematic**.

2. **Subscription Pricing (7.25/10)**: **Strong** on user experience, predictability, and simplicity. However, lacks usage-based fairness and may not optimize value capture for providers.

3. **Outcome-Based Pricing (5.95/10)**: **Optimal** for value alignment but **challenging** to implement due to measurement complexity and attribution difficulties. Best suited for **specific, well-defined use cases**.

4. **Hybrid Tiered Models (8.25/10)**: **Best overall performance** by combining:

   - **Predictability** (base subscription component)

   - **Fairness** (usage-based component)

   - **Flexibility** (tier selection for different needs)

   - **Sustainability** (stable revenue + growth potential)

Design Principles for Optimal Pricing Models

Based on the comprehensive analysis, optimal pricing models for online services should adhere to these principles:

1. Value-Cost Alignment

- Price based on **value delivered** (outcomes, business impact), not **inputs consumed** (tokens, API calls)[14] [33] [11]

- Use **value metrics** (e.g., "queries resolved," "documents processed") rather than technical units (tokens)[3] [34]

2. Predictability & Transparency

- Provide **pre-transaction cost estimates** with confidence intervals [4] [16]
- **Real-time monitoring** with alerts to prevent bill shock [4] [16] [35]
- **Standardized metrics** enabling cross-provider comparison [7] [8]

3. Behavioral Simplicity

- Minimize **cognitive load** (simple tier selection, not complex optimization) [13] [36]
- Align with **mental accounting** (base subscription feels "sunk," usage feels "fair") [13]
- Reduce **payment pain** through bundling and prepayment [13] [36]

4. Equity & Fairness

- **Language-normalized pricing** (same cost for equivalent outcomes regardless of language) [7] [8]
- **PPP-adjusted tiers** for global accessibility [30] [31]
- **Educational/nonprofit discounts** for social value use cases [30] [37]

5. Sustainability

- **Carbon pricing** in usage component to internalize environmental costs [29]
- **Committed-use structures** enabling long-term infrastructure investment [28]
- **Energy-efficient incentives** (reward providers for using green energy) [29] [28]

6. Ecosystem Health

- **Graduated API tiers** for third-party developers (low barriers to entry, discounts at scale) [25] [38]
- **Transparent, stable pricing** enabling complementor business planning [25] [26]
- **Revenue sharing** models aligning platform + ecosystem success [25] [38]

Implementation Roadmap

Phase 1: Immediate (0-6 months)

For Providers:

- Introduce **hybrid tiered plans** alongside token-based pricing
- Implement **cost calculators** and **real-time monitoring** dashboards
- Offer **committed-use discounts** for predictable revenue

For Policymakers:

- Mandate **pre-transaction cost disclosure** (good-faith estimates)
- Require **language fairness audits** (detect tokenization discrimination)
- Establish **standardized benchmark suites** for cross-provider comparison

Phase 2: Medium-Term (6-24 months)

For Providers:

- Migrate majority of customers to **hybrid models** (data suggests higher satisfaction + retention)

- Develop **outcome-based pricing** for strategic enterprise use cases

- Implement **carbon footprint tracking** in usage dashboards

For Policymakers:

- Create **universal service obligations** (affordable basic tier requirements)

- Develop **PPP-adjusted pricing guidelines** for global equity

- Establish **ecosystem fairness standards** (API pricing disclosure, anti-lock-in rules)

Phase 3: Long-Term (2+ years)

For Providers:

- Transition to **predominantly outcome-based pricing** for mature use cases with measurable outcomes

- Integrate **full carbon pricing** (renewable energy procurement + carbon offsets)

- Develop **portable data standards** (reduce lock-in, enable competition)

For Policymakers:

- Enforce **comprehensive fairness certification** (distributional equity, environmental sustainability, consumer protection)

- Mandate **data + model portability** to prevent anti-competitive lock-in

- Establish **international standards** for AI service pricing equity

Conclusion

The comprehensive evaluation reveals that **per-token pricing**, while theoretically aligned with computational costs, **fails to deliver** on critical dimensions of user experience, fairness, sustainability, and market health. The model's **fundamental flaw** is misalignment between the **unit of pricing** (tokens consumed) and the **unit of value** (outcomes delivered).

Hybrid tiered models combining **predictable base subscriptions** with **value-based usage components** achieve superior outcomes across nearly all evaluation dimensions. These models:

✅ **Preserve fairness** (usage-based component ensures pay-for-use)
✅ **Enable predictability** (base provides budget certainty)
✅ **Align incentives** (outcomes, not tokens, drive pricing)
✅ **Support sustainability** (stable revenue enables infrastructure investment)
✅ **Promote equity** (tiered structures can accommodate diverse ability-to-pay)
✅ **Encourage innovation** (balanced incentives for providers and users)

Outcome-based pricing represents the **theoretical optimum** (perfect value alignment) but faces **practical implementation challenges** (measurement, attribution, standardization). It is best deployed for **specific use cases** with **well-defined, measurable outcomes**, rather than as a universal model.

Pure subscription pricing, while simpler and more predictable, **foregoes fairness** advantages of usage-based models and may **under-capture** value from high-consumption users.

The **path forward** for the AI services industry—and online services more broadly—lies in **hybrid architectures** that combine the strengths of multiple pricing approaches while mitigating their respective weaknesses. Providers who successfully navigate this transition will achieve:

- **Higher customer satisfaction** (predictability + fairness)

- **More stable revenue** (base + growth)

- **Stronger competitive positioning** (value alignment)

- **Sustainable long-term growth** (infrastructure investment + equity + environmental responsibility)

The pricing model is not merely a **billing mechanism**—it is a **strategic choice** that shapes market structure, innovation incentives, equity outcomes, and environmental sustainability. Getting it right is essential for the long-term health of the digital economy.

[39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68] [69] [70] [71] [72] [73] [74] [75] [76] [77] [78] [79] [80] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94] [95] [96] [97] [98] [99] [100] [101] [102] [103] [104] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147] [148] [149] [150] [151] [152] [153] [154] [155] [156] [157] [158] [159] [160] [161] [162] [163] [164] [165] [166] [167] [168] [169] [170] [171] [172] [173] [174] [175] [176] [177] [178] [179] [180] [181] [182] [183] [184] [185] [186] [187] [188] [189] [190] [191] [192] [193] [194] [195] [196] [197] [198] [199] [200] [201] [202] [203] [204] [205] [206] [207] [208] [209] [210] [211]

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1. https://www.ikangai.com/the-llm-cost-paradox-how-cheaper-ai-models-are-breaking-budgets/

2. https://www.finops.org/wg/genai-finops-how-token-pricing-really-works/

3. https://kinde.com/learn/billing/billing-for-ai/ai-token-pricing-optimization-dynamic-cost-management-for-llm-powered-saas/

4. https://www.prompts.ai/en/blog/managing-token-level-costs-ai

5. https://verpex.com/blog/marketing-tips/price-discrimination-online-the-fairness-of-personalized-pricing-based-on-user-data

6. https://www.sciencedirect.com/science/article/abs/pii/S0278431924003268

7. https://arxiv.org/pdf/2305.13707.pdf

8. https://aclanthology.org/2023.emnlp-main.614.pdf

9. https://instituteofinterneteconomics.org/behavioral-economics-of-subscription-pricing/

10. https://flexprice.io/blog/why-ai-companies-have-adopted-usage-based-pricing

11. https://www.getmonetizely.com/articles/genai-pricing-models-from-tokens-to-outcomes

12. https://techforward.io/the-token-economy-why-usage-based-ai-pricing-is-both-a-blessing-and-a-trap/

13. https://www.behavioraleconomics.com/mental-money-the-psychology-of-subscription-payment-options/

14. https://sevenfigureagency.com/implementing-value-based-pricing-in-digital-agencies/

15. https://stripe.com/resources/more/token-pricing-how-it-works-and-how-to-make-the-most-of-it

16. https://stripe.com/resources/more/pricing-flexibility-in-ai-services

17. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2023.1162916/full

18. https://onlinelibrary.wiley.com/doi/10.1111/jems.12612

19. https://conference.iza.org/DATA_2022/stenzhorn_e32647.pdf

20. https://www.tandfonline.com/doi/full/10.1080/01605682.2023.2269212

21. https://www.fiegenbaum.solutions/en/blog/dramatic-drop-ai-token-prices-opportunities-challenges-sustainability

22. http://ledger.pitt.edu/ojs/ledger/article/download/226/214

23. https://www.mercatus.org/research/working-papers/data-really-barrier-entry-rethinking-competition-regulation-generative-ai

24. https://www.sciencedirect.com/science/article/abs/pii/S1059056022003112

25. https://pubsonline.informs.org/doi/10.1287/mnsc.2023.4917

26. https://dl.acm.org/doi/fullHtml/10.1145/3497701.3497733

27. https://www.tandfonline.com/doi/full/10.1080/13241583.2024.2393933

28. https://www.ey.com/en_sg/media/podcasts/moneymultiple/2025/06/unlocking-value-in-growing-digital-infrastructure

29. https://www.pwc.com/gx/en/industries/tmt/digital-infrastructures-defining-moment-on-climate.html

30. https://ctu.ieee.org/blog/2023/02/03/solutions-to-the-digital-divide-moving-toward-a-more-equitable-future/

31. https://martinhilbert.net/CheapEnoughWD_Hilbert_pre-print.pdf

32. https://www.brookings.edu/articles/fixing-the-global-digital-divide-and-digital-access-gap/

33. https://www.ibbaka.com/ibbaka-market-blog/pricing-patterns-for-generative-ai

34. https://www.getmonetizely.com/articles/understanding-token-based-pricing-for-agentic-ai-systems-a-new-paradigm-in-ai-economics

35. https://schematichq.com/blog/why-usage-based-billing-is-taking-over-saas

36. https://bear.warrington.ufl.edu/brenner/mar7588/Papers/thaler-mktsci1985.pdf

37. https://www.nature.com/articles/s41598-022-19792-3

38. https://www.getmonetizely.com/articles/how-to-design-effective-pricing-models-for-network-effects-and-platform-businesses

39. http://www.emerald.com/jeim/article/36/6/1533-1555/205340

40. https://onlinelibrary.wiley.com/doi/10.1002/mde.4472

41. https://www.frontiersin.org/articles/10.3389/fmars.2025.1601322/full

42. https://arxiv.org/abs/2410.13090

43. https://www.mdpi.com/0718-1876/19/2/61

44. https://arxiv.org/pdf/2101.06210.pdf

45. https://www.frontiersin.org/articles/10.3389/fphy.2021.631659/pdf

46. https://arxiv.org/pdf/2307.16874.pdf

47. https://arxiv.org/pdf/2208.10271.pdf

48. https://dl.acm.org/doi/pdf/10.1145/3649318

49. https://www.rairo-ro.org/articles/ro/pdf/2022/01/ro210226.pdf

50. https://backend.orbit.dtu.dk/ws/files/290548890/2022_TMG_PartC_1_.pdf

51. https://arxiv.org/pdf/2410.19107.pdf

52. https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID4437801_code2617082.pdf?abstractid=3613261&mirid=1

53. https://skywork.ai/skypage/en/Technical-Barriers-to-Entry:-Challenges-in-North-American-AI-Model-Localization-and-Implementation/1950070050110914560

54. https://competition-bureau.canada.ca/en/how-we-foster-competition/education-and-outreach/consultation-artificial-intelligence-and-competition-what-we-heard

55. https://en.wikipedia.org/wiki/Two-sided_market

56. https://www.sciencedirect.com/science/article/abs/pii/S0304405X23000715

57. http://arxiv.org/pdf/2502.16363.pdf

58. https://competitionpolicyinternational.com/assets/Uploads/Autumn2014Schmalensee.pdf

59. https://www.nfx.com/post/network-effects-manual

60. https://www.linkedin.com/pulse/global-ai-llm-market-critical-analysis-through-five-uzwyshyn-ph-d--is3dc

61. https://academic.oup.com/jeea/article-pdf/1/4/990/10312916/jeea0990.pdf

62. https://ieeexplore.ieee.org/document/10172155/

63. https://www.multiresearchjournal.com/arclist/list-2024.4.6/id-4262

64. https://elibrary.imf.org/openurl?genre=journal&issn=1018-5941&volume=2023&issue=027

65. https://ieeexplore.ieee.org/document/10380440/

66. https://ijsab.com/volume-32-issue-1/6438

67. https://www.mdpi.com/2071-1050/13/17/9762/pdf

68. https://www.frontiersin.org/articles/10.3389/fgwh.2022.696529/full

69. https://jaesj.journals.ekb.eg/article_398940.html

70. https://www.mdpi.com/1911-8074/17/4/133

71. https://fepbl.com/index.php/csitrj/article/view/577

72. https://www.mdpi.com/2071-1050/13/16/8996

73. https://www.mdpi.com/2071-1050/13/16/8996/pdf

74. https://www.mdpi.com/2071-1050/12/1/49

75. https://www.mdpi.com/2079-9292/5/4/65/pdf?version=1475056683

76. https://www.adb.org/sites/default/files/publication/939786/source-multilateral-platform-sustainable-infrastructure.pdf

77. https://www.mdpi.com/1911-8074/17/4/133/pdf?version=1711119244

78. https://www.frontiersin.org/articles/10.3389/fpsyg.2022.821979/pdf

79. https://arxiv.org/pdf/2208.04710.pdf

80. https://www.mdpi.com/2071-1050/12/9/3893/pdf

81. https://www.bci.ca/adapting-risk-models-for-todays-infrastructure-investment-opportunities/

82. https://daijobu.ai/2025/05/19/millions-of-tokens-the-invisible-unit-of-measurement-shaping-modern-ai/

83. https://www.getmonetizely.com/articles/should-your-ai-agent-use-token-based-or-subscription-pricing

84. https://arxiv.org/pdf/2402.09697.pdf

85. https://premierscience.com/wp-content/uploads/2024/11/pjcs-24-356-.pdf

86. https://www.sciencedirect.com/science/article/pii/S0148296323001157

87. https://www.linkedin.com/pulse/provisioned-capacity-ai-beginners-guide-dedicated-vs-asaf-liveanu-i1mhe

88. https://www.semanticscholar.org/paper/cef1b80bd30d8c31beb37bc73cf1f15a37962008

89. https://ieeexplore.ieee.org/document/10825591/

90. https://academic.oup.com/jamiaopen/article/doi/10.1093/jamiaopen/ooaf055/8161131

91. https://arxiv.org/abs/2508.19008

92. https://mededu.jmir.org/2025/1/e67244

93. https://ieeexplore.ieee.org/document/11170906/

94. https://www.mdpi.com/0718-1876/17/4/63/pdf?version=1664164923

95. https://ej-ai.org/index.php/ejai/article/view/82

96. https://www.cureus.com/articles/350635-preparing-for-vascular-surgery-board-certification-a-comparative-study-using-large-language-models

97. https://theaspd.com/index.php/ijes/article/view/10923

98. https://ascopubs.org/doi/10.1200/JCO.2025.43.16_suppl.e21598

99. http://arxiv.org/pdf/2503.18129.pdf

100. https://arxiv.org/pdf/2502.07736.pdf

101. https://arxiv.org/html/2410.17950

102. https://arxiv.org/pdf/2407.10834.pdf

103. https://arxiv.org/pdf/2402.11754.pdf

104. http://arxiv.org/pdf/2406.06565.pdf

105. https://arxiv.org/pdf/2409.01666.pdf

106. https://www.solvimon.com/pricing-guides/openai-versus-anthropic

107. https://www.econtribute.de/RePEc/ajk/ajkdps/ECONtribute_258_2023.pdf

108. https://www.aipricingcomparison.com/text-generation-api-pricing-calculator

109. https://www.econstor.eu/bitstream/10419/171619/1/wp-13-176_rev.pdf

110. https://anotherwrapper.com/tools/llm-pricing

111. https://www.hec.ca/finance/Fichier/Mimra2013.pdf

112. https://arxiv.org/abs/2403.06150

113. https://langtail.com/llm-price-comparison

114. https://www.sciencedirect.com/science/article/pii/S0899825623000726

115. https://www.younium.com/blog/usage-based-pricing

116. https://jurnal.unikal.ac.id/index.php/hk/article/view/3664

117. https://arxiv.org/abs/2509.06069

118. https://www.tandfonline.com/doi/full/10.1080/09537325.2022.2088342

119. https://link.springer.com/10.1007/s10479-021-04036-w

120. https://www.tandfonline.com/doi/full/10.1080/07421222.2023.2229122

121. https://www.ssrn.com/abstract=5218518

122. https://breached.company/red-sea-cable-cuts-the-hidden-crisis-threatening-global-internet-infrastructure/

123. https://journals.sagepub.com/doi/10.1177/10591478241305333

124. https://journal.uinjkt.ac.id/index.php/etikonomi/article/view/33892

125. https://www.semanticscholar.org/paper/f61fed43aa07694fa1df0a4ead140ed1ac39a4bf

126. https://www.semanticscholar.org/paper/e7fbad668e5b950d901cf706b8b300b2a28958c6

127. http://arxiv.org/pdf/1007.4586.pdf

128. https://linkinghub.elsevier.com/retrieve/pii/S0148296322005689

129. https://arxiv.org/pdf/1904.05656.pdf

130. http://www.scholink.org/ojs/index.php/ibes/article/download/4410/4994

131. https://arxiv.org/pdf/2303.13295.pdf

132. https://nottingham-repository.worktribe.com/preview/943810/Cred_SubEval_EJ-Style.pdf

133. https://link.springer.com/10.1007/s10257-025-00702-9

134. https://downloads.hindawi.com/journals/jam/2023/4456931.pdf

135. https://aisel.aisnet.org/ecis2018_rp/147/

136. https://conjointly.com/blog/willingness-to-pay/

137. https://journals.sagepub.com/doi/10.1177/20539517211069632

138. https://www.frontiersin.org/journals/sociology/articles/10.3389/fsoc.2022.883999/full

139. https://www.econstor.eu/bitstream/10419/238225/1/2020-01.pdf

140. https://www.quantilope.com/resources/how-to-conduct-pricing-research-using-conjoint-analysis

141. https://onlinelibrary.wiley.com/doi/abs/10.1111/poms.13369

142. https://pure.mpg.de/pubman/item/item_3031522_6/component/file_3501197/2019_03online.pdf

143. https://www.productfocus.com/willingness-to-pay-the-hidden-engine-behind-effective-pricing/

144. https://arxiv.org/pdf/2105.01441.pdf

145. https://labs.adaline.ai/p/token-burnout-why-ai-costs-are-climbing

146. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2022.821979/full

147. https://www.abacademies.org/articles/pricing-strategies-in-a-digital-economy-a-microeconomic-perspective-17498.html

148. https://www.sciencedirect.com/science/article/abs/pii/S0377221724006362

149. https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID3358724_code2714802.pdf?abstractid=3108333&mirid=1&type=2

150. https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-025-12321-8

151. https://psychotricks.com/bounded-rationality/

152. https://www.tamarly.ai/blog-2-1/melvines-ai-analysis-12-understanding-tokens-and-the-costs-of-large-language-models-llms-for-enterprises

153. https://www.sciencedirect.com/science/article/abs/pii/S0925527321001225

154. https://ijsi.in/wp-content/uploads/2025/07/18.02.024.20251003.pdf

155. https://thedecisionlab.com/biases/bounded-rationality

156. https://cloudwars.com/ai/enterprise-ai-minute/breaking-down-token-based-pricing-for-generative-ai-large-language-models-llms/

157. https://www.investopedia.com/terms/a/asymmetricinformation.asp

158. https://ojs.apspublisher.com/index.php/amit/article/download/391/300/769

159. https://www.renascence.io/journal/bounded-rationality-customers-simplified-decision-making-processes

160. https://www.mdpi.com/0718-1876/20/3/201

161. http://www.emerald.com/jeim/article/34/5/1429-1451/216071

162. https://ieeexplore.ieee.org/document/9934060/

163. https://www.ijecs.in/index.php/ijecs/article/view/4447

164. https://noonomy-journal.ru/images/3_1_2024/3_1_10.pdf

165. https://www.mdpi.com/2071-1050/16/19/8545

166. https://ieeexplore.ieee.org/document/10502110/

167. https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-024-10777-8

168. https://link.springer.com/10.1007/978-3-031-43185-2_10

169. https://journals.sagepub.com/doi/10.1177/10946705231173116

170. https://www.allsocialsciencejournal.com/search?q=SER-2025-3-064&search=search

171. http://arxiv.org/pdf/2404.00311.pdf

172. https://www.iiakm.org/ojakm/articles/2023/OJAKM_Volume11_2pp1-24.php

173. http://arxiv.org/pdf/1506.06648.pdf

174. https://journals.sagepub.com/doi/pdf/10.1177/10946705231173116

175. https://www.mdpi.com/2071-1050/14/19/11954/pdf?version=1663838570

176. http://arxiv.org/pdf/2503.21448.pdf

177. https://www.mdpi.com/2227-7072/6/4/87/pdf

178. https://www.mdpi.com/2071-1050/13/24/13701/pdf?version=1639475248

179. https://arxiv.org/html/2407.05484v1

180. http://www.tandfonline.com/doi/abs/10.1080/00207543.2014.922707

181. https://easydigitaldownloads.com/blog/value-based-pricing-for-digital-products-and-services/

182. https://sevenfigureagency.com/implementing-value-based-pricing-for-digital-agencies/

183. https://socsc.ktu.lt/index.php/Social/article/view/14247/7540

184. https://www.willingnesstopay.com/webinar/agentic-ai-pricing-4-of-6-ai-pricing-models---part-2-tokens-credit-systems

185. https://www.salesforce.com/sales/cpq/value-based-pricing/

186. https://journals.umcs.pl/h/article/download/1742/1357

187. https://www.youtube.com/watch?v=ZHIwPwAPzlA

188. http://mecs-press.org/ijieeb/ijieeb-v15-n3/v15n3-3.html

189. https://ges.jvolsu.com/index.php/en/component/attachments/download/1848

190. https://www.semanticscholar.org/paper/974665e62c139c842cb12359ea08e20222904f10

191. https://www.semanticscholar.org/paper/2875e7d26ede8bbc59a0d4bc2e187d369e72a15c

192. https://www.semanticscholar.org/paper/62d07091dfd8deb3f688b7599e563e04534ab415

193. https://journals.sagepub.com/doi/10.1016/j.ausmj.2019.07.002

194. https://www.emerald.com/insight/content/doi/10.1108/JIDE-08-2021-0004/full/pdf?title=the-achilles-tendon-of-dynamic-pricing-the-effect-of-consumers-fairness-preferences-on-platforms-dynamic-pricing-strategies

195. https://www.ccsenet.org/journal/index.php/ibr/article/download/66540/36058

196. https://arxiv.org/pdf/2311.00846.pdf

197. https://www.mdpi.com/0718-1876/18/3/60/pdf?version=1688609520

198. https://ejbe.org/EJBE2021Vol14No28p107-J-GOTMARE.pdf

199. https://asistdl.onlinelibrary.wiley.com/doi/10.1002/pra2.2015.145052010043

200. https://journals.sagepub.com/doi/10.1177/21582440241293304

201. https://www.tandfonline.com/doi/pdf/10.1080/1331677X.2020.1844587?needAccess=true

202. https://pmc.ncbi.nlm.nih.gov/articles/PMC10361766/

203. https://papers.ssrn.com/sol3/Delivery.cfm/5251923.pdf?abstractid=5251923&mirid=1

204. https://journals.sagepub.com/doi/10.3233/ISU-240230

205. https://www.untaylored.com/post/demystifying-the-lock-in-business-model-a-comprehensive-explanation

206. https://www.sciencedirect.com/science/article/pii/S305070062500043X

207. https://www.ewadirect.com/proceedings/aemps/article/view/25070

208. https://onlinelibrary.wiley.com/doi/10.1002/mde.4460

209. https://pubsonline.informs.org/doi/10.1287/mnsc.2022.4530

210. https://s-lib.com/en/issues/eiu_2025_05_v8_a22/

211. https://www.mdpi.com/0718-1876/20/4/286