

Pricing a Good That Costs Nothing to Copy

Discount dynamics and demand on Steam

Preliminary and incomplete — comments welcome

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An unusually clean pricing problem

A released PC game is close to a pure **information good**:

- marginal cost of a copy = 0; no inventory, no depreciation, no capacity, infinite shelf life
- **durable**: one purchase per consumer, consumed repeatedly, no resale
- competes for a scarce input — the player's *time and attention* — with new releases *and* with the games the consumer already owns
- the only “cost” of a sale is the revenue lost on consumers who would have paid more

⇒ the posted price is a pure **allocation and screening device**: intertemporal price discrimination (Stokey 1979; Bulow 1982), the Coase problem for a durable-good seller, skimming with forward-looking consumers (Nair 2007; Conlon 2012)

And the platform shapes the game: a 30-day cooldown between discounts, a 90% cap, no list-price increase right before a sale, and four announced platform-wide *seasonal sales* — a coordinated, anticipated event structure.

Questions

1. **How do sellers price such a good over its life cycle?**

How often, how deep, how long, and when — and what role do the platform's rules and calendar play?

2. **How does demand respond?**

How elastic is the purchase flow to a temporary price cut? Is the response a price effect or an *attention* effect? Is there intertemporal substitution (consumers waiting, firms cannibalising later sales)?

3. **[Next step] What is the equilibrium discount policy, and what do platform-coordinated sales and the cooldown rule do to surplus?**

A dynamic model of a zero-marginal-cost durable good with a stock of waiting (wishlisting) consumers.

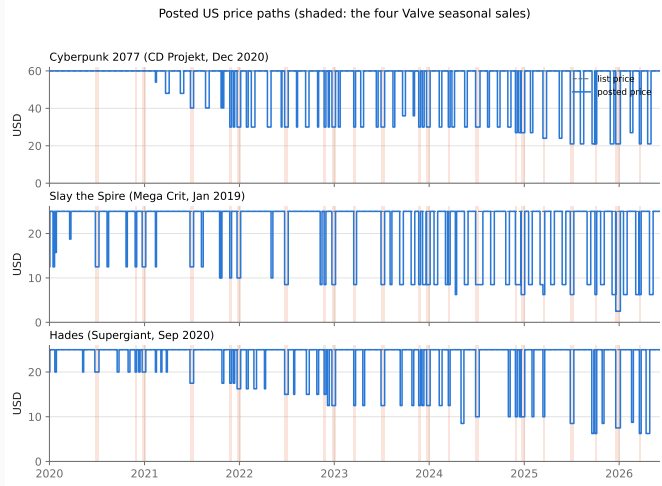
Today: new facts on (1), reduced-form evidence on (2), a model sketch for (3).

Data: prices, activity, products, users

Block	N	Products	Period
US posted-price history (IsThereAnyDeal, Steam store)	5.60m price events	167,507 apps	2020-01 – 2026-06
Discount spells, paid games, known start	1.67m spells	86,307 games	2020-01 – 2026-06
Weekly price panel, paid games	18.8m game-weeks	96,645 games	2020-01 – 2026-05
Monthly price $\times$ review panel	3.96m game-months	87,601 games	2020-01 – 2026-03
Dated, deduplicated reviews	154.2m reviews	146,022 apps	2010 – 2026-04
Balanced weekly activity panel (reviews, paid reviews, mean CCU)	0.99m game-weeks	9,598 games	2024 – 2025
Daily peak concurrent players (SteamDB)	5.0m game-weeks	21,298 games	2020-01 – 2026-05
Public libraries (owned games, playtime)	30.3m user-game rows	139,966 users	May 2026
Product metadata (release, genres, tags, publisher)	218,981 apps	140,017 paid games	March 2026

- A discount *spell*: a maximal run of states with cut > 0 ; depth = cut at start; duration = time to the first zero-cut state.
- Seasonal calendar: official Steamworks dates from Winter 2023; earlier windows reconstructed from the daily spike in starts (30–75k starts on a sale's first day vs. a median of 246).
- What we do *not* observe: transactions. Reviews are dated, require ownership, carry a Steam-purchase flag and playtime at review — our purchase-flow proxy.

Three price paths

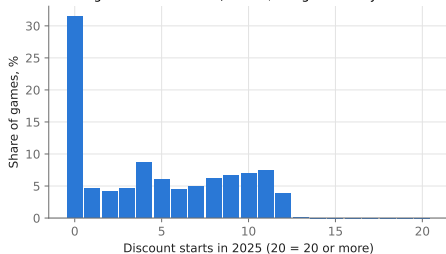


List price dashed, posted price solid; shaded: the four seasonal sales. Source: ITAD US price history.

Fact 1: discounts are the price instrument

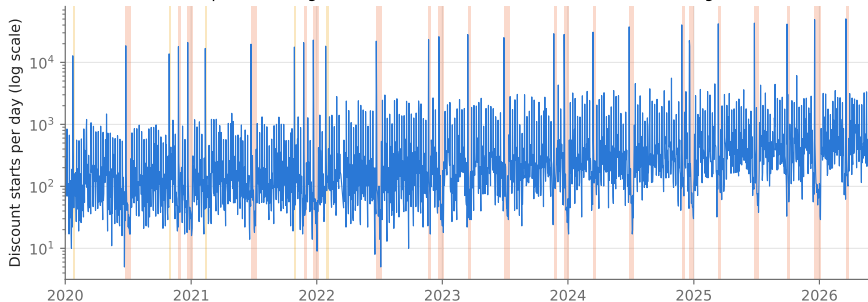
- 2.7 discount starts per game-year (4.6 among games fully observed in 2025) vs. 0.09 list-price changes per game-year
- 65% of the within-game variance of the log posted price comes from discounts
- list-price changes are more often cuts (33.5k) than increases (22.6k)
- the typical discounted game is on sale 14% of the time; a third of listed games are not discounted in a given year
- 55% of new releases carry a launch discount (median 16%); 73% are discounted within a year

How often is a game discounted? (n = 73,477 games fully observed in 2025)



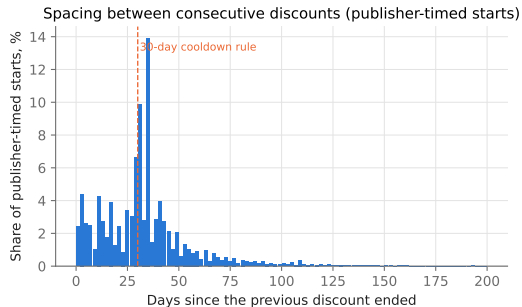
Fact 2: timing follows the platform calendar ...

Daily number of discount starts, paid Steam games (US store). Shaded: 4 seasonal sales (orange), other Valve-wide sales (yellow)



43% of all discount starts fall inside the four seasonal sales, 5% inside other Valve-wide sales, 52% are publisher-timed. In the week a seasonal sale starts, 56% of eligible games start a discount.

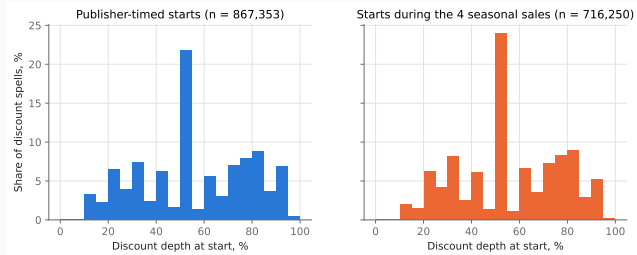
... and the 30-day cooldown rule



Median gap between consecutive publisher-timed discounts: 31 days; 63% restart within 35 days. The weekly hazard of a new discount is 0.4% for never-discounted games, 23% in the week the cooldown expires, then declines monotonically. (The 7% inside the window are mostly smaller Valve fests, which waive the rule.)

Weeks outside Valve-wide sales, game not on sale at the start of the week. `tab_hazard_by_cooldown`.

Fact 3: depth is deep, discrete, and the same inside and outside sales



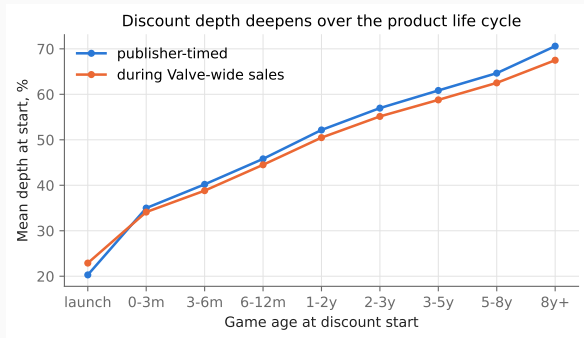
tab_depth_by_timing, tab_duration_by_timing, tab_modal_depths.

	publisher-timed	seasonal
spells	867k	716k
mean depth (%)	54.0	54.1
median depth (%)	51	51
share $\geq 50\%$	0.66	0.68
median duration (days)	7.0	13.8

Modes: 50% (16% of spells), 75, 80, 51, 30, 40, 20, 90.

Durations cluster at 7 and 14 days (publisher-timed) and at the sale length (seasonal).

Fact 4: a life-cycle ratchet



Depth at start: 20% at launch → 35% in months 0–3 → 46% at 6–12 months → 52% at 1–2 years → 61% at 3–5 years → 71% after 8 years.

Within game, relative to the previous discount: 64% same depth, 23% deeper, 13% shallower. 60% of spells are at or above the game's running maximum.

The posted price path is a *sawtooth with a falling floor*: the list price almost never moves, the depth ratchets down, each cut is temporary.

tab_depth_by_age, facts_descriptives.json.

What determines the depth of a discount?

Dependent variable: depth at start (pp). Paid games, 2020–2026, $0 < \text{depth} < 100$. SE clustered by publisher.

	(1) all + publisher FE	(2) all game FE	(3) publisher-timed + publisher FE	(4) seasonal only + publisher FE
log list price	6.87*** (0.38)		7.22*** (0.40)	6.49*** (0.36)
log(1 + months since release)	10.39*** (0.30)	10.43*** (0.31)	10.46*** (0.30)	10.09*** (0.34)
log(1 + prior discounts)	3.15*** (0.31)	2.58*** (0.34)	3.02*** (0.32)	3.63*** (0.35)
log(1 + cumulative reviews)	−2.22*** (0.13)	−2.10*** (0.41)	−2.23*** (0.14)	−2.23*** (0.13)
share of positive reviews	−3.37*** (0.92)	−3.23*** (1.21)	−2.93*** (0.99)	−3.80*** (0.90)
early access	−9.54*** (0.84)		−9.60*** (0.96)	−9.60*** (0.79)
start in a seasonal sale	0.67*** (0.08)	0.58*** (0.07)		
genre dummies, year-month FE	yes	yes	yes	yes
N	779,020	774,954	404,986	322,518
R ² within	0.335	0.167	0.348	0.338

A game twice as expensive discounts 4.8 pp deeper; one year after release the depth is ≈ 27 pp deeper than at launch; popular and early-access games discount less. Adding the previous depth (coef. 0.69) cuts the age gradient to 2.9 pp: **most of the ratchet is persistence.**

When does a publisher start a discount?

Linear probability model, weekly, in pp. Game not on sale at the start of the week. SE clustered by game. 1/8 sample of games.

	(1) all weeks, game FE	(2) non-seasonal, game + week FE	(3) non-seasonal, + activity
cooldown <28 d (vs. never discounted)	-1.1***	-4.7***	-5.1***
cooldown 28-35 d	14.4***	16.9***	17.8***
cooldown 36-49 d	7.7***	6.3***	8.6***
cooldown 50-70 d	3.2***	2.0***	4.0***
cooldown 71-98 d	3.9***	0.9***	3.5***
cooldown >1 year	-3.0***	-2.4***	-3.6***
seasonal sale starts this week	47.1***		
Δ log players, last 4 wks vs. previous 4			-4.26*** (0.28)
log players, last 4 wks			-0.58*** (0.19)
N	1,994,156	1,741,278	395,386
mean of dep. var.	9.5	5.4	5.4

Publishers discount when the rule allows them to and **when attention is declining** (a halving of concurrent players raises the weekly start probability by ≈ 3 pp on a base of 5). Price changes are not exogenous: this matters for everything that follows.

From prices to demand: what we can measure

- We do not observe transactions. We observe **dated reviews** (a review requires ownership; 154m of them), the Steam-purchase / received-for-free flags, the **playtime at review**, and **concurrent players**.
- Mean playtime at review *falls* when the price falls (elasticity +0.15, game and month FE): sale-period reviews come from fresh owners.
- Two panels: a broad monthly panel (42.8k paid games aged ≥ 6 months, 2020–2026) and a balanced weekly panel (9.6k games, 2024–2025) with reviews, paid-channel reviews and mean concurrent users.
- Estimates are *review-flow* elasticities: a purchase elasticity up to the reviews-per-purchase ratio, which we will calibrate with external sales estimates and the library cross-section.
- Two threats: (i) firms discount into declining demand (bias toward zero); (ii) a discount is also *advertising* — Steam e-mails every wishlister and features discounted games.

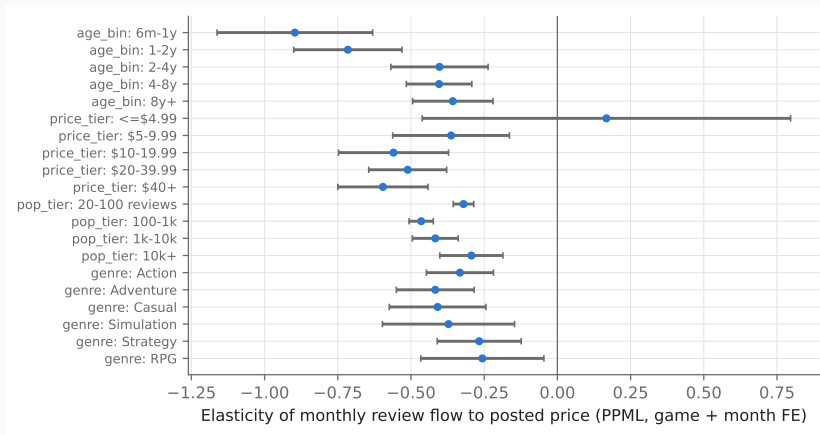
Monthly review-flow elasticity, broad panel

2.08m game-months, 42,841 games, 2020-01 – 2026-03. Game and month FE; SE clustered by game. Price = time-weighted posted price.

	coefficient on log price	N
(1) OLS $\log(1 + \text{reviews})$	-0.147 (0.004)	2,086,423
(2) PPML reviews	-0.321 (0.046)	2,078,371
(3) PPML reviews on discount exposure (share of month $\times$ depth)	+1.029 (0.061)	2,078,371
(4) PPML: $\log$ list price / discount exposure	+0.144 (0.083) / +1.023 (0.062)	2,078,371
(5) PPML, seasonal share $\times$ log price	-0.328; interaction +0.050 (0.041)	2,078,371
(6) PPML, t / $t-1$ / $t-2$ / lead $t+1$	-0.506 / +0.113 / +0.079 / +0.230	1,949,429
(7) PPML Steam-purchase reviews	-0.350 (0.048)	2,054,809
(8) PPML, months without any Valve-wide sale	-0.289 (0.057)	938,130

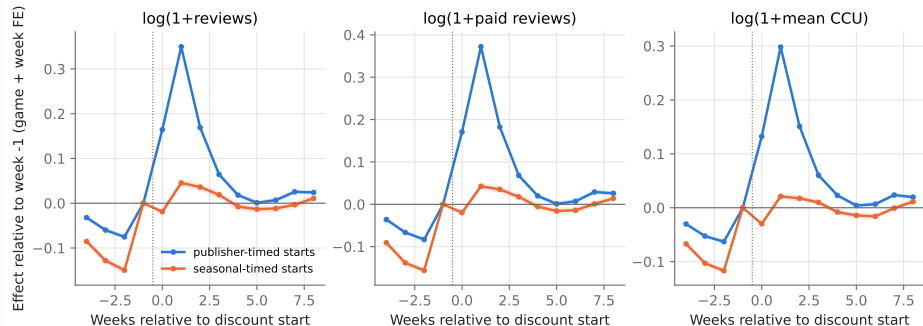
- The response comes from discounts, not from list-price changes (which are endogenous to updates and repricing).
- A one-week 50% discount (≈ 0.12 exposure) raises the month's reviews by $\approx 13\%$.
- Same elasticity inside and outside seasonal sales; the positive lead mixes consumer anticipation with the firms' response to weak months.

Who is price-sensitive? Young games and the \$10+ tier



PPML elasticity of monthly reviews to the posted price, game and month FE, 95% CIs. [tables/reg_demand_monthly_heterogeneity](#).

Weekly dynamics around a discount start



Game and

week FE, 39,202 publisher-timed and 29,841 seasonal starts with four clean pre-weeks, reference week -1. Reviews: +18% in the start week, +40% the week after, back to baseline by week 5, **no dip in weeks 5–8**. Seasonal starts look small because the week FE absorb the platform-wide surge. The slightly rising pre-trend suggests discounts follow updates/attention events — to be checked with the SteamDB event feed.

The discount event matters more than its depth

PPML on weekly counts, publisher-timed starts, game and week FE; effect in week 1 relative to week -1.

Depth bin	mean depth	events	reviews, week 1	paid reviews	mean CCU	arc elasticity (reviews)
$\leq 33\%$	25%	4,336	+63% (0.06)	+70%	+45%	-1.68
34-50%	46%	9,385	+64% (0.05)	+71%	+30%	-0.80
51-66%	59%	6,217	+62% (0.04)	+70%	+30%	-0.54
67-99%	79%	19,264	+80% (0.03)	+90%	+45%	-0.38

- A 25% cut and a 79% cut produce almost the same proportional jump. Depth is chosen (deeper for older, less popular games), so this is not a causal dose-response — but it is hard to square with a pure price response.
- Consistent with a **notification / visibility channel**: wishlisters are e-mailed when the game goes on sale, discounted games are featured. The discount is partly advertising to a stock of waiting consumers.
- Weeks 4-8 after the start: reviews +2 to +8% above baseline, not below — no visible cannibalisation of later demand on this horizon.

tables/dose_response_weekly_ppml (standard errors in parentheses).

Weekly elasticities and engagement

Game and week FE; SE clustered by game. A: balanced panel, 9,593 games $\times$ 104 weeks (2024–25). B: broad players panel, 19,574 games, 4.1m game-weeks (2020–26).

panel	outcome	OLS $\log(1+y)$	PPML
A	reviews	−0.252 (0.004)	−0.420 (0.018)
A	Steam-purchase reviews	−0.272 (0.004)	−0.454 (0.018)
A	mean concurrent users	−0.216 (0.004)	−0.226 (0.028)
A	PPML reviews, $\log$ price at t / $t-1$ / $t-2$ / $t-3$	−0.364 / −0.204 / −0.074 / −0.022	
A	cumulative $t \dots t-4$		−0.667
B	$\log(1 + \text{weekly peak players})$	−0.249 (0.004)	
B	weeks outside Valve-wide sales	−0.279 (0.005)	

- Reviews lag purchases by about a week: the contemporaneous coefficient understates the response; the cumulative review-flow elasticity is about -0.7 .
- Engagement (concurrent players) responds with an elasticity of about -0.25 — a discount brings in players, not only reviewers.

What the facts say

1. The price of a zero-marginal-cost durable good is a **sawtooth with a falling floor**: list prices are sticky, discounts are frequent, short, deep, discrete, and ratchet down with age.
2. Timing is governed by **platform rules and events** (cooldown, seasonal sales) and by **declining attention**: firms discount to reach consumers who are no longer looking.
3. Demand responds strongly but **almost independently of depth**: the discount acts as a notification to a stock of waiting consumers at least as much as a price cut.
4. No visible post-discount dip within two months: the stock of owners grows; intertemporal substitution, if any, operates through anticipation of the predictable calendar.

A model has to deliver: (a) frequent temporary cuts rather than permanent ones, (b) a depth ratchet, (c) a notification channel, (d) a role for the platform calendar.

Next step: a structural model — primitives

Good. Game g with list price P_g , zero marginal cost; posted price $p_{gt} = (1 - d_{gt})P_g$, $d_{gt} \in \{0, 0.1, \dots, 0.9\}$, weekly.

Consumers. Potential buyers arrive over time (release spike, then a flow driven by attention). Consumer i has valuation $v_i \sim F_g$, discount factor β , interest that decays at rate λ , and an **attention state**: she sees the price only when she visits the page or is *notified*. Wishlisting = choosing to be notified. Each period a non-owner buys, waits, or exits. Waiting pays because the price process is predictable: a Markov chain over (time since last discount, last depth, calendar) — exactly what Sections 2–3 estimate.

Publisher. Chooses d_{gt} to maximise the present value of revenue, subject to the cooldown (no new spell within 30 days of the previous end unless a Valve event is running), $d \leq 0.9$, and a cost of changing the depth (the persistence we see). State: stock of waiting consumers W_{gt} , time since last discount, last depth, age, calendar.

Platform. Seasonal sales are anticipated common shocks to arrivals/attention that waive the cooldown; the platform chooses the calendar and the rules.

Structural model — demand side and identification

Purchase flow: $Q_{gt} = W_{gt} \cdot h(p_{gt}, \mathbb{E}_t[p_{g,t+1}, \dots], \text{notified}_{gt})$.

- **Price sensitivity of the hazard** h_p : from depth variation *within* the notified set (deep vs. shallow discounts both notify), from spell duration (the notification is a one-off shock while the price stays low), and from seasonal sales where the platform, not the publisher, creates the traffic.
- **Notification effect**: the common jump in the hazard at any start — the flat dose-response says it is first-order.
- **Stock of waiting consumers** W_{gt} : needs wishlist (or follower) *histories*; we have 2026 wishlist ranks only. SteamDB publishes follower histories — the first data task.
- **Expectations**: rational expectations over the estimated price process; test against the anticipation dip before seasonal sales.
- **Reviews** → **purchases**: calibrate reviews per purchase with external sales estimates (Gamalytic / VG Insights) and the library cross-section (observed owners among 445k sampled users $\approx$ cumulative sales).
- Estimation by indirect inference on the event-study and dose-response moments (plus the no-dip moment), separately for young and mature games.

Structural model — supply, platform, counterfactuals

Supply. A dynamic discrete-choice problem (Rust): choice-specific values from the estimated start-hazard and depth policies (CCP approach). The ratchet is the equilibrium skimming path: as high-valuation waiting consumers are exhausted, the optimal depth rises. The flat dose-response plus the cooldown explain *short, frequent, deep* discounts rather than permanent cuts: each discount is a periodic notification to an accumulating stock, and the platform caps the frequency.

Objects recovered: the depth-adjustment cost, the publisher's discount factor, the distribution of valuations and the decay of interest, the value of a notification.

Counterfactuals.

- no cooldown rule; no seasonal sales; a longer or shorter sale calendar
- a ban on discounts (the Coasian durable-good seller with commitment)
- notification without a price cut (pure advertising) vs. price cut without notification
- entry of similar games (release pressure) and the discount response

Welfare split between patient (waiting) and impatient consumers, small and large publishers, and the platform.

What we do next

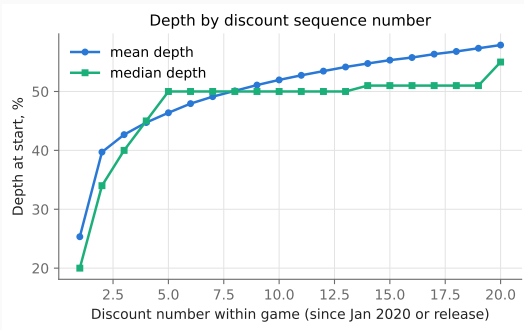
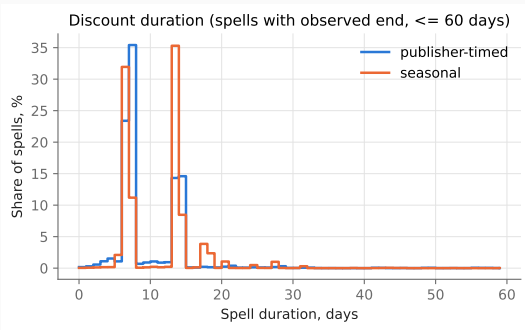
- **Data:** wishlist/follower histories (SteamDB); fest and Daily-Deal participation; the SteamDB event feed (updates vs. discounts); regional prices (FR, GB parsed); the broad weekly review panel (script ready); external sales estimates for calibration.
- **Identification clean-ups:** stacked event design with matched clean controls (as in our earlier matched analysis: +31.7 reviews over weeks 0–3, 95% CI 23.5–39.9); separate updates from discounts; use the cooldown expiry as a timing instrument.
- **Model:** estimate the price process by publisher type; the consumer hazard with the notification channel; the publisher's dynamic problem; counterfactuals on the calendar and the cooldown rule.

Thank you.

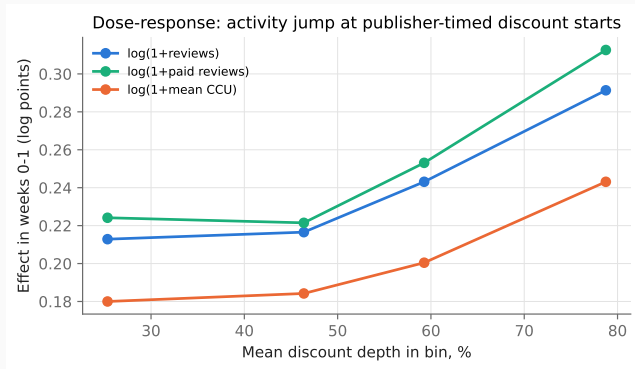
Backup: definitions and samples

- **Weeks** run Thursday–Wednesday UTC (a seasonal sale starting on a Thursday falls entirely in one week).
- **Known start:** spells already running at the first observation (synthetic 2020-01-01 state for 49,099 apps) are excluded from timing and depth analyses. 100% cuts (giveaways) are excluded from depth analyses.
- **Paid games:** Steam store type “game”, not free-to-play, listed in March 2026 (ITAD may stop tracking delisted products).
- **Seasonal windows** (start, end): Summer 2020 06-25/07-10, Autumn 2020 11-25/12-02, Winter 2020 12-22/01-06, Summer 2021 06-24/07-09, Autumn 2021 11-24/12-02, Winter 2021 12-22/01-06, Summer 2022 06-23/07-08, Autumn 2022 11-22/11-30, Winter 2022 12-22/01-06, Spring 2023 03-16/03-24, Summer 2023 06-29/07-14, Autumn 2023 11-21/11-29, Winter 2023 12-21/01-04, Spring 2024 03-14/03-21, Summer 2024 06-27/07-11, Autumn 2024 11-27/12-04, Winter 2024 12-19/01-02, Spring 2025 03-13/03-20, Summer 2025 06-26/07-10, Autumn 2025 09-29/10-06, Winter 2025 12-18/01-05, Spring 2026 03-19/03-26. Lunar New Year 2020–22 and Halloween 2020–21 are “other Valve-wide” events.
- **Monthly demand sample:** paid games with ≥ 20 reviews in total, age ≥ 6 months, full price coverage in the month. **Weekly:** the 9,598-game balanced panel of the earlier project (complete price, review and mean-CCU coverage in 2024–2025).
- **Event sample:** a start in week 0 with no discount in weeks $-4..-1$; publisher-timed = no Valve-wide sale in week 0.

Backup: depth distribution and duration



Backup: dose-response, $\log(1+y)$ version



Mean effect in weeks 0-1 relative to week -1, by depth bin of publisher-timed starts. `tables/dose_response_weekly`.