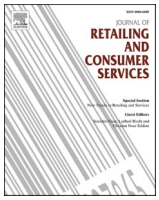
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Sponsored visibility and attention allocation in E-commerce marketplaces: Evidence from a multi-country Amazon search panel

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A R T I C L E I N F O

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A B S T R A C T

Search visibility is a central competitive resource in e-commerce marketplaces, where sponsored products appear within ranked search results alongside ratings, reviews, prices, delivery cues, and platform badges. This study examines how sponsored visibility relates to the conversion of organic marketplace signals into consumer-facing search visibility and whether this relationship varies across sellers and search-market conditions. The analysis uses a daily panel of the first 50 Amazon search results for 96 harmonized purchase-oriented keywords in the United States, United Kingdom, and Germany, covering 1,482,650 product–keyword–country–day observations, 247,318 products, 61,442 sellers, and 120 days. Marketplace visibility is measured using inverse rank and top-position indicators, sponsored visibility from platform-displayed labels, and sponsored density as the sponsored share of a keyword–country–day search market. Fixed-effects models indicate that sponsored visibility is associated with higher search visibility and a 5.94 percentage-point higher probability of top-ten placement. Higher sponsored density is associated with weaker visibility returns from ratings, review volume, fast delivery, and marketplace badges, and with a weaker visibility penalty for higher relative price. Event-study estimates around the first sponsored appearance indicate higher visibility after sponsored entry, with no detectable pre-entry trends. Seller-level analyses show stronger sponsored-visibility associations among larger sellers, while advertising-intensive search markets exhibit greater seller-visibility concentration. The theoretical contribution is to specify sponsored visibility as a ranking-interface condition that changes how organic marketplace signals become discoverability. The findings clarify how retail media reshapes the visibility value of ratings, reviews, delivery, badges, and price, with implications for seller competition, marketplace design, and transparency.

1. Introduction

In digital marketplaces, listing no longer guarantees discovery. Sellers may offer high ratings, low prices, fast delivery, and strong reputational cues, yet remain marginal without prominent search positions. Search visibility therefore conditions marketplace competition (Jürgensmeier and Skiera, 2025). On large platforms, ranking environments allocate visibility by placing organic product signals beside sponsored placements (Rock et al., 2024). This architecture raises the study's core question. Organic rankings are commonly treated as mechanisms that help consumers identify relevant, reliable, and high-quality products (Berends and Gerpott, 2025). Sponsored placements insert paid exposure into the same interface (Chen et al., 2025). The issue is how sponsored visibility relates to the conversion of organic marketplace signals into search visibility. The analysis treats displayed ranking visibility as a consumer-facing precondition for attention, not as direct evidence of clicks, consideration, purchases, or individual-level consumer behavior.

Consumer attention is scarce. Rank determines which products enter consideration, since higher-ranked products are more likely to be noticed, clicked, compared, and purchased (Yoo and Kim, 2012; Ursu, 2018). When sponsored listings occupy visible positions, ratings, reviews, delivery speed, prices, and marketplace badges may lose part of their role in generating visibility (Dash et al., 2024). Competition may still reflect quality and price, but the path from organic marketplace performance to consumer-facing visibility becomes more dependent on paid access (Rock et al., 2024). This mechanism also affects seller competition. Larger sellers often have broader assortments, stronger fulfillment, accumulated reputations, and larger advertising budgets (Zhu and Liu, 2018). These resources can make sponsored visibility more productive for them than for smaller sellers. Smaller sellers may remain present while becoming less discoverable in valuable search spaces (Rietveld and Schilling, 2021). The distinction between platform participation and platform discoverability is central to marketplace

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competition (Yang et al., 2014).

Prior research shows that platform rules govern market access, sponsored-search auctions price exposure, and ranking systems allocate consumer attention (Boudreau and Hagiu, 2009; Yang and Ghose, 2010; Ursu, 2018; Degen and Gleiss, 2025). The remaining theoretical issue is how a ranked marketplace interface converts observable product signals into discoverability when paid listings enter the same visible space. This study makes signal conversion the focal mechanism. Sponsored visibility is defined as a ranking-interface condition that changes the marginal visibility value of ratings, reviews, delivery speed, badges, and relative price. The contribution is to explain why paid placement can reshape the informational role of organic marketplace cues, rather than simply add exposure for advertised products. This helps explain why broad access to sell can coexist with unequal discoverability.

Recent work on sponsored product listings and retail media shows that paid placements affect seller outcomes, marketplace design, and platform competition (Joo et al., 2024; Long and Amaldoss, 2024; Abhishek et al., 2025). This study extends that literature by treating sponsored density as a property of the search environment rather than solely as a focal product attribute. The central theoretical claim is that advertising intensity can alter the visibility value of organic marketplace performance within the ranked interface where consumers infer relevance, quality, reliability, and value.

The study examines how sponsored visibility is associated with the relationship between organic marketplace signals, search visibility, and seller competition. Marketplace visibility is measured through inverse rank and top-position indicators. Sponsored visibility denotes product appearances with platform-displayed sponsored labels. Sponsored density is the sponsored share of visible results in a keyword–country–day market. Organic marketplace signals refer to non-sponsored product cues displayed in the search interface, including ratings, reviews, relative price, fast delivery, and badges. The empirical setting is ranked marketplace search on Amazon in the United States, the United Kingdom, and Germany, where sponsored products appear alongside organic results within the same consumer-facing search interface. The final sample includes 1,482,650 product–keyword–country–day observations from the first 50 search results for 96 harmonized purchase-oriented keywords, covering 247,318 products and 61,442 sellers over 120 days. The empirical strategy combines product–keyword–country fixed effects, keyword–country–day fixed effects, sponsored-density interactions, event-study estimates, seller-scale heterogeneity tests, and market-level concentration measures.

The estimates show that sponsored visibility is positively associated with search visibility and top-position placement. The key pattern is that sponsored-product density is associated with a weaker relationship between organic marketplace signals and search visibility. Ratings, review volume, fast delivery, marketplace badges, and price competitiveness remain relevant, yet their visibility returns decline when sponsored listings occupy a larger share of the search environment. Event-study estimates indicate higher visibility after sponsored entry, with no detectable pre-entry trend. Larger sellers obtain stronger visibility associations with sponsorship, and higher sponsored density is associated with greater seller-level visibility concentration. The analysis therefore shifts attention from individual ad performance to the market-level consequences of sponsored density and explains why open marketplace access does not guarantee meaningful discoverability.

2. Conceptual background

Digital marketplaces have shifted competition from catalog access to ranked discoverability. Search position shapes entry into consumer consideration sets (Ursu, 2018). Ratings, reviews, prices, delivery cues, badges, and sponsored labels form the visible architecture through which consumers evaluate marketplace alternatives. This architecture also performs a governance function. Platform rules define access conditions (Boudreau and Hagiu, 2009), interfaces coordinate participation among marketplace actors (Tiwana et al., 2010; de Reuver et al., 2018; Hein et al., 2020), and ranking systems organize control over market visibility (Degen and Gleiss, 2025). Marketplace competition therefore depends on whether product signals become visible within the ranked interface, not merely on whether sellers can list products.

This study uses one core concept: signal conversion. Signal conversion refers to the ranking-interface process through which observable marketplace cues become visible placement. Sponsored visibility matters because it changes this process by inserting paid access into the same ranked list that displays ratings, reviews, delivery cues, badges, and price. Organic rankings reduce search friction by ordering assortments around relevance, price, reputation, fulfillment, availability, and seller reliability. Reviews affect consumer response and product performance (Chevalier and Mayzlin, 2006; Ghose et al., 2012), but their economic value depends on visible placement. A high rating, large review base, fast-delivery cue, or marketplace badge can influence consumers only when the product appears in positions they are likely to notice.

Sponsored listings alter signal conversion because they enter the same ranked list in which organic cues are interpreted. Sponsored-search research explains auction design (Varian, 2007), position value, paid-organic interaction (Agarwal et al., 2011), click response (Cheng and Zhu, 2025), and advertising automation (Yang and Ghose, 2010; Reisenbichler et al., 2026). Marketplace search adds a distinct mechanism. Paid placement competes for the same scarce visible positions that would otherwise be allocated through relevance, reputation, price, fulfillment, and platform badges. As sponsored density rises, the interface becomes less fully governed by organic signal strength, so the same rating, review base, delivery cue, badge, or relative price difference yields a smaller visibility return.

Recent retail-media research shows that sponsored product listings affect seller outcomes (Joo et al., 2024), while work on self-preferencing shows how sponsored advertising can interact with private labels and marketplace power (Long and Amaldoss, 2024). Field evidence also indicates that retail media can alter marketplace outcomes beyond the focal advertiser (Abhishek et al., 2025). The remaining theoretical gap concerns signal conversion: whether sponsored density, as the advertising intensity of a keyword–country–day search market, changes how ratings, reviews, price, fulfillment, and badges translate into rank-based marketplace visibility. This question is distributional because visible positions remain scarce even when seller access is broad (Ronayne and Taylor, 2022).

The framework also links sponsored visibility to seller inequality. Larger sellers may convert sponsored placement into visibility more effectively because they have broader assortments, stronger fulfillment, richer content, accumulated reputations, and larger advertising budgets (Zhu and Liu, 2018; Rietveld and Schilling, 2021). Platform design can further shape opportunity in hybrid marketplaces (Hagiu and Wright, 2015; Hagiu et al., 2022). The empirical gap therefore concerns whether sponsored density weakens the conversion of organic marketplace performance into consumer-facing placement and whether this process reinforces seller-level visibility concentration.

3. Hypotheses development

The hypotheses follow the signal-conversion mechanism across three levels. At the product level, sponsored visibility should raise placement because it provides a paid route into scarce visible positions. At the search-market level, higher sponsored density should weaken the conversion of organic cues into rank-based visibility because paid listings absorb part of the visible interface. At the seller level, the same paid exposure should be more productive for larger sellers because they possess complementary resources that reinforce sponsored placement. At the market level, these unequal returns should be associated with greater seller-level visibility concentration.

In information-rich markets, scarcity shifts from products to

attention. As assortments expand, competition moves from evaluation to noticeability because products must be seen before they can be clicked, compared, or purchased (Simon, 1971; Davenport and Beck, 2001). E-commerce marketplaces intensify this problem because search results are the main gateway to consideration. Products near the top attract disproportionate attention, while lower-ranked products can remain peripheral despite favorable attributes (Yoo and Kim, 2012; Ursu, 2018). In this study, this logic is examined through displayed ranking positions rather than through individual-level clicks, consideration, or purchases.

Organic marketplace signals provide the informational basis for ranked allocation. When quality is uncertain, consumers use ratings, review volume, price, delivery speed, availability, and badges to infer quality, reputation, value, and reliability (Akerlof, 1970; Spence, 1973). These cues affect consumer response and product performance, but their commercial value depends on whether rankings convert them into visible placement (Chevalier and Mayzlin, 2006; Ghose et al., 2012).

Sponsored visibility is the paid component of this conversion process. A sponsored result is not a peripheral advertisement when it appears inside the ranked product list (Zhong, 2023). It is a paid claim on visible search space, placed among organic cues from which consumers infer relevance, reliability, and value (Joo et al., 2024; Rock et al., 2024). By creating a paid route into prominent positions, sponsored placement extends the governance function of ranking systems (Boudreau and Hagiu, 2009; Tiwana et al., 2010; Degen and Gleiss, 2025). The first implication is direct: a product should receive greater marketplace visibility when it appears as sponsored within a keyword-country-day search market.

H1. Sponsored visibility is positively associated with marketplace visibility after controlling for organic marketplace signals and search-market conditions.

Sponsored density should change the visibility value of organic signals because it changes the composition of the ranked interface. Ratings, reviews, fast delivery, and badges should carry positive visibility associations because they reduce uncertainty about quality, reputation, fulfillment, and platform endorsement. Higher relative price should carry a visibility penalty because it weakens value relative to competing products. When sponsored listings occupy more visible positions, ranking outcomes become less tightly linked to these organic cues. Sponsored results can appear ahead of stronger organic alternatives, and prominent paid positions can reduce the visibility penalty associated with weaker price competitiveness (Dash et al., 2024; Rock et al., 2024).

H2. As sponsored-product density increases, the positive visibility associations of quality, reputation, fulfillment, and badge signals weaken, while the visibility penalty associated with higher relative price is attenuated.

This prediction concerns marginal visibility returns rather than the disappearance of organic signal value. A negative sponsored-density interaction indicates that an organic cue remains relevant but is less strongly converted into rank-based visibility when the visible interface contains more sponsored placements.

Paid entry may create dynamic visibility patterns. A prominent position can generate an initial visibility shock and may be associated with later reviews or ranking persistence. Paid and organic visibility can interact in search environments (Yang and Ghose, 2010; Berman and Katona, 2013), and sponsored listings increasingly function as part of marketplace design rather than a separate advertising channel (Abhishek et al., 2025). The analysis examines visibility before and after first sponsored entry, with review growth treated as a proxy for marketplace traction rather than sales.

Seller resources should condition the conversion of sponsored visibility into placement. Larger sellers often combine broader assortments, stronger fulfillment, better listing content, established reputations, pricing flexibility, and larger advertising budgets. These resources make sponsored exposure more effective because paid placement is reinforced by signals that rankings and consumers can recognize. Smaller sellers may purchase sponsorship, yet receive weaker visibility returns when these complementary resources are thinner. This asymmetry is consistent with power and dependence dynamics in digital platform ecosystems (Verlooy et al., 2026).

H3. The positive association between sponsored visibility and marketplace visibility is stronger among larger sellers than among smaller sellers.

Unequal returns to sponsored visibility can reshape competition at the market level. If larger sellers convert paid exposure into stronger placement gains, advertising-intensive search markets may allocate prominent positions less evenly. Formal access can coexist with concentrated consumer attention. Platform design is central to market-power concerns, and sponsored advertising can interact with self-preferencing and private-label strategies (Degen and Gleiss, 2025; Long and Amaldoss, 2024).

H4. Higher sponsored-product density is associated with greater seller-level visibility concentration within keyword-country marketplaces.

4. Research context and data

This study uses daily panel data from Amazon US, UK, and Germany. Amazon provides a suitable setting because sponsored listings appear within the same search interface as organic results, where rankings allocate attention among competing products and sellers (Joo et al., 2024; Rock et al., 2024; Bhattacharya et al., 2022). The three-country design keeps the platform architecture comparable while allowing variation in marketplace size, seller competition, and sponsored-listing intensity.

The unit is product–keyword–country–day. The data cover 96 purchase-oriented keywords from 1 January 2025 to 30 April 2025. These keywords were selected to represent comparable product-search markets across the three country marketplaces, rather than all Amazon searches, and span six product groups: electronics accessories, home and kitchen, beauty and personal care, office products, sports and outdoor products, and small household items. Keywords were harmonized across marketplaces; German terms were translated and manually validated, and category-inconsistent or ambiguous keywords were excluded. For each keyword–country–day, the first 50 search results were recorded to capture consumer-facing visibility rather than the full catalog. The analysis therefore focuses on visible search space and does not make claims about products outside the observed search-result window.

For each result, the dataset records product identifier, rank, sponsored status, price, rating, review count, availability, delivery information, badges, seller information where available, URL, country, keyword, date, and timestamp. Sponsored status is coded from platform-displayed labels, allowing sponsorship to vary across keywords, countries, and days for the same product.

Data collection followed a standardized protocol to limit personalization, location-specific variation, interface variation, and measurement noise. Searches were conducted daily between 09:00 and 13:00 local marketplace time using non-logged-in sessions, fixed country-specific delivery locations, isolated browser profiles, and stable marketplace, language, device, and viewport settings. All 34,560 planned keyword–country–day searches were collected, with no missing collection days. Because marketplace interfaces are dynamic, ranks and sponsored labels were recorded from the displayed results on each collection date. Sponsored status was coded only from platform-displayed labels on product cards, using “Sponsored” in the US/UK and “Gesponsert” in Germany. Manual audits showed 99.6% agreement for sponsored-label coding and 99.8% exact rank-position agreement across 17,300 inspected positions. Supplementary Material reports the full protocol,

missingness checks, sponsored-label rules, cleaning decisions, reproducibility materials, and audit results (Tables S1–S3, S6, S8–S11). The study uses public product- and seller-level information and collects no consumer-level data or personally identifiable information.

The raw data were cleaned before analysis. The cleaning process distinguishes collection coverage from analytical exclusions. Collection coverage was complete at the planned keyword-country-day level, whereas analytical observations were removed for invalid product identifiers, invalid ranks, missing sponsored-status information, technical duplicates, unparseable required fields, and implausible values. Prices, ratings, and review counts are standardized, and technical duplicates are consolidated at the product-keyword-country-day level. Supplementary Table S8 reports each cleaning step and the number of observations removed. The final analytical sample contains 1,482,650 observations across 247,318 products, 61,442 sellers, 96 keywords, three country marketplaces, and 120 days. Tables 1 and 2 report sample structure and descriptive statistics.

The dataset enables within-market comparisons between sponsored and non-sponsored products, product tracking around sponsorship changes, and measurement of sponsored density across search markets.

Table 1
Data structure and sample construction.

Element	Description
Empirical setting	Amazon US, Amazon UK, Amazon Germany
Unit of observation	Product–keyword–country–day
Collection period	1 January 2025–30 April 2025
Frequency	Daily
Duration	120 days
Search depth	First 50 search results
Keywords	96 purchase-oriented product-search keywords
Raw observations	1,728,000 search-result observations
Final sample	1,482,650 observations after cleaning
Unique products	247,318
Unique sellers	61,442
Main visibility variables	Search rank, sponsored status, top-position indicators
Main product signals	Price, rating, review count, availability, delivery information, badges
Main seller variables	Seller identifier/name, seller type where available

Table 2
Descriptive statistics of main variables.

Panel A. Main variables

Variable	Mean	SD	Min	Max
Visibility score	0.0897	0.1194	0.0200	1.0000
Top 10	0.2000	0.4000	0.0000	1.0000
Sponsored	0.1846	0.3880	0.0000	1.0000
Sponsored density	0.1846	0.0928	0.0000	0.6200
Rating	4.3275	0.4122	1.0000	5.0000
Log reviews	4.8163	2.1195	0.0000	12.4300
Relative price	1.0000	0.4318	0.0800	6.9700
Fast delivery	0.5732	0.4946	0.0000	1.0000
Badge	0.0714	0.2575	0.0000	1.0000
Seller visibility share	0.0186	0.0412	0.0002	0.4260
HHI visibility concentration	0.0418	0.0365	0.0041	0.3180

Panel B. Sponsored density by country marketplace

Country marketplace	**Sponsored density**
Amazon US	0.2248
Amazon UK	0.1763
Amazon Germany	0.1527

5. Variables and measures

The empirical analysis focuses on three dimensions of marketplace competition: marketplace visibility, sponsored visibility and sponsored density, and seller-level visibility concentration. The unit of observation is a product appearing for a specific keyword in a specific country marketplace on a given day. Product-level variables are therefore measured at the product-keyword-country-day level unless stated otherwise. Products are indexed by i, keywords by k, country marketplaces by c, days by t, and sellers by s. Supplementary Table S9 summarizes variable construction, measurement levels, and empirical roles.

The main dependent variable is marketplace visibility. Search rank is ordinal, but consumer-facing exposure is highly nonlinear because top positions receive disproportionate attention. The inverse-rank score is therefore used as a monotonic, rank-based visibility index that gives greater weight to higher positions while preserving the full observed top-50 ordering:

$$Visibility_{ikct} = \frac{1}{Rank_{ikct}}$$

where $Rank_{ikct}$ is the observed position of product i for keyword k in country marketplace c on day t. Higher values therefore indicate greater visibility. A product ranked first receives a visibility score of 1.0000, while a product ranked fiftieth receives 0.0200. The measure is not interpreted as a cardinal measure of consumer attention. Binary top-position indicators and log-rank specifications are used in additional analyses to assess sensitivity to the ordinal and nonlinear nature of search rankings. $Top10_{ikct}$ equals one if the product appears among the first ten search results, and $Top20_{ikct}$ equals one if it appears among the first twenty results.

The main explanatory variable is sponsored visibility. $Sponsored_{ikct}$ equals one when product i is displayed with a platform-provided sponsored label for keyword k, country marketplace c, and day t. Sponsorship is measured at the product-keyword-country-day level because it may vary across keywords, countries, and days for the same product. Sponsored status is not inferred from rank position, visual similarity, or predicted advertising status; observations with missing or unreadable sponsored-label information are excluded from sponsored-status analyses.

Advertising intensity is measured through sponsored-product density at the keyword-country-day level:

$$SponsoredDensity_{kct} = \frac{\sum_i Sponsored_{ikct}}{N_{kct}}$$

where N_{kct} is the number of observed products for keyword k in country marketplace c on day t. $SponsoredDensity_{kct}$ captures the share of visible search results that are sponsored.

Organic marketplace signals refer to non-sponsored, publicly displayed marketplace cues that may inform rank-based visibility and consumer evaluation. These include ratings, review volume, relative price, fast delivery, availability, and marketplace badges. $Rating_{ikct}$ captures the displayed star rating. Review volume is log-transformed because review counts are highly skewed:

$$LogReviews_{ikct} = \log\left(Reviews_{ikct} + 1\right)$$

where $Reviews_{ikct}$ is the displayed number of product reviews. Price is measured using a relative price variable within each keyword-country-day search market:

$$RelativePrice_{ikct} = \frac{Price_{ikct}}{\overline{Price}_{kct}}$$

where $\overline{Price}_{kct}$ is the average observed price for the same keyword, country, and day. Values above one indicate prices above the local search-market average, while values below one indicate lower prices. $FastDelivery_{ikct}$ equals one when the product displays Prime eligibility, next-day delivery, or an equivalent fast-delivery signal. $Availability_{ikct}$ equals one if the product is available for purchase. $Badge_{ikct}$ equals one if the product displays a prominent marketplace badge, such as "Best Seller," "Amazon's Choice," or a country-specific equivalent.

Review growth is used as a secondary outcome to capture subsequent marketplace traction. Since direct sales are not publicly observable, it is interpreted as an indirect proxy rather than a sales measure. Review growth is calculated at the product-country-day level and merged into the product-keyword-country-day panel:

$$ReviewGrowth_{ict} = \log\left(Reviews_{ict} + 1\right) - \log\left(Reviews_{ic,t-1} + 1\right)$$

Seller scale is measured using the lagged number of distinct products associated with seller s in country marketplace c:

$$SellerScale_{sc,t-1} = \log\left(1 + ProductCount_{sc,t-1}\right)$$

where $ProductCount_{sc,t-1}$ is the number of unique products associated with seller s on the previous day. For the seller-scale heterogeneity models, seller scale is computed as the lagged logged number of observed seller products and then median-centered in the estimation sample before interaction with sponsored visibility. The sponsored coefficient therefore represents the sponsored-visibility association at the median seller-scale level. Marginal associations in Fig. 4 are calculated as $\beta_{\text{Sponsored}} + \beta_{\text{Interaction}} \times \left(P_q - P_{50}\right)$, where P_q is the uncentered seller-scale percentile and P_{50} is the sample median.

The lagged measure reduces simultaneity concerns between current sponsorship and current seller visibility.

Seller visibility share is defined as:

$$SellerVisibilityShare_{skct} = \frac{VisibleProducts_{skct}}{\sum_{s} VisibleProducts_{skct}}$$

where $VisibleProducts_{skct}$ is the number of visible product appearances associated with seller s for keyword k, country marketplace c, and day t. Seller-level visibility concentration is then measured using the Herfindahl-Hirschman Index (Rhoades, 1993):

$$HHI_{kct} = \sum_{s} SellerVisibilityShare^2_{skct}$$

Higher HHI values indicate that visible search positions are concentrated among fewer sellers. For the event-study analysis, $SponsoredStart_{ikc}$ denotes the first day on which product i appears as sponsored for keyword k in country marketplace c. Event time is defined as:

$$EventTime_{ikct} = t - SponsoredStart_{ikc}$$

The event-study compares visibility before and after the first observed sponsored appearance. Always-sponsored units lack a pre-entry period and never-sponsored units do not identify event-time coefficients, although both remain in the baseline fixed-effects models when they meet the sample criteria. This design distinguishes focal sponsored entry from the broader sponsored-density environment.

6. Empirical strategy

Sponsored visibility is not randomly assigned: sellers may sponsor products with stronger demand potential, better prices, higher ratings, larger review bases, or higher expected profitability. The empirical strategy therefore relies on within-product variation within the same keyword-country market while absorbing contemporaneous keyword-country-day conditions. These specifications reduce confounding from stable product, seller, and search-market differences but do not eliminate endogeneity, since time-varying demand expectations, campaign decisions, seller capability, platform ranking changes, or campaign optimization may affect both sponsorship and visibility (Wooldridge, 2010; Angrist and Pischke, 2009). The estimates are therefore interpreted as conditional within-product associations rather than causal treatment effects, and the event study assesses timing and pre-entry patterns rather than exogenous assignment.

The baseline specification relates sponsored status to marketplace visibility:

$$Visibility_{ikct} = \beta_1 Sponsored_{ikct} + X'_{ikc,t-1}\theta + \mu_{ikc} + \lambda_{kct} + \varepsilon_{ikct}.$$

Here, i denotes the product, k the keyword, c the country marketplace, and t the day. $Visibility_{ikct}$ is measured using the inverse-rank score and, in alternative specifications, top-position indicators such as $Top10_{ikct}$ and $Top20_{ikct}$. $Sponsored_{ikct}$ equals one when the product appears with a sponsored label for the relevant keyword, country, and day. $X_{ikc,t-1}$ includes lagged product-level controls, including relative price, rating, logged review count, availability, fast delivery, and marketplace badges. Lagged controls reduce concerns that the model conditions on variables affected by current sponsored placement.

The fixed-effect structure is central to the design. Product-keyword-country fixed effects, μ_{ikc}, absorb stable differences across products within search markets, including baseline relevance, brand strength, persistent product quality, and time-invariant seller characteristics. Keyword-country-day fixed effects, λ_{kct}, absorb conditions shared by products competing in the same search environment on the same day, including demand shocks, seasonality, country-market conditions, search-result composition, and marketplace-wide advertising intensity. The coefficient β_1 is therefore identified from changes in sponsored status for the same product within the same keyword-country market, relative to products observed in the same keyword-country-day environment.

To test whether organic signals have weaker visibility associations in more advertising-intensive search environments, the analysis interacts organic marketplace signals with sponsored density:

$$Visibility_{ikct} = \sum_{m} \beta_m QualitySignal^{m}_{ikc,t-1} + \sum_{m} \phi_m \Big(QualitySignal^{m}_{ikc,t-1} \times SponsoredDensity_{kct} \Big) + \beta_1 Sponsored_{ikct} + W'_{ikc,t-1}\theta + \mu_{ikc} + \lambda_{kct} + \varepsilon_{ikct}.$$

$QualitySignal^{m}_{ikc,t-1}$ includes lagged rating, logged review volume, relative price, fast delivery, and marketplace badges. $W_{ikc,t-1}$ includes additional lagged controls not already captured among the organic signals. Since keyword-country-day fixed effects absorb the main effect of $SponsoredDensity_{kct}$, the coefficients of interest are ϕ_m. Negative interactions for ratings, reviews, fast delivery, and badges indicate that these signals are less strongly associated with visibility when sponsored density is higher. A positive interaction for relative price indicates that the visibility penalty for higher prices is weaker in more advertising-intensive search markets.

Changes around sponsored entry are examined using an event-study centered on the first transition from non-sponsored to sponsored status after at least seven consecutive prior non-sponsored days for the same product–keyword–country unit.

$$Y_{ikct} = \sum_{\substack{r=-R \\ r \neq -1}}^{R} \beta_r \mathbf{1}(t - T_{ikc} = r) + X'_{ikc,t-1}\theta + \mu_{ikc} + \lambda_{kct} + \varepsilon_{ikct}.$$

T_{ikc} is the first sponsored-entry day, and r indexes days relative to that transition. The period $r = -1$ is omitted as the reference category. Y_{ikct} represents marketplace visibility, top-position indicators, ranking persistence, or review growth. This specification assesses whether treated products show upward visibility trends before sponsorship and whether sponsored entry is followed by changes in marketplace outcomes. The design follows event-time specifications for evaluating dy-

namic patterns around treatment timing (Autor, 2003; Sun and Abraham, 2021). It is not interpreted as randomized treatment evidence. The absence of detectable pre-entry trends reduces one concern but cannot rule out time-varying selection, campaign optimization, or platform algorithmic changes around sponsored entry. As a robustness check, the event-study is also estimated using not-yet-treated product-keyword-country units as the comparison group.

The analysis then tests whether sponsored visibility has stronger associations for larger sellers:

$$Y_{ikct} = \beta_1 Sponsored_{ikct} + \beta_2 \left(Sponsored_{ikct} \times SellerScale_{sc,t-1}\right) + \beta_3 SellerScale_{sc,t-1} + X'_{ikc,t-1}\theta + \mu_{ikc} + \lambda_{kct} + \varepsilon_{ikct}.$$

$SellerScale_{sc,t-1}$ is measured using the lagged logged number of observed products associated with seller s in country marketplace c, with seller visibility share used as an alternative measure. A positive β_2 indicates that sponsored visibility has a stronger association with marketplace outcomes for larger sellers. In these models, seller scale is the lagged logged seller-product count, median-centered before interaction with sponsored status. The marginal association at a given percentile is calculated as $\beta_1 + \beta_2 \times (P_q - P_{50})$, where Pq is the uncentered seller-scale percentile and P_{50} is the sample median.

To examine seller-level concentration in marketplace attention, the analysis moves to the keyword-country-day level:

$$HHI_{kct} = \beta_1 SponsoredDensity_{kct} + Z'_{kct}\theta + \eta_{kc} + \tau_t + \varepsilon_{kct}.$$

HHI_{kct} captures seller-level visibility concentration within a keyword-country-day market. η_{kc} denotes keyword-country fixed effects, and τ_t denotes day fixed effects. Z_{kct} includes market-level controls such as the number of unique sellers, average rating, average logged review volume, relative price dispersion, the share of fast-delivery products, the share of badged products, and category composition. These models are interpreted as market-level associations rather than causal estimates.

The cross-country analysis examines whether sponsored-visibility associations differ across Amazon US, Amazon UK, and Amazon Germany. Country-specific sponsored effects are estimated as:

$$Y_{ikct} = \sum_{g \in \{US,UK,DE\}} \beta_g \left(Sponsored_{ikct} \times Country_g\right) + X'_{ikc,t-1}\theta + \mu_{ikc} + \lambda_{kct} + \varepsilon_{ikct}.$$

$Country_g$ is an indicator for marketplace g. The coefficients β_g report country-specific sponsored-visibility associations. Additional specifications allow the sponsored-density mechanism to vary by country:

$$\begin{aligned} Visibility_{ikct} = {} & \sum_m \beta_m QualitySignal^m_{ikc,t-1} \\ & + \sum_{g \in \{US,UK,DE\}} \sum_m \phi_{gm} \Big(QualitySignal^m_{ikc,t-1} \\ & \times SponsoredDensity_{kct} \times Country_g\Big) \\ & + \sum_{g \in \{US,UK,DE\}} \delta_g \Big(Sponsored_{ikct} \times Country_g\Big) + W'_{ikc,t-1}\theta + \mu_{ikc} \\ & + \lambda_{kct} + \varepsilon_{ikct}. \end{aligned}$$

These estimates assess cross-market variation rather than country-level causal effects. Product-level models cluster standard errors at the product–keyword–country level, with two-way clustering used in robustness checks (Cameron and Miller, 2015). Linear fixed-effects and linear probability models are used for interpretability, with nonlinear alternatives reported as robustness checks (Angrist and Pischke, 2009).

7. Results

7.1. Sponsored visibility and marketplace visibility

Table 3 presents the baseline estimates. Models 1–4 use inverse-rank visibility, while Models 5–6 estimate Top 10 and Top 20 placement to assess whether the results are robust to threshold-based measures of ranked visibility. All models include lagged controls and increasingly restrictive fixed effects. Sponsored visibility is positive and statistically significant across specifications (see Fig. 1). In the preferred model, with product–keyword–country and keyword–country–day fixed effects, the coefficient is 0.0187 ($p < .001$). The estimate comes from within-product changes in sponsored status relative to contemporaneous competitors in the same search market. Relative to the mean visibility score of 0.0897, the coefficient represents about 20.8% of average visible-rank exposure. The Top 10 estimate is also meaningful because it raises first-page placement from the sample baseline of 20.0% to about 25.9%, conditional on the model structure. Sponsored visibility is also associated with a 5.94 percentage-point higher probability of Top 10 placement and an 8.37 percentage-point higher probability of Top 20 placement. The smaller coefficient under stricter fixed effects suggests that raw visibility differences partly reflect persistent product-market heterogeneity. The remaining association is consistent with H1 and indicates that sponsored placement carries a rank-based visibility advantage in marketplace search.

Table 3
Sponsored visibility and marketplace visibility.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Visibility	Visibility	Visibility	Visibility	Top 10	Top 20
Sponsored	0.0264***	0.0229***	0.0201***	0.0187***	0.0594***	0.0837***
	0.0013	0.0012	0.0011	0.0011	0.0046	0.0059
Relative price, lagged	−0.0058***	−0.0051***	−0.0047***	−0.0039***	−0.0148***	−0.0216***
	0.0005	0.0005	0.0004	0.0004	0.0019	0.0024
Rating, lagged	0.0128***	0.0109***	0.0084***	0.0069***	0.0217***	0.0302***
	0.0011	0.0010	0.0009	0.0008	0.0038	0.0047
Log reviews, lagged	0.0067***	0.0059***	0.0048***	0.0041***	0.0129***	0.0184***
	0.0003	0.0003	0.0003	0.0003	0.0011	0.0014
Fast delivery, lagged	0.0076***	0.0068***	0.0054***	0.0049***	0.0175***	0.0261***
	0.0007	0.0007	0.0006	0.0006	0.0023	0.0031
Badge, lagged	0.0159***	0.0142***	0.0128***	0.0117***	0.0386***	0.0524***
	0.0014	0.0013	0.0012	0.0011	0.0049	0.0062
Product–keyword–country FE	No	Yes	Yes	Yes	Yes	Yes
Keyword–country–day FE	No	No	Yes	Yes	Yes	Yes
Lagged product controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,482,650	1,482,650	1,482,650	1,482,650	1,482,650	1,482,650
Adjusted R^2	0.1842	0.3916	0.4728	0.4869	0.4382	0.4517

Notes. Standard errors clustered at the product–keyword–country level are reported in parentheses. Models 1 to 4 use inverse-rank visibility as the dependent variable. Models 5 and 6 are linear probability models for top-position outcomes. *p < .05, **p < .01, ***p < .001.

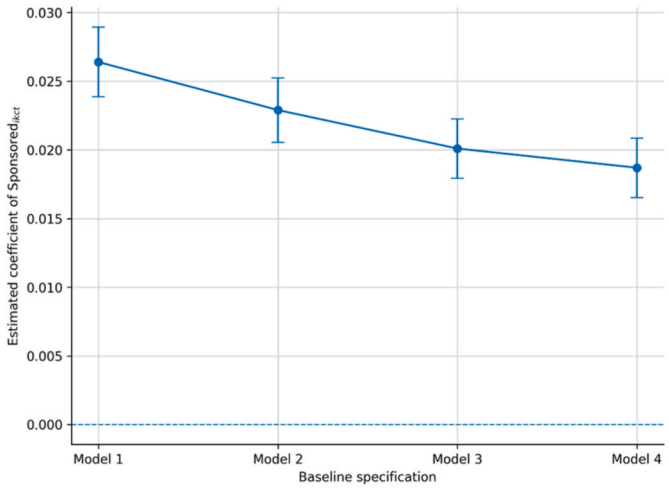


Fig. 1. Sponsored-visibility coefficients across baseline specifications.

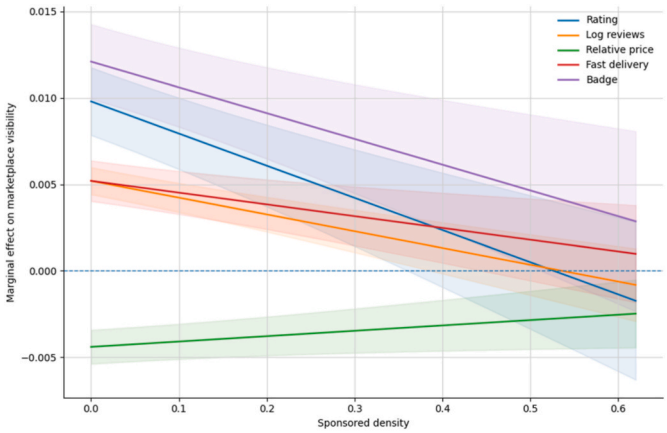


Fig. 2. Marginal effects of organic quality signals across sponsored-density levels.

7.2. Sponsored density and the weakening of organic quality signals

Table 4 evaluates whether sponsored-product density moderates the visibility value of organic marketplace signals. Because keyword–country–day fixed effects absorb the main effect of density, interpretation centers on the interaction terms.

Model 5 supports H2. Higher sponsored density attenuates the visibility returns to ratings, review volume, fast delivery, and marketplace badges. The rating interaction is negative and significant ($\beta = -0.0186$, $p < .001$), with the marginal effect falling from 0.0089 at density 0.05 to 0.0033 at density 0.35. Review volume shows similar attenuation ($\beta = -0.0097$, $p < .001$), declining from 0.0047 to 0.0018 across the same range.

Delivery and badge signals follow the same pattern. The interactions are negative for fast delivery ($\beta = -0.0068$, $p < .01$) and badges ($\beta = -0.0149$, $p < .001$). Price moves in the opposite direction: the positive interaction for relative price ($\beta = 0.0031$, $p < .05$) indicates a weaker visibility penalty for higher prices in advertising-intensive search markets. These estimates are consistent with H2 and indicate that organic signals retain value, but convert less strongly into visibility when sponsored density is higher. In proportional terms, the rating and review gradients decline by roughly 63% and 62% as sponsored density increases from 0.05 to 0.35. Fig. 2 reports the marginal effects.

7.3. Event-study evidence

Table 5 reports estimates around the first observed transition into sponsored status, using the day before entry as the reference period. Fig. 3 plots the event-time coefficients. The event-study specification identifies 42,386 first sponsored-entry events across 36,914 distinct products, 96 keywords, and three marketplaces. The event-study

Table 4
Sponsored density and the weakening of organic quality signals.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	Visibility	Visibility	Visibility	Visibility	Visibility
Sponsored	0.0185***	0.0181***	0.0183***	0.0180***	0.0179***
	0.0011	0.0011	0.0011	0.0011	0.0011
Rating, lagged	0.0107***				0.0098***
	0.0009				0.0010
Rating × Sponsored density	−0.0204***				−0.0186***
	0.0032				0.0034
Log reviews, lagged		0.0055***			0.0052***
		0.0003			0.0004
Log reviews × Sponsored density		−0.0106***			−0.0097***
		0.0015			0.0016
Relative price, lagged			−0.0046***		−0.0044***
			0.0005		0.0005
Relative price × Sponsored density			0.0037**		0.0031*
			0.0013		0.0014
Fast delivery, lagged				0.0056***	0.0052***
				0.0006	0.0006
Fast delivery × Sponsored density				−0.0075***	−0.0068**
				0.0020	0.0021
Badge, lagged				0.0127***	0.0121***
				0.0011	0.0011
Badge × Sponsored density				−0.0162***	−0.0149***
				0.0037	0.0039
Product–keyword–country FE	Yes	Yes	Yes	Yes	Yes
Keyword–country–day FE	Yes	Yes	Yes	Yes	Yes
Lagged controls	Yes	Yes	Yes	Yes	Yes
Observations	1,482,650	1,482,650	1,482,650	1,482,650	1,482,650
Adjusted R^2	0.4891	0.4904	0.4886	0.4912	0.4923

Notes. Clustered SEs at the product–keyword–country level are in parentheses. Seller scale is the lagged log product count in the relevant country marketplace, median-centered; the sponsored coefficient is evaluated at the median. *p < .05, **p < .01, ***p < .001.

Table 5
Event-study estimates around first sponsored appearance.

Event window	Visibility score	Top 10	Review growth
Days −30 to −15	−0.0014	−0.0031	0.0002
	0.0016	0.0042	0.0004
Days −14 to −8	−0.0008	−0.0017	0.0001
	0.0013	0.0038	0.0004
Days −7 to −2	0.0006	0.0024	0.0003
	0.0012	0.0035	0.0003
Days 0 to 7	0.0209***	0.0641***	0.0021***
	0.0015	0.0047	0.0005
Days 8 to 14	0.0163***	0.0516***	0.0018***
	0.0014	0.0045	0.0005
Days 15 to 30	0.0112***	0.0374***	0.0012**
	0.0013	0.0040	0.0004
Days 31 to 60	0.0067***	0.0219***	0.0007*
	0.0012	0.0036	0.0003
Product–keyword–country FE	Yes	Yes	Yes
Keyword–country–day FE	Yes	Yes	Yes
Lagged controls	Yes	Yes	Yes
Observations	1,482,650	1,482,650	1,204,318
Adjusted R^2	0.4937	0.4415	0.2148

Notes. Clustered standard errors at the product–keyword–country level are reported in parentheses. The omitted category is the day before first sponsored appearance. Event time is measured around the first observed transition after at least seven prior non-sponsored days. Observations are product–keyword–country–day records. *p < .05, **p < .01, ***p < .001.

specification identifies 42,386 first sponsored-entry events across 36,914 distinct products, 96 keywords, and three marketplaces. These events are distributed across the collection window, with 21.2% recorded in January, 24.8% in February, 27.4% in March, and 26.6% in April. Supplementary Table S18 reports the distribution by marketplace, product-category group, and calendar month.

Pre-entry coefficients are small and statistically indistinguishable from zero, providing no evidence that treated products were already moving upward before sponsorship. Visibility rises sharply at entry. During days 0–7, the visibility coefficient is 0.0209 ($p < .001$), while the Top 10 coefficient is 0.0641 ($p < .001$), implying a 6.41 percentage-point increase in first-page placement. The gain is largest immediately after entry and declines across later windows, although it remains positive through days 31–60.

Review-growth estimates are smaller and should be read conservatively because review growth is an indirect proxy for marketplace traction rather than sales. Still, the positive post-entry pattern through the first 30 days suggests a limited downstream response to greater search visibility. The event-study results indicate a sharp visibility increase around sponsored entry without detectable pre-entry improvement, but they remain consistent with strategic campaign timing, budget reallocation, or platform optimization around products expected to perform better.

7.4. Seller-scale heterogeneity

Table 6 tests whether sponsored visibility has stronger associations for larger sellers. Seller scale is measured as the lagged logged number of observed products linked to the seller in the relevant country marketplace. Fig. 4 reports marginal sponsored-visibility associations at the 25th, 50th, and 75th percentiles of the uncentered lagged log seller-scale distribution.

The sponsored visibility × seller scale interaction is positive and statistically significant across visibility, Top 10, Top 20, and review-growth outcomes. In the visibility model, the sponsored coefficient is 0.0123 ($p < .001$), and the interaction is 0.0049 ($p < .001$), with similar positive gradients for Top 10 and Top 20 placement. Because seller scale is median-centered, the sponsored coefficient reflects the median-seller

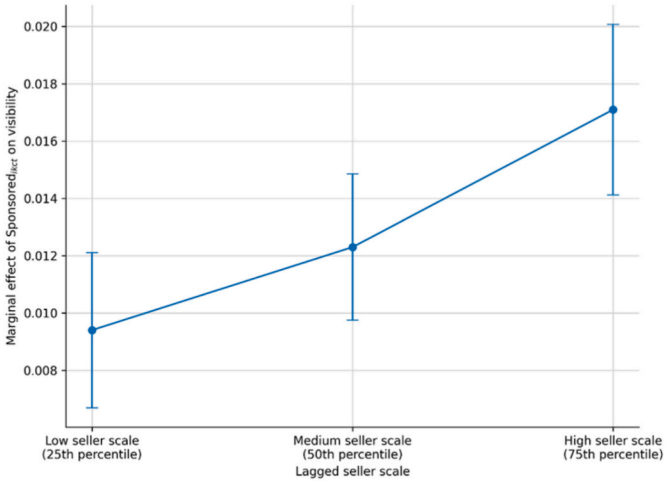


Fig. 4. Marginal association between sponsored visibility and marketplace visibility by seller scale.

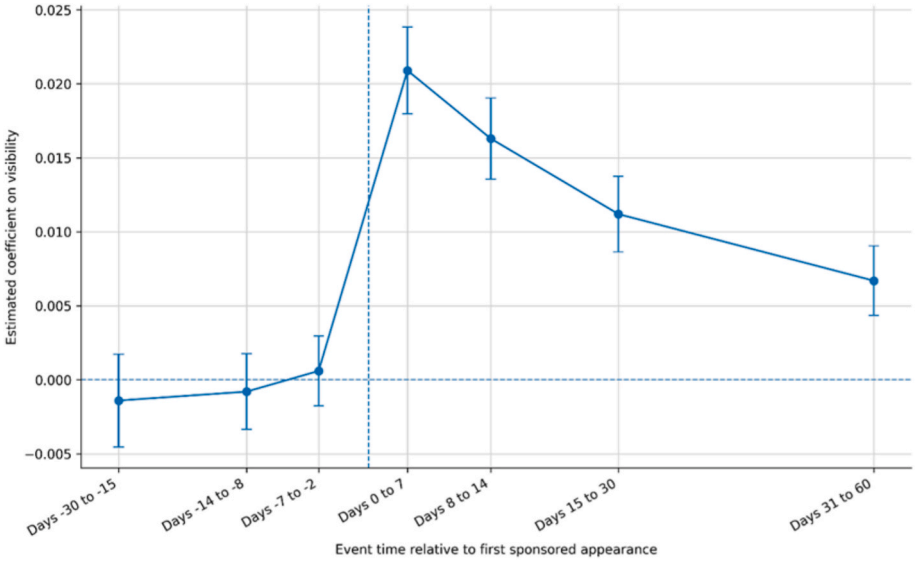


Fig. 3. Event-study estimates around first sponsored appearance.

Table 6
Seller-scale heterogeneity in sponsored-visibility associations.

Variable	Model 1	Model 2	Model 3	Model 4
	Visibility	Top 10	Top 20	Review growth
Sponsored	0.0123***	0.0386***	0.0548***	0.0009*
	0.0013	0.0045	0.0058	0.0004
Sponsored × Seller scale, lagged	0.0049***	0.0147***	0.0205***	0.0006**
	0.0008	0.0027	0.0034	0.0002
Seller scale, lagged	0.0021**	0.0062**	0.0088**	0.0003
	0.0007	0.0022	0.0030	0.0002
Relative price, lagged	Yes	Yes	Yes	Yes
Rating, lagged	Yes	Yes	Yes	Yes
Log reviews, lagged	Yes	Yes	Yes	Yes
Fast delivery, lagged	Yes	Yes	Yes	Yes
Badge, lagged	Yes	Yes	Yes	Yes
Product–keyword–country FE	Yes	Yes	Yes	Yes
Keyword–country–day FE	Yes	Yes	Yes	Yes
Observations	1,482,650	1,482,650	1,482,650	1,204,318
Adjusted R^2	0.4918	0.4382	0.4513	0.2116

Notes. Standard errors clustered at the product-keyword-country level are reported in parentheses. Seller scale is the lagged logged number of observed seller products and is median-centered before interaction with sponsored visibility. The sponsored coefficient is evaluated at the median seller scale. *p < .05, **p < .01, ***p < .001.

association. Using the uncentered 25th, 50th, and 75th percentiles in the centered interaction specification, the marginal association rises from 0.0094 at the 25th percentile to 0.0171 at the 75th percentile. These results support H3, suggesting that sponsorship is more visibility-enhancing for sellers with stronger complementary marketplace resources, while review-growth evidence is interpreted as marketplace traction rather than sales.

7.5. Sponsored density and visibility concentration

Table 7 tests whether advertising-intensive search markets exhibit higher seller-level visibility concentration. The analysis is conducted at the keyword–country–day level, with HHI as the main outcome. Higher HHI values indicate that visible search positions are concentrated among fewer sellers. Fig. 5 plots predicted concentration across sponsored-density levels.

Sponsored density is positive across all specifications. In the most restrictive model, with keyword–country and day fixed effects, the coefficient is 0.0368 (p < .001). A 0.10 increase in sponsored density implies a 0.0037 increase in HHI, equal to 8.8% of the mean HHI of 0.0418. In practical terms, this means that advertising-intensive search markets concentrate a larger share of visible positions among fewer sellers. The result remains stable when concentration is measured by largest-seller share or top-five seller share. These estimates are consistent with H4: advertising-intensive search markets are associated with less even allocation of visible attention across sellers, even after accounting for seller counts and observable search-result composition. The evidence reinforces the distinction between marketplace participation and practical discoverability.

7.6. Cross-country heterogeneity

Table 8 examines whether the sponsored-visibility association varies across Amazon US, Amazon UK, and Amazon Germany. Fig. 6 plots the country-specific estimates.

7.7. Robustness checks

This section evaluates the sensitivity of the main estimates to alternative visibility measures, nonlinear ranking specifications, sample

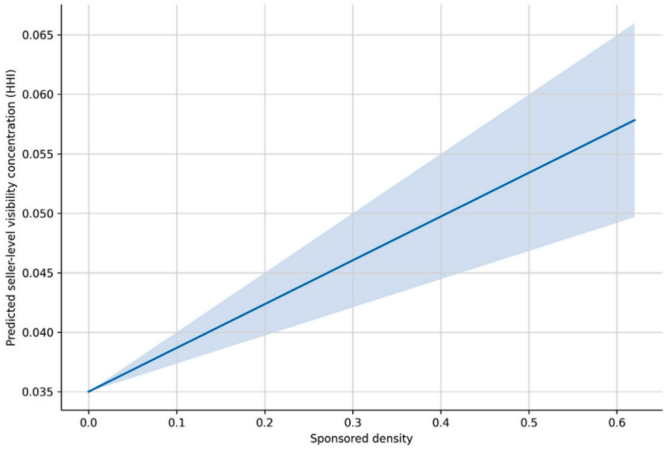


Fig. 5. Sponsored density and predicted seller-level visibility concentration.

Table 7
Sponsored density and seller-level visibility concentration.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	HHI	HHI	HHI	Largest seller share	Top-five seller share
Sponsored density	0.0529***	0.0437***	0.0368***	0.0416***	0.0739***
	0.0058	0.0062	0.0067	0.0089	0.0114
Number of unique sellers		−0.0004***	−0.0003***	−0.0005***	−0.0008***
		0.0001	0.0001	0.0001	0.0002
Average rating		−0.0039	−0.0041	−0.0063	−0.0098
		0.0031	0.0032	0.0047	0.0064
Average log reviews		0.0028*	0.0026*	0.0037*	0.0062*
		0.0011	0.0011	0.0018	0.0026
Relative price dispersion		0.0047**	0.0042*	0.0069*	0.0108*
		0.0016	0.0017	0.0031	0.0045
Share of fast-delivery products		0.0061**	0.0054*	0.0086*	0.0147*
		0.0022	0.0023	0.0041	0.0063
Share of badged products		0.0184***	0.0167***	0.0229***	0.0386***
		0.0043	0.0045	0.0068	0.0102
Keyword–country FE	No	Yes	Yes	Yes	Yes
Day FE	No	No	Yes	Yes	Yes
Observations	34,560	34,560	34,560	34,560	34,560
Adjusted R^2	0.2146	0.3298	0.3764	0.3517	0.3689

Notes. Standard errors, clustered at the keyword-country level, are in parentheses. The unit is the keyword-country-day market. HHI is the sum of squared seller visibility shares. Models 4 and 5 use alternative concentration outcomes. *p < .05, **p < .01, ***p < .001.

Table 8
Cross-country heterogeneity.

Panel A. *Sponsored visibility and marketplace visibility by country*		
Country marketplace	Sponsored association with visibility	SE
Amazon US	0.0221***	0.0017
Amazon UK	0.0174***	0.0015
Amazon Germany	0.0142***	0.0014

Panel B. *Sponsored density and weakening of organic quality signals by country*			
Interaction term	**Amazon US**	**Amazon UK**	**Amazon Germany**
Rating × Sponsored density	−0.0228***	−0.0172***	−0.0126**
	0.0039	0.0036	0.0041
Log reviews × Sponsored density	−0.0114***	−0.0091***	−0.0063**
	0.0019	0.0018	0.0021
Fast delivery × Sponsored density	−0.0081**	−0.0065**	−0.0042*
	0.0028	0.0025	0.0020
Badge × Sponsored density	−0.0187***	−0.0138**	−0.0095*
	0.0046	0.0044	0.0042
Product–keyword–country FE	Yes	Yes	Yes
Keyword–country–day FE	Yes	Yes	Yes
Lagged controls	Yes	Yes	Yes
Observations	604,820	461,390	416,440

Notes. Standard errors clustered at the product-keyword-country level are in parentheses. Panel A reports country-specific sponsored-visibility effects on inverse-rank visibility; Panel B reports sponsored-density interactions by country. *p < .05, **p < .01, ***p < .001.

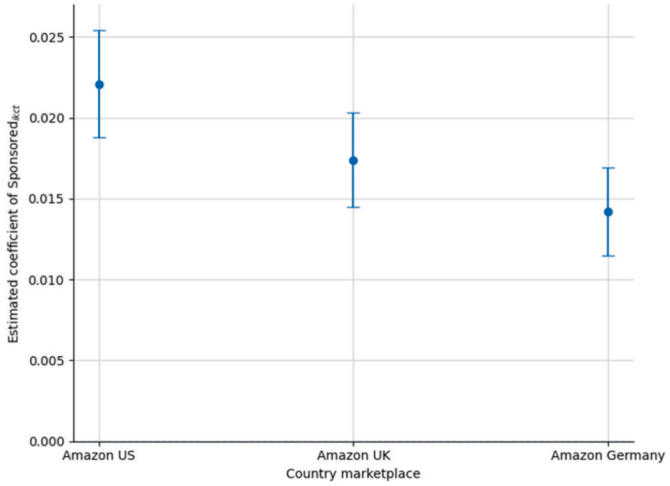


Fig. 6. Sponsored-visibility associations by country marketplace
Panel A shows positive associations in all three marketplaces. The coefficient is largest for Amazon US (β = 0.0221, p < .001), followed by Amazon UK (β = 0.0174, p < .001) and Amazon Germany (β = 0.0142, p < .001). This ordering mirrors the descriptive pattern in Table 2, where sponsored density is highest in the United States and lower in the United Kingdom and Germany.
Panel B shows that sponsored density weakens organic-signal visibility returns in each marketplace. The rating interaction is negative throughout, with the strongest estimate in Amazon US (β = −0.0228, p < .001), followed by Amazon UK (β = −0.0172, p < .001) and Amazon Germany (β = −0.0126, p < .01). Review volume, fast delivery, and badge interactions follow the same direction. These exploratory estimates suggest that the sponsored-density mechanism is more pronounced in advertising-intensive marketplace environments.

restrictions, clustering decisions, event-study assumptions, placebo tests, and category-level heterogeneity. Detailed results are reported in Supplementary Table S12–S17. Fig. 7 summarizes sponsored-visibility estimates across alternative specifications, and Fig. 8 reports placebo event-study estimates.

The sponsored-visibility coefficient remains positive and statistically significant across alternative clustering levels, fixed-effect structures, country omissions, visibility outcomes, and sample exclusions. The alternative visibility outcomes include Top 10, Top 20, and log-rank specifications, addressing the ordinal and nonlinear nature of search rankings. These exclusions remove Amazon-sold products, price outliers, high-review outliers, duplicate appearances, and intermittently unavailable products.

The sponsored-density mechanism remains stable across alternative density measures, including top-position, leave-one-out, lagged, and weekly average density. Event-study checks show no meaningful pre-entry trend, positive post-entry effects, and no comparable placebo effects. The concentration result also holds with alternative outcomes, sample exclusions, and lagged sponsored density.

Table 9 shows positive and statistically significant sponsored-visibility estimates across all six product-category groups, suggesting that the baseline association is not category-specific.

8. Discussion

The findings support the signal-conversion account of marketplace search. Sponsored placement is associated with higher visibility because it creates a paid route into scarce ranked positions. More importantly, sponsored density changes the surrounding conversion process: ratings, review volume, fast delivery, badges, and relative price continue to matter, yet their marginal visibility roles weaken when sponsored listings occupy a larger share of the interface. This pattern explains why paid visibility changes the informational function of rankings, rather than merely adding an advertising layer to search results.

This evidence reframes sponsored search in ranked marketplaces. Sponsored listings operate inside the interface where consumers infer relevance, quality, trust, and value, rather than as advertising units attached to it. Search results therefore function as a governance site because they determine which products become visible, which seller signals gain commercial force, and how rank-based visibility is distributed. This interpretation extends research on ranking and interface design as instruments of platform control (Degen and Gleiss, 2025), and connects to work on network-driven platform governance (Kari et al., 2025) and boundary-resource management in e-commerce ecosystems (Wulfert, 2023).

The findings extend sponsored-search and retail-media research by shifting the unit of explanation from advertiser response to marketplace signal conversion. Prior work shows that sponsored product listings affect seller outcomes (Joo et al., 2024), sponsored advertising interacts with private-label and self-preferencing dynamics (Long and Amaldoss, 2024), and retail media can affect marketplace outcomes beyond the focal advertiser (Abhishek et al., 2025). This study adds that

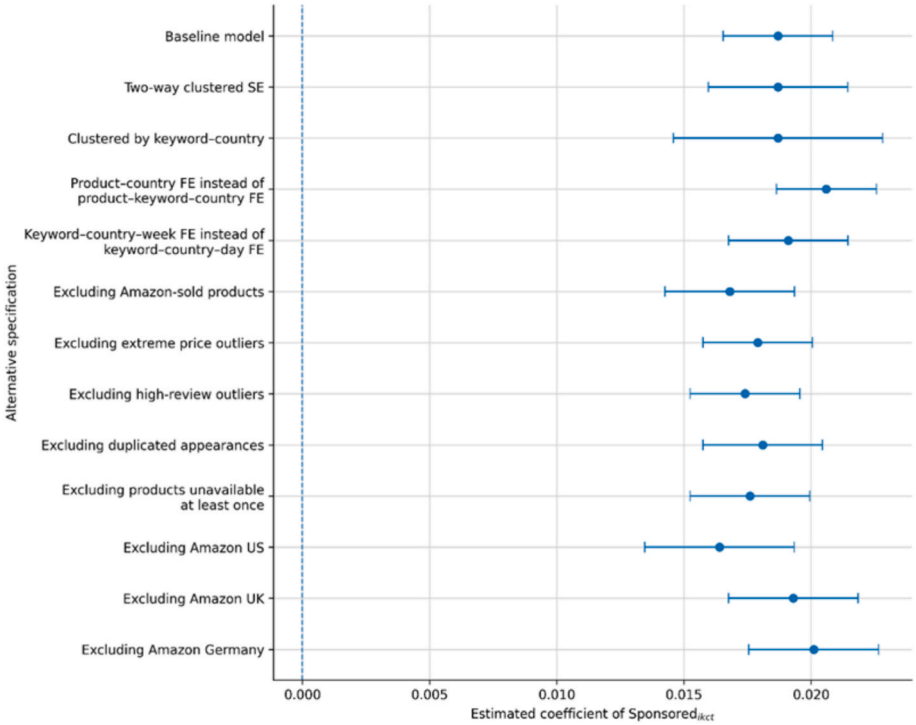


Fig. 7. Robustness of sponsored-visibility estimates across alternative specifications.

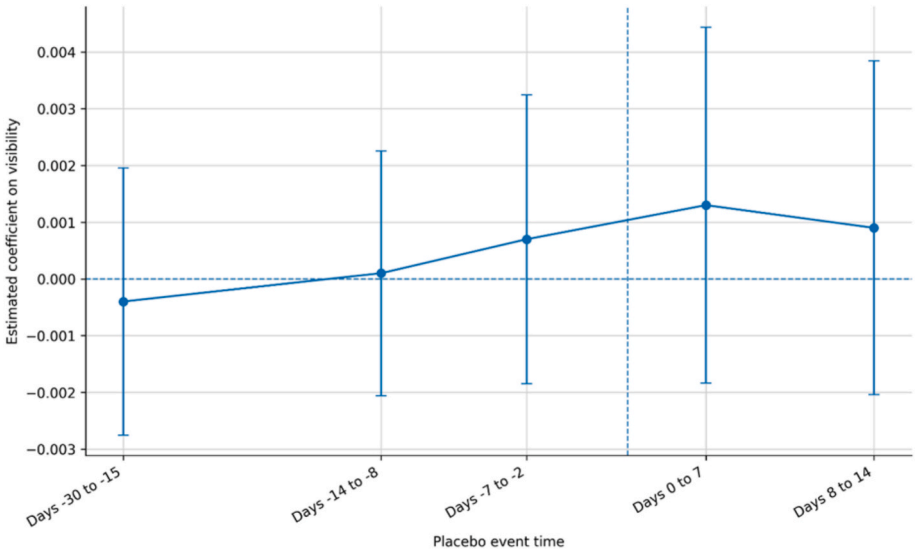


Fig. 8. Placebo event-study estimates.

Table 9
Category-level heterogeneity in sponsored-visibility associations.

Product category	Mean sponsored density	Sponsored association with visibility	SE	Sponsored association with Top 10	SE	Observations
Electronics accessories	0.2106	0.0226***	0.0021	0.0712***	0.0080	302,540
Home and kitchen	0.1791	0.0179***	0.0019	0.0563***	0.0071	287,689
Beauty and personal care	0.1987	0.0208***	0.0022	0.0667***	0.0085	241,861
Office products	0.1694	0.0161***	0.0018	0.0524***	0.0070	232,430
Sports and outdoor products	0.1562	0.0154***	0.0022	0.0489***	0.0083	206,782
Small household items	0.1832	0.0186***	0.0021	0.0586***	0.0079	211,348

Notes. Standard errors are clustered at the product–keyword–country level. All models include product–keyword–country fixed effects, keyword–country–day fixed effects, and lagged product controls. The dependent variable is inverse-rank visibility in the visibility models and a Top 10 indicator in the Top 10 models. Top 10 coefficients are linear probability estimates and can be interpreted as percentage-point differences. *p < .05, **p < .01, ***p < .001.

advertising-intensive search environments change the visibility value of organic signals. When sponsored density is high, prominent placement reflects marketplace performance, paid access, and platform control over rank-based discoverability.

The seller-level findings show that sponsored visibility is distributional as well as positional. Larger sellers receive stronger visibility returns from sponsorship because paid exposure is reinforced by assortment breadth, fulfillment capacity, reputation, content quality, and advertising capacity. This helps explain the concentration result: when sponsored density rises, sellers with stronger complementary resources are better positioned to convert paid placement into visible rank positions. Platform openness should therefore not be equated with competitive access: access describes the ability to list, while discoverability describes the ability to be seen.

8.1. Managerial and policy implications

The signal-conversion account yields three practical implications. First, sponsored density should be monitored as an interface-level design parameter because it changes how organic cues become visible placement. Because higher sponsored density is associated with weaker visibility returns from ratings, reviews, fast delivery, badges, and relative price, ad load should be evaluated alongside organic-signal visibility and seller-level concentration.

Second, the seller-level findings suggest that sponsored placement should not be treated as a substitute for organic marketplace capability. Larger sellers exhibit stronger associations between sponsorship and visibility, indicating that paid placement is more effective when combined with complementary resources such as assortment breadth, fulfillment capacity, accumulated reputation, product content quality, and advertising capacity. For sellers, especially smaller sellers, the implication is that retail-media spending is likely to be more effective when coordinated with improvements in price competitiveness, delivery reliability, review generation, and listing quality.

Third, the transparency implications extend beyond the individual sponsored label. A label identifies a paid listing, but it does not show the sponsored share of the visible interface, the persistence of paid placements, or the concentration of visibility across sellers. The evidence suggests that sponsored density and seller-level visibility concentration are relevant metrics for evaluating marketplace transparency. The study does not estimate consumer welfare, legal harm, anticompetitive intent, or individual-level consumer behavior; its practical contribution is to show that advertising-intensive search environments are associated with weaker organic-signal visibility and greater concentration of consumer-facing seller visibility.

The cross-country results add a practical boundary condition. Sponsored visibility is positive in all three marketplaces, but the association is largest in the United States, where sponsored density is highest. Organic-signal attenuation follows the same pattern. These exploratory results suggest that sponsored density should be monitored at the keyword, category, and country levels, especially in more advertising-intensive environments.

9. Limitations and future research

Several limitations qualify the findings. First, the data cover the first 50 search results for 96 harmonized purchase-oriented keywords in each keyword-country-day market. This captures consumer-facing visibility rather than the full Amazon catalog or all possible Amazon search queries. The keywords span multiple product categories and were validated for cross-country comparability, but the sample should not be interpreted as representative of all Amazon searches. Future research could link search-result data to catalog-level coverage or broader query samples to examine how products enter the visible search space.

Second, the analysis relies on publicly observable marketplace information and does not include bids, budgets, impressions, clicks, conversions, sales, or individual-level consumer attention. Displayed ranking visibility is therefore interpreted as a consumer-facing precondition for attention, not as direct evidence of clicks, consideration, purchases, or consumer behavior. Review growth is therefore interpreted as a proxy for marketplace traction rather than a sales measure. Access to advertiser dashboards, clickstream records, or transaction data would allow closer analysis of the pathway from sponsored exposure to consumer response.

Third, sponsored visibility is not randomly assigned. Sponsorship decisions may reflect expected demand, seller capability, campaign optimization, platform ranking changes, or other time-varying factors that are not fully observed. Product–keyword–country fixed effects, keyword–country–day fixed effects, lagged controls, event-study estimates, placebo checks, and robustness tests reduce several concerns, but they cannot rule out anticipatory seller behavior, campaign learning, budget shifts, platform-side optimization, or other time-varying selection. The estimates should therefore be read as conditional associations. Future studies could exploit changes in sponsored-listing formats, advertising prices, disclosure rules, or interface design to strengthen identification.

Fourth, marketplace interfaces are dynamic and may evolve during data collection. The protocol holds observed browsing conditions constant and validates extracted fields against displayed search-result pages, but unobserved platform-side interface changes, experimentation, or ranking updates cannot be fully ruled out. The findings should therefore be interpreted as evidence from standardized, non-logged-in, fixed-location search sessions rather than from all possible personalized user experiences.

Finally, the evidence is limited to Amazon US, UK, and Germany. The mechanism should travel most clearly to marketplaces where sponsored products appear inside ranked organic lists, while it may be weaker where ads are separated, search is less central, or disclosure is more prominent. Future research should test these boundary conditions across other marketplaces, platform-owned products, private-label settings, personalization regimes, and consumer-trust outcomes.

Consent to participate

Not applicable.

Ethics approval

Not applicable. This study uses publicly displayed product- and seller-level marketplace information and does not involve human participants, consumer-level data, or personally identifiable information.

Consent for publication

Not applicable.

Code availability

The code used for data cleaning, variable construction, estimation, robustness checks, and figure/table generation is documented in Supplementary Material. Code files are not submitted as supplementary files but are available upon reasonable request.

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Declaration of competing interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jretconser.2026.104987.

Data availability

The data used in this study were collected from publicly displayed marketplace search results. The data-collection protocol, keyword harmonization procedure, sponsored-label coding rules, cleaning decisions, audit checks, and reproducibility materials are documented in Supplementary Material. Product-level analytical data and raw HTML or screenshot files are not publicly shared because of platform terms, file size, and audit constraints. Aggregated materials and additional documentation are available from the author upon reasonable request.

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