Competition, Contracts, and Creativity: Evidence from Novel Writing in a Platform Market

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Abstract

We examine how competition affects worker effort and creative outcomes under different incentive structures on a Chinese online novel-writing platform. Authors produce and sell their works chapter-by-chapter under a revenue-sharing or pay-by-the-word contract with the platform. Exploiting an anti-pornography regulation that induced a massive entry of romance novels but not others, we find that intensified competition on average led authors to produce content faster while the effect on book novelty was weak. However, revenue-sharing books responded substantially more than pay-by-the-word books, particularly regarding novelty. Finally, the platform increased promotion of contracted books and this increase disproportionately favored pay-by-the-word books.

1 Introduction

In creative production such as entertainment, arts, design, and software development, workers' efforts that lead to product innovation are crucial for consumer welfare and industrial dynamics. A key concern is that workers may not exert sufficient creative effort when provided incentives are insufficient. Starting from Hicks (1935), one Darwinian view posits that this concern is not important in a highly competitive environment, because product market competition will discipline organizational slack and individual inactivity (e.g., Leibenstein 1966; Machlup 1967; Hart 1983; Nickell 1996). However, following Schumpeter (1942), some other economists argue that increased competition may discourage creative (or innovative) effort if competition destroys the rent that inspires the exertion of this effort (e.g., Schmidt 1997; Aghion et al. 2001, 2005; Vives 2008). Moreover, theoretical studies have suggested

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that the effect of competition on individual behavior depends on the contractual relationship between the worker and the organization (Jensen and Meckling 1976; Scharfstein 1988; Hermalin 1992; Raith 2003). Therefore, without detailed information on market conditions, organizational relationship, and worker activities, it is empirically challenging to address the question of whether and how market competition propels creative effort.

This question becomes more relevant nowadays because a large amount of creative activities have moved online (Waldfogel 2017; Liebowitz and Zentner 2018). Many producers leverage digital platforms such as YouTube (videos), the Apple AppStore and Google Play (apps and games), Kindle Direct Publishing (books), Coursera (education), and numerous other platforms to commercialize their creative work. However, because of low barriers to entry on these platforms, fierce competition among producers gives rise to a pronounced trade-off between rent-dissipation and competition-escaping. On one hand, the marginal cost of producing additional copies after the first one is near zero. Such a feature gives rise to rent whose size is determined by market demand (e.g., Rosen 1981; Caves 2000). This rent inspires workers to innovate but is vulnerable to market competition. On the other hand, the highly competitive environment encourages workers to increase efforts to escape competition. A clear understanding of this trade-off and the conditions under which competition stimulates creative activities is crucial to predicting the development of these online markets and to making regulatory policies in creative industries.

In this paper, we assemble a unique dataset on the daily writing activities of novelists who contracted with a Chinese online novel-writing platform. Exploiting an exogenous regulatory change that affected the entry of novels in some genres but not others, we estimate the causal effects of product competition on novelists' efforts to produce quantities and improve book novelty and the resulting performance of their books. We then examine the differential effect of competition under two types of incentive contracts: revenue-sharing and fixed-price (pay-by-the-word) in a sample where the assignment of contracts to authors mimics a random assignment.

The Chinese online novel-writing business is a multibillion-dollar industry with over 300 million users and more than one million novelists (CNNIC 2017). As one of the top ten websites in the industry, the platform under study matched more than 10,000 writers of commercial novels to millions of readers during the period of our study (2013-2015). Authors publish their books chapter-by-chapter, and readers purchase the book chapters at a fixed unit price determined by the platform. An author can sign a revenue-sharing contract with the platform and tie her income to the market performance of her work, as J.K. Rowling did when she collected royalties for her Harry Potter series. Alternatively, an author can sign a fixed-price contract and get paid by the word as Charles Dickens did when he serialized his novels in newspapers.

One major innovation in our study is that we are able to measure detailed workers' activities other than performance (reader clicks and purchases). Specifically, we measure an

author's routine effort by the word count and frequency of updates of a book per month. This expansion of quantities enables an author to compete for readers who generally dislike reading novels that have short chapters and are infrequently updated. We also use the amount of bonus content offered by an author to capture her intention to reduce the effective price of her works. Importantly, we measure book novelty based on nearly one million review posts written by readers. We classify these posts using two approaches: (1) search of key words relating to novelty/creativity and (2) supervised machine-learning. We then construct monthly measures of book novelty to capture an author's exertion of creative effort. Furthermore, to separate the effects of the platform's influence and authors' efforts on book performance, we measure the platform's promotion (book recommendation) exploiting information on hundreds of thousands of archived web pages of the platform.

Identifying the causal effect of competition is notoriously difficult because competition is often an endogenous outcome. To address this identification issue, we leverage a sudden change in internet regulation that exogenously intensified competition among a subset of authors on the platform. In April 2014, the Chinese government engineered a sweeping Web-Cleaning Campaign (WCC hereafter) to crack down on internet pornography. This campaign resulted in the shutdown of dozens of novel-writing platforms that specialized in romance novels, many of which contained pornographic content. After the launch of the WCC, authors who wrote on these closed platforms as well as many new authors flooded the platform under study. The number of romance novels that entered the platform during the WCC nearly tripled, while the number of books in other genres (e.g., science fiction and mystery novels) increased only modestly. On the demand side, data provided by the platform show that the traffic (measured by daily user volume) on the website changed little after the WCC, suggesting that readers of the closed platforms did not switch to reading non-salacious content. We thus take a difference-in-differences (DID) approach to estimate the effect of competition on the treated group (romance) relative to the control group (others). The absence of pre-trends in all outcome variables lends strong support to the validity of this approach. We control for book fixed effects to focus on books that were contracted before the WCC. We also include category-specific time trends to strengthen the DID estimation. Standard errors are clustered by category and bootstrapped using methods that are suitable for a small number of clusters.

We then estimate the differential effects of increased competition on our outcome measures under the two contractual formats. Specifically, we estimate a triple-differences specification with an interaction between the WCC dummy, the treatment dummy, and the contractual format dummy. The identification challenge here is to isolate the contractual effect from a selection bias caused by unobserved author and book characteristics that may drive contractual choices. To circumvent this challenge, we construct a subsample of books whose contractual choices can be treated as randomly assigned by the platform. According to our interviews with the company, the platform tended to offer low prices to some unknown books

in order to buy them out early. Because little information can be used to estimate the market potential of books by unknown authors in the early stage, these low-cost offers were described as "betting on the promising." Given their negligible bargaining power, nearly all unknown authors who received such offers accepted them. Therefore, we restrict attention to the books by authors who were unknown to the market and had no previous contracting experience. In this arguably random sample, the pre-contracting characteristics between revenue-sharing and fixed-price books are well balanced.

The above procedures generate three sets of findings. First, the DID estimates show that in response to intensified competition, authors substantially increased their routine efforts: at the monthly level, the number of characters nearly doubled, the number of chapters increased by 28%, and the amount of bonus content increased by 70%. The effect of competition on book novelty, however, is small in magnitude and statistically insignificant. These findings are consistent with a theoretical argument that competition spurs worker effort if the business-stealing (or competition-escaping) effect dominates the market-erosion effect induced by the entry of new products. In the current setting, authors were neck-and-neck, and the pressure to escape market competition was enormous. Despite the fact that the entry of new books eroded the market share of existing books, authors were still willing to exert more efforts in order to steal business from competitors and prevent business from being stolen. The weak effect of competition on book novelty is primarily caused by the fixed-price authors' lack of response to competition, as discussed below.

Second, the triple-differences estimates show that intensified competition increased the novelty and quantities of revenue-sharing books substantially more than those of fixed-price books. In fact, the effects on fixed-price books are insignificant, while the effects of revenue-sharing books are positive and statistically significant. These findings suggest that authors under the fixed-price contract were immune from competition and did not respond to changes in the market environment, whereas the revenue-sharing contract provided strong incentives to elicit greater author efforts, both routine and creative.

The third set of findings concerns the effect of competition on book performance and platform promotion. We find that intensified competition increased reader purchases of contracted books by almost 40%. Surprisingly, the triple-differences estimates show that both reader clicks and purchases of fixed-price books increased considerably more than those of revenue-sharing books, even though the previous finding shows that revenue-sharing authors exerted significantly more efforts than fixed-price authors.

To reconcile these results, we investigate the platform's response to intensified competition. We find that the platform increased its promotion of the contracted books by nearly 20% after the WCC, and that this increase in promotion was disproportionately in favor of fixed-price books, resulting in significant increases in their market performance. The shift in platform promotion can be explained as follows. The massive entry of books reduced the platform's need to attract potential upcoming authors by promoting new (free) books.

The platform thus reallocated more of its promotional resources to existing contracted books. The platform's disproportionate promotion of fixed-price books was driven by the contractual arrangement that stipulates the platform as the sole residual claimant.

Our paper makes a unique contribution to the long-standing economic inquiry of the relationship between market competition and organizational inefficiency. Although numerous business cases and a number of firm-level studies (Nickell 1996; Blundell et al. 1999; Bloom and Van Reenen 2007; Bloom et al. 2015) have suggested the importance of competition in affecting managerial practices and firm performance, rigorous evidence on individual behavior is lacking. Based on detailed personnel data on worker actions along multiple dimensions, we articulate the effects of competition on inducing workers' different types of efforts (routine or creative) and show how the effects are limited by the structure of the incentives provided to workers.

This paper also contributes to the empirical studies of how the design of incentive structure affects worker behavior in personnel economics. Existing studies have shown that the effects of incentive contracts depend upon task attributes and worker characteristics (Lazear 2000; Bandiera et al. 2005; Azoulay et al. 2011; Gneezy et al. 2011; Ederer and Manso 2013; Calvo et al. 2018). A strand of recent research explores the interaction between incentive structures and social mechanisms within the workplaces (Mas and Moretti 2009; Bandiera et al. 2007, 2009, 2010). Our study shifts this focus from factors inside the organization to factors outside the organization, with market competition being the foremost external force. Particularly, we show that market competition enhances the ability of performance-based incentive structures to motivate workers.

Because of the analogy between creative efforts and innovation investments, our study speaks to the vast literature that studies the relationship between competition and innovation (e.g., Cohen and Levin 1989; Vives 2008; Aghion et al. 2014). In the settings of manufacturing firms, existing studies stress that market competition affects innovation through the trade-off between escaping competition to survive and rent-dissipation due to the diminished market power. We extend this insight to individual-based innovative activities and in online market settings.[1] Furthermore, our study refines this insight by showing how organizational relationship moderates the effect of competition.

Finally, our paper relates to the burgeoning literature on platform economics.[2] Platform owners engage in contractual relationships with individual producers in many markets, such as the home video game industry and the daily local deal market. However, because of data limitations, few studies investigate the effects of contractual arrangements. Our paper provides some of the first evidence on the impact of contractual arrangements on the behavior of the contracting parties in a platform setting. Our finding on the platform's disprop ortionate

[1]Recent research on individual-based innovation includes Boudreau et al. (2016) on software development and Gross (2017) on commercial logo design. But they study contest-based competition instead of regular product market competition.

[2]See Rochet and Tirole (2006), Rysman (2009) and Levin (2013) for literature reviews.

promotion in favor of the paid-by-the-word books accords to several recent studies in which platform owners have incentives to be biased in their treatment of producers (e.g., Hagiu and Jullien 2011; De Corniere and Taylor 2014; Aguiar and Waldfogel 2018). It also echoes the literature that studies media bias (Reuter and Zitzewitz 2006; Sun and Zhu 2013; DellaVigna and Hermle 2017). In some extreme cases, platforms' biased treatment of their ecosystem participants have led to intervention from policy makers.[3]

The remainder of the paper is organized as follows. The next section depicts the empirical setting. Section 3 presents a theoretical framework. Section 4 describes the data, and Section 5 discusses the empirical strategy. Sections 6 and 7 are devoted to empirical analysis. Section 8 concludes the paper. A model that formulates the theoretical argument and additional empirical results are relegated to the online appendix.

2 Institutional Background

Since 2002, the Chinese online novel business has evolved into a multibillion-dollar industry. This entertainment business operates through platforms, which match authors of original novels and readers online. During our study period (2013-2015), ten leading platforms dominated the industry, all backed by technology giants in China such as Tencent, Baidu, and Alibaba (Jiang 2017). Our study focuses on one of these top platforms. Its business model is representative of the industry.

2.1 Business Model

The online novel platform provides a digital infrastructure for authors to post their works and for consumers to read books on computers or mobile devices. As a commitment to providing a clean production and reading environment, neither the platform nor the authors use advertising for income. Instead, the platform plays the role of a publisher: it charges readers and pays contracted authors. Thus, the revenues of the platform come from reader purchases of books that are contracted with the platform. As all other mainstream online novel platforms, the platform sets the same unit price per reader purchase for all books, which is RMB 1 cent (roughly ¢0.17) per 1,000 Chinese characters per view.[4] Readers purchase books by chapters. For instance, a reader pays RMB 3 cents to read a chapter of 3,000 characters. This uniform pricing strategy is implicitly agreed upon by platforms; it is sustainable because the price level is already very low.

The burgeoning online novel-writing business in China is driven by the growing popularity of online reading and the enormous demand for commercial writing.[5] A platform market

[3]For example, the European Union imposed a record-high fine on Google for favoring its own comparison-shopping service on its search engine in 2018.

[4]In Chinese, characters form the basic unit of meaning. Most Chinese words are formed by two or three characters.

[5]In the traditional Chinese publishing market, book publication is subject to strict regulation including

has the advantage of offering a huge variety of books to satisfy readers with heterogeneous preferences. A senior manager of the platform under study exclaimed, "We are a one-stop shop. Readers come and dwell. No need to go to other places."

The low entry cost in these platforms invites hundreds of thousands of aspiring novelists to enter the market. Although many authors are only writing part-time, they are very competent. Some authors produce national best-sellers and become millionaires within a few years. However, competition in this market is fierce. Hundreds of thousands of novels, distributed among ten big platforms and more than one hundred small platforms, compete for readership. Less than 20 percent of authors are ever contracted with platforms, and less than 10 percent of books can generate enough income for their authors to make a living. According to industry experts, each platform has a loyal readership, and reader multi-homing is not salient. Thus, product competition occurs mostly among books published on the same platform, where a typical book faces dozens of competing books on similar topics.

2.2 Production and Promotion

Online novel writing is mostly an individual activity; co-authorship is rare. Any potential author can approach the platform and propose an original book project with sample chapters. Once the platform reviews and approves the proposal, the author starts to post her works chapter by chapter on the site. After a trial period during which these chapters are free to view, the editorial team of the platform assesses the quality and popularity of the book project. If a book is recognized to have business potential, the platform will offer its author an "up-to-the-shelf" opportunity, whereby the author will sign a contract with and receive payment from the platform. Readers will then have to pay to read the following chapters.

As part of the contract, the book project's market position (category) is fixed. An author exerts two types of efforts to attract and maintain readership. First, she could write lengthier chapters and update more frequently. We see abundant compliments in readers' reviews when an author's writing exceeds the average level (two chapters or 6,000 characters per day), while readers leave negative comments and give up on books that do not have updates in consecutive days. An author may even offer bonus content—extra words free of charge—in each chapter. We refer to an author's effort to expand quantities as routine effort.

Second, to keep a loyal readership and entice new readers, an author needs to maintain and improve the novelty of her works. This is particularly true when a book is produced chapter-by-chapter. Although readers are fond of familiar stories, they want more than a recycled cliché across chapters within the same book. A talented author can start a book with a few attractive chapters. But if the author does not keep adding new features, readers' interest will wane. Conversely, a book stands out when its author can develop unexpected plots, add clever twists, build up suspense, write unanticipated cliffhangers, and creatively combine

quota and a long period of content examination by the government. By contrast, the regulation of online publication is much looser, and publication of an author's works is instantaneous.

elements from other artistic formats such as serious and folk literature, movie and television, and even talk shows. We refer to these novelty-enhancing efforts as creative efforts. Just like R&D investments, creative efforts involve uncertainty and do not always lead to improvement in novelty.

The platform engages in book production in two aspects. First, the platform assigns an editor to each book to perform quality control and screen socially or politically inappropriate content. In reality, the quality-control function is rather weak because an editor typically handles dozens of books at a time. Second, the platform can decide how to promote books on its web page. The front page of the platform website is the most visible space and a critical resource to help authors reach readers. Because of the space limit, the platform can only place a small subset of all available books on the front page. To find other books, readers need to click a specific book category to browse books or search the name of a specific book or author. The platform promotes contracted books and uncontracted new arrivals for different purposes. The promotion of contracted books is to increase readership, which determines the platform's revenues. In contrast, the promotion of new books is to discover promising books and to attract potential authors, and hence affects long-term growth of the platform.

2.3 Contracting and Incentive Structure

Contracting is the key stage for commercializing a book. After contracting with the platform, an author starts to collect income from the platform, but she must forfeit the right to publish the same book or similar books on other platforms within the contracting period (typically ten years). During this period, authors hand over the selling rights of their books to the platform, which sets the price, receives payments from readers, and decides on promotion.

All contracted books are under one of two types of contracts: revenue-sharing or fixed-price. The default contract is revenue-sharing, under which an author and the platform share the revenues generated by readers' purchases. The platform uses a 50:50 split rule, following the common practice in the industry. The other contractual format is fixed-price, under which an author is required to produce a minimum amount of content per month and receives a fixed payment for every thousand characters she publishes. This pay-by-the-word method has a long history in book publishing. One famous example is Charles Dickens who, under this type of contract, published his classics chapter-by-chapter in newspapers. Under the fixed-price contract, the platform buys out a book, and the pay of the author is independent of book purchases, whereas under the revenue-sharing contract, the platform forms a partnership with an author to share the revenue that is determined by the book's market performance.[6] Under either contract, the platform owns the right to terminate a book project if the author

[6]There are other differences between the two contracts regarding copyright and royalties when the books are published in print or turned into other products such as TV shows and video games. Additional contracts need to be signed to specify the division of copyright and royalties between the platform and the author. According to industry experts, less than 2% of the contracted books ever have a chance to generate derivative products.

fails to update the book regularly or meet the minimum quality standard.

From the platform's perspective, the fixed-price contract has two advantages. First, this contract guarantees the publication of a constant number of works to meet reader demand. Because of this, the platform offers a high price to buy out books written by a number of well-known authors. Second, when a fixed-price book has attracted a large audience, the platform has the right to claim all the residual incomes. This concern motives the platform to make fixed-price offers to some nascent authors.

To acquire potentially lucrative books without paying high prices, the platform often approaches unknown authors to make fixed-price offers because books by unknown authors are far cheaper than books by established authors. The platform regularly makes a number of low-price offers to upcoming authors. A senior manager explained this strategy: "Buying out future superstar books at a low price is the best deal. The problem is that it is extremely hard to predict the long-run market performance of a book if its author is not well-known. Even books that are welcomed by the market in the beginning may fizzle out later. If we wait until the book becomes popular, the price the author asks for will be a lot higher. So our strategy is to offer a low price to upcoming authors when their books are still in the early stages. This is like gambling, but the cost is low." This betting-on-the-promising strategy generates randomness in the selection of the fixed-price contracts among unknown authors. We will leverage such random selection to strengthen our identification strategy.

2.4 Web-Cleaning Campaign (WCC)

On April 13, 2014, the Chinese National Internet Control Office and the Central Department of Police jointly waged a campaign to crack down on pornography on the internet. Secretly planned by the central government agencies, this campaign was unexpected by the pubic, resulting in the sudden arrest of many writers who were involved in the production and dissemination of internet pornography and did not have enough time to self-correct. This web-cleaning campaign lasted until the end of November 2014 and had a profound impact on the online novel-writing market. Several notable platforms were fined for publishing novels with substantial pornographic content. More dramatically, dozens of platforms that specialized in publishing romance novels were shut down permanently. These platforms were accused of spreading pornographic content that was particularly harmful to young adults. As a result, authors of romance fiction who had been active on these platforms or who were new to the business had to seek opportunities on mainstream platforms with solid reputations, including the one under our study. We will provide more details about how this event created asymmetric shocks to the entry of books in different categories.

3 Theoretical Framework

In this section, we briefly describe a theoretical framework that fits the current context to guide the empirical investigation. A formal model is included in the appendix. Since in our empirical analysis, contracts are pre-determined before the policy shock, we focus on how workers (authors) respond to increased product competition (entry of new books) under a given contractual arrangement.

In the online novel-writing market, after a chapter is written, the marginal cost of serving an additional reader is zero. Hence, a book earns rent whose size depends on its readership. In the product space, a book can be characterized by its match with readers' taste and its quality. In a market of this kind, typically a producer can use three strategies to compete: (1) pricing, (2) market positioning, and (3) changing product attributes. In the current setting, the price mechanism is muted because the platform sets the same unit price of all books to readers. Moreover, we study contracted books whose market positions (category) are set as part of the contractual agreement. Therefore, we focus on the third strategy.

As described in Section 2.2, an author can change the attributes of an ongoing book project in two ways. First, an author can exert routine effort to increase the length of chapters and frequency of updates. This quantity-expansion strategy caters to readers' preferences for faster consumption. Second, an author can exert creative effort to improve the novelty of a book. Just as in any creative production, there is uncertainty regarding whether such creative effort leads to greater novelty.

With the above empirical background, consider a model in which a fixed number of readers choose books that match their tastes and have a level of novelty that at least meet their expectation. They also prefer books that have lengthier chapters and are updated more frequently. Each author writes one and only one book. Authors are homogeneous in their ability, and they work independently and simultaneously.

Consider authors under the revenue-sharing contract that relates the return to an author's effort closely to a book's market size. Thus, they trade off the benefit of attracting additional readers against the cost of exerting effort. Suppose that a mass of new books enter the market. Given the fixed demand we empirically observe, the entry of new books will erode the market share of each existing book because some readers may allocate their time from existing books to new books. Such market erosion diminishes the marginal return from quantity expansion and novelty improvement, thereby discouraging author efforts. This is the market-erosion effect or the rent-dissipation effect highlighted in the literature (e.g., Aghion et al. 2005; Vives 2008).

On the other hand, a revenue-sharing author may have incentives to exert greater effort for two reasons. First, without being able to produce content faster or improve novelty, a book faces a larger number of competitors that will steal more business from it. Thus, product entry increases the pressure for authors to escape competition. This is the escaping-competition effect in Aghion et al. (2005), which, in its extreme form, can result in the

liquidation of projects as in Schmidt (1997). Second, with more books available, readers may become more sensitive to the differences in quantity and novelty between books, resulting in a greater business-stealing effect when an author expands quantities or improves novelty. Such an enlarged business-stealing effect induced by intensified competition is analogous to the argument that lower prices lead to higher demand elasticity under some common demand structures (Raith 2003; Vives 2008). These two effects inspire authors to take actions to protect or even enlarge their market shares in a more competitive market environment.

Therefore, facing more intense market competition, a revenue-sharing author adjusts her routine and creative efforts, weighing the market-erosion (rent-dissipation) effect and the business-stealing (escaping-competition) effect. In general, the impact of intensified competition on author efforts is ambiguous depending on the comparison between these two effects. As shown in the theory appendix, under reasonable assumptions on the demand structure, the business-stealing effect would dominate. Empirically, books on the platform engage in a neck-and-neck race, and the pressure of escaping competition is large. Moreover, the new arrivals on average are unlikely to be more attractive than the existing books. Hence, the market-erosion effect is likely to be dominated by the business-stealing effect. Authors are thus likely to exert more efforts when competition intensifies.

The analysis for fixed-price authors is different. Under the fixed-price contract, authors are paid by the word, and are immune from changes in market conditions. As a result, intensified competition has no effect on their efforts, either routine or creative.

Our empirical setting also involves the platform's promotion of books. In a reduced form, platform promotion increases the demand for a book at the cost of foregoing the opportunities of promoting other books. In particular, when the platform promotes existing contracted books, it reduces the promotion of non-contracted new books. As discussed in Section 2.2, the platform's main purpose of promoting non-contracted books is to encourage future author participation and entry. When the number of new books increases, the need to encourage author participation decreases, implying a lower cost of promoting existing books. As a result, after competition intensifies, the platform reallocates promotion from non-contracted to contracted books. Furthermore, the platform, as the sole residual claimant of fixed-price books, has a strong incentive to allocate more promotion resources to these books.

Summing up the above analysis, we project the effects of increased competition in the following hypotheses, which are proved as propositions in the formal model in the appendix.

Hypothesis 1 ***(Average Effect of Competition)*** *The entry of new books leads to the following results: 1a) existing authors will increase routine effort to produce more content and update more frequently, 1b) existing authors will increase creative effort to improve the novelty of their works, and 1c) the platform will promote contracted books more intensively.*

Hypothesis 2 ***(Effects of Competition under Different Contracts)*** *The entry of new books leads to the following results: 2a) authors under the fixed-price contract increase neither routine nor creative effort; 2b) authors under the revenue-sharing contract increase both*

routine and creative efforts; 2c) the increase of the platform's promotion of contracted books disproportionately favors fixed-price books over revenue-sharing books.

4 Data

We assemble a dataset that combines detailed personnel information and a large amount of textual data. We scrape the information of books published on the platform website. For each book, we obtain the first 200 characters of every chapter and the corresponding reader comments.[7] We also obtain information about a book's category, key words describing the book, the start and end dates (if the book is finished), and the time when every chapter was uploaded to the platform. The platform provides data on all books (approximately 2,000) that were contracted during the period of 2013-2015. For each book, we obtain information on its contractual format, contracting time, and market outcomes.

4.1 Outcome Measures

One major data advantage of this study is that we are able to observe the production process and measure outcomes at the monthly level. The platform provides monthly observations on the numbers of reader clicks ($Clicks_{it}$) and purchases of chapters ($Purchases_{it}$) for each of the contracted books during the sample period. We also construct outcome variables regarding authors' efforts and platform promotion at the monthly level.

Quantity expansion (routine effort). We use two variables to measure the quantity dimension of effort: the number of characters ($Chars_{it}$) and the number of chapters ($Chapters_{it}$) produced by author i in month t. Moreover, we construct a variable that measures the amount of free content offered by authors to readers, exploiting the fact that the payment of each transaction is rounded to the thousand characters. That is, when an author publishes a chapter of $1000m + n$ characters, where m and n are integers ($m \geq 0$ and $0 \leq n < 1000$), readers only pay for the $1000m$ characters, and get the n extra characters for free. An author who internalizes this cost will minimize n. However, an author who want to please readers will increase n. Given the price for each $1,000$ characters is fixed, a larger n means a lower effective price that a reader pays per purchase. We calculate the number of extra characters per chapter and aggregate it to a monthly level, $Extra\ Char_{it}$, which measures an author's offering of bonus content as a way to reduce prices.

Novelty improvement (creative effort). It is genuinely difficult to measure a person's creative effort and the direct outcome (e.g., book novelty). To overcome this difficulty, we exploit the content of the reviews posted by readers for each book chapter.[8] Although many comments are short and emotional, lengthy reviews with critical opinions on the plot,

[7] For books under contracts, the platform gives readers free access to the first 200 characters of every chapter. Reader comments are organized by chapters.

[8] The platform does not use a star-rating system for the reviews. To express opinions, readers need to post their reviews to the discussion forum associated with each book.

characters, and writing are common. The review data scraped from the website consisted of approximately 1.2 million posts. After purging self-promotion or favoritism-exchange posts, we obtained a clean dataset of nearly one million review posts.[9] We use two approaches to classify these posts.

We first use a dictionary search (or "bag of words") approach. Based on a standard Chinese dictionary, we develop a list of Chinese words indicating "novel" or "lack of novelty."[10] A post is coded as 1 if it contains any of the "novel" words, as -1 if it contains any of the "lack of novelty" words, and as 0 if it contains none of these words.

We also use a machine-learning approach to classify the posts. Specifically, we trained two Chinese research assistants to be familiar with description about novelty or creativity (and the negation) in the context of novel writing. They were assigned several tasks to label small samples of posts independently until 90% of their labeling agreed with each other. Then they manually classified 20,000 posts that were randomly selected from the dataset into one of three categories: "novel," "lack of novelty," or "neutral." We used 10,000 posts as a training dataset to construct a Support Vector Machine (SVM), another 5,000 labeled posts as a test set, and the final 5,000 labeled posts for cross-validation. The accuracy rates in both the test data and the cross-validation data reached the level of 95%. We applied this SVM to classify the remaining posts.

For each approach, we aggregate the classified outcomes to the book-month level and compute the following variable: $\log(\#novelty + 1) - \log(\#lack\ of\ novelty + 1)$, where $\#novelty$ (or $\#lack\ of\ novelty$) is the number of posts that were classified as "novel" (or "lack of novelty") in a month. The use of the difference in logarithm is to neutralize the disproportionate influence of popular books that tend to receive many comments. We label our measures of novelty from the two approaches as "$Novelty\ (DS)$" and "$Novelty\ (ML)$", where DS stands for dictionary search and ML for machine learning. These two measures are positively correlated.

We infer from these measures of novelty an author's engagement in creative production, i.e., creative effort. As noted previously, creative effort does not necessarily lead to successful improvement of quality. On the other hand, our measures of novelty largely capture the kind of novelty that is noticed by readers. As long as creative effort increases novelty (even in a stochastic sense), an improvement in novelty still implies an increase in creative effort. This

[9] Self-promotion posts were easy to identify as they usually contained words calling for readers' attention. A number of posts were written by authors who flattered other authors' books in exchange for favorable comments. Thus we removed reviews that contained both other authors' names and words with flattery. We manually read a random sample of 2,000 posts in the self-promotion and favoritism-exchange dataset and the remaining clean dataset, respectively. In the former dataset, these selected posts conveyed strong sentiments but were rarely about novelty. In the latter dataset, we found no signs of self-promotion or favoritism-exchange.

[10] The "novel" word list includes three types of words: (1) words relating to "new," "creative," and "innovative," (2) words relating to "unique," "different from others," "original," and "pioneer," and (3) words relating to "surprisingly clever," and "unexpected." The "lack of novelty" word list includes words that are the negation of the "novel" words and other words such as "copy," "imitation," "plagiarize," "conventional," "banal," "cliché," and the like.

is similar to the use of patents as a measure of innovation.

Platform promotion. To measure the platform's promotion, we extract the historical web pages of the platform from the Internet Archive (https://archive.org/), which stores a large number of randomly-selected front pages of the platform over time. The platform divides the front page into different promotional zones, each of which contains a different list of books for promotion. Some lists are generated algorithmically based on readers' actions such as the most-clicked or most-purchased books in the past month, while others are based on editors' discretionary recommendation. We focus on the editor-based promotion, which reflects the platform's intention to help a book reach its audience. To verify that our measure of platform promotion is not affected by the platform's expansion of promotion space, we examined a number of randomly selected webpages, and found that the layout of the platform's front pages stayed unchanged during the entire sample period.

After documenting how many times a book is promoted by the editors in a month, we multiply this count with the ratio of the number of times that the Internet Archive captures the snapshots to the number of days in that month. For books that do not appear on any archived front pages in a given month, the promotion measure is coded as zero. Note that the platform's promotion of books is organized by book categories. It is thus not the case that increased promotion in one category of books (e.g., romance) reduces promotion of other categories of books (e.g., science fiction). The substitutive allocation of promotion is among revenue-sharing books, fixed-price books, and books without contracts within a category.

4.2 Summary Statistics

Panel A of Table 1 reports the summary statistics of the books published on the platform during the sample period, classified into five categories: modern romance, ancient romance, martial arts, science fictions/gaming, and others (e.g., mystery and crime fictions). In total, there are 9,160 books, among which modern and ancient romance are the two most popular categories. Modern romance novels are on average longer than novels in other categories. The share of contracted books within each category ranges from 15% in the "others" category to 29% in the martial arts category. Contracted books are far lengthier than an average book because many non-contracted books terminate before they are finished. The average length of a chapter is approximately 3,000 Chinese characters; most contracted books contain more than 300 chapters.

Panel B reports the summary statistics of the outcome measures at the book-month level. An average author produces about 100,000 Chinese characters or 31 new chapters a month. She also supplies about 8,447 characters free of charge (bonus content) in a month. In terms of book novelty, the measure based on dictionary-search is larger in scale and smaller in variance than the measure based on machine-learning. But their maximum and minimum values are similar.[11] Regarding platform promotion, on average, the editors promote a book 0.65 times

[11]These novelty measures can admit a negative value because they are calculated in terms of differences

per month. The large standard deviation verifies that promotion is highly skewed towards a small subset of books. In terms of market performance, the average number of monthly clicks of a book is 9,738 but the average number of purchases is only 47. The standard deviations of these variables are large: extremely successful books attract more than one million clicks and thousands of purchases per month.

5 Empirical Strategy

Our identification strategy relies on the exogenous change in the competitive environment induced by the WCC described in Section 2.4. In this section, we first show that the WCC generated an asymmetric impact that divided the existing books into a treatment group (romance) and a control group (other books), thereby permitting a difference-in-differences (DID) estimation to identify the causal effects. We then specify two regressions that will be used to test the two sets of theoretical predictions (Hypotheses 1 and 2). Finally, we discuss several potential confounding factors that may threaten the validity of the DID identification.

5.1 Asymmetric Impact of the WCC

Recall that the WCC led to the closing of dozens of platforms that specialized in romance novels. Given that the skills of writing romances are not platform specific, authors who were previously active in the closed platforms and new authors who aspired to write romance novels sought their business opportunities in the well-established mainstream platforms. The platform under our study was particularly attractive to these authors for two reasons. First, romance novels were the major book categories for the platform, as shown in Table 1. Second, the platform had a reputation for welcoming newcomers. One senior manager of the platform said, "After the WCC, an unexpectedly large number of authors approached us. Some of them had experiences with other platforms, but the majority were novice authors."

To assess the direct impact of the WCC on books, we first examine how the WCC affected the pornographic content across book categories. We construct a porn-value for every book ever published on the platform in our study. In particular, we searched a list of porn words that were used by the National Internet Control Office to identify salacious content and calculated the number of these words in the first 200 characters of each book chapter. We then computed the average of this value across all book chapters in the same category. Table 2 reports the summary statistics. Several patterns are notable. First, the average porn-value of a book is small, indicating that the platform under study was well-behaved and a safe place for authors to dwell in. Second, in an average month, books in modern and ancient romance categories have higher porn values than those in other categories. This evidence explains why the platforms shut down by the government specialized in romance fiction. Third, the porn-value of these books changed little after the launch of the WCC, suggesting that new

between "novelty" and "lack of novelty" (in logarithm).

authors did not bring their salacious writing to the platform. Instead, they wrote in a clean way as existing authors did. Overall, the results support the view that web-cleaning itself was unlikely to have a direct impact on authors on this platform. The effect of the WCC comes from its asymmetric impact on the entry of books in different categories.

One concern is whether the entry of new authors caused romance novelists to switch to other types of novels. Noted by industry experts, except for a small number of extremely talented authors, most authors specialize in one type of novel because the skills for writing a successful romance are very different from those for crafting science or mystery fiction. Moreover, to attract loyal readers, it is important for an author to establish a reputation in a field. Of the more than 400 authors who ever wrote a modern romance before the WCC, only 57 also wrote books in other categories. Among them, 37 extended their writing to the ancient romance category, and merely 20 ever touched other categories. This pattern has not changed after the WCC. These findings show that within the romance category, modern and ancient romance novels are substitutes to some extent, but the substitution between romance and other types of books is rather weak.

The evidence also helps explain that the WCC may induce the massive entry of books in the two romance categories but have little impact on books in other categories. Table 3 reports the number of new books per month in each category during different periods. The platform was growing over time regardless of the policy shock. An asymmetric jump occurred during the WCC (April-November 2014): the entry of books tripled in the modern romance category and doubled in the ancient romance category, whereas the number of new books in other categories changed only modestly. After December 2014, the entry pattern in each category remained stable except for martial arts, which experienced a substantial increase in new books. This abnormal surge was driven by a sudden entry of martial arts books after July 2015.[12] We will use samples excluding this category or excluding the time period after July 2015 as robustness checks.

Given the evidence presented in Tables 2 and 3, we define the books in the modern romance and ancient romance categories as the treatment group and the books in the categories of martial arts, science fiction/gaming, and others as the control group. Figure 1 plots the number of new books per month (in logarithm) during the entire sample period. The two vertical dotted lines indicate the start of the WCC (April 2014) and the end of the WCC (November 2014). Before the WCC, despite the continuous rising trend, the gap between the two groups remains stable. However, the gap widens drastically during the WCC, and narrows a few months after the WCC. This graphical evidence lends strong support to the DID estimation as a strategy to identify the causal effects of competition.

[12]Interviews with the platform suggest that the surge was because several online martial-art novels were turned into TV shows during that summer, and their success attracted aspiring authors to follow suit.

5.2 Average Treatment Effects: DID Estimation

Our basic DID estimation uses the following specification:

$$outcome_{it} = \alpha + \beta_1 WCC_t + \gamma WCC_t \times treatment_i + X'\delta + \lambda_t + \theta_i + \epsilon_{ij}, \quad (1)$$

where the subscript it indicates book i in month t. The dependent variables (in logarithms) are those outcome variables described in the data section. As for the independent variables, WCC_t is a dummy that equals one if an observation occurs in or after April 2014 and zero otherwise; $treatment_i$ is a dummy indicating whether a book is in the treatment group or not. The coefficient of the interaction variable γ estimates the competition effect on books in the treatment group relative to those in the control group. The vector variable, X, includes a set of time-variant characteristics such as market-level demand factors (e.g., monthly clicks within each category) and supply factors (e.g., monthly entry of books in each category). We also include two kinds of fixed effects: λ_t for year-month fixed effects and θ_i for book-level fixed effects. The inclusion of book-level fixed effects identifies the effect of competition on books that existed both before and after the WCC. This allows for isolation from the effect of the WCC on new books, whose authors faced decisions (e.g., contractual choices) other than adjusting efforts. Finally, ϵ_{ij} is the standard error term. In the most complete specification, we also include category-specific time trends.

We cluster the standard errors by book category, taking into account the potential correlations across books within a category. Because the number of clusters is very small in our data, we use a wild-bootstrapping procedure with Webb weights to deal with clustered standard errors with few clusters, as recommended by Cameron et al. (2008).

5.3 Effects under Different Contracts: Triple-Differences Estimation

To examine how contractual arrangement channels the effect of competition, we extend the above DID regression to a triple-differences specification:

$$\begin{aligned} outcome_{it} = \alpha &+ \beta_1 treatment_i \times share_i + \beta_2 WCC_t \times treatment_i + \beta_3 WCC_t \times share_i \\ &+ \gamma WCC_t \times treatment_i \times share_i + X'\delta + \lambda_t + \theta_i + \epsilon_{ij}. \end{aligned} \quad (2)$$

The new variable, $share_i$, is a dummy that equals one if book i is under the revenue-sharing contract. The coefficient of interest γ, associated with the triple-interaction term $WCC_t \times treatment_i \times share_i$, captures the effect of competition on revenue-sharing books relative to the effect on fixed-price books. Again, the most complete specification includes category-specific time trends. The standard errors are clustered in the same way as in the DID estimation.

Despite controlling for book-level fixed effects, the above estimation is subject to a potential selection bias because authors with different characteristics (e.g., risk preferences and

ability) may choose their preferred contract formats, or the platform may selectively offer a particular contract to its target authors. If such an endogenous contractual matching problem occurs, the responses of authors under different contractual arrangement may be contaminated by the effects of unobservable personal and book characteristics. To address this problem, we construct a sample in which the contractual assignment to books mimics a random assignment. We provide the details in Section 7.

5.4 Potentially Confounding Factors

The key identification assumption underlying the DID estimation is that absent the WCC, the treatment group and the control group would have evolved in parallel. We will justify the validity of this assumption by formally testing the pre-trends with regard to the main outcome variables and performing a number of robustness checks. Here, we address several other potential confounding factors that may threaten the DID identification strategy.

Structural change in market demand. After the small platforms closed, readers on these platforms might have moved to the remaining platforms including the one under study. Since the closed platforms mostly specialized in romance fiction, the influx of readers would have concentrated exactly on the treatment group. This structural change on the demand side, if it indeed had happened, would confound the competition effect with the market size effect. Our interviews with the platform suggested that the romance novels published on the platform under study were rather different from the salacious novels circulated on the closed platforms. Thus, readers of the closed platforms were likely to seek porn content from other channels after the shutdown of their existing channels. To formally address this demand-change concern, we obtained from the platform the traffic data between January 2014 and December 2015 (see Appendix Figure A1).[13] Unlike the entry of new books, the daily volume of active users on the platform shows no discontinuity after the launch of the WCC.

Multi-homing and platform competition. If readers and/or authors were multi-homing, other platforms' business changes associated with the WCC might affect readers and authors on the platform under study. On the supply side, it is rare that an author writes two novels at the same time across different platforms.[14] On the demand side, multi-homing is not a salient feature in the Chinese online novel-writing market, not only because the benefit of switching to other platforms is small as noted in Section 2.1 but also because each platform intends to maintain its own loyal readership.[15] This is also consistent with the stable overall user volume of the platform shown in Figure A1. Therefore, product competition occurs mostly between books on one platform, and competition from other platforms is unlikely to

[13] Data before January 2014 were not available.

[14] An author writing more than one book simultaneously occurs occasionally for well-known authors who start new books when their current projects are close to the end.

[15] One strategy used by the platform under study to reduce reader multi-homing is to require readers to purchase book chapters with virtual currency that is exclusively used on the platform and it gives VIP readers (readers who have earned substantial experience points on the platform) discounts.

affect the behavior of contracted authors in the platform market under study.

6 Average Treatment Effects

In this section, we test Hypothesis 1 by estimating the average treatment effect of intensified competition triggered by the WCC on author efforts, platform promotion, and book performance. Before proceeding to the regression analysis, we provide model-free evidence by plotting the raw data to illustrate the impact of the WCC intervention.

6.1 Model-Free Evidence

Figure 2 plots the monthly difference between the treatment and control groups for each of the main outcome variables (in logarithms) over the entire sample period.

Routine effort. Panel A shows the treatment-control differences in terms of the numbers of Chinese characters, chapters, and extra characters (bonus content) that an author updated in a month. Before the WCC, authors in the treatment group wrote slightly less than authors in the control group, and the difference was stable. After the WCC, the differences in all these three quantity measures increased immediately and remained persistent.

Creative effort. Panel B shows the differential in the two measures of novelty (DS and ML). The pattern is drastically different from that in Panel A. The differences in both measures fluctuated around -0.1 before the WCC, and continued a similar pattern during the WCC. After the WCC, the machine-learning novelty measure barely changed, and the dictionary-search novelty measure declined slightly.

Platform promotion. Panel C shows the difference in terms of platform promotion. Before the WCC, the treated books received significantly less promotion than books in the control group. The difference fluctuated drastically because of the skewed distribution of promotion among contracted books. After the WCC, the promotion of the treated books jumped up immediately and remained at a higher level, and the difference was more stable. This pattern is consistent with the argument that the platform reallocated more promotion from uncontracted new books to contracted books within the treated categories, which results in a higher level as well as a smaller variance of promotion.

Market performance. Panel D shows the differences in reader clicks and purchases. In most months before the WCC, the books in the control group outperformed those in the treatment group, consistent with the evidence in Panels A and C. After the WCC, the performance of the treated books started to pick up, and the treatment-control difference became positive and increased gradually. The graph clearly shows that the WCC had a long-lasting impact on the market performance of the treated books compared to that for the control group.

6.2 Regression Results

We now turn to the regression analyses. Table 4 presents the results based on equation (1). For each outcome variable, we first report the results including time and book fixed effects and the time-variant category-level controls such as monthly clicks and monthly entry of new books in each category. We then report the results after including an additional control for category-specific time trends. Once we control for category-specific time trends, the magnitudes of the coefficients become smaller in most cases, but the results are qualitatively similar. We will focus on the specifications with category-specific time trends in the discussion below.

The results in Panel A show that increased competition had a large impact on an author's routine effort to produce more content. Relative to the control group, authors in the treatment group responded to the WCC shock by writing approximately 107% more characters, 32% more chapters, and 70% more extra characters (bonus content) per month. These results are consistent with Hypothesis 1a. The large magnitudes suggest that routine effort could be adjusted rather quickly. This adjustment is plausible because many authors wrote part-time and were flexible in their time allocation.

Panel B reports the estimations with regard to book novelty. In general, the estimates are small in magnitude and statistically insignificant. These results seem to suggest that competition has a rather weak impact on creative effort. Note that the average treatment effect here combines the effects on both revenue-sharing and fixed-price books. As we show below, revenue-sharing authors expand their creative effort in response to competition.

Panel C of Table 4 reports the results regarding platform promotion and book performance. Column 2 shows that after the WCC, the treated books, relative to the control group, received approximately 16% more platform promotion in terms of editors' subjective recommendations. This result is consistent with Hypothesis 1c. Columns 4 and 6 show that for the same books, intensified competition increased reader clicks by 29% and reader purchases by 40%. Given the increases in author routine effort and platform promotion, such increases in market performance are expected.

6.3 Robustness Checks

Examination of Pretrends. A key requirement underlying the DID estimation for causal inference is that before the WCC, the trends of the treatment and control groups are similar. We thus extend the DID specification to examine pre- and post-trends by interacting the treatment dummy with seven timing dummies for three, two, and one month before the launch of the WCC, the month in which the WCC was launched, and one, two, and three months and beyond after the launch of the WCC. Observations more than three months before the WCC are used as the comparison group. Table 5 reports the results. None of the outcomes under our study exhibits a pretrend. The effect of competition in general gradually increased after the start of the WCC and became persistent three months later.

Continuous Measure of Competition. Our current approach uses a discrete measure of competition, leveraging the differential impact of the WCC on the treatment and control groups. To further rule out other factors that might affect the treatment and control groups in a systematically different way, we construct a continuous measure of competition combining the WCC shock and variations within categories. Specifically, we calculate the number of competitors for each book ($Competitors_i$), based on both the book category and the key words that are used to describe the characteristics of a book. For example, within the ancient romance category, a novel is described by a set of key words that indicate its sub-genre (e.g., love triangle or family love), setting (e.g., which dynasty), and the style (e.g., funny or serious). The competitors of this novel are the books that are within the same category and share at least one of these key words. To leverage the exogeneity of the WCC shock, we define the number of competitors for each book by the number of competing books in the month right before the WCC (i.e., March 2014). Essentially, such a competitive measure captures the propensity of being treated at the time of treatment. As shown in Panel A of Appendix Table A1, the results based on this measure of competition are qualitatively similar to those in Table 4.

Author Response to Platform Promotion. In Table 4, we show that after the WCC, both author routine effort and platform promotion in the treatment group increased significantly. This raises a potential concern that the authors might be responding to the change in platform promotion instead of the change in competition. We examine this possibility by looking at the effect of the WCC on the books that did not receive any platform promotion at all. Appendix Table A2 reports the results. In total, 868 of 1,944 books have never received platform promotion. In this smaller sample, the effects of competition are qualitatively similar to those in the full sample. In terms of magnitude, the coefficients that capture the effects on author efforts are even larger in this sample. Clearly, it is not the case that authors were only responding to platform promotion. Rather, if anything, authors reacted to competition more strongly when the platform did not promote them.

7 Effects under Different Contracts

We next examine the contractual mechanisms that may alter the effects of competition as predicted in Hypothesis 2. Generally, the choice of a contractual format depends on the characteristics of both the contracting parties and the tasks to be performed. This problem of endogenous contractual matching makes it difficult to estimate the causal effect of contractual arrangements in observational studies (e.g., Ackerberg and Botticini 2003; Mortimer 2008; Ho et al. 2012). In the current setting, one side of the contractual arrangement is a single player—the platform that typically makes a take-it-or-leave-it offer to authors, particularly to those unknown authors. The matching problem is thus reduced to an assignment problem, which is relatively easy to deal with because heterogeneity comes solely from the author side.

Therefore, our empirical strategy aims to construct a sample in which the assignment of contracts to authors mimics a random assignment.

7.1 Addressing Endogenous Contractual Choices

Recall Section 2.3 in which we describe the platform's strategy of offering fixed prices to potentially lucrative books in order to avoid paying high royalties. According to industry experts and our interviews with the platform, except for well-known or experienced authors, it is difficult to judge the ability of new authors and the market potential of their works at an early stage. Thus, the platform often makes low-price offers to a number of randomly selected unknown and inexperienced authors. An author rejecting such a fixed-price contract would be matched with the default revenue-sharing contract. In practice, most authors accepted this offer given the low success rate of books by nascent authors and their negligible bargaining power in contracting.[16] Therefore, we select a sample including (1) all revenue-sharing books and (2) fixed-price books with a low price (below RMB 20 per 1,000 Chinese characters).[17] Among this subset of books, we include only books by authors who were unknown to the market prior to their projects (according to an Internet search performed by research assistants) and by authors who had no contracting experience (according to information provided by the platform).

To test whether contracts can be indeed considered to be randomly assigned in the above subsample, we examine the balancing of the pre-contracting characteristics between books under the two types of contracts. Table 6 reports the basic statistics of the main outcome variables before a book is contracted for books under the fixed-price or revenue-sharing contract. Despite the large variances, all variables, including the measures of quantity expansion ($Chars_{it}$, $Chapters_{it}$, $Extra\ Chars_{it}$ defined before), novelty ($Novelty\ (DS)$ and $Novelty\ (ML)$), platform promotion ($Promotion_{it}$), and market performance ($Clicks_{it}$)[18], are similar in the means across contractual types. The last column shows that statistically, there are no systematic differences between the two types of books along these outcome variables. Interestingly, comparing Table 6 with Panel B of Table 1, we find that before signing contracts with the platform, authors tend to write less but more creatively. This result suggests that novelty is crucial to the success of "young" books, a feature we will explore later.

The results in Table 6 lend strong support to the random-assignment argument. We will

[16] In our interviews, authors were often disappointed but also relieved when given a fixed-price offer: "The price is unfairly low. But what can we do? If we don't take it, other people will. Then, we may screw up. So realistically, we don't think about being ripped off by the platform; we just take their buy-out as a victorious sign."

[17] The choice of this price threshold takes into account both insiders' knowledge on what a low price was and the sample size. Choosing a more stringent threshold does not change the results qualitatively but the sample size is considerably smaller and the estimation is less precise.

[18] There is no "purchases" variable because readers do not need to purchase book chapters before a book is contracted.

thus refer to the sample of these selected books as the quasi-random sample. Appendix Table A3 reports the DID estimation of the average treatment effects of competition within this sample. The coefficients are comparable to those in Table 4.

7.2 DID Estimation under Different Contracts

One key theoretical prediction is that other things being equal, authors under the fixed-price contracts will respond to increased competition less than those under the revenue-sharing contracts, whereas the platform will promote fixed-price books more than revenue-sharing books. We test this hypothesis by estimating the triple-differences specification (equation (2)) within the above quasi-random sample. Before this test, we split the sample into two subsamples by contractual types to show the results of the DID estimation in each subsample.

Panel A of Table 7 reports the estimates in the subsample of fixed-price books, using the most complete specification including category-specific time trends. The first three columns present the effect of competition on the three measures of routine effort. The coefficients that capture the DID effect are positive but statistically insignificant. In the next two columns, the effects of competition on the two measures of novelty are negative but statistically insignificant. These two results show that authors under the fixed-price contract did not significantly respond to increased competition, in alignment with Hypothesis 2a.

Column (6) shows that the platform's promotion of fixed-price books on average increased by more than 50%, and the effect is significant at the level of 1%. Columns (7) and (8) show that, despite the lack of author response, competition significantly increased the number of reader clicks and purchases. These results further confirm the theoretical argument that the fixed-price contract mutes an author's response to intensified competition but strengthens the platform's incentive to promote books.

Panel B repeats the same estimations as in Panel A for revenue-sharing books. Regarding routine effort, the effects of competition on authors' updates of characters and book chapters are substantial and statistically significant at the 1% level, and the effect on the offering of extra characters (bonus content) is also large and significant at the 5% level. Columns (4) and (5) show that the effects on the two novelty measures are both positive and statistically significant at the 5% level. These results are consistent with Hypothesis 2b, particularly in view of the sizeable negative effect on the novelty of fixed-price books.[19]

As shown in Column (6), intensified competition did not increase the platform's promotion of revenue-sharing books. Despite this, Columns (7) and (8) demonstrate that the market performance of revenue-sharing books still increased considerably. These results draw a sharp contrast with those for fixed-price books whose performance improvement appeared to

[19]One possible reason for the negative (though statistically insignificant) effect on the novelty of fixed-price books and the weak effect on revenue-sharing books is that we measure novelty based on reader reviews. After the WCC, with more books available in the market, readers might become more stringent in offering praises for the novelty of a book, which resulted in a common decrease in novelty of both types of books. In such cases, our estimates provide lower bounds of the effect of competition on creative efforts.

be driven by a significant increase in the platform's promotion rather than authors' greater efforts.

7.3 Triple-Differences Estimation

We now turn to the triple-differences estimation of the differential effects of increased competition for the two types of books. Table 8 reports the coefficients that capture how much more competition effect on revenue-sharing books relative to fixed-price books. Consistent with the results in Table 7, the first three columns show that after the WCC, revenue-sharing authors exerted far more routine effort than fixed-price authors. Most strikingly, the difference in the amount of bonus content (extra characters) nearly doubles, suggesting that under more competitive pressure, revenue-sharing authors were more willing to offer free content to attract readership.

Regarding book novelty, the substantial and highly significant triple-differences estimates (Columns (4) and (5)) demonstrate that after the WCC, revenue-sharing authors expended considerably more creative efforts to improve book novelty than fixed-price authors did. The results on routine and creative effects clearly demonstrate that the effect of competition on authors is moderated by contractual arrangement.

Consistent with Hypothesis 2c, the result in Column (6) shows that intensified competition led the platform to promote fixed-price books substantially more than revenue-sharing books. This disproportionate promotion enabled fixed-price books to outperform revenue-sharing books considerably, as demonstrated in the last two columns.

Examination of Pretrends. To verify that the above differential effects of competition are not driven by some systematic differences between the two types of books before the WCC, we analyze the pre- and post-WCC dynamics of the triple-differences estimates as we did for the DID estimation (recall Table 5). The results are reported in Appendix Table A4. No significant pretends are observed. Moreover, from the post-WCC dynamics, we observe that the effect on books' market performance appears sizeable and significant two months after the WCC shock, lagging behind the responses of author effort but more synchronizing with the effect on platform promotion. This result suggests that authors responded to increased competition before the platform did, but platform promotion played an important role in influencing a book's market performance.

Robustness Checks. In the appendix, we perform several other robustness checks. First, Panel B of Table A1 reports the results of using the continuous measure of competition defined previously (Section 6.3) in the triple-differences estimation in the quasi-random sample. All our results continue to hold with this measure. Second, in Table A5, we report the results of the same triple-difference regressions in the full sample instead of the quasi-random sample. The results are qualitatively similar. Third, considering the potential disturbance from the surge of martial art fictions after July 2015, we exclude this category of books in all regressions. The results presented in Table A6 show that our findings remain virtually un-

changed. Along the same line, the results are robust in the sample excluding all observations after July 2015.

7.4 Heterogeneous Effects by Book Age

Our findings suggest that in order for intensified competition to have a significant effect on worker effort, workers need to be provided with a strong incentive to internalize the benefit and cost associated with the change in market conditions. This is particularly the case for creative effort whose uncertain returns may weaken an author's response to competition. Along the line of such an argument, among revenue-sharing authors, those who have greater incentives or are more able to internalize the effect of competition should respond to the WCC shock more aggressively. To assess this argument, we examine a heterogeneous treatment effect by the "age" of a book upon the WCC shock.

When a book is in the early stage, its plot and style is not set in stone, and readers are sensitive to new features of the book. It is relatively easy for the author to improve the novelty of a young book. Therefore, we expect that authors of young books exert greater creative efforts than those of old books when competition intensifies. We test this hypothesis by estimating the effects of competition after splitting our sample by book age. Specifically, we construct a pre-determined measure of book age according to the difference between a book's contracting time and the start month of the WCC (i.e., April 2014). For books that were contracted before the WCC, their ages range from 1 to 15 months. Taking sample balancing into consideration, we define a book as "young" if its age is within 6 months (contracting after September 2013), with the rest of books defined as "old." Using a more strict definition of young books does not affect the results qualitatively.

Table 9 reports the DID estimation of the effect of competition on revenue-sharing authors' efforts[20] for the young books (the first four columns) and for the old books (the last four columns) in the quasi-random sample. The effects of competition on the novelty measures of the young revenue-sharing books (Columns (1) and (2)) are all positive and highly significant. Their magnitudes are considerably greater than the corresponding average effects on all revenue-sharing books (Columns (4) and (5) in Panel B of Table 7). In contrast, Columns (5)–(6) show that the effect of competition on the novelty of the old books is negative, albeit statistically insignificant. These results together suggest that increased competition spurred creative efforts of the authors of young books under the revenue-sharing contract.

For comparison, we also report the effect of competition on quantity expansion (Columns (3) and (4) in Table 9). These effects on the young books are essentially the same as the average effects on all the revenue-sharing books. Columns (7)–(8) show that the effects of competition on the old books are only slightly smaller than the corresponding effects on the young books. These results show that the impact of competition on quantity expansion is not affected by book age, consistent with our argument that quantity expansion involves similar

[20]The results for the fixed-price authors are reported in Appendix Table A7.

costs for authors of young and old books. They also suggest that the substitution between routine effort and creative effort is unlikely to be a dominant explanation because comparing the effects for the young books with those for the old books, a greater effect on quantity expansion is not associated with a smaller effect on novelty improvement.

8 Conclusion

Stephen King, the "King of Horror" fiction, said, "Talent is cheaper than table salt. What separates the talented individual from the successful one is a lot of hard work." Among the mechanisms that help spur hard work, market competition has long been considered by economists as one of the most important mechanisms. At the same time, how effective this mechanism is and what limits its working are not yet well understood. We address these questions in the setting of a Chinese online novel-writing platform, leveraging unusually rich personnel data and an anti-pornography regulatory change that generated an exogenous and asymmetric impact on the competitive environment across different genres of novels.

The main finding is that intensified competition substantially increased workers' routine effort that determines the quantity of output, but did not significantly affect workers' creative effort that determines the novelty of output. Further, we find that the fixed-price (pay-by-the-word) contract muted an author's response to competition in terms of both quantity expansion and novelty improvement. In contrast, a revenue-sharing contract drove an author to expand quantities and improve book novelty significantly in response to increased competition.

These findings square with the theoretical argument that when a worker's pay is tied to a firm's market performance, intensified competition that enhances a firm's incentive to steal business from competitors (or avoid business from being stolen) is effective in eliciting worker effort. In other words, the effect of market competition on individual effort is constrained by the structure of incentives provided within an organizational relationship. This argument is particularly true for creative effort, which incurs a high cost and yields an uncertain return. Without an incentive structure that allows workers to internalize the market returns to their efforts, workers will not respond to market competition. This insight can be generalized to other settings outside of creative production.

Another important finding is that increased competition led the platform to promote fixed-price books considerably more than revenue-sharing books, resulting in better market performance of fixed-price books. We argue that this platform response is driven by the platform's incentive to maximize its return on the books of which the platform is residual claimant. This result shows that a platform's strategic response to competition among producers could distort the relationship between producers' efforts and market performance. Such an insight is particularly relevant to the ongoing debate about whether or not the emergence of powerful gatekeepers in a growing number of industries today harms producer

welfare.

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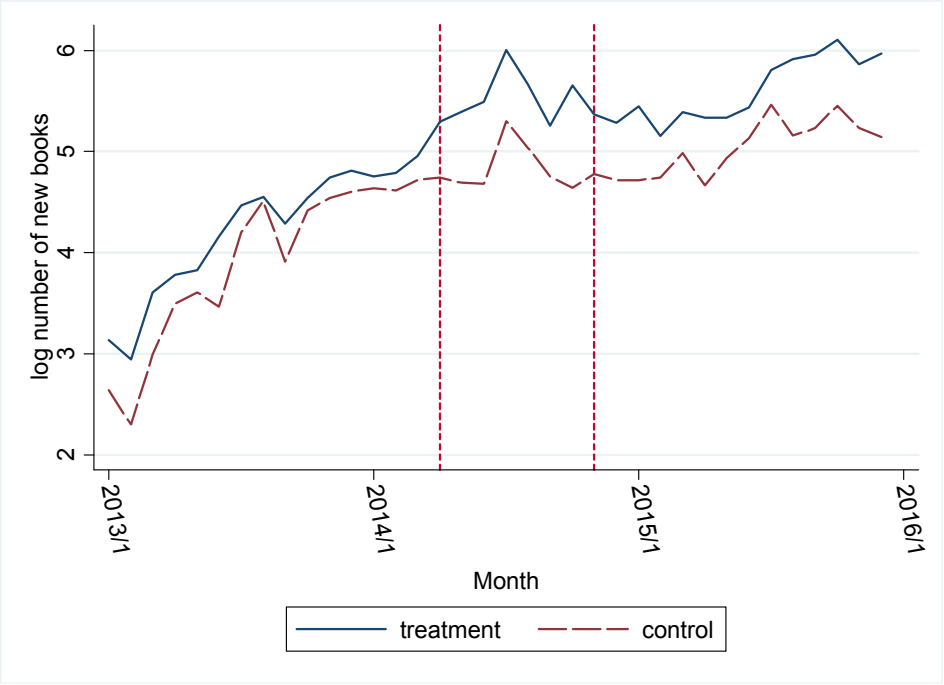
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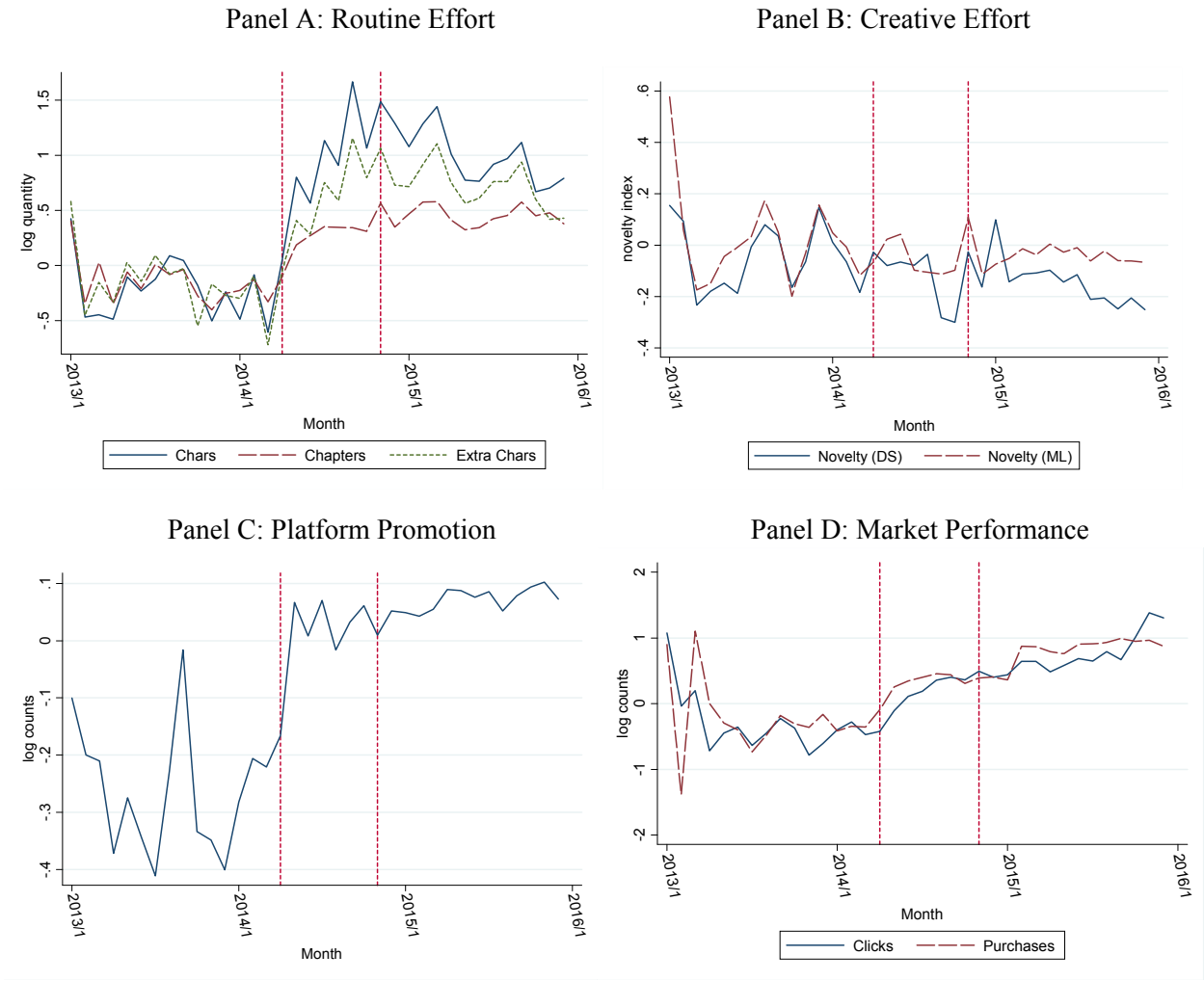
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Figure 1. Entry of New Books over Time by Treatment



Notes: Treatment is books in the categories of modern and urban romance novels, and control is books in the categories of martial arts, science/gaming, and other novels. The two dashed vertical lines indicate the beginning and the end of the WCC, respectively.

Figure 2. Differences between Treatment and Control



Notes: All variables on the y-axis are in logarithm except for the novel index, which is a relative measure in logarithm. The variable "Chars" is the number of characters produced within a month, "Chapters" is the number of chapters updated, and "Extra Chars" is the number of free extra characters (bonus content). "Novelty (DS)" and "Novelty (ML)" are the novelty indices constructed from review posts classified by the dictionary search approach and the machine learning approach, respectively. "Promotion" is platform promotion based on editors' subjective recommendations, and "Clicks" and "Purchases" are the counts of reader clicks and purchases. The two dashed vertical lines indicate the beginning and the end of the WCC, respectively.

Table 1. Summary Statistics

Panel A: Basic Book Information by Category

	modern romance	ancient romance	martial arts	science fictions/ gaming	others
All books					
#books	3,500	2,189	1,174	1,203	1,094
#characters/book	328,116	243,716	296,310	282,493	166,673
Contracted books					
#books	706	372	345	367	154
#characters/book	934,198	883,638	732,535	756,217	649,760

Panel B: Summary Statistics of Outcome Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Chars	17,250	93,830.53	94,839.82	0	4,427,575
Chapters	17,250	31.35	31.21	0	1,416
Extra Chars	17,250	8,447.18	11,217.41	0	225,598
Novelty (DS)	15,074	0.346	0.699	-2.079	4.913
Novelty (ML)	15,074	0.076	0.416	-2.639	4.174
Promotion	31,653	0.65	1.95	0	31
Clicks	31,653	9,737.91	42,250.42	0	1,450,545
Purchases	28,278	46.62	214.84	0	6,430

Notes: Observations in Panel B are at the book-month level. The variable "Chars" is the number of characters produced within a month, "Chapters" is the number of chapters updated, and "Extra Chars" is the number of free extra characters (bonus content). "Novelty (DS)" and "Novelty (ML)" are the novelty indices constructed from review posts classified by the dictionary search approach and the machine learning approach, respectively. "Promotion" is platform promotion based on editors' subjective recommendations, and "Clicks" and "Purchases" are the counts of reader clicks and purchases.

Table 2. Porn-Value by Category

# Porn-related words/200 chars	modern romance	ancient romance	martial arts	science fictions/ gaming	others
Before WCC	0.19	0.19	0.06	0.10	0.11
During WCC	0.17	0.16	0.06	0.10	0.12

Note: Before WCC: January 2013 – March 2014; During WCC: April 2014 – November 2014.

Table 3. Book Entry over Time by Category

# new books/month	modern romance	ancient romance	martial arts	science fictions /gaming	others
Before WCC	58.65	41.66	21.62	28.1	34.93
During WCC	173.1	99.8	18.34	39.81	55.07
After WCC	222.91	94.21	81.53	47.33	52.64

Notes: Before WCC: January 2013 – March 2014; During WCC: April 2014 – November 2014; After WCC: December 2014 – December 2015.

Table 4. DID Estimation of the Effects of Competition

Panel A: Effects on Author Routine Effort

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	log(Chars)		log(Chapters)		log(Extra Chars)	
WCC × Treatment	1.088***	1.072***	0.367**	0.278**	0.763***	0.704**
	(0.088)	(0.223)	(0.081)	(0.066)	(0.142)	(0.196)
	[12.302]	[4.818]	[8.529]	[5.728]	[3.688]	[3.319]
Observations	17,250	17,250	17,250	17,250	17,250	17,250
R-squared	0.518	0.518	0.129	0.130	0.150	0.151
Category Trends	NO	YES	NO	YES	NO	YES
Year-Month FE	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES

Panel B: Effects on Author Creative Effort

	(1)	(2)	(3)	(4)
VARIABLES	Novelty (DS)		Novelty (ML)	
WCC × Treatment	0.031	0.085	0.010	-0.008
	(0.063)	(0.041)	(0.018)	(0.028)
	[0.498]	[2.068]	[0.580]	[0.292]
Observations	15,074	15,074	15,074	15,074
R-squared	0.340	0.341	0.257	0.257
Category Trends	NO	YES	NO	YES
Year-Month FE	YES	YES	YES	YES
Book FE	YES	YES	YES	YES

Panel C: Effects on Platform Promotion and Book Performance

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	log(Promotion)		log(Clicks)		log(Purchases)	
WCC × Treatment	0.197**	0.159**	0.936**	0.285***	0.685**	0.395**
	(0.047)	(0.037)	(0.226)	(0.057)	(0.193)	(0.142)
	[4.2]	[4.332]	[4.144]	[4.989]	[3.552]	[2.786]
Observations	31,653	31,653	31,653	31,653	28,278	28,278
R-squared	0.362	0.363	0.753	0.756	0.748	0.749
Category Trends	NO	YES	NO	YES	NO	YES
Year-Month FE	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES

Notes: The observations are at the book-month level. The number of books is 1944. WCC is a dummy that equals one if an observation occurs in and after April 2014 and zero otherwise; treatment is a dummy for books in the treatment group. All regressions include time-variant characteristics (monthly clicks and monthly entry of books) at the category level. Standard errors clustered by category in parentheses with corresponding Wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Pretrend and Dynamics of the DID Estimation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Log(Chars)	Log(Chapters)	Log(Extra Chars)	Novelty (DS)	Novelty (ML)	Log(Promotion)	Log(Clicks)	Log(Purchases)
Treatment ×								
3M pre-WCC	-0.131	-0.047	-0.055	0.108	0.077	0.043	-0.139	0.096
	(0.397)	(0.087)	(0.273)	(0.068)	(0.053)	(0.079)	(0.141)	(0.117)
	[0.329]	[0.543]	[0.201]	[1.574]	[1.449]	[0.365]	[0.984]	[0.816]
2M pre-WCC	0.139	0.010	0.049	0.062	0.046	0.109	0.037	0.110
	(0.450)	(0.104)	(0.407)	(0.093)	(0.073)	(0.094)	(0.171)	(0.100)
	[0.309]	[0.098]	[0.119]	[0.670]	[0.636]	[1.097]	[0.214]	[1.099]
1M pre-WCC	0.115	0.006	0.024	0.035	-0.016	0.085	-0.031	0.095
	(0.322)	(0.067)	(0.209)	(0.105)	(0.078)	(0.040)	(0.132)	(0.067)
	[0.359]	[0.093]	[0.116]	[0.334]	[0.202]	[1.578]	[0.238]	[1.420]
M of WCC	0.821**	0.192	0.520*	0.144	-0.001	0.138**	0.122	0.330
	(0.263)	(0.092)	(0.226)	(0.112)	(0.066)	(0.044)	(0.200)	(0.261)
	[3.121]	[2.091]	[2.304]	[1.283]	[0.013]	[3.778]	[0.609]	[1.265]
1M post-WCC	1.358*	0.349**	0.910*	0.162**	0.038	0.287***	0.305**	0.546**
	(0.506)	(0.101)	(0.419)	(0.050)	(0.019)	(0.034)	(0.099)	(0.187)
	[2.681]	[3.467]	[2.175]	[3.224]	[2.010]	[9.769]	[3.093]	[2.926]
2M post-WCC	0.937	0.283	0.591	0.121	0.054	0.225**	0.381**	0.497**
	(0.700)	(0.187)	(0.483)	(0.085)	(0.084)	(0.059)	(0.104)	(0.126)
	[1.338]	[1.511]	[1.223]	[1.424]	[0.635]	[4.193]	[3.647]	[3.938]
3M post-WCC	1.200*	0.273*	0.716	0.095	-0.016	0.236**	0.280*	0.449*
and beyond	(0.506)	(0.111)	(0.429)	(0.085)	(0.061)	(0.058)	(0.105)	(0.189)
	[2.371]	[2.465]	[1.669]	[1.108]	[0.261]	[4.592]	[2.665]	[2.382]
Observations	17,250	17,250	17,250	15,047	15,047	31,653	31,653	28,278
R-squared	0.518	0.531	0.531	0.341	0.257	0.364	0.756	0.749
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944

Notes: Treatment is a dummy for books in the treatment group. "3M pre-WCC" is a dummy that equals one if an observation occurs exactly three months before the WCC (i.e., January 2014) and zero otherwise. Other variables involving WCC are similarly defined. All regressions include time-variant characteristics (monthly clicks and monthly entry of books) at the category level. Standard errors clustered by category in parentheses with corresponding Wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Compare Books under Two Contractual Types before Contracting

	Fixed-Price		Revenue-Sharing			
	Mean	Std. Dev.	Mean	Std. Dev.	Mean Diff	P-Value
Chars	64662.15	64447.55	66975.35	47886.91	-2313.20	0.77
Chapters	21.81	22.91	24.06	17.79	-2.25	0.44
Extra Chars	6792.35	9037.36	7864.60	6836.44	-1072.25	0.34
Novelty (DS)	0.69	3.09	0.78	2.82	-0.10	0.83
Novelty (ML)	0.68	2.65	0.62	2.64	0.06	0.89
Promotion	0.64	2.01	0.62	1.86	0.02	0.95
Clicks	5447.00	13132.25	5173.90	11028.73	273.10	0.88

Notes: Observations are at the book-month level. The variable "Chars" is the number of characters produced within a month, "Chapters" is the number of chapters updated, and "Extra Chars" is the number of free extra characters (bonus content). "Novelty (DS)" and "Novelty (ML)" are the novelty indices constructed from review posts classified by the dictionary search approach and the machine learning approach, respectively. "Clicks" is the counts of reader clicks. "Promotion" is platform promotion based on editors' subjective recommendation.

Table 7. Effects of Competition by Contractual Types in the Quasi-random Sample

Panel A: Books under Fixed-Price Contracts

VARIABLES	(1) Log (Chars)	(2) Log (Chapters)	(3) Log (Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) Log (Promotion)	(7) Log (Clicks)	(8) Log (Purchases)
WCC × Treatment	1.038	0.072	0.841	-0.334	-0.200	0.513***	0.524***	0.835**
	(0.990)	(0.325)	(0.641)	(0.223)	(0.156)	(0.063)	(0.086)	(0.194)
	[1.049]	[0.427]	[0.467]	[1.499]	[1.279]	[8.198]	[6.101]	[4.310]
Observations	2,941	2,941	2,941	2,683	2,683	4,971	4,971	4,203
R-squared	0.453	0.427	0.467	0.329	0.243	0.352	0.715	0.634
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	325	325	325	325	325	325	325	325

Panel B: Books under Revenue-Sharing Contracts

VARIABLES	(1) Log (Chars)	(2) Log (Chapters)	(3) Log (Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) Log (Promotion)	(7) Log (Clicks)	(8) Log (Purchases)
WCC × Treatment	1.473***	0.483***	0.915**	0.108**	0.075**	0.128	0.435*	0.258**
	(0.211)	(0.044)	(0.227)	(0.025)	(0.019)	(0.080)	(0.199)	(0.058)
	[6.984]	[10.87]	[4.024]	[4.246]	[3.954]	[1.605]	[2.186]	[4.47]
Observations	9,027	9,027	9,027	7,566	7,566	20,049	20,049	16,939
R-squared	0.537	0.552	0.553	0.297	0.270	0.312	0.723	0.678
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091

Notes: The observations are at the book-month level. WCC is a dummy that equals one if an observation occurs in and after April 2014 and zero otherwise; treatment is a dummy for books in the treatment group. All regressions include a set of time-variant characteristics (monthly clicks and monthly entry of books) at the category level. Standard errors clustered by category in parentheses with corresponding Wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Triple-Differences Estimation in the Quasi-Random Sample

VARIABLES	(1) Log (Chars)	(2) Log (Chapters)	(3) Log (Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) Log (Promotion)	(7) Log (Clicks)	(8) Log (Purchases)
WCC × Treatment × Share	1.105***	0.370***	0.998***	0.636***	0.406**	-0.457**	-0.700*	-1.211***
	(0.199)	(0.071)	(0.120)	(0.089)	(0.106)	(0.124)	(0.290)	(0.201)
	[5.558]	[5.195]	[8.342]	[6.935]	[3.436]	[3.696]	[2.411]	[6.01]
Observations	11,968	11,968	11,968	10,249	10,249	25,020	25,020	21,142
R-squared	0.528	0.538	0.542	0.304	0.259	0.318	0.725	0.691
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,416	1,416	1,416	1,416	1,416	1,416	1,416	1,416

Notes: WCC is a dummy that equals one if an observation occurs in and after April 2014 and zero otherwise; treatment is a dummy for books in the treatment group. "Share" is a dummy for books under the revenue-sharing contract. All regressions include time-variant characteristics (monthly clicks and monthly entry of books) at the category level. Standard errors clustered by category in parentheses with corresponding Wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

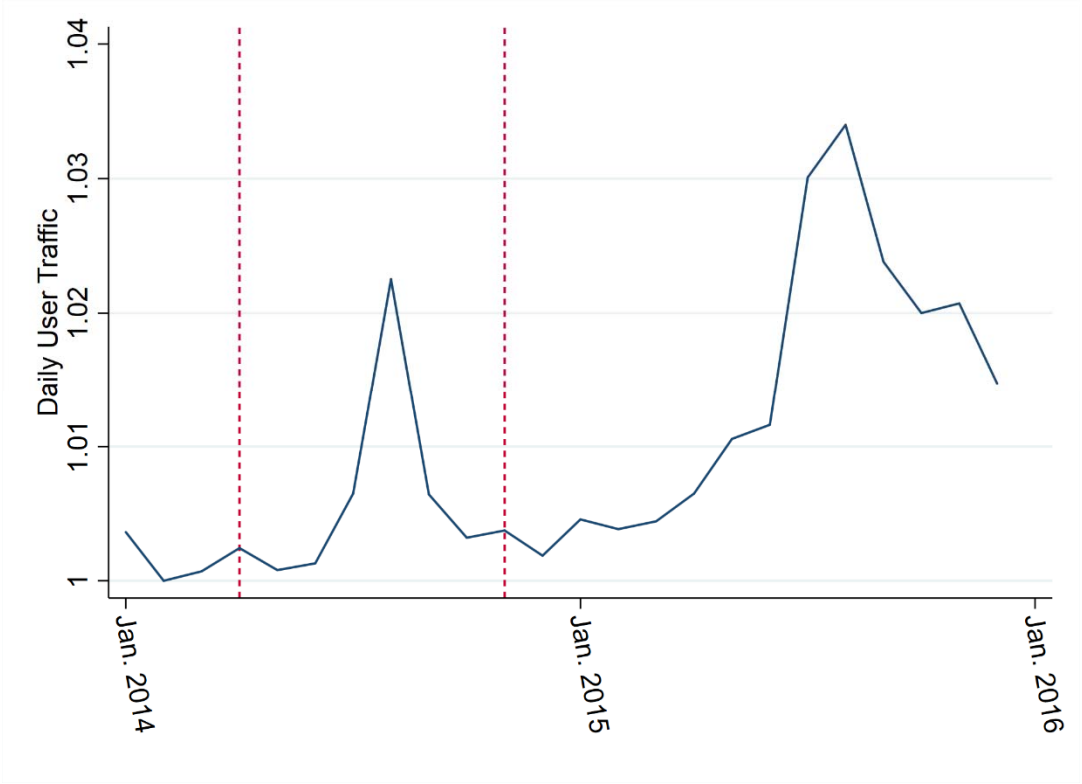
Table 9: Comparison between Young and Old Books under Revenue-sharing Contracts

	Young Books (contract time after 2013.9)				Old Books (contract time in and before 2013.9)			
VARIABLES	(1) Novelty (DS)	(2) Novelty (ML)	(3) Log (Chars)	(4) Log (Chapters)	(5) Novelty (DS)	(6) Novelty (ML)	(7) Log (Chars)	(8) Log (Chapters)
WCC × Treatment	0.178***	0.125**	1.329**	0.440**	-0.031	-0.042	1.062*	0.343*
	(0.038)	(0.030)	(0.380)	(0.140)	(0.103)	(0.071)	(0.432)	(0.154)
	[4.655]	[4.213]	[3.138]	[3.145]	[0.296]	[0.662]	[2.460]	[2.234]
Observations	5,294	5,294	5,989	5,989	1,839	1,839	2,554	2,554
R-squared	0.317	0.276	0.525	0.546	0.314	0.296	0.584	0.630
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: WCC is a dummy that equals one if an observation occurs in and after April 2014 and zero otherwise; treatment is a dummy for books in the treatment group. All regressions include time-variant characteristics (monthly clicks and monthly entry of books) at the category level. Standard errors clustered by category in parentheses with corresponding Wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Empirical Appendix

Figure A1. Daily User Traffic over Time



Notes: We scale the user traffic data to maintain the company's data confidentiality. The first spike is due to summer effects, and the second spike is due to the combination of summer effects and the release of the company's mobile app.

Table A1: The Effects of the Continuous Measure of Competition

Panel A: DID Estimation

VARIABLES	(1) log(Chars)	(2) log(Chapters)	(3) log(Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) log(Promotion)	(7) log(Clicks)	(8) log(Purchases)
log(Competitors)	-0.101	-0.049	-0.118	-0.108**	-0.033	-0.065**	-0.090	0.060
	(0.173)	(0.051)	(0.154)	(0.039)	(0.039)	(0.019)	(0.079)	(0.065)
	[0.587]	[0.973]	[0.766]	[2.803]	[0.854]	[3.365]	[1.128]	[0.925]
log(Competitors) × Treatment	0.261***	0.068**	0.153*	-0.001	-0.017*	0.056***	0.098**	0.103**
	(0.055)	(0.022)	(0.061)	(0.012)	(0.008)	(0.005)	(0.029)	(0.032)
	[4.727]	[3.078]	[2.484]	[0.099]	[2.134]	[10.296]	[3.331]	[3.216]
Observations	17,250	17,250	17,250	15,074	15,074	31,653	31,653	28,278
R-squared	0.518	0.531	0.531	0.343	0.258	0.364	0.756	0.750
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944

Panel B: Triple-Differences Estimation

VARIABLES	(1) log(Chars)	(2) log(Chapters)	(3) log(Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) log(Promotion)	(7) log(Clicks)	(8) log(Purchases)
log(Competitors) × Treatment × Share	0.349***	0.079**	0.318***	0.186***	0.130***	-0.147***	-0.196*	-0.302***
	(0.057)	(0.020)	(0.042)	(0.027)	(0.021)	(0.022)	(0.072)	(0.043)
	[6.089]	[3.936]	[7.488]	[6.828]	[6.302]	[6.801]	[2.736]	[6.977]
Observations	11,968	11,978	11,945	10,249	10,249	25,020	23,523	21,142
R-squared	0.528	0.538	0.542	0.304	0.260	0.319	0.725	0.691
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,416	1,416	1,416	1,416	1,416	1,416	1,416	1,416

Notes: Standard errors clustered by category in parentheses with corresponding wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A2. Effects of Competition in the Sample of Books without Platform Promotion

VARIABLES	(1) log(Chars)	(2) log(Chapters)	(3) log(Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) log(Clicks)	(7) log(Purchases)
WCC × Treatment	2.086***	0.536***	1.432**	0.121	0.059	0.555**	0.267***
	(0.311)	(0.075)	(0.218)	(0.067)	(0.068)	(0.166)	(0.023)
	[6.695]	[2.806]	[2.034]	[1.803]	[0.875]	[3.352]	[11.36]
Observations	6,464	6,464	6,464	5,130	5,130	15,076	13,631
R-squared	0.574	0.189	0.202	0.341	0.293	0.725	0.628
Category Trends	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES
# of Books	868	868	868	868	868	868	868

Notes: Standard errors clustered by category in parentheses with corresponding Wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A3. DID Estimation in the Quasi-Random Sample including All Contracted Books

VARIABLES	(1) log(Chars)	(2) log(Chapters)	(3) log(Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) Log(promotion)	(7) log(Clicks)	(8) log(Purchases)
WCC × Treatment	1.219***	0.307***	0.713**	0.088**	0.034	0.165**	0.326**	0.405***
	(0.201)	(0.048)	(0.194)	(0.030)	(0.025)	(0.043)	(0.093)	(0.079)
	[3.359]	[4.706]	[2.604]	[2.964]	[1.377]	[3.812]	[3.359]	[5.138]
Observations	11,968	11,968	11,968	10,249	10,249	25,020	25,020	21,142
R-squared	0.149	0.148	0.174	0.302	0.255	0.313	0.725	0.689
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,416	1,416	1,416	1,416	1,416	1,416	1,416	1,416

Notes: Standard errors clustered by category in parentheses with corresponding Wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A4. Dynamics of the Triple-Difference Estimation of the Effects of Competition in the Quasi-Random Sample

VARIABLES	(1) log(Chars)	(2) log(Chapters)	(3) log(Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) log(Promotion)	(7) log(Clicks)	(8) log(Purchases)
Treatment × Share ×								
3M pre-WCC	0.595	0.132	0.536	0.140	0.154	0.004	0.093	0.178
	(0.608)	(0.216)	(0.485)	(0.198)	(0.165)	(0.128)	(0.187)	(0.282)
	[0.979]	[0.613]	[1.105]	[0.709]	[0.933]	[0.034]	[0.498]	[0.63]
2M pre-WCC	0.328	0.111	0.106	0.163	-0.036	-0.206	0.051	0.134
	(0.556)	(0.144)	(0.471)	(0.253)	(0.211)	(0.228)	(0.279)	(0.171)
	[0.59]	[0.773]	[0.225]	[0.646]	[0.171]	[0.904]	[0.182]	[0.785]
1M pre-WCC	-0.096	0.012	0.627	0.022	0.285	-0.150	-0.027	0.045
	(0.596)	(0.369)	(0.327)	(0.208)	(0.225)	(0.170)	(0.282)	(0.295)
	[0.162]	[0.032]	[1.919]	[0.106]	[1.266]	[0.881]	[0.096]	[0.152]
M of WCC	1.571*	0.669***	1.191**	0.722**	0.415*	-0.094	0.455	-0.172
	(0.601)	(0.099)	(0.359)	(0.204)	(0.156)	(0.345)	(0.277)	(0.266)
	[2.614]	[6.754]	[3.32]	[3.539]	[2.655]	[0.273]	[1.641]	[0.649]
1M post-WCC	1.363	0.597*	0.971	0.563***	0.560***	-0.474*	0.093	-0.355
	(0.666)	(0.271)	(0.517)	(0.059)	(0.094)	(0.216)	(0.166)	(0.335)
	[2.047]	[2.202]	[1.878]	[9.472]	[5.968]	[2.195]	[0.564]	[1.06]
2M post-WCC	0.869	0.421	0.931	0.333	0.224	-0.403*	-0.885***	-0.544*
	(0.701)	(0.230)	(0.652)	(0.179)	(0.161)	(0.177)	(0.152)	(0.213)
	[1.24]	[1.831]	[1.428]	[1.862]	[1.386]	[2.28]	[5.806]	[2.554]
3M post-WCC and beyond	1.042***	0.265***	1.244***	0.790***	0.476**	-0.535**	-0.769*	-1.385***
	(0.137)	(0.049)	(0.115)	(0.077)	(0.162)	(0.150)	(0.297)	(0.221)
	[7.605]	[5.389]	[10.83]	[10.24]	[2.945]	[3.567]	[2.593]	[6.266]
Observations	11,968	11,968	11,968	10,249	10,249	25,020	25,020	21,142
R-squared	0.528	0.538	0.542	0.306	0.262	0.320	0.726	0.693
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,416	1,416	1,416	1,416	1,416	1,416	1,416	1,416

Notes: Standard errors clustered by category in parentheses with corresponding Wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A5. Triple-Difference Estimation of the Effects of Competition in the Full Sample

VARIABLES	(1) log(Chars)	(2) log(Chapters)	(3) log(Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) log(Promotion)	(7) log(Clicks)	(8) log(Purchases)
WCC × Treatment × Share	1.781***	0.519**	0.861**	0.328**	0.348**	-0.368**	-0.395*	-1.460***
	(0.376)	(0.128)	(0.278)	(0.082)	(0.122)	(0.083)	(0.167)	(0.114)
	[4.742]	[4.069]	[3.095]	[4.014]	[2.859]	[4.435]	[2.358]	[12.849]
Observations	17,250	17,250	17,250	15,074	15,074	33,622	33,622	28,278
R-squared	0.520	0.532	0.530	0.344	0.264	0.369	0.756	0.752
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,944	1,944	1,944	1,944	1,944	1,944	1,944	1,944

Notes: Standard errors clustered by category in parentheses with corresponding wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A6: Excluding the Martial Arts Category from the Control Group

Panel A: Main Effects

VARIABLES	(1) log(Chars)	(2) log(Chapters)	(3) log(Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) log(Promotion)	(7) log(Clicks)	(8) log(Purchases)
WCC × Treatment	1.190**	0.278**	0.768*	0.103**	0.006	0.138**	0.301***	0.369*
	(0.239)	(0.068)	(0.248)	(0.028)	(0.031)	(0.037)	(0.050)	(0.143)
	[4.978]	[5.478]	[3.393]	[3.708]	[0.194]	[3.747]	[6.019]	[2.585]
Observations	14,256	14,256	14,256	12,451	12,451	27,428	27,428	22,954
R-squared	0.517	0.121	0.142	0.345	0.261	0.365	0.746	0.751
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599

Panel B: Triple-Difference Estimation of the Effects of Competition in the Quasi-random Sample

VARIABLES	(1) log(Chars)	(2) log(Chapters)	(3) log(Extra Chars)	(4) Novelty (DS)	(5) Novelty (ML)	(6) log(Promotion)	(7) log(Clicks)	(8) log(Purchases)
WCC × Treatment × Share	1.172**	0.360**	1.083***	0.605***	0.349***	-0.485**	-0.587	-1.151**
	(0.226)	(0.076)	(0.135)	(0.079)	(0.059)	(0.114)	(0.261)	(0.205)
	[5.181]	[4.755]	[8.012]	[7.668]	[5.953]	[4.245]	[2.246]	[5.621]
Observations	9,705	9,712	9,684	8,294	8,294	20,192	18,833	16,937
R-squared	0.528	0.539	0.540	0.298	0.241	0.319	0.713	0.695
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES
# of Books	1,091	1,091	1,091	1,091	1,091	1,091	1,091	1,091

Notes: Standard errors clustered by category in parentheses with corresponding wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table A7. Comparison between Young and Old Books under the Fixed-price Contract

	Young Books (contract time after 2013.9)				Old Books (contract time in and before 2013.9)			
VARIABLES	(1) Novelty (DS)	(2) Novelty (ML)	(3) Log (Chars)	(4) Log (Chapters)	(5) Novelty (DS)	(6) Novelty (ML)	(7) Log (Chars)	(8) Log (Chapters)
WCC × Treatment	0.036	-0.145	0.263	-0.249	-0.352	-0.167	0.822	0.223
	(0.312)	(0.192)	(0.614)	(0.469)	(0.310)	(0.232)	(0.797)	(0.260)
	[0.115]	[0.758]	[0.391]	[0.531]	[1.133]	[0.718]	[1.032]	[0.855]
Observations	2,123	2,123	2,288	2,288	540	540	633	633
R-squared	0.372	0.320	0.400	0.357	0.319	0.258	0.613	0.633
Category Trends	YES	YES	YES	YES	YES	YES	YES	YES
Year-Month FE	YES	YES	YES	YES	YES	YES	YES	YES
Book FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Standard errors clustered by category in parentheses with corresponding wild-bootstrap t-statistics in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Theory Appendix

In this appendix, we provide a stylized model based on our empirical setting to analyze the effect of competition on author behavior. The general idea is that in a market with imperfect competition, a producer enjoys rent whose size increases in its market share. The entry of new products erodes the marginal return to creative activities, thereby discouraging the producer's incentive to engage in creative activities. On the other hand, the entry of products incentivizes the producer to protect its market share or steal other producers' market shares. This business-stealing effect (and the pressure of protecting businesses from being stolen) inspires creative effort. Such a trade-off between market erosion (or rent dissipation) and business stealing (or escaping competition) is central in the study of how competition affects innovation (e.g., Aghion et al. 2005; Vives 2008) and how competition disciplines managerial slack (e.g., Schmidt 1997; Raith 2003). We model this mechanism in the current empirical setting to investigate how it affects authors' routine efforts for quantity expansion and creative efforts for novelty improvement under a given contractual relationship.

1 Model Setup

In the online novel-writing market, after a chapter is written, the marginal cost of serving an additional reader is zero. Hence, a book earns rent whose size depends on its readership. In the product space, a book can be characterized by its match with readers' taste and its quality. In a market of this kind, typically a producer can use three strategies to compete: (1) pricing, (2) market positioning, and (3) changing product attributes. In the current setting, the price mechanism is muted because the platform sets the same unit price of all books to readers. Moreover, we study contracted books whose market positions (category) are set as part of the contractual agreement. Therefore, we focus on the third strategy.

As described in Section 2.2, an author can change the attributes of an ongoing book project in two ways. First, an author can exert routine effort to increase the length of chapters and frequency of updates. This quantity-expansion strategy caters to readers' preferences for faster consumption. Second, an author can exert creative effort to improve novelty of a book. Just as in any creative production, there is uncertainty regarding whether such creative effort leads to greater novelty.

With the above empirical background, consider N authors with equal ability in the market. Each author independently produces one and only one book project, whose market position is fixed. The unit price of all books is normalized to 1, and thus the demand (readership) of a book is also its revenue. Author i aims to maximize her profit by exerting routine

effort l_i to produce quantity and creative effort e_i to stochastically improve novelty. To save on notation, l_i will also indicate the length of writing, and e_i also indicate the probability of a successful improvement of novelty. The platform can take action p_i to promote book i.

Based on their contractual status, there are three types of books in the market: revenue-sharing books, fixed-price books, and books without contracts. Under the revenue-sharing contract, an author splits the revenue equally with the platform. Under the fixed-price contract, an author receives a fixed price per unit of the quantity she produces. Since we empirically do not analyze the books without contracts, we regard them as the numeraire and do not explicitly model them. To facilitate the analysis, we make the following assumptions.

Assumption 1 *The total market demand (overall reader time) is fixed and normalized to one.*

Assumption 2 *The demand for a book increases in its own length and novelty, and decreases in its competitor length and novelty because of the business-stealing effect. The market share an author can steal from another book through increasing its book length or novelty is a decreasing exponential function of the number of books in the market, N.*

Assumption 3 *The costs of exerting routine effort and creative effort are separable.*

Assumption 4 *A book's demand increases in the platform's promotion it receives. The platform's marginal cost of promoting a book decreases in N.*

Assumption 1 fits the empirical observation that the traffic (measured by daily user volume) on the platform changed little after competition intensified. Our empirical setting thus allows us to isolate the pure competition effect from the market size effect.

Assumption 2 assumes a reduced-form competitive relationship between books. A book with more desirable attributes (faster updates and novelty) steals demand (readership) from competitors. The size of this business-stealing effect from each competitor decreases in the total number of books in the market because as N increases, each book has a smaller market share to steal from. We use an exponential function for analytical simplicity.

Assumption 3 is a technical assumption that separates the decision on routine effort from the decision on creative effort. It can be relaxed easily.

Assumption 4 helps simplify the platform promotion strategy. The platform uses promotion to help a book enlarge its demand at the cost of reducing promotion resources for other books (particularly non-contracted books). The assumption that the marginal cost of promotion decreases in N is to capture the platform's main purpose of promoting non-contracted books, which is to encourage the participation of new authors (recall Section 2.2). When the number of new books increases, this need to encourage participation decreases.

With these four assumptions, we construct a simple model that captures the main features of the empirical setting to illustrate the key mechanisms and deliver testable results. We

discuss how relaxing each of these assumptions would change the results in Discussion section. We start with books under the revenue-sharing contract, which account for the dominant share of all contracted books.

1.1 Revenue-sharing Contracts

Under a revenue-sharing contract (indicated with superscript S), author i and the platform receive the following payoffs, π_i^S and Π_i^S, respectively, from book i.

$$\pi_i^S = \frac{1}{2}[\frac{1}{N} + \beta N^{-\sigma}\sum_{j\neq i}(l_i - l_j) + \gamma N^{-\sigma}\sum_{j\neq i}(I_i(e_i) - I_j(e_j)) + \alpha(p_i)] - c(l_i) - c(e_i), \quad (1)$$

$$\Pi_i^S = \frac{1}{2}[\frac{1}{N} + \beta N^{-\sigma}\sum_{j\neq i}(l_i - l_j) + \gamma N^{-\sigma}\sum_{j\neq i}(I_i(e_i) - I_j(e_j)) + \alpha(p_i)] - g(p_i, N). \quad (2)$$

Equation (1) describes author i's payoffs. The fraction $\frac{1}{2}$ comes from her equal share of the total revenue. In the bracket, $\frac{1}{N}$ represents the market demand for book i absent any additional forces because of Assumption 1 and the assumption that all books are equally good *ex ante*. The term $\beta N^{-\sigma}\sum_{j\neq i}(l_i - l_j)$ reflects Assumption 2. When facing chapters of books i and j, a reader spends more time on the lengthier one, which in turn reduces the time spent on the other book. The coefficient $\beta N^{-\sigma}$ captures the business stealing effect from each rival book if its author increases one unit of routine effort to produce one more unit of quantity. $\sum_{j\neq i}(l_i - l_j)$ captures the number of available books an author can steal market shares from or lose its market share to. $\beta > 0$ measures readers' sensitivity to the quantity difference between books; $\sigma > 0$ captures how easily the entry of new books erodes the market share of the existing books. When σ is larger, it is easier for new books to erode the demand for the existing books. Similarly, the term $\gamma N^{-\sigma}\sum_{j\neq i}(I_i(e_i) - I_j(e_j))$ captures the effect of novelty competition on gaining readership. Here, $\gamma > 0$ measures readers' sensitivity to novelty, and I_i is an indicator function that equals 1 if novelty is improved and 0 otherwise. After exerting effort e_i, author i can improve the novelty of her writing with probability e_i. Thus, $I_i(e_i) - I_j(e_j) = e_i(1 - e_j) - (1 - e_i)e_j$. The term $\alpha(p_i)$, with $\alpha'(p_i) > 0$, captures book i's additional readership caused by platform promotion.

The last two terms are the cost functions for routine effort and creative effort. By Assumption 3, they are separable. We further assume $c'(l_i) > 0$, $c''(l_i) > 0$, $c'(e_i) > 0$, and $c''(e_i) > 0$ to ensure the existence of interior solutions.

Equation (2) describes the platform's payoffs. The benefit part is the same as the one for author i because they equally split the revenue. The only new term is $g(p_i, N)$, which is the cost of promoting book i in terms of the reduction of other books' promotion resources. We assume that $\frac{\partial g}{\partial p_i} \geq 0$ to ensure the existence of solutions. By Assumption 4, $\frac{\partial g^2}{\partial p_i \partial N} < 0$.

1.2 Fixed-Price Contracts

We now turn to the books under the fixed-price contract. The payoffs to an author under this contract and the platform, indicated with a superscript F, are described below, respectively:

$$\pi_i^F = \theta l_i - c(l_i) - c(e_i), \tag{3}$$

$$\Pi_i^F = \frac{1}{N} + \beta N^{-\sigma} \sum_{j \neq i} (l_i - l_j) + \gamma N^{-\sigma} \sum_{j \neq i} (I_i(e_i) - I_j(e_j)) + \alpha(p_i) - \theta l_i - g(p, N). \tag{4}$$

The author's payoff is simpler in this case because she is paid by the word at a predetermined price θ for a unit output. The platform claims the entire residual net of the pay to the author. The promotion cost function is the same as the one under the revenue-sharing contracts.

2 Equilibrium Analysis

Under the given contractual formats, authors simultaneously and independently choose their optimal levels of routine and creative efforts to maximize their objective functions specified above. The platform chooses the optimal level of promotion for each book at the same time. The market clears when the supply equals the demand.[1] Below we add superscripts $\{S, F\}$ to indicate equilibrium outcomes for the decision variables under the two contractual types.

2.1 Solutions

For revenue-sharing books, under the regularity conditions to ensure interior solutions, the optimal responses are determined by the following first order conditions:

$$\frac{\beta}{2} N^{-\sigma}(N-1) = c'(l_i^S), \tag{5}$$

$$\frac{\gamma}{2} N^{-\sigma}(N-1) = c'(e_i^S), \tag{6}$$

$$\frac{1}{2}\alpha'(p_i^S) = \frac{\partial g(p_i^S, N)}{\partial p_i^S}. \tag{7}$$

The left-hand side of equation (5) is the marginal benefit of increasing routine effort: a book steals $\frac{\beta}{2} N^{-\sigma}$ from each of the $N-1$ competitors. The right-hand side is the marginal cost of exerting routine effort. Similarly, when an author exerts one more unit of creative cost to improve quality, her book will steal $\frac{\gamma}{2} N^{-\sigma}$ from each of the $N-1$ competitors.

The solutions to the optimization problems under the fixed-price contract are straightforward. Since the payoff of an author under fixed-price is independent of market performance, she has no incentive to exert any amount of creative effort: $e_i^F = 0$. Under the regularity

[1] With the demand being fixed by Assumption 1, clearing the market requires that the increased consumption of the contracted books should be offset by the decreased consumption of the non-contracted books. This is feasible given that empirically the non-contracted books are four times as many as the contracted books.

conditions that we have imposed on the functional forms to ensure interior solutions, the optimal levels of routine effort and platform promotion are determined by the following first order conditions:

$$\theta = c'(l_i^F), \tag{8}$$

$$\alpha'(p_i^F) = \frac{\partial g(p_i^F, N)}{\partial p_i^F}. \tag{9}$$

Note that although a revenue-sharing author will always exert more creative effort than a fixed-price author, this is not necessarily true for routine effort. If the price paid to a fixed-price author is large enough, she may exert more routine effort (write a lengthier book) than a revenue-sharing book.

From equations (7) and (9), the platform equalizes the net marginal benefit of promoting either type of contracted books and will allocate more promotion resources to fixed-price books, of which the platform claims the entirety, instead of half, of the residual.

2.2 Comparative Static Analysis

We now consider how an author and the platform respond to an increase in N. For revenue-sharing books, differentiating the first order conditions (equations (5), (6) and (7)) with respect to N, we obtain the following equations.

$$\frac{dl_i^S}{dN} = \frac{\beta}{2} N^{-\sigma}(1 - \sigma\frac{N-1}{N})\frac{1}{c''(l_i^S)}, \tag{10}$$

$$\frac{de_i^S}{dN} = \frac{\gamma}{2} N^{-\sigma}(1 - \sigma\frac{N-1}{N})\frac{1}{c''(e_i^S)}, \tag{11}$$

$$\frac{dp_i^S}{dN} = \frac{\frac{\partial^2 g(p_i^S, N)}{\partial p_i \partial N}}{\frac{1}{2}\alpha''(p_i^S) - \frac{\partial^2 g(p_i^S, N)}{\partial p_i^2}}. \tag{12}$$

By the convexity assumption of the cost functions, $c''(l_i^S) > 0$ and $c''(e_i^S) > 0$. Hence, the signs of $\frac{dl_i^S}{dN}$ and $\frac{de_i^S}{dN}$ both depend on the sign of $1 - \sigma\frac{N-1}{N}$. The intuition is that the entry of new books (an increase in N) erodes the market share of book i, which decreases the business that an existing book can steal from another book. However, exerting more effort now allows author i to steal businesses from more books. The term $1 - \sigma\frac{N-1}{N}$ reflects the trade-off between market erosion and business stealing. The overall effect is ambiguous, depending crucially on the magnitude of σ.

Consider a special case where $\sigma = 1$. In this case, when a new book enters the market, it equally share the market demand with the existing books, and the market-erosion effect is thus proportional to $\frac{1}{N}$. Then, the business-stealing effect dominates, leading to an unambiguous result: $\frac{dl_i^S}{dN} > 0$ and $\frac{de_i^S}{dN} > 0$. This result also holds for $\sigma < 1$. However, when $\sigma > 1$, the elasticity of market erosion with respect to N is sufficiently large, it is possible that $\frac{dl_i^S}{dN} < 0$

and $\frac{de_i^S}{dN} < 0$. In our empirical setting, the new books on average are unlikely to be more attractive to readers than the existing books. Hence, we will focus on the case where $\sigma \leq 1$.

Consider (7), the second order condition that ensures the existence of interior solutions requires the denominator to be negative (i.e., $\frac{1}{2}\alpha''(p_i^S) - \frac{\partial^2 g(p_i^S,N)}{\partial p_i^2}$). By Assumption 4, $\frac{\partial^2 g(p_i^S,N)}{\partial p_i \partial N}$. Hence, $\frac{dp_i^S}{dN} > 0$.

For fixed-price books, neither the author's routine effort nor her creative effort depends on N. The only response comes from the platform. Differentiating equation (9) with respect to N, we obtain:

$$\frac{dp_i^F}{dN} = \frac{\frac{\partial^2 g(p_i^F,N)}{\partial p_i \partial N}}{\alpha''(p_i^F) - \frac{\partial^2 g(p_i^F,N)}{\partial p_i^2}}. \tag{13}$$

Again, by the second order condition ($\alpha''(p_i^F) - \frac{\partial^2 g(p_i^F,N)}{\partial p_i^2} < 0$) and by Assumption 4, we have $\frac{dp_i^F}{dN} > 0$.

Compare equations (12) and (13). Under the regularity conditions on the functional form, $|\frac{1}{2}\alpha''(p_i^S) - \frac{\partial^2 g(p_i^S,N)}{\partial p_i^2}| > |\alpha''(p_i^F) - \frac{\partial^2 g(p_i^F,N)}{\partial p_i^2}|$ and $\frac{\partial^2 g(p_i^S,N)}{\partial p_i \partial N} < \frac{\partial^2 g(p_i^F,N)}{\partial p_i \partial N}$. Thus, $\frac{dp_i^S}{dN} < \frac{dp_i^F}{dN}$, implying that entry of new books increases the platform's promotion of fixed-price books more than that of revenue-sharing books.

We summarize the above analysis in the following two propositions.

Proposition 1 ***(Average Effect of Competition)*** *The entry of new books leads to the following results: (1a) existing authors will increase routine effort to produce more content and update more frequently, (1b) existing authors will increase creative effort to improve the novelty of their works, and (1c) the platform will promote contracted books more intensively.*

Proposition 2 ***(Effects of Competition under Different Contracts)*** *The entry of new books leads to the following results: 2a) authors under the fixed-price contract increase neither routine nor creative effort; 2b) authors under the revenue-sharing contract increase both routine and creative efforts; 2c) the increase of the platform's promotion of contracted books disproportionately favors fixed-price books over revenue-sharing books.*

It should be noted that even if the sign of the effect of competition on author effort is certain, the magnitude of this effect depends importantly on readers' sensitivity to the quantity difference between books β, and readers' sensitivity to novelty γ. In the empirical setting, an author's improvement of book novelty does not necessarily trigger a uniform response from readers because not all readers may appreciate the same type of novelty. In this case, the effect of competition may appear only modest. The effect of competition also depends on the convexity of the cost functions $c(l_i^S)$ and $c(e_i^S)$. For instance, if the cost goes up very fast when an author tries to improve book novelty, the effect of competition on her creative effort may not be significant.

3 Discussion

Our empirical analysis focuses on Propositions 1 and 2, which are derived under Assumptions 1-4. We now discuss how the results change if we relax these assumptions.

Assumption 1 fixes the market size. We adopt this assumption because empirically we observe stable market demand and we also control for monthly clicks by book category in regressions. Suppose that the market demand also expands because as a result of authors' increased efforts, the attributes of books become more attractive. Then, the strategy of quantity expansion or novelty improvement will allow a book to steal more business from competitors. Thus, the incentives of revenue-sharing authors to exert routine and creative effort will increase. The results in Propositions (1a), (1b), and (2b) will become stronger and the others will be unchanged.

Assumption 2 imposes a simple functional form for the business stealing effect for analytically tractability. More generally, we can assume $\beta(N)$ and $\gamma(N)$ to be more flexible functions of N. For example, one could allow for a nested demand structure. In this situation, the business-stealing effect will be stronger for closer substitutes and weaker for remote substitutes. The basic insights from the model will continue to hold.

Assumption 3 assumes independence between the exertion of routine effort and that of creative effort. Suppose that it does not hold: routine effort and creative effort are interdependent. If they are complements, the results remain unchanged. However, if they are substitutes in the sense that they both occupy the author's time, then the result that both routine effort and creative effort increase with N may not hold. Presumably, it is more costly to adjust creative effort than to increase routine effort, at least for books that have existed in the market for a while. In this case, after competition intensifies, an author will increase routine effort, which may lead to negative correlation between competition and her creative effort. Our empirical evidence does not support that the two types of efforts are not substitutes on average.

Assumption 4 helps simplify the function of platform promotion substantially. In practice, platform promotion can complement an author's effort. For instance, it is easier to have an effect on readers when the platform promotes books that are updated faster and have a higher level of novelty. In this case, the results in Propositions 1 and 2 will be strengthened. It is also possible that platform promotion alleviates the pressure of increased competition, resulting in a lack of author response to competition. To separate the promotion effect and the competition effect, in the empirical analysis, we show that authors whose books do not receive platform promotion still respond to competition as hypothesized in Propositions 1 and 2.

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