

# Does Free Consultation Promotion Affect Paid Consultations? An Empirical Investigation of Online Medical Consultations

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## Abstract

*Recently, online healthcare platforms have started offering free consultation services for patients and have launched promotions to encourage physicians to engage in free consultations. However, it is unclear whether and how these promotions may spill over and affect paid consultations, which is the primary form of OMCs and the major profit for OHPs. We fill this gap and provide practical suggestions by studying the spillover effect of platform-initiated promotion of free consultations on subsequent paid consultations. Exploiting an OHP-initiated event, we draw causal inferences by adopting a staggered difference-in-difference approach combined with matching techniques. We find that the free-consultation promotion has a positive spillover effect on the volume of subsequent paid consultations. Our mechanism analyses suggest that this result may stem from patient-side changes through two pathways: a direct freemium effect and an indirect, mediating awareness effect. Our findings provide all stakeholders with a deeper understanding of the impact of free consultations on OHPs and insights into promoting such services.*

**Keywords:** online medical service, free consultations, spillover effects, staggered DID, mechanism analysis

## 1. Introduction

With the rapid development of digitalization, individuals increasingly rely on the Internet for health and medical advice. According to recent reports, more than half of adults in the United States search for health information and address health-related issues online (Lewis and Mcinturff 2024) and nearly a quarter of users in China engage in online consultation services two to four times a year (Zheng 2024). The sheer volume of demand has caused online healthcare platforms (OHPs) to become an increasingly important intermediary linking patients and physicians for medical consultations. Compared to clinic visits, interacting with physicians on OHPs is more convenient for patients as

it overcomes location and time constraints (Power 2025). Nonetheless, many patients may lack the ability to discern the quality of online medical information, and the advice provided in online question-and-answer (Q&A) may not be trustworthy or reliable (Chen and Walker 2023).

To improve the quality of online medical advice, a new form of service, online medical consultations (OMCs), has been increasingly used on major OHPs, such as MDLIVE and BetterHelp. As suggested by industry experts, OMCs can reduce healthcare costs while improving patients' experience and thus provide an ideal model for the future of healthcare (Ustun et al. 2024). Compared to online Q&As or knowledge sharing, OMCs are more formal medical services in which qualified physicians perform one-on-one consultations with patients and provide treatment advice (Liu et al. 2023). The primary form of OMCs is paid consultations, where patients select and compensate specific physicians for medical advice. The economic benefits from paid consultations may incentivize physicians' continued engagement and foster OHPs' sustained development.

Nonetheless, as OMCs are credence service, patients face challenges in quality evaluation even after consumption (Jiang et al. 2025, Saifee et al. 2020). This hinders OHPs from attracting patients to consultation services. Such challenge stems primarily from information asymmetry between patients and physicians. Specifically, physicians generally know patients' conditions and needs, but patients have limited knowledge about physicians' expertise and service quality (Xu et al. 2021). As a result, the uncertainty about consultation services and service providers (physicians) often makes patients hesitant to pay for consultations (e.g., choose paid consultations) with unfamiliar physicians (Jiang et al. 2025).

To address the challenges associated with paid consultations, managers and practitioners of OHPs have been increasingly focusing on free consultation as an effective way to engage patients and physicians (Pellegrino 2022). Compared to the paid consultation,

the free consultation has the same format and requirements, providing a lower-cost opportunity for patients (Duhan 2023).

### 1.1. Motivation

The practice of providing online free consultations has been increasingly embraced by healthcare providers to help patients establish remote, low-cost access to physicians for non-emergency medical needs and reduce unnecessary offline visits (Duhan 2023, Pellegrino 2022). In practice, more OHPs, hospitals, and governments have recognized the importance of free online consultations and launched promotional campaigns. For example, major Chinese OHPs such as JD Health and Ping An Good Doctor have initiated promotional campaigns for their free online consultations (Nandu 2020, Shen and Yang 2023). In Delhi, the government has joined hands with the CallDoc app to launch free OMC services (IANS 2020). Some OHPs, such as WeDoctor and haodf.com, have launched promotions offering small financial rewards to physicians who participate in free consultations (Nandu 2020).

Despite this emerging trend of platform-initiated promotions to increase free consultations, little is known about the effectiveness of such promotion initiatives on physician and patient engagement in OMCs. It is a widely debated question in the healthcare industry without an answer. Some industry commentators have argued that free consultations can improve the efficiency of OMCs (Duhan 2023), while others have urged caution in using platform-initiated promotions in healthcare, as it may have unintended consequences on physicians' medical consultation performance (Khullar et al. 2018).

Given the ongoing debates among industry practitioners regarding the effectiveness of promoting free consultations, the answer to this question is not clear in practice. Nonetheless, understanding the effect of platform-initiated promotions of free consultations is important for OHP managers, as they need to know whether such promotions can bring more traffic to the platforms by attracting more patients to use online consultations (Zhang et al. 2022). It is also important for physicians, as their economic benefits can be greatly affected by such promotional initiatives. In addition, some healthcare practitioners have highlighted the importance of understanding the mechanisms by which the platform-initiated promotional activities influence physicians and patients (Bestsenny et al. 2021, Reilly 2022). Therefore, our study responds to the practical call by investigating the effects of free consultation promotion and its underlying mechanism, which remain unexplored in practice and current literature.

### 1.2. Research questions and contributions

Although the promotion of free consultations on OHPs has become increasingly common, there are debates about its effects on paid consultations, which is the dominant form of OMCs on OHPs and the primary source of physicians' economic benefits (Fan et al. 2023, Ryan 2023, Strkljevic et al. 2024). To address these practical issues raised by healthcare practitioners and shed light on the effectiveness of promoting free medical services on OHPs, we examine the potential externalities of the platform-initiated promotion of free consultations on the primary form of OMCs: paid consultations, which are highly relevant to physicians, patients, and OHPs. By understanding the effectiveness of the promotion of free consultations, managers of OHPs may design tailored promotions to encourage physician and patient engagement and implement suitable measures for free consultation services that can benefit physicians and patients. To bridge this research gap, we raise our first research question: (1) *Does the platform-initiated promotion of free consultations exert a spillover effect on the subsequent paid consultations? If so, what is the direction of the effect?*

We find that the platform-initiated promotion of free consultations exerts a significant and positive spillover effect on the volume of paid consultations. This result suggests that promoting free consultations does not cannibalize but improve the quantity of paid consultations. We are among the first to measure the impact of the platform-initiated promotion of free consultations on physicians' paid consultations. Our findings imply that OHPs may not need to worry about the negative externalities of such promotions, and we further provide practical insights into the design and implementation of the platform-initiated promotion.

After discussing the spillover effect of free consultation promotion, our follow-up question is to ask what the mechanism underlying this effect is. Some practitioners and commentators have suggested that studying the underlying mechanism is an important practical issue, as it can guide OHPs on maximizing the effectiveness of the promotion (Bestsenny et al. 2021). However, in our online healthcare context, little is known about how the platform-initiated promotion of free consultations affects subsequent paid consultations. Understanding these dynamics is crucial for developing effective management strategies in OMCs. Therefore, to identify the mechanism of the platform-initiated promotion of free consultations and address the practical questions raised by practitioners, we propose our second research question: (2) *What is the underlying mechanism of the spillover effect of the platform-initiated promotion of free consultations on the subsequent paid consultations?*

Our mechanism analyses identify two distinct mechanisms through which the promotion of free consultations influences paid consultation volume: a direct freemium effect and an indirect awareness effect. We find that promoting free consultations may serve as a freemium strategy, which directly contributes to patients' choice of physicians for paid consultations. In addition, the promotion may improve other patients' awareness and consideration of physicians who offer free consultations, which may in turn increase patients' participation in paid consultations (e.g., mediation effect).

To empirically answer these research questions, we obtain data about physicians' participation in free consultations and paid consultations over a six-month period from one of the largest OHPs in the world. During this period, the platform launched a promotion to encourage physicians to provide and engage in free consultations. Exploiting this platform-initiated event, we perform a difference-in-difference analysis to measure the spillover effects of the promotion of free consultations on the subsequent paid consultations, measured by volume. To analyze the reasons underlying the potential spillover effects, we conduct mechanism analyses.

## 2. Literature

Our study relates to the literature on OHPs in general and online healthcare services. In practice, there are different online healthcare services available to physicians and patients, including OMCs, medical Q&A, and appointment scheduling (Liu et al. 2023, Peng et al. 2020, Xu et al. 2021). The extant research related to the physician side focuses primarily on the impact of physicians' participation on OHPs and incentives for physicians' participation (Fan et al. 2023, Liu et al. 2023). Prior research related to the patient side focuses mainly on the impact of patients' use of online healthcare services on their health outcomes, such as health improvement (Yan and Tan 2014), health literacy and health attitude (Chen et al. 2019), and subsequent hospitalizations (Bao et al. 2020). While prior research has discussed physicians' and patients' engagement in OHPs and the use of OMCs, literature on the impact of promoting free OMCs remains scarce. As free consultations become increasingly relevant in practice, their promotion by OHPs may affect patient and physician engagement in other online medical activities (Napit 2022). Therefore, there is a need to examine this possible externality. Our research fills this gap by identifying the causal impact of platform-initiated promotion of free consultations on physicians' paid consultations.

In addition, our study is related to free service

provision (freemium). The provision of free services or products is a common promotional strategy used to attract consumers in online markets, such as e-commerce platforms and mobile app stores (Deng et al. 2023, Lin et al. 2019). Two common types of strategies are free trial and freemium. The former is a full-featured pricing strategy with quantity or time restrictions, while the latter is a limited-featured strategy with or without quantity or time restrictions (Li 2022, Pattabhiramaiah et al. 2022). In our context, the free consultation service is not a free trial service. Instead, it is a service with limited features analogous to the basic product/service in a freemium model. Literature on freemium strategy has examined the impact of free versions of apps on paid versions in terms of the speed of adoption (Arora et al. 2017), demand (Deng et al. 2023), and sales (Liu et al. 2014). Although freemium strategies have been extensively studied in contexts such as e-commerce and the application market, their effectiveness in online healthcare remains unknown. We fill this gap by examining how platform-initiated promotion of free consultations (as a freemium strategy) influences paid consultations and explores the underlying mechanisms. We contribute to freemium literature by extending it into the healthcare context, where services are characterized as credence goods requiring physicians to provide customized responses to patient needs. In addition, our findings provide practical implications for healthcare providers to understand freemium strategies on OHPs.

## 3. Empirical context and data

We collect data from one of the largest OHPs in China, with over 260,000 registered physicians for various types of diseases. The platform allows patients to select paid or free consultations. If a patient chooses free consultations, the platform will randomly assign them to a physician with related expertise. If the patient chooses paid consultations, the patient can select a physician they would like to consult. In January 2020, the COVID-19 (coronavirus) outbreak began in Wuhan and spread rapidly to other areas in China. In response to this crisis, on January 26, 2020, the platform designated 5 million RMB as financial rewards and launched a promotional campaign to encourage physicians from all departments to sign up to provide voluntary consultations for all types of diseases. A physician would receive a small amount of financial reward (5 RMB) from the platform for completing each free consultation. A few weeks later, the reward fund was used up, but the platform continued to encourage physicians to provide free consultations in the promotional message, and physicians can still provide free consultations.

The platform-initiated nature of this promotion allows us to identify a causal impact. Specifically, the promotion creates plausibly exogenous variations in free consultation provision, which may exert an effect on patient-side changes related to paid consultations, i.e., consultation volume. Similar to previous studies (Liu et al. 2020b), we use a quasi-experimental design with the launch of the free-consultation promotion as our cutoff time point for the pre-promotion and post-promotion period. We designate six weeks before the promotion launch as the pre-promotion period and the eighteen weeks following the promotion launch as the post-promotion period to allow for the full exertion of any spillover effect.

For dependent variables, we examine the quantity of paid consultations. Similar to Huang et al. (2021), we measure the quantity using the number of paid consultations conducted by physician  $i$  during a particular week  $t$ , denoted as  $SerNums_{it}$ . To reduce the

skewness and yield elasticity-based interpretation (Zhao et al. 2022), we log the quantity variable, denoted as  $Log(SerNums)_{it}$  in the subsequent analyses. In addition, we use the number of the physician  $i$ 's replies in paid consultations during a particular week  $t$  as the alternative measure (denoted as  $Replies_{it}$ ), which is also commonly used in the online healthcare literature (Burtch et al. 2018b). Similarly, we log this variable to reduce the skewness, denoted as  $Log(Replies)_{it}$ .

Our independent variable is the treatment variable  $Treated_{it}$ . For notation, the treatment grouping variable  $Treated_{it}$  takes the value of 1 if physician  $i$  has provided free consultations influenced by the platform-initiated promotion of free consultations in week  $t$ , and the value continues to be 1 for all the subsequent weeks (treatment group); it takes the value of 0 otherwise (control group). We present the definitions and descriptive statistics of key variables in Table 1.

**Table 1. Definitions and descriptive statistics of key variables.**

Variables	Description	Mean	SD	Min	Max
$Treated_{it}$	Dummy variable indicating whether physician $i$ has engaged in free consultations influenced by the platform-initiated promotion by week $t$	0.165	0.371	0.000	1.000
$Log(SerNums)_{it}$	Log number of paid consultations conducted by physician $i$ in week $t$	0.567	0.896	0.000	5.398
$Log(RepNums)_{it}$	Log number of physician $i$ 's replies in paid consultations in week $t$	1.059	1.578	0.000	7.943
$Log(Tenure)_{it}$	Log days since physician $i$ started on OHP by week $t$	7.601	0.721	3.611	8.404
$Title_{it}$	Dummy variable indicating whether physician $i$ is a chief physician in week $t$	0.353	0.478	0.000	1.000
$Log(Price)_{it}$	Log consultation price of physician $i$ in week $t$	3.528	1.186	0.000	7.231
$Log(Patients)_{it}$	Log number of cumulative patients treated by physician $i$ in week $t$	6.467	1.699	2.485	11.234
$Log(Letters)_{it}$	Log number of thank-you letters from patients received by physician $i$ in week $t$	2.904	1.569	0.000	7.309

#### 4. Empirical identification and analysis

Our empirical analyses aim to quantify the spillover effect of the platform-initiated promotion of free consultations on physicians' subsequent paid consultations. The key variation we leverage is the provision of free consultations by physicians influenced by the promotion. Following the literature (Chen et al. 2023, Liang et al. 2024), we employ the staggered DID estimation to identify the spillover effect of physicians' provision of free consultations at different times after the promotion launch on paid consultations.

In addition, in our context, some physicians signed up for free consultations in response to the promotion announcement, while others did not. This might give rise to a self-selection concern: the promotion treatment may not be randomized, which may cause the treatment group to be systematically different from the control group, thus violating the parallel trend assumption. To mitigate this concern, we use the propensity score matching (PSM) method to construct a control group of

physicians similar to the treated physicians, i.e., the two groups have a similar likelihood of engaging in free consultations after the promotion launch.

With the matched sample, we use a two-way fixed-effects model, a popular model specification in DID under the staggered treatment (Li and Wang 2025, Liang et al. 2024), to compare the changes in paid consultations before and after the provision of free consultations across the treatment and control groups of physicians. We employ the model in the following:

$$Y_{it} = \beta_0 + \beta_1 Treated_{it} + Controls_{it} + \alpha_i + \delta_t + \varepsilon_{it}, \quad (1)$$

where  $Y_{it}$  refers to  $Log(SerNums)_{it}$  and  $Log(RepNums)_{it}$ .  $Treated_{it}$  is a binary variable indicating whether physician  $i$  has provided free consultations influenced by the platform-initiated promotion in week  $t$ . It equals to 1 if physician  $i$  has provided free consultations in week  $t$  and the value continues to be 1 for all the subsequent weeks (treatment group) and 0 otherwise (control group). Our coefficient of interest is  $\beta_1$ , which measures the impact of the promotion of free consultations on paid consultation volume.  $Controls_{it}$

includes  $\text{Log}(\text{Tenure})_{it}$ ,  $\text{Title}_{it}$ ,  $\text{Log}(\text{Price})_{it}$ ,  $\text{Log}(\text{Patient})_{it}$ , and  $\text{Log}(\text{Letter})_{it}$ .  $\alpha_i$  captures the unobserved, time-invariant, individual-specific effects,  $\delta_t$  captures the time-specific effects, and  $\varepsilon_{it}$  captures idiosyncratic random errors. We present the results in Table 2.

In Column (1) of Table 2, which shows the result for the log number of paid consultations conducted by physicians, we find that the coefficient of  $\text{Treated}_{it}$  is positive and statistically significant (0.315). Specifically, compared to the control group physicians, the treated physicians who have provided and engaged in free consultations have 31.5% more paid consultations on average after the promotion launch. Column (2) reports the results for the log number of physicians' replies in paid consultations, where the coefficient of  $\text{Treated}_{it}$  is also positive and statistically significant (0.613). These findings suggest that the platform-initiated promotion of free consultations can significantly increase the treated physicians' subsequent paid consultation volume compared to those in the control group.

**Table 2. Spillover effects of the free consultation promotion on paid consultations.**

Variables	(1) <i>Log(SerNums)</i>	(2) <i>Log(RepNums)</i>
<i>Treated</i>	<b>0.315***</b> (9.81)	<b>0.613***</b> (11.53)
<i>Log(Tenure)</i>	-0.639*** (-3.06)	-0.847** (-2.21)
<i>Title</i>	0.145 (1.63)	0.273* (1.73)
<i>Log(Price)</i>	0.056* (1.79)	0.109** (2.15)
<i>Log(Patients)</i>	0.024 (0.24)	0.078 (0.42)
<i>Log(Letters)</i>	0.334** (2.02)	0.564* (1.90)
Constant	3.438** (2.54)	3.734 (1.51)
Observations	26,496	26,496
R-squared	0.202	0.187
Physician FE	YES	YES
Week dummies	YES	YES

Robust t-statistics in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The results in Table 2 answer our first research question. Contrary to the industrial belief that free consultations may cannibalize paid consultations (Ryan 2023), our findings indicate that the platform-initiated promotion of free consultations has a positive spillover effect on the quantity of subsequent paid consultations. Our findings contribute to the IS literature on the promotion and provision of free OMCs in online healthcare. Specifically, our findings identify the key role of the platform-initiated promotion of free

consultations in improving patient participation in paid consultation. This addresses a research gap regarding how platform promotions shape subsequent user performance on OHPs, which has not been examined in prior studies. To uncover the mechanism behind this effect, we conduct in-depth empirical analyses in §5, responding to the appeal from healthcare practice (Bestsenny et al. 2021, Reilly 2022).

In addition, we provide a set of robustness checks on our analyses. First, to test the key assumptions of the DID specification in the main analysis, i.e., the behavioral outcomes of the treatment group and control group should exhibit a similar trend prior to the exogenous shock (Greenwood and Watal 2017), we refer to several IS studies to test for parallel trends using the relative time model (Burtch et al. 2018a, Kuang et al. 2019). Following Liang et al. (2023), we incorporate multiple lead and lag periods into the DID model to estimate whether treatment group physicians who are “treated” at different times follow parallel trends with matched control group physicians in the pre-promotion period.

We visualize the weekly dynamic treatment effect estimates on physicians' paid consultation before and after their engagement in free consultations with 95% confidence intervals in Figure 1. As expected, the coefficients of the pre-treatment variables in (1) and (2) of Figure 1 are insignificant, suggesting that the parallel trend assumption is met. This finding indicates there are no significant differences in the quantity of paid consultations between the treatment and control groups before physicians' engagement in free consultations facilitated by the platform promotion. Furthermore, the coefficients of the post-treatment variables are all positive and significant regarding the quantity of paid consultations, but with an overall downward trend for treated physicians compared to physicians in the control group. Overall, results in Figure 1 show that the parallel trend assumption is met.

In addition, we have conducted several other robustness checks including 1) excluding the confounding impact of COVID-19 pandemic-related events; 2) excluding the influence of most active physicians; and 3) a falsification test to check if the observed spillover effects are exclusive to physicians involved in free consultations. We perform this test by randomly selecting a sample from the control group to act as the new “treated” group. We find that 1) after controlling for the impact of pandemic-related factors, the results of the DID analysis are consistent with the results of the main analysis; 2) after excluding the most active physicians, the results for the rest of the physicians are consistent with those in the main analysis; and 3) no significant results are observed for the new “treated” group, suggesting the observed spillover

effects are caused by physicians' actual participation in free consultations.

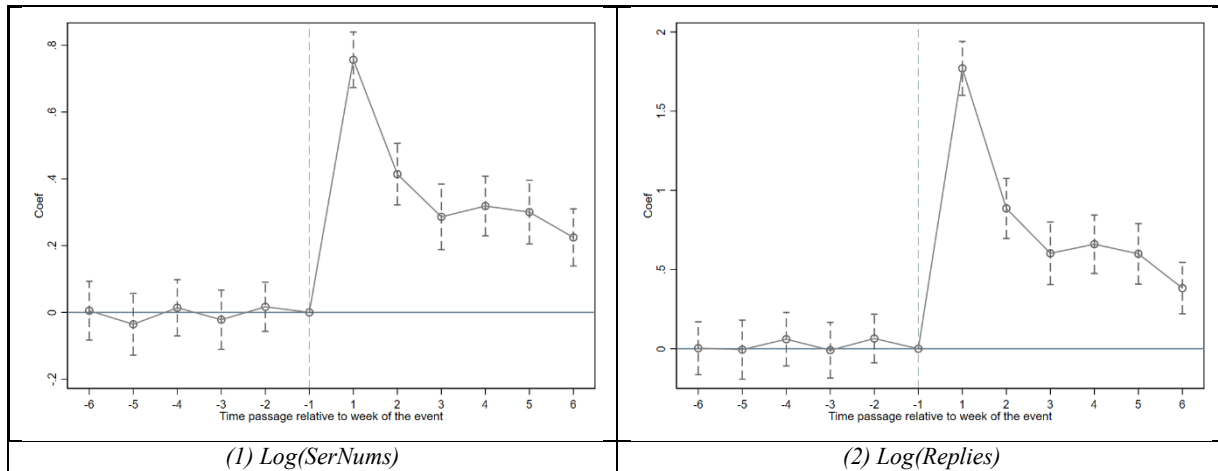


Figure 1. Group differences in physicians' paid consultations.

## 5. Mechanism analysis

In this section, we first construct a mechanism framework comprising two pathways: a direct effect through the freemium strategy (freemium effect) and an indirect effect through increased patient awareness (awareness effect). Then, we investigate whether the freemium strategy plays a role in the promotion of free consultations. Finally, we use causal mediation analysis to quantify the awareness effect by studying the changes in patient awareness and in the subsequent paid-consultation decisions.

### 5.1. Mechanism framework

We propose a mechanism framework to explain how the platform-initiated promotion of free consultations increases paid consultation volume through both direct and indirect effects (in Figure 2). First, we examine a direct effect through the freemium mechanism, where free consultations serve as the basic service in a freemium model. Previous research shows that the freemium strategy enables consumers to directly experience services before purchasing, thereby increasing their willingness to pay for premium services (Cheng and Tang 2010). On OHPs, this freemium strategy is particularly valuable since patients face uncertainty about physicians and their services due to information asymmetry (Yan et al. 2022). By promoting free consultations, OHPs provide patients with more opportunities to directly experience online medical services, which may reduce their uncertainty for healthcare providers and medical services. This, in turn, may facilitate patients' conversion to physicians' paid consultation services. Therefore, we propose that the

promotion of free consultations may exert a direct freemium effect on patients' subsequent participation in paid consultations (e.g., the volume of paid consultations).

Second, we propose an indirect effect through the patient awareness mechanism. Prior literature suggests that platform-initiated activities (e.g., product recommendations) can influence consumers' awareness of specific products by directing consumers' attention to them (Li et al. 2022). Along this line, the platform-initiated promotion of free consultations can direct patients' attention to free consultations and the providers (physicians) who offer such services. This makes more patients become aware of the physicians who provide free consultations, thereby prompting more patients to consider those physicians. Moreover, prior literature suggests that customers' purchase decisions are drawn from their consideration sets rather than from all available alternatives (Roberts and Lattin 1997, Zhao et al. 2024). Therefore, we propose that the increased patients' awareness and consideration of physicians who offer free consultations may lead to more patients choosing those physicians for their consultation services. Put together, there is a potential indirect (mediation) effect where the platform-initiated promotion of free consultations increases patients' awareness of those physicians who provide free consultations, which in turn results in more patients choosing those physicians for paid consultations (increases paid consultation volume). We call such a mediation effect the patient awareness effect.

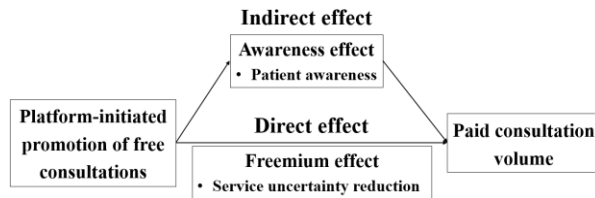


Figure 2. Mechanism framework.

## 5.2. The role of freemium strategy

In this section, we investigate whether the platform-initiated promotion of free consultations can influence paid consultation volume through the freemium mechanism. Following prior literature (Kumar 2014), we assess the effectiveness of the freemium strategy by analyzing patients' conversion rates to paid consultations. Using a DID analysis, we examine changes in conversion rates before and after the promotion launch across physicians in treatment and control groups. In the pre-promotion period, patients made consultation decisions primarily based on information obtained from visiting physicians' homepages. Thus, we use the number of patients' homepage visits to measure the number of patients who are aware of and pay attention to the physicians whose homepages are visited by patients. Correspondingly, we measure the conversion rates by the ratio of the number of paid patients (e.g., who participate in paid consultations) to the number of homepage visits by patients. In the post-promotion period, conversion rates are measured as the proportion of patients who participate in treated physicians' paid consultations after experiencing free consultations with those physicians (e.g., first-party information). For physicians in the control group who did not offer free consultations, the conversion rate remains measured by the ratio of the number of paid patients to the number of physician-homepage visits by patients.

Table 3. Results of DID analysis on patient conversion rates to paid consultations

Variables	(1) <i>Patient</i> <i>conversion rate</i>	(2) <i>Patient</i> <i>conversion rate</i>
<i>Treated</i>	<b>0.119***</b> (19.94)	
<i>Treatment</i> × <i>After</i>		<b>0.124***</b> (18.05)
Constant	0.213 (0.75)	0.189 (0.70)
Observations	24,276	24,924
R-squared	0.217	0.179
Physician FE	YES	YES
Week dummies	YES	YES

Robust t-statistics in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 3 presents our DID analysis results. In Column (1), using a staggered DID estimation, we find that the coefficient of *Treated* is positive and statistically significant (0.119), indicating that the patients' paid conversion rates for physicians in the treatment group are significantly higher than that for physicians in the control group. In addition, Column (2) reports the results of a canonical DID analysis, using the platform's announcement date of the free consultation promotion as the time point of the exogenous shock. The results are consistent with those in Column (1). These findings indicate that the platform-initiated promotion of free consultation effectively serves as a freemium strategy to facilitate the subsequent patients' participation in paid consultations (increase paid consultation volume).

## 5.3. Awareness effect

In this section, we examine the indirect effect (mediation effect) of patient awareness in the main relationship between the platform-initiated promotion of free consultations and changes in the volume of paid consultations. To examine this potential mediation mechanism, we conduct causal mediation analysis to identify the direct and indirect effects while accounting for potential confounding factors (Lin and Rai 2024, Mousavi and Gu 2024).

Specifically, we use patients' awareness of physicians as the mediator, measured by the log number of patient visits to the physician *i*'s homepage in week *t*, denoted as  $Log(Visits)_{it}$ . Given that patients' awareness of physicians and the paid consultation volume are correlated and could lead to reverse causality concerns, we lag the homepage visits by one week (relative to the paid consultation volume). Furthermore, to accurately quantify the promotion's effect on patient awareness, which in turn affects the subsequent paid consultations, we replace the treatment dummy variable with promotion intensity, measured by the number of free consultations for physician *i* in week *t* (denoted as  $Intensity_{it}$ ).

Using the causal mediation framework, we calculate the natural direct effect (NDE) and natural indirect effect (NIE). We present the results of the causal mediation analysis in Table 4. In Column (1), we find that the NIE for patient awareness is 0.035 (significant at 0.01). In Column (2), we find the NIE is 0.054 (significant at 0.01). These results suggest that the promotion of free consultations significantly increases paid consultation volume by increasing patients' awareness of physicians who provide free consultations. The NDEs for promotion intensity in two columns are 0.122 and 0.262, respectively (both significant at 0.01), representing the direct effect when the mediator is

controlled. According to the causal mediation analysis, if patient awareness is a mechanism channeling the influence of the promotion, a significant proportion of the total effect should be mediated through this pathway.

Indeed, the results of the last row in two columns of Table 4 show that a significant proportion of the total effect (22.1% and 17%, respectively) is channeled through patient awareness.

**Table 4. Mediating role of patient awareness in the main effect.**

Variables	(1) <i>Log(SerNums)</i>	(2) <i>Log(RepNums)</i>
Natural indirect effect (NIE): <i>Intensity</i> → patient awareness → paid consultation volume	<b>0.035***</b> [0.029, 0.041]	<b>0.054***</b> [0.044, 0.063]
Natural direct effect (NDE): <i>Intensity</i> → paid consultation volume	<b>0.122***</b> [0.095, 0.150]	<b>0.262***</b> [0.214, 0.310]
Total effect: <i>Intensity</i> on paid consultation volume	<b>0.157***</b> [0.134, 0.180]	<b>0.316***</b> [0.275, 0.356]
Proportion mediated	<b>0.221***</b> [0.155, 0.286]	<b>0.170***</b> [0.121, 0.218]

Confidence intervals in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## 6. Discussion and conclusion

Our research contributes to the literature on physicians' engagement on OHPs by studying the spillover effect of the platform-initiated promotion of free consultations on physicians' subsequent paid consultations, which has not been studied in the literature. Considering the essential role of physicians as medical service providers on OHPs, it is important to fill this research gap because the outcomes of online medical consultations may directly affect patients, physicians, and the sustainability of OHPs (Liu et al. 2020b, Wang et al. 2020). In addition, free online consultation has become increasingly popular on OHPs and has been widely promoted by governments and hospitals (IANS 2020, McArthur 2020). Practitioners and researchers need to understand free consultations and their externalities. Our study is among the first to examine and quantify the economic spillover effect of platform-initiated promotion of free consultations on paid consultations on OHPs.

By exploiting an exogenous event, an OHP-initiated promotion of free consultations, our results reveal that the promotion has a significant and positive spillover effect on the quantity of paid consultations. Further, our mechanism analyses show that the positive spillover effect is mainly driven by the changes on the patient side. Specifically, the promotion of free consultation provision has a direct freemium effect on patients' subsequent participation in paid consultations (e.g., paid consultation volume). Furthermore, the impact of promotion is mediated through improved patients' awareness of physicians who provide free consultations, which in turn translates into an increased volume of patients' subsequent paid consultations.

### 6.1. Theoretical implications

Our study contributes to the literature on the impact of physicians' engagement in online healthcare services. Prior literature has studied the effect of patients' use of OHPs on their health outcomes (Bao et al. 2020, Chen et al. 2019, Yan and Tan 2014). With regard to physicians, prior research has examined the impact of physicians' online engagement on patients' recommendations (Khurana et al. 2019), health outcomes, and physician-patient relationships (Liu et al. 2020b). Although it has become increasingly popular for OHPs to promote free consultations, the impact of physicians' engagement in free consultations has been less studied. Our study fills this gap in the literature by exploring the effect of physicians' promotion-influenced participation in free consultations on their paid consultations.

### 6.2. Managerial implications

It is crucial for platform managers to understand the spillover effects of such promotion to avoid or mitigate any potential adverse or unintended effects on medical consultation outcomes. Our findings contribute to a deeper understanding of the impact of free medical consultations among healthcare stakeholders, including practitioners of OHPs and physicians.

Our answers to the research question (1) suggest that the OHPs promoting free consultations does not cannibalize paid consultations but improves them in the long term. This implies that OHPs may not need to worry about the negative externalities of the free consultation promotion. Instead, we recommend that OHPs launch different promotional campaigns for free consultations to foster physicians' engagement, and such recommendation aligns with industry

practitioners' opinions (Nandu 2020). Although most platform-initiated promotions of free consultations tend to be rather ad-hoc and in response to external stimulus, e.g., the increased popularity of online consultations or the competitor's first move (McArthur 2020, Shen and Yang 2023), our findings suggest that OHPs may consider providing more promotions for free consultations regularly, even in the absence of external stimuli.

In addition, our mechanism results imply that the promotion of free consultations can serve as a freemium strategy and enhance patients' awareness and consideration of physicians who provide free consultations, thereby increasing patients' subsequent participation in paid consultations. Correspondingly, we recommend that OHP managers implement separate patient evaluation and recognition channels for free and paid consultations. In particular, the independent evaluation and recognition channel for free consultations, such as achievement badges (Liu et al. 2020a), can prominently increase the visibility of physicians who provide free consultations. This can effectively facilitate patients' choice of physicians for their free consultations.

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