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Does media-based health risk communication affect commercial health insurance demand? Evidence from China

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ABSTRACT

In recent years, the mass media (such as TV shows and movies) plays an important role in communication with the general public. In this paper, we investigate the impact of a recent movie from China, 'Dying to Survive', on the demand for commercial health insurance. To explore this impact, a fixed-effect model and instrumental variable estimation are utilized, and the causal effect of movie-based health risk communication on commercial health insurance demand is studied. The result shows that the cumulative box office value of a movie has a significantly positive impact on the income from commercial health insurance premium, with a one- or two-day lag. This movie has encouraged viewers to purchase short-term commercial health insurance rather than long-term insurance. In addition, the heterogeneity of the impact exists for movie arrangement rate, average family size, urbanization rate, medical resource level, and per capita disposable income. The results show that sufficient health risk communication can improve the social 'visibility' of health risk.

I. Introduction

Presently, individuals face increased health risks. However, there is no significant consistency between actual and perceived risk (Covello & Sandman 2001). It has also become common for people to overlook health risks, which reduces appropriate management actions, such as purchasing health insurance (Wei and Li 2007; Bränström, Kristjansson, and Ullén 2006; Gold 2008).

Previous studies have shown that risk communication can improve people's risk perception (Slovic 1986). Some of the examples of risk communication include presenting slides that emphasize the use of sunglasses to prevent skin cancer, senile plaques and wrinkles; breast cancer risk counselling; genetic risk counselling; and providing social comparison feedback on colorectal cancer risk factor (Mahler et al. 1997; Bowen et al. 1998; Hopwood 2000; Lipkus and Klein 2006). Previous studies have also investigated the impact of media-based communication on risk perception. For example, media coverage of skin cancer and H1N1 promotes people's perception of the risk (Morton and Duck 2001; Schmälzle et al. 2013; Xie, Li, and Yu 2008).

Improved risk perception usually urges people to take measures to avoid the risk, as high risk causes fear, anxiety, depression, and other negative emotions. People will take the initiative to take measures to relieve or alleviate this state (Cho and Lee 2006; Cooper and Faseruk 2011). The higher the severity and ease of encountering a perceived threat, the stronger the motivation for individual protection (Rogers 1975). As an effective instrument of health risk protection, commercial health insurance has become an important way for residents to manage health risks. Previous studies investigated the effect between risk perception and insurance purchase. For example, Bhat and Jain (2006) find that residents' risk perception of future health care expenditure significantly promotes the purchase of commercial health insurance. Wang and Sun (2011) find that after the outbreak of SARS, residents increased their demand for commercial health insurance, but this effect only had a short-term effect. Low risk perception is an important reason for the low purchase of long-term care insurance (Boyer et al. 2017; Tian, Browne, and Gründl 2010, 2010). The more

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optimistic males are concerning their cancer risk, the lower their willingness to pay for cancer insurance (Riddel and Hales 2018).

There are few studies on the direct effect of health risk communication on commercial health insurance purchase. This is essential as identifying the potential direct effect of risk communication on risk transfer can guide policy makers in improving the demand for commercial health insurance and residents' health. Due to the unavailability of data, previous studies mainly conduct research with a small sample size using experimental methods (Mahler et al. 1997; Bowen et al. 1998; Morton and Duck 2001; Lipkus and Klein 2006; Schmälzle et al. 2013) or non-empirical approaches (Hopwood 2000). However, a small number of observations may affect the accuracy of the research results and increase the difficulties in conducting heterogeneous research. Non-empirical research results are difficult to quantify, and thus, the causal effect is hard to examine. To solve these problems, we use a longitudinal database at city level. This allows us to deal with the endogeneity issues by adopting empirical analysis and enabling us to carry out heterogeneity in analysis.

Following previous studies, we consider movies as a measurement of health risk communication. The movie, Dying to Survive ('Wo bu shi yao shen', DTS henceforth), is a nationwide famous movie that discusses topics related to health risks and the social security system. Based on the daily city level panel data, including information on the cumulative box office of DTS and the premium income of one of the biggest insurance companies in China, denoted as H insurance company, we apply the fixed-effect and instrumental variable methods. This paper studies the impact of media-based health risk communication on residents' commercial health insurance demand. The results show that the daily cumulative box office of DTS does not have a significant impact on the current commercial health insurance premium, however the impact becomes significant when we consider one- or two-day lag of the treatment variable. More specifically, a ten thousand yuan increase in the cumulative box office of DTS in day t, will significantly increase the commercial health insurance premium in day t + 1 and t + 2 by 10.07–11.46 and 8.63–10.01 yuan, respectively. No evidence is found that movie performance in day t, can increase the insurance purchase behaviour in day t + 3 and onwards. In addition, when taking into consideration the different types of commercial health insurance, the cumulative box office of DTS has a significant positive impact on short-term commercial health insurance premium income, rather than a long-term one. We further justify the phenomenon from both demand and supply sides of Chinese commercial health insurance market.

The contribution of this paper is reflected in two aspects: first, to the best of the authors' knowledge, this paper is the first to study the direct impact of media-based health risk communication, on residents' demand for commercial health insurance. Second, the up-to-date longitudinal database (a daily, city level, panel data covering 20 Chinese cities) enables us to study the causal effect and conduct various robustness checks.

The following sections proceed as follows: section 2 introduces the background of Chinese commercial health insurance development and the movie DTS. Section 3 describes the data. Section 4 explains the estimation methods. Section 5 analyzes the estimation results. Section 6 is the extended analysis, and the final section is the research conclusion and policy implication.

II. Background

Commercial health insurance in China

Chinese commercial health insurance is at very early stage of development, and is closely related to the development of social health insurance. In the early 1990s, China did not have a comprehensive medical security system covering all city residents; only employees of state-owned enterprises received social health insurance. In 1998, 8.9% of rural residents received medical insurance (Liu 2012). Many people could not afford basic health care, and families bore the burden of high medical expenses (Watts 2006).

In 1998, China issued the decision on establishing the Urban Employees' Basic Medical Insurance (UEBMI), which encouraged residents to purchase commercial medical insurance as a supplement. The number of people participating in commercial

health insurance gradually increased. New Cooperative Medical Scheme (NCMS) for rural areas and Urban Residents' Basic Medical Insurance (URBMI) were established in 2003 and 2007, respectively, forming a comprehensive social health insurance system for all residents.[1] Since then, government turned its attention to the development of commercial health insurance.

In 2009, the State Council issued the Opinions on Deepening the Reform of the Medical and Health System, which proposed a multi-level medical security system, in which social health insurance provides security for residents' basic medical needs, and commercial health insurance provides security for high-cost and catastrophic inpatient care (Liu, Gao, and Rizzo 2011). Social health insurance has limited coverage for treatment and prescriptions, co-payments, deductibles, and limited reimbursement (Yip et al. 2012), leaving enough room for the development of commercial health insurance which can provide more options to meet people's needs (Wu, Li, and Ercia 2020; He and Wu 2017). A series of policies and announcements were approved to encourage the development of commercial health insurance (Choi et al. 2018),[2] leading to its prosperous development. As shown in Figure 1, the income from commercial health insurance premiums has increased a hundred-fold since year 2000 (Figure 1). Additionally, there are more types of products available. Specifically, by July 2021, there were 37 individual and 5370 non-personal tax preferential commercial health insurance products on sale, including disease insurance, medical insurance, disability income insurance, care insurance and medical accident insurance.[3] However, commercial health insurance is still in the early stage of development in China (Choi et al. 2018). In 2019, the income from commercial health insurance premiums was 706.6 billion yuan, the insurance depth of commercial health insurance was 0.71%, and the insurance density was 504.70 yuan. Compared to developed countries (such as the United States), the commercial health insurance development level is still low and there is room for development.
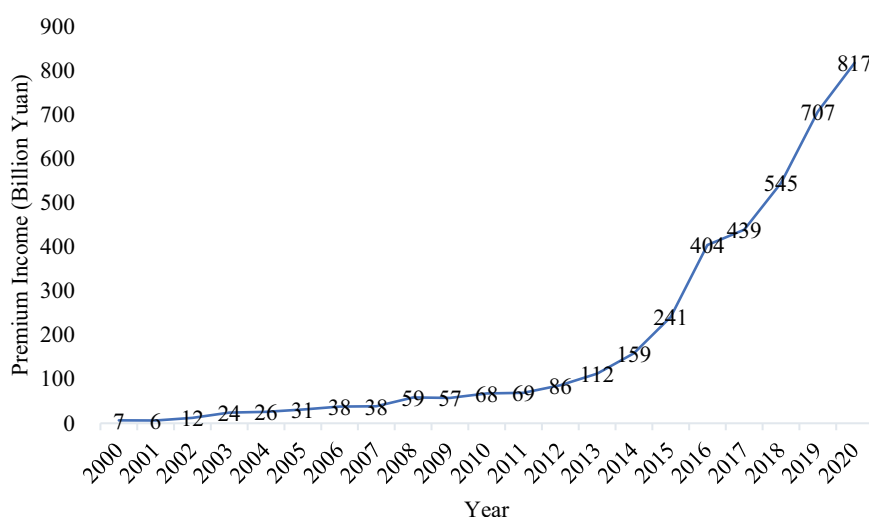

Figure 1. Annual commercial health insurance premium income in China 2000–2020. Data source: China Banking and Insurance Regulatory Commission.

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[1]From 2016, China starts to integrate the URBMI and the NCMS into the medical insurance for urban and rural residents' basic medical insurance (URBMI) (Wan et al. 2020).

[2]In 2003, the former China Insurance Regulatory Commission promulgated the Guiding Opinions on Accelerating the Development of Health Insurance. In 2014, the State Council issued several Opinions on Accelerating the Development of Commercial Health Insurance. From 2015, the Chinese government implemented tax relief policies to promote the development of commercial health insurance (Jiang and Ni 2020). In 2016, Healthy China 2030 Planning Outline proposes to encourage enterprises and individuals to participate in commercial health insurance. In 2020, Suggestions of the Central Committee of the Communist Party of China on Formulating the Fourteenth Five-year Plan for National Economic and Social Development and the Long-Term Goals for the Year 2035 proposes to actively develop commercial medical insurance.

[3]Insurance Association of China, http://www.iachina.cn.

Release of the movie Dying to Survive

On 5 July 2018, the movie DTS was released in China, with a total box office of 3.1 billion yuan. The movie was adapted from a real event; it focuses on patients with chronic myelogenous leukaemia and introduces the phenomenon of 'sky-high drugs'. The main characters in the movie face their own life difficulties and bear economic pressure, illness, and sadness (Zhong and Wang 2019). DTS presents nearly real health risks to the viewers, as well as the risks of illness, death, property loss, family accidents, and other risks derived from health risks.

As a phenomenologically realistic movie (Liu and Cui 2020), DTS caused heated discussion and wide acclaim (Zhong and Wang 2019), and aroused especially wide discussion and concern on health risk and health insurance from all walks of life. The greatest value of DTS lies in its ability to make people and the government think deeply about the reform of the medical system (Hang 2018). Premier Li Keqiang reacted after the release of DTS by asking relevant departments to implement measures, such as reducing the price of anti-cancer medicines and guaranteeing the supply of medicines as soon as possible so as to truly ensure patients' real protection (Zhong and Wang 2019).

DTS did improve viewers' health risk perception, however, did they take practical actions to manage health risks? To answer this question, it is necessary to study the causal effect of media-based health risk communication on thecommercial health insurance premium income.

III. Data

Based on publicly available authoritative and government data, as well as the internal data of the insurance company, the authors construct a unique panel database to support this study. The database covers the period from 1 June 2018 to 30 September 2018, covering 20 cities in 15 provinces/municipalities in the eastern, central, and western regions.[4] The database includes information about different movies, including daily index data, cumulative box office, arrangement rate,[5] cumulative viewers, cumulative shows etc. In addition, it includes the insurance company's daily information, such as their commercial health insurance premium income, and daily H insurance Baidu index. Other daily variables, such as cumulative Baidu index, date of weekend or festival, weather, and air quality are included. The 2017 annual variables, such as average family size, urbanization rate, number of medical institutions per thousand people, and per capita disposable income are also included.[6]

The insurance company information is from H insurance company, one of the top 500 enterprises in the world, covering businesses, such as life insurance, health management, medical care and pension, and asset management. The 2017 annual data is from the websites of the statistical bureaus of 20 cities. Other variables are collected from corresponding official websites.[7]

This study focuses on whether media-based health risk communication affects residents' demand for commercial health insurance. The dependent variable is commercial health insurance premium income. To distinguish the effect of different types of insurance products, we further consider two extra dependent variables: short-term and long-term commercial health insurance premium income.[8]

Movies are a common instrument to measure health risk communication (Lerbinger 1997). Our independent variable is media-based health risk communication measured by the cumulative box

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[4]Twenty cities include Shanghai, Beijing, Chengdu, Shenzhen, Guangzhou, Wuhan, Chongqing, Hangzhou, Suzhou, Xi'an, Nanjing, Changsha, Zhengzhou, Ningbo, Wuxi, Tianjin, Hefei, Dongguan, Shenyang and Fuzhou.

[5]The arrangement rate refers to the proportion of the number of showings of a movie in all movies' showings arranged by the cinema per day.

[6]The annual data is used for heterogeneity research and not included as the control variables due to the application of fixed-effect model. Considering that DTS released in June 2018, not at the end of December 2018, we choose the 2017 annual data to conduct the heterogeneity research. Due to the availability of data, the average family size of Changsha sourced from the sixth national census in China, and the data on the urbanization rate of Shenzhen is from the year 2015.

[7]The data on the box office and movie arrangement rate are from Maoyan professional website (the website provides timely, accurate and professional box office data for movie industry practitioners), https://piaofang.maoyan.com/dashboard. The data on the Baidu index is from the Baidu index website, http://index.baidu.com/v2/index.html#/. The data on weather is from the Tianqi website, http://www.tianqi.com. The data on air quality is from the official website of the ministry of ecology and environment of the people's republic of China, http://www.mee.gov.cn.

[8]Short-term commercial health insurance refers to policies that cover people for one year or within one year, while long-term commercial health insurance policies cover people for more than one year or cover people for no more than one year but contain a guarantee renewal clause.

office income of DTS.[9] It should be noted that after watching DTS, people may not purchase insurance on the same day due to non-business hours of the insurance company, or individuals' time arrangement. Thus, a lag effect of DTS on commercial health insurance purchase may exist. The application of the cumulative box office income rather than daily data can avoid this issue, as it is commonly used to measure the performance of a movie (Eliashberg and Shugan 1997).

Control variables include H insurance Baidu index, which is the daily search scale of the keyword 'H insurance' in the Baidu search engine. The inclusion of this variable is because insurance premium income may be easily affected by the company marketing policy, the change of marketing policy of any type of insurance in H insurance company may influence residents' behaviours regarding entering the keyword 'H insurance' in the Baidu search engine. Control variables also include a dummy variable for non-working days, which takes the value 1 when the day is a holiday or festival break, and takes 0 otherwise. The inclusion of this variable is because insurance companies do not open on holidays or weekends, which may have an important impact on residents' purchase of commercial health insurance. In addition, weather and air quality may also impact residents' commercial health insurance demand (Chang, Huang, and Wang 2018). Therefore, we included average temperature, rainfall, and air quality. Rainfall is a dummy variable depending on whether the day is rainy or not. The descriptive statistical results of the main indicators are shown in Table 1.

IV. Method

Our purpose is to estimate the effect of media-based health risk communication on residents' demand of commercial health insurance; however, time-unvarying unobservable variables may have an impact on residents' purchasing

Table 1. Descriptive statistics of variables (number of observations: 1260).

Variable	Mean	Standard deviation	Minimum	Maximum
Commercial health insurance premium income (yuan)	35420.21	272871.60	0.00	6761140.00
Short-term commercial health insurance premium income (yuan)	30057.34	239238.20	0.00	5027490.00
Long-term commercial health insurance premium income (yuan)	5362.87	52369.98	0.00	1733650.0
Cumulative box office (ten thousand yuan)	6274.49	4764.48	9.50	19400.00
Cumulative Baidu index	177725.00	138775.10	911.00	683187.00
H insurance Baidu index	116.21	42.59	0.00	268.00
Weekend or festival (0/1)	0.32	0.47	0.00	1.00
Average temperature (°C)	29.22	2.36	17.00	36.00
Rainfall (0/1)	0.42	0.49	0.00	1.00
Air quality	74.69	36.24	18.00	204.00

behaviour of commercial health insurance. In order to avoid the influence of these omitted time unvarying variables, we construct a fixed-effect model. The basic regression model is as follows:

$$I_{m,t} = \alpha + \beta \text{movie}_{m,t} + \delta X_{m,t} + \mu_m + \theta_t + \varepsilon_{m,t} \quad (1)$$

where $I_{m,t}$ represents three types of commercial health insurance premium income, from city m at time t. $\text{movie}_{m,t}$ represents the cumulative box office of the movie DTS from city m at time t. $X_{m,t}$ represents control variables mentioned in the data section. μ_m represents the city fixed effect. θ_t measures the time fixed effect. $\varepsilon_{m,t}$ represents residual error.

There might be a lag effect in the above specification. Thus, we consider the lagged value of the treatment variable; the specification is listed below.

$$I_{m,t} = \alpha + \beta \text{movie}_{m,t-1} + \delta X_{m,t} + \mu_m + \theta_t + \varepsilon_{m,t} \quad (2)$$

Formula (2) represents the impact of the cumulative box office of day t-1 on the commercial health insurance premium income of day t. Since we use the cumulative box office, $\text{movie}_{m,t}$ from Equation (1) is not added in formula (2).

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[9]On 30 June 2018, DTS began to be shown nationwide; on 5 July 2018, DTS was formally released. On 31 August 2018, the cumulative box office had reached 3.098 billion yuan. Since then, the increase of the cumulative box office was negligible. Therefore, this study selects the box office data of DTS from 30 June 2018 to 31 August 2018.

To measure the long-term lag effect, we further estimate the impact of the cumulative box office with a two-period lag on current commercial insurance premium income. The specification is listed as below:

$$I_{m,t} = \alpha + \beta movie_{m,t-2} + \delta X_{m,t} + \mu_m + \theta_t + \varepsilon_{m,t} \tag{3}$$

As mention before, since we use the cumulative box office, not the daily box office, $movie_{m,t}$ and $movie_{m,t-1}$ are not added in formula (3). By considering Equations (1) – (3), we can detect the current and different period lag effect of DTS on commercial health insurance.

Although the fixed-effect model has controlled the city level, time unvarying, unobservable heterogeneities, endogenous problems may exist due to omitted time varying variables. We further applied instrumental variable method to solve this issue. This paper takes the cumulative Baidu index as an instrumental variable, which is the daily cumulative search scale of the keyword 'DTS' in the Baidu search engine. Lag treatment variables in Equation (2) and (3) correspond to lagged values of Baidu index. Instrumental variables should satisfy two conditions. First is that the instrumental variable is highly correlated with the treatment variable, but not correlated with the random errors of the model. After the movie, DTS, was released, residents usually learned about the movie online before going to the cinema. Baidu, as the largest Chinese search engine, is one of the most important platforms for residents to learn about DTS. However, it is reasonable to assume that searching DTS online could not affect the insurance purchasing decision of an individual, thus guaranteeing that it satisfies the second condition, that it is an exogenous instrumental variable.

Table 2 shows the estimation from first stage regression. The results indicate that instrumental variables significantly increase the DTS cumulative box office. F statistics are 1271.05, 1245.57, and 1244.30 for specifications (1) to (3), respectively, which are larger than 10, indicating good instruments (Staiger and Stock 1997).

Table 2. The first stage regression.

Variable	Cumulative box office		
	Current period	One-period lag	Two-period lag
Cumulative Baidu index (Current period)	0.03*** (0.00)		
Cumulative Baidu index (One-period lag)		0.03*** (0.00)	
Cumulative Baidu index (Two-period lag)			0.03*** (0.00)
H insurance Baidu index	0.08 (0.45)	0.05 (0.46)	0.09 (0.46)
Weekend or festival	314.33 (327.06)	156.78 (134.91)	169.70 (134.04)
Average temperature	−10.52 (11.58)	−3.74 (11.74)	−0.07 (11.99)
Rainfall	75.64** (37.83)	71.23* (37.90)	71.89* (38.80)
Air quality	2.33*** (0.61)	1.84*** (0.61)	1.54** (0.61)
F-test	1271.05	1245.57	1244.30
# Obs.	1260	1240	1220

Driscoll-Kraay standard error in parentheses.
* p < 0.1, ** p < 0.05, *** p < 0.01.

V. Results

Table 3 presents the impact of media-based health risk communication measured by DTS on residents' commercial health insurance demand. Results under both approaches show that cumulative box office cannot significantly increase the purchase of commercial health insurance on the same day, but significantly improves individuals' purchasing behaviour after one or two days. However, this significant positive effect disappears after three days. This might be because the people's feeling after watching the movie might decrease with time after a couple of days.[10] More specifically, when cumulative box office revenues increase by 10 thousand yuan on day t, the increase of commercial health insurance premium income on day t + 1 and t + 2 are 10.07–11.46 yuan and 8.63–10.01 yuan, respectively.

Nearly all the control variables have an insignificant effect on commercial health insurance demand under both approaches. However, if we focus on the IV approach, the significant effect of a holiday or festival break stand out. Such a break has a significant negative effect on commercial health insurance demand. This is reasonable, as no services are offered by companies during those days. The insignificant effects of other control variables are consistent with previous research finding that rainfall

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[10]Due to limited space, relative regression results are not reported for lags n (n > 2) periods.

Table 3. Effect of health risk communication on commercial health insurance demand.

Variable	FE	IV	FE	IV	FE	IV
Cumulative box office (Current period)	−20.46 (27.26)	−25.99 (28.40)				
Cumulative box office (One-period lag)			10.07*** (3.75)	11.46** (5.11)		
Cumulative box office (Two-period lag)					8.63** (3.83)	10.01* (5.35)
H insurance Baidu index	92.61 (96.62)	80.48 (130.22)	70.63 (89.45)	73.24 (106.10)	79.72 (91.84)	81.87 (106.70)
Weekend or festival	262282.80 (203855.82)	229483.57 (148314.25)	7557.69 (34702.64)	−92921.42** (41874.28)	−58464.73 (38460.85)	−93001.25** (41842.19)
Average temperature	8060.09 (4955.14)	7788.16 (5919.06)	4429.66 (4352.93)	4476.40 (4384.59)	4675.65 (4359.39)	4707.05 (4474.38)
Rainfall	42747.73 (37686.00)	42346.81 (33852.16)	7084.33 (16973.16)	7101.51 (17190.97)	8886.19 (17278.13)	8904.45 (17314.54)
Air quality	266.33 (661.79)	265.82 (595.27)	−324.41 (268.84)	−324.29 (260.78)	−320.62 (268.80)	−319.94 (262.80)
R square	0.10	0.10	0.07	0.07	0.07	0.07
# Obs.	1260	1260	1240	1240	1220	1220

Driscoll-Kraay standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

and temperature are not significant predictors for commercial health insurance (Chang, Huang, and Wang 2018); however, the insignificant nature of air quality is inconsistent with the results of Chang, Huang, and Wang (2018). This may be because our study was conducted during a time of good air quality.[11]

We are also interested to see the effect of DTS on different types of commercial health insurance. Table 4 presents the estimation of the effect of DTS on the premium income of short-term and long-term commercial health insurance. The results indicate that DTS significantly improves short-term, rather than long-term, commercial health insurance purchases. Similar to the baseline estimation in Table 3, the DTS does not affect purchase behaviour on the same day of watching the movie, but one or two days later. However, after three days, the positive effect disappears.

Potential explanations for the insignificant improvement of long-term commercial health insurance can be considered from both demand and supply sides. On the demand side, the price of long-term commercial health insurance is relatively high due to the consideration of risk factors including healthcare costs rising and increased risk associated with age. Therefore, short-term commercial health insurance

Table 4. Effect of media-based health risk communication on short-term/long-term commercial health insurance demand.

Variable	Premium income of short-term commercial health insurance		Premium income of long-term commercial health insurance	
	FE	IV	FE	IV
Cumulative box office (Current period)	−14.93 (22.39)	−18.43 (21.47)	−5.52 (4.93)	−7.56 (7.36)
Cumulative box office (One-period lag)	9.93*** (3.61)	11.24** (5.02)	0.14 (0.50)	0.22 (0.53)
Cumulative box office (Two-period lag)	8.52** (3.74)	9.88* (5.28)	0.10 (0.49)	0.13 (0.53)
Control variable	Yes	Yes	Yes	Yes

Driscoll-Kraay standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Numbers of observations for current, one-period lag, and two-period lag specification are 1260, 1240, and 1220, respectively. For sake of brevity, estimations of control variables are not reported and are available upon request.

becomes an affordable solution for residents looking for health coverage.[12] In addition, purchasing long-term commercial health insurance means committing to future expenditures. This makes it less attractive than short-term policies, especially when residents have a low degree of trust in the Chinese commercial insurance market (Fan and Wang 2015).

On the supply side, there is an unbalanced development between short-term and long-term insurance products, and the former account for a relatively high proportion of the market.[13] This also applies to H company (58 short-term vs. 17

[11]Based on the Technical Regulation on Ambient Air Quality Index (on trial) (HJ633 − 2012) (http://www.mee.gov.cn/ywgz/fgbz/bz/bzwb/jcffbz/201203/t20120302_224166.shtml), the average air quality of the study period was 74.69, in the second highest ranking level out of six levels.
[12]The price of short-term commercial health insurance is usually less than 500 yuan per year (Song and Chen 2021), which is much lower than the price of long-term commercial health insurance. For instance, the average annual premium of a typical long-term policy, tax-preferential health insurance, is 2947 yuan based on the Sina Financial Website, http://finance.sina.com.cn/money/insurance/bxdt/2019-03-04/doc-ihrfqzkc1062841.shtml.
[13]Based on information from the Insurance Association of China (http://www.iachina.cn), by the end of July 2021, there were 3363 (2044) short (long)-term commercial health insurance products available.

long-term commercial health insurance products).[14] The reason for this unbalanced development is because of the operating risk embedded in long-term commercial health insurance (Song 2020). Thus, China Banking and Insurance Regulatory Commission issued two important documents to encourage its development.[15] The low accessibility of long-term commercial health insurance products inhibits residents from purchasing them (Yin, Wu, and Gan 2015). Therefore, it is reasonable to find an insignificant effect of health risk communication on residents' purchase of long-term commercial health insurance.

VI. Extended analysis

In this section, we conduct extended analysis by using different measurements of media-based health risk communication, different types of risk communication rather than health risk communication, the use of logarithm for outcome variables, and the subgroup analysis.[16]

Different measurements for media-based health risk communication

To test the robustness of the model, we use cumulative viewer and cumulative show to replace the cumulative box office. Table 5 shows the results of the impact of two new treatment variables on commercial health insurance demand. We get similar results with our baseline model, showing that DTS has a lag positive effect on health insurance purchase.

Different types of risks communication

In order to find out whether communication of other types of risk has an impact on residents' commercial health insurance demand, we select three adventure movies; Doraemon The Movie 2018: Nobita's Treasure Island, The Island 2018, and The Solutrean 2018, to investigate the impact of cumulative box office on commercial health insurance premium income. In order to eliminate the potential time trend of insurance premium income, the above mentioned three movies are selected based on their release dates which are before, during, and after the hot showing of the movie DTS.[17]

Table 6 presents the results showing that none of the three movies has significant effect on commercial health insurance purchase. This emphasizes the message that a movie plays a vital role. Direct and specific health risk communication is essential for increasing commercial health insurance demand.

Log transformation of the commercial health insurance premium income

The log-linear model is widely used in health economics papers to manage skewed outcomes (Manning and Mullahy 2001). Therefore, this section

Table 5. Effect of cumulative viewer and cumulative show on commercial health insurance demand.

Variable	Commercial health insurance premium income			Variable	Commercial health insurance premium income		
Cumulative viewer (Current period)	−831.18 (1104.89)			Cumulative show (Current period)	−19900.18 (29087.51)		
Cumulative viewer (One-period lag)		403.90*** (148.37)		Cumulative show (One-period lag)		12015.02** (4818.62)	
Cumulative viewer (Two-period lag)			351.32** (152.65)	Cumulative show (Two-period lag)			10618.79** (4832.29)
Within R square	0.10	0.06	0.07	Within R square	0.09	0.06	0.06
Control variable	Yes	Yes	Yes	Control variable	Yes	Yes	Yes
# Obs.	1260	1240	1220	Observation	1260	1240	1220

Driscoll-Kraay standard errors in parentheses.
* p < 0.1, ** p < 0.05, *** p < 0.01.

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[14]These data are from H insurance company.
[15]The two documents are the Measures for the Administration of Health Insurance in 2019 and the Notice on Issues Related to the Rate Adjustment of Long-term Medical Insurance Products in 2020.
[16]The results of fixed-effect and instrumental variable approaches are similar based on previous analysis, for the sake of brevity, only the estimations of FE are reported in this section.
[17]Doraemon The Movie 2018: Nobita's Treasure Island is an adventure cartoon movie, which released on 1 June 2018. We examine the impact of cumulative box office of this movie (cumulative box office_NTI) on commercial health insurance premium from 1 June 2018 to 29 June 2018. The Island 2018 is a movie about individual adventure, which released on 10 August 2018. We examine the impact of cumulative box office of this movie (cumulative box office_TI) on commercial health insurance premium from 10 August 2018 to 31 August 2018. The Solutrean 2018 is a movie about collective adventure that was released on 7 September 2018. We examine the impact of cumulative box office of this movie (cumulative box office_TS) on commercial health insurance premium from 7 September 2018 to 29 September 2018.

Table 6. The effect of other types of risks communication on residents' commercial health insurance demand.

Variable	Commercial health insurance premium income			Variable	Commercial health insurance premium income			Variable	Commercial health insurance premium income		
Cumulative box office_NTI	316.64			Cumulative box office_TI	−5.88			Cumulative box office_TS	−183.66		
(Current period)	(262.74)			Current period	(19.36)			Current period	(189.82)		
Cumulative box office_ NTI		354.49		Cumulative box office_TI		−8.36		Cumulative box office_TS		−93.11	
(One-period lag)		(268.85)		One-period lag		(20.92)		One-period lag		(223.29)	
Cumulative box office_ NTI			274.56	Cumulative box office_TI			−17.18	Cumulative box office_TS			−151.83
(Two-period lag)			(295.05)	Two-period lag			(19.04)	Two-period lag			(217.77)
Within R square	0.08	0.08	0.08	Within R square	0.07	0.07	0.08	Within R square	0.08	0.08	0.08
Control variable	Yes	Yes	Yes	Control variable	Yes	Yes	Yes	Control variable	Yes	Yes	Yes
Observation	580	560	540	Observation	720	700	680	Observation	480	460	440

Driscoll-Kraay standard errors in parentheses of regression result of the fixed effect model.
* p < 0.1, ** p < 0.05, *** p < 0.01.

transforms the outcome variable values by taking the natural logarithm of the commercial health insurance premium income. Results in Table 7 indicate that cumulative box office numbers can only significantly increase the purchase of commercial health insurance after one or two days, which is consistent with results from baseline models. Specifically, each ten thousand yuan increase of DTS cumulative box office earnings significantly increase the commercial health insurance premium income on day t + 1 and t + 2 by 0.0020% (0.0020% = (e^(0.00002)−1)*100) and 0.0017% (0.0017% = (e^(0.000017)−1)*100), respectively. Comparing these interpretations to the baseline models, the latter are more intuitive as they tell us the premium income improvement measured by yuan regardless of the company size.

Heterogeneity analysis

This section conducts the subgroup analysis regarding different subgroup indicators, including average movie arrangement rate, average family size, urbanization rate, number of medical institutions per thousand people, and per capita disposable income, to study the heterogeneity of the effect of health risk communication on residents' commercial health insurance demand. These indicators could affect commercial health insurance demand and movie viewing (Fan and Wang 2015; Suo, Wanyan, and Chen 2015); however, they are not

Table 7. Effect of health risk communication on commercial health insurance demand – log transformation of the commercial health insurance premium income.

Variable	Log transformation of the commercial health insurance premium income	Log transformation of the commercial health insurance premium income	Log transformation of the commercial health insurance premium income
Cumulative box office (Current period)	−0.000005		
	(0.000021)		
Cumulative box office (One-period lag)		0.000020**	
		(0.000009)	
Cumulative box office (Two-period lag)			0.000017*
			(0.000009)
Control variable	Yes	Yes	Yes
R square	0.14	0.11	0.12
# Obs.	1260	1240	1220

Driscoll-Kraay standard errors in parentheses.
* p < 0.1, ** p < 0.05, *** p < 0.01.

included in the control variable list because these data are collected annually rather than daily. Thus, they cannot be estimated under the FE model.

Table 8 presents the estimation from subgroup analysis. The results show that the impact of DTS on insurance demand is larger when the city has a higher DTS arrange rate, higher urbanization rate, more medical institutions, smaller family size, and higher disposable income level. The potential explanation could be that the higher arrangement rate gives residents more

Table 8. Subgroup analysis.

Group indicators		High	Low	High	Low
Average movie arranging rate	One-period lag	15.76**	4.40*		
		(6.24)	(2.44)		
	Two-period lag			12.87**	4.36*
				(6.25)	(2.47)
Average family size	One-period lag	1.72	10.84**		
		(1.26)	(4.80)		
	Two-period lag			1.73	9.39*
				(1.34)	(5.12)
Urbanization rate	One-period lag	10.19**	−0.89		
		(4.32)	(2.19)		
	Two-period lag			9.03**	0.15
				(4.51)	(1.88)
Number of medical institutions per thousand people	One-period lag	19.22**	3.75**		
		(8.17)	(1.79)		
	Two-period lag			15.47*	3.73**
				(8.50)	(1.81)
Per capita disposable income	One-period lag	9.16**	−0.77		
		(4.58)	(2.80)		
	Two-period lag			8.01*	0.59
				(4.78)	(2.20)
Control variable	-	Yes	Yes	Yes	Yes

Driscoll-Kraay standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Number of observations are 620 and 610 for one-period lag and two-period lag specifications; estimations based on specification (1) are not reported due to the insignificant estimation and are available upon request.

opportunities to carry one health risk communication. A smaller family size sets barriers to risk management among family members; thus, people seek more help from insurance companies (Fan and Wang 2015). Higher urbanization rate, per capita disposable income, and more medical institutions indicate that commercial health insurance and medical service are more accessible.

VII. Conclusion

Based on the cumulative box office of the movie DTS from 20 cities in China, and the health insurance premium income of one of the biggest Chinese insurance companies, we study the effect of media-based health risk communication on commercial health insurance demand, using fixed-effect and instrumental variable methods. We found that media-based health risk communication can significantly encourage residents to manage health risk by purchasing commercial health insurance, especially short-term ones, and that a lagged

effect exists. The accumulated performance of DTS on day t has an insignificant effect on insurance demand on day t, but a significant and positive effects on days t + 1 and t + 2. The impact decreases with time and becomes negligible after day t + 3. In cities with more risk communication opportunities, smaller average family sizes, larger number of medical institutions per thousand people, and more per capita disposable income, media-based health risk communication can better encourage residents to manage health risks by purchasing commercial health insurance.

This paper provides a new perspective for the government to enhance citizens' risk awareness, improve health risk protection, and innovate health risk management tools by carrying out multi sectoral cooperation. An eternal topic in the field of public health is promoting citizens' health with high efficiency and low cost. People are not completely rational, and they need to feel risks before they can take action to prevent them. This paper finds that the media can effectively promote risk perception, make people feel the existence of risk and take actions without experiencing real health disasters and economic loss. It is a low-cost, low harm, high-efficiency and high-quality instrument to intervene in public health management. With the advancement of film internationalization, the improvement of citizens' income, and the enrichment of cultural and entertainment life, film is available to a bigger population and has influence worldwide.

This study provides theoretical support for a variety of health policies: First, media can be a social governance risk tool. Government should promote the development of media and insurance industries and strengthen their cooperation to encourage citizens' health risk management actions. Second, the government and insurance sector can use multimedia to publicize knowledge about health risk protection. However, when using media as a health risk promotion instrument, we need to pay attention to the following aspects: first, the information that media conveys is essential. The films based on real events and close to reality are a good choice. Second, the impact of media on insurance purchase is short-term, and a variety of programmes are needed, including increased medical resources, improved access to medical services,

and so on. Finally, health risks should be appropriately publicized to avoid unnecessary social panic.

Due to data limitation, this study cannot examine the mediating effect of health risk perception between media-based health risk communication and commercial health insurance demand. Even though we have justified how media-based health risk communication affects short-term commercial health insurance demand rather than on long-term policies, we are unable to check the effect mechanism quantitatively. In addition, our sample is at city level rather than individual level, making us unable to detect individual heterogeneities. Studies on these topics will be necessary when more data are available.

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Data availability statement

Restrictions apply to the availability of data. Data related to H insurance company were obtained from H insurance company and are available with the permission of that company. Other data unrelated to the insurance company are openly available from different websites and were collected by authors. The latter are available upon request. Websites include China Banking and Insurance Regulatory Commission (http://www.cbirc.gov.cn/cn/view/pages/index/index.html); Insurance Association of China (http://www.iachina.cn); Maoyan professional website (https://piaofang.maoyan.com/dashboard); Baidu index website (http://index.baidu.com/v2/index.html#/); Weather (Tianqi) website (http://www.tianqi.com); The official website of the Ministry of Ecology and Environment of the People's Republic of China (http://www.mee.gov.cn); and statistical bureau websites of 20 cities (http://tjj.sh.gov.cn; http://tjj.beijing.gov.cn; http://cdstats.chengdu.gov.cn; http://tjj.sz.gov.cn; http://tjj.gz.gov.cn; http://tjj.wuhan.gov.cn; http://tjj.cq.gov.cn; http://tjj.hangzhou.gov.cn; http://tjj.suzhou.gov.cn; http://tjj.xa.gov.cn; http://tjj.nanjing.gov.cn; http://tjj.changsha.gov.cn; http://tjj.zhengzhou.gov.cn; http://tjj.ningbo.gov.cn; http://tj.wuxi.gov.cn; http://stats.tj.gov.cn; http://tjj.hefei.gov.cn; http://tjj.dg.gov.cn; http://tjj.shenyang.gov.cn; http://tjj.fuzhou.gov.cn).

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