Realization of Information Resources-Taking the Economic Effect of Network Platforms Caused by Hot News as an Example

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Abstract. This essay explores the economic effects of realizing information resources through online platforms, particularly those driven by hot news events. Using Zhihu as a case study, the research introduces the concepts of Single-Influence News (SH) and Multi-Influence News (MH), and employs event study methodology to analyze their impact on the income of Zhihu's knowledge providers. The data, collected from November 2020 to April 2021, focuses on events like the Civil Code (SH) and Brexit (MH). The results show that MH news significantly impacts multiple sectors, generating higher income, whereas SH news has a relatively smaller effect. Additionally, the study examines substitution and complementary effects through a mathematical model, revealing that MH news tends to bring about complementary effects, leading to revenue growth across various sectors. The conclusion highlights that hot news has a notable economic effect on online platforms, providing new methods to quantify information resource realization, and offering strategic insights for both platforms and knowledge providers.

Keywords: Information Resources; Internet Economy; Event Study; Substitution effect.

1   Introduction and Literature

Information resources refer to the general term for various elements in information activities. The elements include information, information technology and the corresponding equipment, funds and people. Information resources themselves have the special nature of non-material goods [1].

In today's digital economy, information resources, as a new type of production factor integrating digitalization, networking, and intelligence, can be used and shared by multiple parties, which is a key factor in the development of the sharing economy in the data era [2]. With the progress of online payment technology and the maturity of copyright awareness, China's unique and huge knowledge payment market has been rapidly formed [3]. It is predicted that by 2025, 640 million people in China will participate in

knowledge payment, and the market size of knowledge payment will reach 290.88 billion yuan [4]. In terms of this emerging channel of information resource realization, a number of researches have been done to analyze knowledge payment. Qi T pointed out that there are some problems in the current research literature on knowledge payment, such as single research context and limited extensibility [5]. Lu's research shows the mechanism of knowledge payment can affect the willingness of knowledge producers to contribute knowledge and the degree of knowledge anxiety alleviation of knowledge consumers. [6]. But we find few studies have focused on the economic benefits created by knowledge-paying platforms, more generally, the realization of information resources. In fact, hot news that occurs in certain period of time can produce significant economic benefits, and based on this, we will do further research [7].

In the choice of research methods, considering the special nature of hot news, according Neumann's research and Miller's paper, we choose event study as our research model [8,9]. When building the model, we are also inspired by Sheng's research, who introduced substitution effect as a possible explanation for the empirical model [10].

Logically, hot news, as an information resource that acts instantly, spreads widely. The concerns of the people, the focus of public discussion, the flashpoints of social contradictions, as well as the controversial points of the topic concentration, can all be called hot news [11], and the emergence of online platforms provides a new way for them to influence knowledge transactions from the Internet [12]. We define the hot news as news enter to the top 10 of rank published by China People's Daily.

Here we choose Zhihu, a platform with paid answer services as our study entities, for its paid Q&A design is relatively professional. As a mobile app, Zhihu's internal updates and revisions are less volatile and can be regarded as irrelevant external variables [13]. Zhihu's information exchange boards are more clearly divided, making it easier to match them with news and study their roles.

The questions we want to study can be divided into three levels. The first asks whether hot news create economic effect. Secondly, we want to clarify the gap between single influence news and multiple influence news. Finally, we may discuss the substitutional effect inter-sectors.

2   Mechanism

In this paper, we identify the kinds of information sources more detailly depends on its influence on Sectors on Zhihu. By logical inference, we differ the fluence power by two types. If there is only one sector influencing by one hot news in our logical inference, we sort it for single influence hot news (SH). However, except for SHs, there also existing multiple influences hot news (MH), which can be roughly described as affecting more than one sectors. We think MH is more normal to be seen in the reality. But it is hard to have a clear definition through the logical inference [14].

Logical intuition is used to define the strong influence power. If we ranked all the 10 sectors' logical relationship with certain MH. We may say the top 3 strong ones who is also significant in logical deductions are the strong relationship sectors. Meddle 4 sectors are the weak parts and the last 3 can be considered as irrelative sectors [15].

Some basic assumptions are also needed. For SH, we assume that it can only influence one sector. Moreover, we ignore the tiny indirect impact caused by SH to other sectors. For MH, its effects are spread gradually from one to all. Depending on the final data, we assume that the impact will remain around 15 days on the income.

Under the normal mathematical deduction of demand curve, we find that economic effect is unclear in our calculation.

$$U = a \cdot Q, L = \sqrt{Q}, Q = \frac{4a^2 f^2}{w^2}, P = \frac{w^2}{4af^2} \tag{1}$$

We cannot make sure the relative relationship between Δw^2 and Δa in the function of P. But substitution effect does exist.

$$C = w \cdot L(x_1) + \cdots + w \cdot L(x_n) + F, R = f(P_1 x_1 + \cdots + P_n x_n) - a \tag{2}$$

$$MC = w \cdot ML_1 + \cdots + w \cdot ML_n, MR = f(P_1 + \cdots + P_n) \tag{3}$$

If we get the price of x_1 we can also find the price may be influenced by other price in a positive way and other quantity in a negative way if MR equals to MC. Thus, we can detect that, price and marginal labour investment will lead to a negative way as the positive effect has a negative relationship with a certain price. Thus, there may existing a substitution effect makes the income of MH of sectors becomes smaller than that of SH individually but with higher aggregate income than income of SH.

We still believe that hot news can bring higher incomes for consultants in Zhihu for the slope of downward supply curve is normally steeper than that of demand. Thus, the income may be positively influenced and economic effect is crated. It is also clear that MH must create higher income than SH for its wider influence and higher incentives.

According to our calculation, substitution effect exists. But this may not be real in all industries, especially there is network effect existing in this network platform. So, the final result we predict is that the substitution effect maybe not so clear.

3   Methodology

Here we choose the data from Shanghai University of Finance and Economy. The dataset totally includes 440 knowledge suppliers in 10 categories. The data is from November 15, 2020 to April 6, 2021 and one period in this dataset is 4 days. Summary of all variables is in Table 1.

Table 1. Descriptive Statistic

	(1)	(2)	（3）	（4）	(5)
VARIABLES	N	Mean	Sd	Min	Max
Period	12419	19.50	10.38	1	37
CompetitorNum	12419	45.13	14.18	11	76
TopicHot	12419	0.11	0.04	0.03	0.22
ID	12419	207.29	124.00	1	440

ConsultNum	12419	647.56	1548.70	3	19108
Score	12419	4.97	0.06	4.5	5
Price	12419	121.62	241.79	1	2333
Upvote	12419	182984.90	398831.30	60	3790525
Favorite	12419	123550.90	305035.60	37	4494425
Content	12419	468.75	926.92	0	11617
Follower	12419	116168.30	210280.60	21	2623848

In general, we use the event study. Thus, our independent variable is the event dummy and the dependent variable shall be the income per capita, here we use Table 2 to explain them and other control variables [16,17].

Table 2. Variables

Income per capita	Dependent variable.
(E)	Price times consulting number.
Event	Independent variable.
(I)	Equals to 1 if the event is happened or it will equal to 0.
Competitor Numbers	Control variable.
(N)	Number of competitors in the same type.
Topic hot	Control variable.
(H)	Topic hot indicates the impact scale in one way.
Upvote& Favorite& Follower	Control variables.
(U1&U2&U3)	The willingness to pay and the evaluation of the consumers.
Content	Control variable.
(C)	It counts the articles the consultants have published.
Price	Control variables.
(P)	Avoid the event impact on price distracting the measurement.
Fixed Effect	Control variable.
(F)	We only introduce individual levels.

The baseline estimation is as follow.

$$E_{it} = \phi_0 I_{1it} + \phi_1 I_{2it} + \phi_2 N_{it} + \phi_3 H_{it} + \phi_4(U_{1it} + U_{2it} + U_{3it}) + \phi_5 C_{it} + \phi_6 P_{it}$$
$$+ \phi_7 F_{it} + \varepsilon_{it} \tag{4}$$

This estimation can be used for both SH and MH. We can use different scale model by different identify strategy to enhance our estimations. Moreover, if we want to estimate the substitution effect, we can use traditional substitution effect model. We can find two events happening nearly and one is SH and one is MH to stimulate the substitution effect [18]. The regression model should be like:

$$E_{it} = \phi_0 I_{1it} + \phi_1 I_{2it} + \phi_2 I_{1it} \cdot I_{1it} + \phi_3 N_{it} + \phi_4 H_{it} + \phi_5(U_{1it} + U_{2it} + U_{3it})$$
$$+ \phi_6 C_{it} + \phi_7 P_{it} + \phi_8 F_{it} + \varepsilon_{it} \tag{5}$$

We added the interaction term of two event as the substation effect indicator and ϕ_2 is the key measurement. If ϕ_2 is positive, it means the power of event 1 and event 2 superimpose together to have an overlap effect on capital per capita. Then it can be considered as a complementary effect. Otherwise, it is a substitution effect. We also try to do a more precise stimulation. If there is n identical information we are going to obtain, the incentive by MH change from a into a'.

$$Q = \frac{f}{na'w}, P = \frac{n(a')^2 w}{f} \tag{6}$$

$$\Delta I = a - a' \tag{7}$$

You can see that the income is totally depends on the incentives by hot news. Thus, in order to calculate the ΔI, we shall calculate the pervious a and a'. suppose $n = 10$.

$$\Delta I = \frac{1}{10} \sum_{n=1}^{10} (a_n - a_{n-1}) = \frac{a_{max} - a_{min}}{10} \tag{8}$$

Here, a_{max} represents that the kind of information has the most powerful incentives and a_{min} is the smallest amount in pre-event period. So, we should use our existing dataset to measure whether the ΔI is positive for the positive ΔI meaning the complementary effect holds.

4   Empirical Study

Here we first investigate the economic effect of SH and then build a system about the correlation. Basically, we used the publishment of civil code as our study event for this event works on period 19 (2020.1.1) and has a quick effect on the average income. We identify this event is SH which influence the law sector. We also select Brexit as MH. In this regression of SH, we select 11 periods from period 14 to 24 as our event window. We do the experiment for all 10 sectors and the results are shown in Table 3.

Table 3. Benchmark Regression Results-1

	(1)	(2)	(3)	(4)	(5)
	Law	Education	Profession	Psychology	Health
Event	3323.9 **	181.5 *	182.9 *	157.4 *	80.6 *
Control	Y	Y	Y	Y	Y
	(6)	(7)	(8)	(9)	(10)
	Emotion	Finance	Nurture	Sports	Technology
Event	40.1 *	7898.7	2239.4	6.8	2.7
Control	Y	Y	Y	Y	Y

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The publishment of civil code only has one sector with over 95% significant level and that is the law sector and 4 of the total sectors is irrelated. This means, for SH, it does make economic effect generally. We can also build a classification depend on the significant level. Over 95%, we can consider it as the strong related sector. Among 95% to 90%, it is weak relation. And for those whose significant level is under 90%, they are irrelated sectors. The mechanism of this new system is showed in Table 4.

Table 4. Mechanism

Relationship Types	
Coefficient	Significance
High	Over 95%
	↓
↓	95%-90%
	↓
Low	Under 90%

After benchmark regression, we choose civil code as SH and Brexit as MH. We run two individual regressions. Civil codes went publishment in January 1st and Brexit went valid in January 20th with gap over half month. Please check Table 5 now.

Table 5. General Test

	(1)	(2)
	SH	MH
CivilCode	719.55 **	-
	(317.01)	-
Brexit	-	1163.32 ***
	-	(178.00)
Control	Y	Y

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The promulgation of the Civil Code has a strong impact on all sectors. While Brexit has a strong impact on all sectors, its coefficient is much larger than that of civil code. This shows that Brexit has a stronger economic effect on Zhihu rather than civil code.

While the result is close to our prediction, it is also unclear for civil code event for it is an SH rather than MH. Moreover, the impact of MH may be increased by complementary effect or decreased by substitution effect. Thus, we decide to test SH's and MH's effect on a certain sector. It is unfair to choose strong related sector for different influence. Then we select all sectors and find one sector is weakly related to both civil code and Brexit. That is education sector, please check Table 6.

Table 6. Education Sector Test

	(1)	(2)
	SH	MH
CivilCode	181.51 *	-
	(97.03)	-
Brexit	-	632.43 ***
	-	(206.98)
Control	Y	Y

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The result is not surprise here and we can find the same tendency of all sectors test in the education sector and the economic effect of MH is even higher, nearly 350% of that of the SH. Up to now, we can say that from the perspective of all sectors, the promulgation of civil code with single impact characteristics and Brexit with multiple impact characteristics are strongly related to the impact of all sectors, but Brexit has a greater impact on all sectors. By comparing SH and MH, we find that MH brings higher economic benefits for the whole platform and the weakly correlated segments after eliminating endogeneity. The more sectors it affects, the more revenue it brings.

To have a more precise measurement, here we select two ways to let our answer be clear. The first one is to use the substitution model. As we have mentioned in methodology part, the term inter is the measurement of substitution effect. Table 7 represents the scale of substitution effect.

Table 7. Substitution Effect Test

	SH
CivilCode	0.0486 ***
	(0.0070)
Inter	0.0764***
	（0.0064）
Control	Y

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The coefficient of inter is as 2 times as that of Civil Code. It is positive. So, the complementary effect takes place of the substitution effect. Thus, two events have a "superimposed" positive influence on the personal earnings of knowledge suppliers in ZhiHu. We also use another way in mathematical. ΔI is used to analysis the changing of income per capita. The final formula should be represented like this:

$$\Delta I = \frac{a_{max} - a_{min}}{10} \tag{9}$$

To encounter the analysis requirement in a scientific way, we choose 3 MH and 1 SH as our samples to calculate the ΔI. They all happened within the time window of our dataset and has significant influence to the nation or the world. In this calculation, we also choose to compare the difference of pre 5 periods data to the post 5 periods data and calculate their a_{max}, the a of the sector which is most incentive, and a_{min}, the a of least incentive sector. From the view of influence power, we think that Brexit > the 14th 5-year plan > civil code > death of Maradona, this is a rank ranking by logic inference. If the substitution effect holds, the ΔI should be negative. Table 8 shows the results.

Table 8. Changing of Income per Capita

	(1)	(2)	(3)	(4)
	Brexit	Civil Code	Death of Maradona	The 14th 5-year Plan
ΔI	7.9	0	0.2	3.8

In Table 7, ΔIs are shown. We can see that the values of ΔI are basically ranked by their influence powers in MHs and it is not surprise that the value of civil code is 0 as it is a SH. But the substitution effect doesn't hold in any of the MHs. Thus, the conclusion combing three tests of substitution effect is that there is a complementary effect between the economic effect caused by MH of individual sectors.

Why we didn't deduce this conclusion but went to an opposite direction? The answer might be we ignore the network effect of the internet products as the value of the product increases with the number of consumers who purchase this product and its compatible products. Furthermore, we only obey the economics of scale in the supply curve of a specific goods. If we enter these factors into our mathematical model, the result might be closer to the realistic world.

5   Conclusion and Contribution

We take the economic benefits of information resources as the starting point, using Zhihu's consumer payment question-and-answer mechanism as an example to explore the economic effects of hot news on network platforms. We discover the economic effect caused by hot news and discuss the difference between different types of information. We also build a system to measure the relationship between news and sectors of Zhihu and calculate the income difference caused by news type.

Mainly, we can conduct the research on 3 aspects:

1) Single-factor hot news does create economic effect;

2) More sectors hot news affects, more revenue hot news will bring;

3) Hot news affects more sectors create a 'complementary effect' between all sectors.

Our results suggests that the occurrence of hot news can significantly increase the income of Zhihu's knowledge suppliers, in this way can the information resources generate economic effects.

Our results will also bring some lightful ideas in theoretical and practical areas. We try to discuss the mechanism of the realization of information by building relationship system and we use the combination of statistic and mathematical ways to measure the substitution effect, providing new views and new methods to quantify the economic effect of hot news. We also build untraditional substitution effect regression by using similar event to stimulate the process of spreading news. In practical aspects, we can also give some guidance to relative clusters. For knowledge suppliers, mostly are single person, they should be as active as possible on the front of hot news and increase the personal income. As for Zhihu, or more network platform providing similar approach to realize the information, we think they should seize the hot news window period to create economic effects. Broadening access to information and obtaining resources from online platforms according to needs are what public should do. Meanwhile, if you are policy maker, it is reasonable for you think about the power of news and information and be careful to the publishment of the news.

When we speak more, there always exist more possible threats to our study. It is difficult to measure the substitution effect in reality. What's more, do other network platforms perform the same as Zhihu? It still needs to be further discussed. There still exist multicollinearity with no theoretical insights. We are confused by these questions.

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