

## Market structure and product diversity

a case study of Chinese media industry

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**Abstract**—When we cast our eyes on Chinese media industry, we can see that media industry cannot produce large revenue, which can be produced in developed country. At the same time, we also can see that the theoretical study and research for media market are not enough in China. All the years, scholars use theory of public management to analyze media industry. Seldom of them treat it as a normal industry and use economic theory to analyze it. In fact, it is in possession of same character as other industries. So I want to introduce Hotelling model and Salop classic industrial model to analyze Chinese media industry and then build an empirical model. The empirical results show that these factors have asymmetrical effect on each other: Industry revenue per show, Number of art troupes and Average number of audience per show are positively related to diversity of art performance show, but average industry wage per show is negative associated with diversity. Constant is obviously positive, which means the policy of “loosen” is the most effective factor leading the product of diversity.

**Key words:** China, Media industry, Hotelling model, Salop model, product diversity

### I. INTRODUCTION

The relationship among market structure, competition in product and social welfare is always the popular issue for many years in the world. At the same time, some excellent model was built by economists. Hotelling and Salop model are the most popular models in this area. In recently years, these economic models are introduced to explain phenomenon of culture industry. But in China, these classic and practical model are seldom used, a lot of measure of reformation put up by economists' imagination, not to mention empirical analysis. So in my article, I will introduce Hotelling and Salop model to analyze relationship between diversity and industry structure for media industry of China in general point.

In China From year of 1978 to 2008, Chinese Media industry has been affected under the circumstance of political reformation. At the beginning, culture industry develops slowly. Until the year of 2001, numerous firms fairly compete in market and provide goods to fulfill consumers' demand. Diverse product and reformation of industrial structure happens at the same time with this

process. In the year of 2007 and 2008, the outcome of reformation emerges. I find some relative data for every stage, we can see these trends from the data of art performance market.

Our problem is that are these theoretical models also suitable for Chinese media industry? If we can prove these models are fit for China, what conclusion we can draw from them? The relationship among different economic variables is the key point. Such as the ideal model addresses that the product diversity positive relate to the number of firms. So can we get the same result from empirical analysis in reality?

The structure of this article is as follows:

Chapter 1 describes observed tides and development in Chinese media industries, specifically art performance troupes. In chapter 2, I summary a wide range of theories about media industry. And then, I try to introduce classic hotelling linear model and Salop circle model to explain present situation in China media industry with free entry. In chapter 3, I build an empirical model to prove that the theoretical models I introduced in chapter 2 match the actual situation. Furthermore, we can draw the conclusion and give advices from the combined result of theoretical model and empirical model.

### II. MODELING

In markets of media industry, products are differentiated. Consumers is not only interested in price of products, but also characteristics of product, such as quality, content, the location of the seller, pre-sale services, transport fee and so on. Therefore, companies compete in location as well as competing over price. Industrial economists separate horizontal differentiation from vertical differentiation. Under horizontal differentiation, different types of consumers prefer to choose different products, although the prices of these products are similar. In the media industry, consumers often have diverse tastes about art work. For example, artists use the same technology to produce two songs, but it is possible that one of these songs is more popular than the other one, because the lyrics and tune are more suitable for the demand of consumers. Horizontal product differentiated is the object which we focus on here.

### A. Linear Location Model

We first consider linear location model, in which consumers are evenly distributed along a “linear city” of length  $L$ . There are two firms in this market, which provide media goods and service with same physical character but different content. Hotelling assume that every consumer only can purchase one good or service. Timing of the game is as following: at stage 1 firms simultaneously choose their locations, namely firm 1 chooses A, and firm 2 chooses B. And then, at stage 2, set the location, the firms launch competition each other over price.

If firm 1 and firm 2 both choose a point as their common location. That must cause a severe competition over price, thus the profit of two firms equal to zero. But if firm 1 chooses A, and firm 2 chooses B, which means two firms want to maximum the product differentiate. In this situation, companies often can earn profit  $> 0$ . Therefore, when we use backward induction, we can assume that the location of two firms is given: as can be seen from picture 1, consider location of firm 1 is location at the end of left of line (A), firm 2 is location at the end of right (B).



The marginal cost to produce one unit good or service is  $c$ , and the consumers spend a transportation cost  $t$  per unit of length. We set the transportation cost as quadratic, thus consumer incurs a transportation cost  $tx^2$ , when he or she is located at distance  $x$  away from the left firm. In this case,  $x$  represents  $D(p_1, p_2)$ , where  $x$  can be defined as follows:

$$p_1 + tx^2 = p_2 + t(L - a - b - x)^2$$

So rewritten the equation, we can get the demand function for firm 1 is:

$$D_1(p_1, p_2) = a + x = a + \frac{L - a - b}{2} - \frac{p_1 - p_2}{2t(L - a - b)}$$

For the similar reason, we can get the demand function for firm 2 which is:

$$D_2(p_1, p_2) = L - a - x = L - a - \frac{L - a - b}{2} + \frac{p_1 - p_2}{2t(L - a - b)}$$

After gaining the demand, cost and price of goods, we can calculate profit of firm in the next stage. The function of revenue of firms can be expressed as follows:

$$\begin{aligned} \pi_1^1(p_1, p_2) &= (p_1 - c) D_1(p_1, p_2) \\ \pi_2^2(p_1, p_2) &= (p_2 - c) D_2(p_1, p_2) \end{aligned}$$

We solve the system of first order conditions  $\frac{d\pi_1^1}{dp_1} = 0$  and  $\frac{d\pi_2^2}{dp_2} = 0$ , then we can get the equilibrium price, which can be represented as below:

$$\begin{aligned} p_1^* &= c + t(L - a - b) \left( L + \frac{a - b}{3} \right) \\ p_2^* &= c + t(L - a - b) \left( L + \frac{b - a}{3} \right) \end{aligned}$$

For obtaining the equilibrium of profit of firm, drag  $p_1^*$  and  $p_2^*$  into the profit function  $\pi_1$  and  $\pi_2$ , solving the function we can gain:

$$\begin{aligned} \pi_1^* &= \frac{1}{18} t(L - a - b)(3L + a - b)^2 \\ \pi_2^* &= \frac{1}{18} t(L - a - b)(3L - a + b)^2 \end{aligned}$$

From above equation, we can tell that the differentiation between two kinds of goods is the basic reason to let firms avoid competition over price and get a higher profit, because it satisfies the demand differentiated to the highest level. We can draw another conclusion: maximizing differentiation is the Nash equilibrium in this model. In other words, no matter any condition, firms always choose to produce the goods with absolutely different content. This is also the basic assumption for the next Salop circle city model.

For one market, how many firms will be the optimal choose? Whether welfare improve or not with the increase of number of firms? Is that related to product diversity? For solving the problem mentioned before, I want to introduce Salop model into my article.

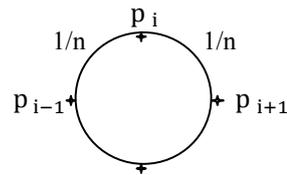
### B. Circle Location Model

From the result of Hotelling model, we know that firms always maximum product differentiated for profit reason under any condition. Therefore, we should set a fundamental assumption: firms do not need to choose location, which means firms are automatically situated at equal distance  $(1/N)$  each other on the circle. Product differentiate is exogenous.

Consumers now are uniformly distributed along the circle with the perimeter 1, as can be seen from picture 2. So far we know the total demand  $D$  equals to  $Sx$ . In this model, every consumer only can buy one unit of goods. We assume that a consumer is located at distance  $x$  away from any one of firms in media market. When he or she wants to purchase a unit of goods or service, they should spend transport cost  $t$ . we consider transport fee as linear, so the total cost is  $tx$ . Firms are also located on the circle and each of them can only locate on one point. After made a choice of location of firm, it incurs a marginal cost  $c$  for providing per unit of service and a good.

There is also a two-stage game. At first step, potential entrants only need to decide whether to enter or not at sunk cost  $f$ . at stage 2, all of firms located in this market compete over prices simultaneously.

We still use backward induction. We assume that  $N$  firms have entered into the market, so we only need to discuss the competition on the stage 2. The equilibrium price can be represented as  $P^*$  and all the other firms set price  $P^*$ . In practice, firms only need to compete over price with two neighboring firms. Then suppose that firm  $I$  sets price  $p_i$ . However, the rest of neighboring firms set the price  $P^*$ .



There is indifferent between buying from firm 1 or the closest neighboring firm, when consumer is situated at any point  $x$ . So we can get the equation as below:

$$p_i + tx = P^* + t \left( \frac{1}{N} - x \right) \Rightarrow x = \frac{P^* + \frac{t}{N} p_i}{2t}$$

So firm (i) is in face of the consumers' demand from its west side to east side, the total distance come up to  $2x$ . For this reason, we can write the demand function by  $D_i(p_i, p^*) = 2Sx$ . At the same time, we can get the profit function:  $\pi^i = (p_i - c) D_i(p_i, p^*)$  substituting function of  $x$  into it, we can rewrite expression of  $\pi^i$ :

$$\Pi^i = \frac{(p_i - c) S \left( p^* + \frac{t}{N} - p_i \right)}{t}$$

Where  $p^*$  is given.

### C. Social Optimum

For calculating the max value of profit, we solve the system of first-order condition:

$$D\pi^i / dp^i = 0 \Rightarrow \frac{s}{t} \left( p^* + \frac{t}{N} - 2p_i + c \right) = 0$$

Because of symmetric equilibrium,  $p^* = p_i$  is given as a known condition. Dragging it into previous function, we can get the expression of equilibrium price

$$p^* = c + \frac{1}{N}$$

And then we set  $p^* = p_i$  again and substitute it into the profit function  $\pi^i$ . We can obtain equilibrium function of

$$\pi^* = S(p^* - c) / N = st / N^2$$

Moreover, we set the fixed cost as  $f$  before, from the free-entry zero-profit condition  $\pi^* = f$ , so the final expression of  $N^*$  is  $N^* = \left( \frac{st}{f} \right)^{\frac{1}{2}}$  and  $p^* = c + \left( \frac{tf}{S} \right)^{\frac{1}{2}}$

### D. Conclusion for theoretical model

At the beginning, I should highlight a few points firstly. In Hotelling model and Salop model, location of firm can be considered as a choice of product specification. Then, a consumer's site can be regarded as her or his favorite's product specification and the transport cost would denote the utility loss.

Model of Hotelling has given us deep inspiration: Increasing the product differentiated relates to the lower level of price competition between two firms, which means a company can earn more profit.

Drawing lesson from the result of Salop model,

$$p^* = c + \frac{1}{N} = c + \left( \frac{tf}{S} \right)^{\frac{1}{2}}$$

$$\pi^* = S(p^* - c) / N = st / N^2$$

$$N^* = \left( \frac{st}{f} \right)^{\frac{1}{2}}$$

Obviously, equilibrium price and revenue of firm decline with the increase of number of firm. Moreover, the area of producer surplus become smaller gradually. At the same time, consumer can purchase more kind of goods and service but spend less money for transport. They also can get benefit from the decrease of price, thus the total surplus rise as well. In the end of this process, price and revenue can reach the level of clearing market and the total surplus reaches the highest point.

Market size ( $S$ ) is an important reason to effect profit of firms. As can be seen from previous equilibrium function,  $S$  positive relates to profit of firms.

We get so many Suggestions from these two models, which show us the relationship among welfare, market structure and profit of firm. But are they suitable for Chinese media industry? Therefore, in next step, I seek to build an empirical model about these variables mentioned before, and bring the data from Chinese media industry into this model.

## III. METHODOLOGY

From the previous chapter, we can get two main conclusions: firstly, the revenue negatively relate with location of company and transportation fee, which can be included into the price of goods. Secondly, if the potential companies exist, the revenue shows the positive relationship with size of market, and negatively relate with the number of companies and transportation fees.

In this section I want to use empirical analysis to support the model of product diversity on media industry mentioned before. It will start with related data collection.

### A. Data

China statistic yearbook is the main source for this study, published by Zhong Guo Tong Ji Chu Ban She. It provides detailed information on various Chinese economic statistic data. I explain market definition and sample selection as following.

### B. Sample selection

In this paper, I try to find the relationship among diversity, welfare and market structure in media structure. Diversity implies difference; it is hard to define in practical matter, not to mention measure, especially in the media industry. However, a technique for measuring diversity in the content of broadcast news enlightened me—this measure count the total seconds of local news. In this measure, if two or more local news broadcasts the same story on the same time, that will not count into total seconds. But if the same story broadcasts in the different time, that will be counted into total seconds of news. I realize that media industry cover too much markets, such as newspaper, broadcast, radio and so on, to define and measure. Therefore, I decide to concentrate on a specific market to find a common rule in media industry. After viewing papers and comparing data from one another, I select industry of art performance as target market, and then choose number of art performance to reflect diversity in whole media industry, because following the rule of differentiation mentioned before, art performance usually show at different time and the programmers are also different. After set a specific market, I choose four economic indicators as main independent variables to explain explanatory variables—number of troupes, number of audience, industry average wage and industry revenue.

### C. Empirical model

To examine the effort of market structure and welfare on product diversity in Chinese culture industry, I will use OLS model for the performance market during 1978-2008. The

data covers for 23 years, the first stage object function can be written as follows:

$$\ln Y = \alpha_1 + \alpha_2 X_2 + \alpha_3 \ln X_3 + \alpha_4 X_4 + \alpha_5 \ln X_5 + \varepsilon$$

Where

$\varepsilon$ —the error term include all the unobservable factors that affect the rate of change of Y. Y denotes the number of performance shows per year, which is the important statistic to measure product diversity.

$\alpha_1$  represents intercept term which is effected by a good or bad policy environment.

$X_2$  denotes the total number of audience in market of performance from 1978 to 2008 with several gaps. I use this data to measure how the preference of consumers influences on product diversity.

$X_3$  is average industrial wages per year, which can be used to find the related changes between number of performance and wages.

$X_4$  is a vector representing , which can be used for analyze the structure of industry.

$X_5$  denotes industry revenue. We can observe the change of quantity of performances, when the industry revenue changes per year.

Y for number of art performance per year

$\alpha_2, \alpha_3, \alpha_4, \alpha_5$  respective is coefficient of  $X_2, X_3, X_4, X_5$ . In other words, when one of these four variables changed one unit, how much Y will change.

On the basis of previous OLS regression model, setting  $NA=X_2/Y$ ,  $aaw=\ln(X_3/Y)$ ,  $AR=X_5/Y$  and  $y=\ln Y$  to remove the effect of multicollinearity, and then add lag on explanatory variables of diversity firstly to eliminate the effect of serial correlation, so I get a new equation set as follows:

$$y_t = \beta_{1t} + \beta_{2t} NA_t + \beta_{3t} aaw_t + \beta_{4t} X_{4t} + \beta_{5t} AR_t + \mu_t$$

$$y_t = \gamma_1 + \gamma_2 y_{t-1} + v_t$$

We can see from the final result: R-square is 0.9755 finally. every independent variable is significant, when  $p < 0.01$ .

Now, we can go into the next stage—result. In this section, we discuss our OLS regression results. My independent variables include number of art performance troupes, industry revenue, the rate of change in wage and the number of audience.

#### IV. DISCUSSION

As can be seen from table 1, it reports OLS results using the relative diversity measure as a dependent variable. All of the independent variables for the OLS regression in table 4 are significant at the 1% level. The coefficient for every variable can be written as below:

$$y = \beta_1 + \beta_2 NA + \beta_3 aaw + \beta_4 X_4 + \beta_5 AR + \mu$$

$$R\text{-squared} = 0.9755$$

$$\text{Prob} > F = 0.0000$$

We can tell from the final result that:

##### A. Constant

Constant often denotes economic policy and industry environment, which is determined by government and have a significant effect on development of industry. As can be

observed from table 1, constant are positive. It can be interpreted that the industry policy drawn up from 1978 to 2008 by government is advantage to promote the diversity of art performance show. Financial support from state and reforming of economic system are positive effect on the product diversity. The decrease of government purchase is a good sign to support the current policy for media industry.

##### B. Average number of audience per show

Average number of audience per show significantly positive relates with art performance show diversity. The higher level of diversity denotes that the character of show is closer to the taste of audience. Thus audience can spend less transport costs to consume what they want. Moreover, number of audience can be considered as the market size. It has the positive relationship with diversity of goods not only in ideal economics model, but also showed in reality.

##### C. Average industry wage per show per person (marginal cost)

Average industry wage per show is negative associated with diversity. It is obvious that the profit from content diversity did not transfer to the wage. When the marginal cost is greater than zero, which means the output did not reach the level of optimum quality. So we can tell here, Chinese media industry still have a long way to go. Moreover, as can be observed from the empirical model, the negative relationship between level of product diversity and average wage per show per person represent that marginal cost have a downward tendency with a upward trend of product diversity, namely, there is no stable optimum marginal cost. It is obvious that we still have opportunity to develop the media industry. Because marginal cost keeps down with a higher level of product diversity, we can predict that reformation of diversity should and will deepen.

##### D. Number of art troupes

Number of art troupes has a positive relationship with diversity of shows. In common case, more potential troupes entering into market means they provide more kinds of live shows. As we know from diversity model, a firm's 'location' can be interpreted as a choice of product specification. It also satisfies the current situation of Chinese media industry. Because we are at the first stage of development, lots of companies want to enter the market, and competition must be the main stream. Number of troupes and kinds of shows will increase at the same time.

##### E. Industrial revenue per show

Industry revenue per show is also positively related to diversity. In most case, industry revenue equals to total income minus total cost. Thus we often calculate industry revenue by comparing the total profit and cost. If the product diversity expands market enough, the profit from diversity is more than the diversity cost, and then the total revenue is going to up.

As can be found from the result, the index of R-square reaches up to 9.75, which means the data from real economic life almost perfect fit for the model. So far, the empirical model proves that two theoretical models I introduced in part 2 are suitable for Present Status of Chinese media Industry, especially the art performance market. So next stage, we can

give some advices for Chinese media industry in line with the relationship of economic variables.

## V. CONCLUSION

In this article, we examine various aspects of Chinese media industry

In this article, I examine and compare two theoretical models to explain this relationship and prove that these two models are suitable for Chinese media industry by building an empirical model.

First of all, Using Hotelling model and Salop model, economists explored that there is a definite link between product diversity, market structure and social welfare. We can find out that the level of product diversity positive relates to the social welfare and higher product diversity happens when more companies enter into media market.

And then, Using a simple OLS framework, I prove that Chinese media industry also follow the relationship that theoretical models mentioned by introducing data of Chinese art performance troupes. We can find out that the level of product diversity (denoted by type of performance show) have a positive relationship with number of firms (represent market structure) and social welfare (including number of audience and industrial profit). It is obvious that we totally can use the relationship existed in the ideal model to explain the reality and find the direction of development in China media.

We know from previous models that market size is a very important role for product diversity. Revenue and number of audience are significant related with it, namely market size is an implicit factor to effect on social welfare. When a firm enters in a market with large size, it can obtain profit more than a small size market. If we want to increase firm's profit (producer surplus) and number of audience (consumer surplus) at one time, we should estimate the market size and use it well.

It is beneficial for Chinese media industry. In China, media firms can generally be divided into two groups—state owned company (including Enterprises of Collective Ownership) and private (overseas-invested enterprise). The type of show, number of audience and industry revenue showed a rise tendency. Especially in the year of 2007 and 2008, a sharp increase can be found, because lot of private firms enter into the market of popular art performance show, even statistical data of private firms published by Chinese statistical bureau was highlight. So we can predict the development direction of media industry in China. Classic product market, such as folk dance, folk music and so on, is filled with various state-owned firms. Market is already saturated and hard to be creative. But popular product market has a huge potential for exploiting. Furthermore, as the income increase in China, the potential demand emerges; it is a large size market. As evidence, the sharp rise of industry revenue, number of audience and the higher level of diversity size emerge with large number of art performance

troupes entering into popular product market in year of 2007 and 2008. So we can tell that providing diverse products may be a trend which will last for many years.

Moreover, as can be observed from the empirical model, the negative relationship between level of product diversity and average wage per show per person represent that marginal cost have a downward tendency with a upward trend of product diversity, namely, there is no stable optimum marginal cost. It is obvious that Chinese industry stay in a developing stage, we still have opportunity to develop the media industry. Because marginal cost keeps down with a higher level of product diversity, we can predict that reformation of diversity should and will deepen. So for, we can say that the reform measure Chinese economists addressed certainly inspires us and is fit for the character of Chinese media industry.

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## APPENDICES

TABLE1. THE REGRESSION

		reg L.y NA aaw X4 AR				
Source	SS	df	MS	Number of obs = 19		
Model	.814445349	4	.203611337	F( 4, 14) = 139.29		
Residual	.02046541	14	.001461815	Prob > F = 0.0000		
				R-squared = 0.9755		
				Adj R-squared = 0.9685		
				Root MSE = 0.03823		
Total	.834910758	18	.046383931			

L.y	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
NA	.0000812	9.86e-06	8.24	0.000	.0000601	.0001024
Aaw	-.3664051	.0305395	-12.00	0.000	-.4319059	-.3009044
X4	.0001433	.0000197	7.28	0.000	.0001011	.0001856
AR	.0000714	7.53e-06	9.49	0.000	.0000553	.0000876
_cons	10.60537	.1707948	62.09	0.000	10.23905	10.97169

(A) reg L.y NA aaw X4 AR

TABLE2. INFORMATION OF MEDIA INDUSTRY IN CHINA

Year	Performance (thousand)	Art Performance Troupes	average wage	performance	industrial revenue (million)	number of audience (thousand)
1995	412.3	2682	5435	412300	6476830	431658
1996	419	2664	6144	419000	18423990	479343
1997	417	2633	6759	417000	20679440	463610
1998	424	2652	7474	424000	21854550	534856
1999	423	2632	8510	423000	24264460	469038
2000	430	2630	9482	430000	26366400	461680
2001	423	2605	11452	423000	31185230	473848
2002	416	2587	13290	416000	36533100	459800
2003	424	2618	17268	424000	40086740	534856
2004	425	2759	20730	425000	48562500	387010
2005	459	2805	22885	459000	52714600	388910
2006	490	2866	26126	490000	59087950	461150
2007	922	4512	30662	922000	69104980	758956
2008	905	5114	34494	905000	80303000	6318680