

Analysis of Attention to the Confucius Institute from Domestic and Foreign Mainstream Media

Wei Yang, Xiaohui Cui, Weiping Zhu, Liqun Liu

Abstract—The rapid development of the Confucius Institute is attracting more and more attention from mainstream media around the world. Mainstream media plays a large role in public information dissemination and public opinion. This study presents efforts to analyze the correlation and functional relationship between domestic and foreign mainstream media by analyzing the amount of reports on the Confucius Institute. Three kinds of correlation calculation methods, the Pearson correlation coefficient (PCC), the Spearman correlation coefficient (SCC), and the Kendall rank correlation coefficient (KCC), were applied to analyze the correlations among mainstream media from three regions: mainland of China; Hong Kong and Macao (the two special administration regions of China denoted as SARs); and overseas countries excluding China, such as the United States, England, and Canada. Further, the paper measures the functional relationships among the regions using a regression model. The experimental analyses found high correlations among mainstream media from the different regions. Additionally, we found that there is a linear relationship between the mainstream media of overseas countries and those of the SARs by analyzing the amount of reports on the Confucius Institute based on a data set obtained by crawling the websites of 106 mainstream media during the years 2004 to 2014.

Keywords—Confucius Institute, correlation analysis, mainstream media, regression model.

I. INTRODUCTION

FOUNDED in 2004, the Confucius Institute (CI) is a project overseen by Hanban, the Office of Chinese Language Council International. The CI's aim is to promote the knowledge of Chinese language and culture and to enhance friendships between China and other countries around the world [1]. Official statistics show that 471 CI offices and 730 Confucius Classrooms have been established in 125 countries and regions around the world, as of October, 2014 [2]. During the past 10 years the CI has grown dramatically, attracting much media attention from both China and the rest of the world. Actually, mainstream media play a significant role in promoting Chinese culture and shaping the image of China internationally.

Mainstream media greatly influence information dissemination, and usually represent the attitudes of governments and the masses. Generally, mainstream media reflect and spread the social mainstream gestalt consciousness and values that guide social orientation [3]. Because of their

special role, the views of mainstream media are likely to eventually affect other media and public opinion. With the development of the Internet, information dissemination has become quite rapid, and public opinion can affect the government, and in turn even society. Therefore, research on mainstream media is likely to become common. However, because of the cultural differences between China and many other countries, news reports on the same topic may differ substantially from one another [4]. These researchers assumed that the number of news reports represented the degree of public attention or concern. This paper focuses on studying attention to or concern about the CI. Reports about the CI considered as representing Chinese culture may differ between China and other countries. For this consideration the search divided the countries into three regions: the mainland of China, the two special administration regions (SARs) of China (Hong Kong and Macao), and overseas countries. Because the SARs' implementation of capitalism differs from that of the mainland, the SARs mainstream media were separated for special analysis. For convenience, the mainland, the SARs, and overseas countries are termed s_1 , s_2 , and s_3 , respectively. The paper concentrates on the quantitative variation tendency to analyze the correlations between s_1 , s_2 , and s_3 . If there was a high correlation, a regression model was applied to mine the functional relationship.

Correlation analysis is a statistical method usually and used to measure the degree of closeness between two or more variables. This study focuses mainly on measuring the linear association between two variables, called the correlation coefficient. Several methods of correlation analysis proposed. The PCC is named after Karl Pearson, who described many of its properties [5] and developed several forms of the PCC in different fields, such as two random variables, two random vectors, frequency domain, and the Karhunen-Loève (KLE) domain. Each of them has some interesting properties that are of value, not only for deriving, but also for analyzing optimal filters in the context of noise reduction. The SCC is a nonparametric rank statistic proposed by Charles Spearman as a measure of the strength of the associations between two variables [6]. It is not a measure of the linear relationship between two variables, but a monotone association used when the distribution of the data makes the PCC undesirable or misleading [7]. The KCC is used to measure the degree of similarity between two sets of ranks given to the same set of objects depending upon the number of inversions of pairs of objects that would be needed to transform one rank order into the other [8]. In this paper, the research verified the correlation among mainstream media from s_1 , s_2 , and s_3 with the three

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correlation calculation methods. If there was a correlation, the research mined the concrete relationship with a regression model. The regression model described the relationships between a dependent variable and one or more independent variables [9]. The results were then analyzed to determine the corresponding coefficients and reliability, allowing an assessment of the probability of the relationship.

This work's contributions are as follows:

1. A high correlation was discovered between the mainstream media in domestic and overseas countries in terms of the number of reports on the CI.
2. Using a regression model, we revealed a functional relationship between the mainstream media from the SARs and those of overseas countries.

The remainder of the paper is organized as follows. Section II will explicit the theories of Pearson, Spearman and Kendall correlation coefficient and the knowledge of data fitting by regression model. The experiments on the news report about CI, from 2004 to 2014, are conducted to verify the correlation among the mainland, SARs and overseas mainstream media in Section III. Section III also confirms the concrete relationship among the mainstream media of the three regions. Section IV describes the literature review about the research on CI. Finally, Section V concludes the paper with a discussion of future work.

II. CORRELATION AND FUNCTIONAL ANALYSIS

A. Correlation Analysis

In the mainland, SARs and overseas countries, the concern over the same matter may be differentiated. This paper quantifies the attention to CI with the amount of news reports published in the mainstream media. To analyze the correlation coefficient between different mainstream media, the paper models time-series, the quantity of news reports of mainstream media from each region in a certain time interval, to form a vector and analyze correlation. The vector of attention to CI is denoted by X_s in (1):

$$X_s = (x_{s,t_1}, x_{s,t_2}, x_{s,t_j}, \dots, x_{s,t_n}) \quad (1)$$

where s represents reports source of mainstream media such as the mainland (s_1), SARs (s_2), overseas countries (s_3) and $s = \{s_1, s_2, s_3\}$ simplistically, t_j represents the publication time of news reports in a certain mainstream media, and x_{s,t_j} represents the amount of news reports published on time t_j from s .

Based on the vectors it adopts PCC, SCC, KCC to measure the correlation coefficient (r) among mainstream media, which are defined as r_p , r_s , r_k given in (2), (3), (4), respectively.

The formula of PCC [5] is shown in (2):

$$r_p = \frac{\sum(X_{s_1} - \bar{X}_{s_1})(X_{s_2} - \bar{X}_{s_2})}{\sqrt{(\sum(X_{s_1} - \bar{X}_{s_1})^2) \times (\sum(X_{s_2} - \bar{X}_{s_2})^2)}} \quad (2)$$

where X_{s_1} , X_{s_2} represent the time series of news reports from the certain mainstream media, that is $s_1, s_2 \in s = \{s_1, s_2, s_3\}$.

As for SCC [6], let $R(x)$ represent the rank of x in the related vector, d_i ($i=1,2,\dots,n$) the difference in the ranks of

x_{s_1,t_i} and x_{s_2,t_i} , that is, $d_i = R(x_{s_1,t_i}) - R(x_{s_2,t_i})$. For example, $X_{s_1} = \{1.3, 5.4, 0.5\}$, $X_{s_2} = \{3.2, 4.2, 6.1\}$, the ranks, $R(X_{s_1}) = \{2, 1, 3\}$ and $R(X_{s_2}) = \{3, 2, 1\}$, then $d = \{1, 1, -2\}$.

$$r_s = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2-1)} = 1 - \frac{6 \sum_{i=1}^n (R(x_{s_1,t_i}) - R(x_{s_2,t_i}))^2}{n(n^2-1)} \quad (3)$$

The Kendall coefficient r_k [7] is defined as (4)

$$r_k = \frac{4P}{n(n-1)} - 1 \quad (4)$$

where P is the number of concordant pairs in X_{s_1} and X_{s_2} . Concordant means that $x_{s_1,t_i} < x_{s_1,t_j}$ and $x_{s_2,t_i} < x_{s_2,t_j}$ for the two pairs of $(x_{s_1,t_i}, x_{s_2,t_i})$ and $(x_{s_1,t_j}, x_{s_2,t_j})$. For example, $X_{s_1} = \{1.3, 5.4, 0.5\}$, $X_{s_2} = \{3.2, 4.2, 6.1\}$. Because $1.3 < 5.4$, $3.2 < 4.2$ (True); $1.3 > 0.5$, $3.2 < 6.1$ (False); $5.4 > 0.5$, $4.2 < 6.1$ (False), so $P=1$.

The correlation coefficient, ranging from -1 to 1, is frequently called to reflect the degree of correlation between two vectors. If $r > 0$, it means that there is a positive correlation between the two vectors. And the higher value of r means stronger correlation between the two variables positively. Oppositely, If $r < 0$, it suggests that there is a negative correlation. And the lower r declares stronger correlation negatively. Besides, if $r=0$, the two vectors are said to be uncorrelated. When $0 <= |r| <= 1$, it implicates different degree of correlation, shown in Table I in detail. First, when $|r| \in [0, 0.3]$, it means there is no correlation. Next, when $|r| \in (0.3, 0.5]$, it indicates the positive or negative correlation is low. Then, when $|r| \in (0.5, 0.8]$, it means there is remarkable correlation. And last, there is high correlation when $|r| \in (0.8, 1.0]$. In this paper, if $|r| \in (0.8, 1.0]$, it will mine the functional relationship among mainstream media.

TABLE I
THE IMPLICATION OF CORRELATION COEFFICIENT

$ r $	degree of correlation
[0, 0.3]	No correlation
(0.3, 0.5]	Low correlation
(0.5, 0.8]	Remarkable correlation
(0.8, 1.0]	High correlation

B. Functional Relationship Analysis

Further, the paper mines the concrete functional relationship between mainstream media from two news sources if the correlation is high from the perspective of the amount of news reports. As the amount of news reports is a discrete value, we apply data fitting to obtain a continuous function, describing the relationship of different reports sources from the perspective of the amount of news reports. According to the Weierstrass's first theorem [10], every continuous function could be described with a polynomial function. Besides, as there is only one independent vector, it is feasible to describe the relationship between mainstream media with a polynomial function, one kind of regression model, which is shown in (5):

$$X_{s_i} = F(X_{s_j}) = \sum_{k=0}^n a_k \times X_{s_j}^k \quad (5)$$

where s_i and s_j represent the source of mainstream media, a_k is the coefficient of $X_{s_j}^k$.

For solving coefficients, the regression model is used to obtain the standard parameters that can test the reliability of the functional relationship, which would be explained in Section IV according to real data.

III. EXPERIMENTS

In this section, the research evaluates the PCC, SCC and KCC among mainstream media, from the mainland, SARs and overseas countries, based on news reports about CI, during the years 2004 -2014.

A. Data Collection

To collect the news reports set about CI, we searched related news reports using keywords such as CI, Confucius Classroom and the corresponding Chinese phrases in the websites of mainstream media and search engines such as Goolge and Baidu, and then obtained the reports using the “octopus” tools and crawlers implemented in Python. As the structures of mainstream media sites are various, we implemented the sole crawlers in Python for each kind of site. The data set consists of 17,239 news reports after filtering the noise and reduplicative data from 106 mainstream media sources in the mainland, SARs and overseas countries, including 15 countries totally. Additionally, 473 English news reports are not accessible to us as they are published on certain mainstream media sites that requirement payment to read them. The amount of news reports from mainland, SARs and overseas countries are shown in Table II. And we tabulate the number of news reports from the three regions in Table III.

TABLE II
THE NUMBER OF NEWS REPORTS FROM MAINLAND, SARs AND OVERSEAS COUNTRIES

Source of news reports	Number
The Mainland	16,900
SARs	711
overseas countries	508

B. Experimental Results and Analysis

In this subsection, we consider the questions, the overall trends of the number of reports and whether the domestic and overseas mainstream media are correlated. For further research, we implement a regression model that is polynomial function, essentially to fit the curve between the numbers of news reports published in different mainstream media from different regions if there is high correlation.

1. The Trend Analysis

The number of news reports during last 10 years reveals the general concern trend of public opinion to CI. To analyze the overall trend, a graphical representation is used to display the number of news reports in Fig. 1 (a), which shows that the number of news reports in the mainland (s_1) of China is much higher than that in SARs (s_2) and overseas countries (s_3). On

the one hand, it is difficult to collect the news reports about CI expect in the mainland because of the network environment. On the other hand, it may explain that the influence of CI is limited, in so far as it does not attract more attention from foreign countries. However, Fig. 1 (a) also shows that news reports about CI have increased during last 10 years from 2004 to 2014 on the whole. That is, Chinese language and culture attracts more and more attention around the world. This trend may be related to the world situation that China is growing increasingly influential in the world, and meanwhile, China vigorously promotes Chinese language and culture. In fact, the increasing concern over CI is a manifestation of growing concern over the development of China.

TABLE III
THE NUMBER OF NEWS REPORTS IN THE THREE REGIONS FROM 2004 TO 2014

Time	The Mainland	HK and Macao	Oversea countries
2004	0	0	0
2005	26	0	3
2006	57	1	7
2007	206	1	10
2008	523	0	3
2009	793	5	19
2010	923	4	15
2011	993	39	26
2012	2,419	59	47
2013	1,608	42	43
2014	3,017	151	118

As there is a serious difference between the mainstream media in the three regions from the perspective of the number of news reports, the time series are normalized and shown in Fig. 1 (b). Fig. 1 (b) and indicates that the increases or decreases of the three curves over time are similar, especially between the mainstream media in s_2 and s_3 . It can be observed that the attention of the mainstream media in overseas countries and SARs, are almost the same when it comes to reporting the news about CI.

2. Correlation Verification

From Fig. 1, the trend to report the news about CI among the mainland, SARs and oversea countries is similar. In order to explain this trend, we analyze the correlation between mainstream media using the PCC, SCC and KCC and evaluate it with the rules in Table I. In the experiments, we calculate PCC, SCC and KCC among the mainstream media for the three pairs of regions, from s_1 and s_2 , s_1 and s_3 , s_2 and s_3 . Table IV provides the experimental results. From Table IV, it can be observed that all the values are greater than 0.8, which means that there exists high correlation in terms of any one correlation coefficient, consistent with the results in Fig. 1. It reveals that the situation concerning CI is similar based on the news reports published on mainstream media at home and abroad. Note that all the three kinds of correlation coefficients between s_2 and s_3 are extremely great, close to 1. So it reveals that the attention of mainstream media in SARs and overseas countries to CI is almost the same.

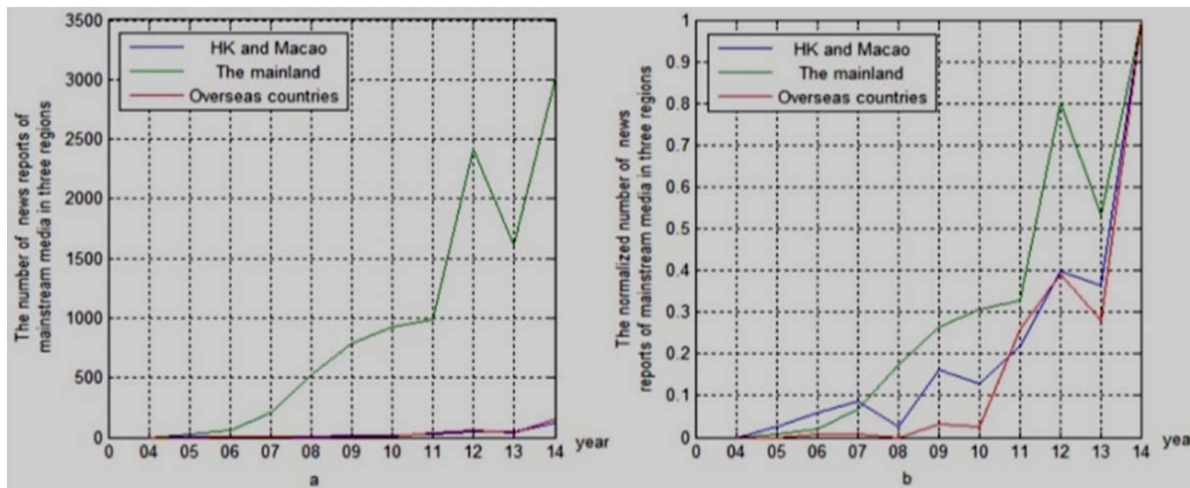


Fig. 1 The time-series and normalized -time-series of the number of news reports during the year 2004-2014 in the mainland, HK and Macao, overseas countries

TABLE IV
THE THREE CORRELATION COEFFICIENTS OF THREE PAIRS OF MAINSTREAM MEDIA FROM THE VIEW OF THE ATTENTION TO CI

Correlation coefficient	s ₁ and s ₂	s ₁ and s ₃	s ₂ and s ₃
PCC	0.8497	0.8808	0.9718
SCC	0.9068	0.9215	0.9868
KCC	0.9334	0.9522	0.9908

3. Functional Relationship Verification

Correlation analysis aims at measuring whether there is a correlation between the mainstream media, neglecting the concrete relationship between them. According to the Weierstrass's first theorem, every continuous function could be described with a polynomial function. First, we analyze the relationship between the mainstream media from SARs and overseas countries (s₂ and s₃) to determine the greatest sum of the exponents (n in formula (5)) of the variable in formula (5). The paper conducts experiments on different values of n, from 1 to 4, and the results are shown in Table V, which contains three parameters, R², F, p. R² represents the reliability of functional relationship, F the statistical magnitude that need be larger than the corresponding threshold and p, the probability of the F. Note that all the three parameters need to meet the conditions. In this paper, higher R² is better. The value of F should be larger than F_{0.95}(1,9)= 240.54 and p should be smaller than (1-0.95=0.05) based on the knowledge of statistics. Additionally, R² and F are drawn in Figs. 2 and 3, respectively. Fig. 2 shows that R² becomes higher with the increase of the greatest sum of the exponents of the variable. From Fig. 3, it reveals that F decreases constantly when the greatest sum of the exponents of the variable increases, and eventually, only the case that the value is equal to 1 meets the condition that F < F_{0.95}(1,9). As the values of p is smaller than 0.05, it can conclude that only the function whose the greatest

sum of the exponents of the variable is equal to 1 is tenable. Under the analysis, the result and evaluation indicators are shown in Table VI.

Table VI indicates that α₀=-7.7657, α₁=1.3313, then the functional relationship of attention between the mainstream media from s₂ and s₃ can be described as (6)

$$X_{s_2} = -7.7657 + 1.3313 * X_{s_3} \tag{6}$$

where X_{s₂} and X_{s₃} represent the number of news report about CI from mainstream media in SARs (R₁) and overseas countries (R₂).

In Table VI, R², F and p are used to verify the reliability of formula (6). R is the correlation coefficient and R²=0.9738 means that the probability of the functional relationship is 97.38%. Besides, the statistics F=334.8291 is much higher than the threshold F_{0.95}(10,1)=241.88 and p is lower than 0.05. In summary, formula (6) can quantify the functional relationship between the number of news report about CI published on mainstream media in SARs and overseas countries. However, the experiments on (s₁,s₂) and (s₁,s₃) show the parameter R is close to 0. It means that there is no reliable functional relationship between s₁ and s₂, s₁ and s₃.

TABLE V
THE COMPARISON AMONG DIFFERENT GREATEST SUM OF THE EXPONENTS OF THE VARIABLE IN THE POLYNOMIAL EQUATION FOR S₂ AND S₃

Parameter	The greatest sum of the exponents of the variable in the polynomial equation(n)			
	1	2	3	4
R ²	0.9738	0.9791	0.9832	0.9836
F	334.8290	109.3301	87.77.1	59.9680
p	0	0	0	0.0002

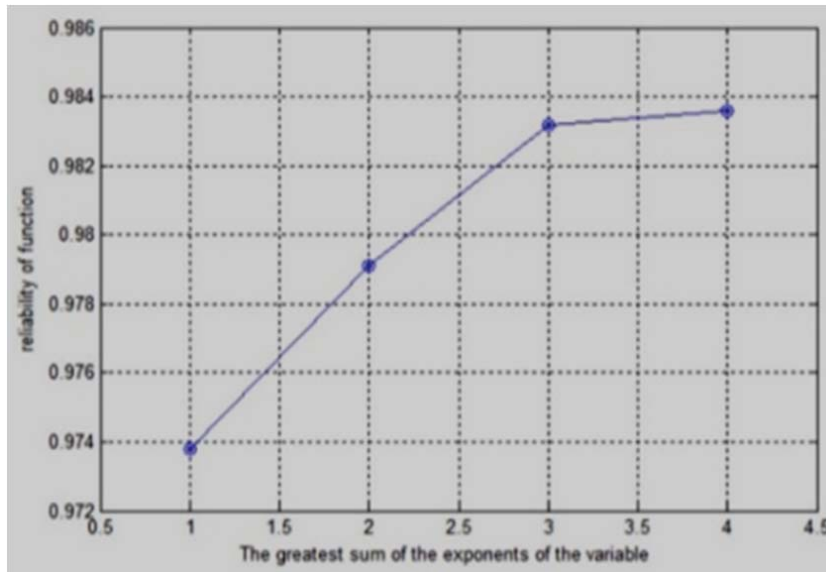


Fig. 2 The reliabilities, R^2 , of different greatest sum of the exponents of the variable in the polynomial equation for s_2 and s_3

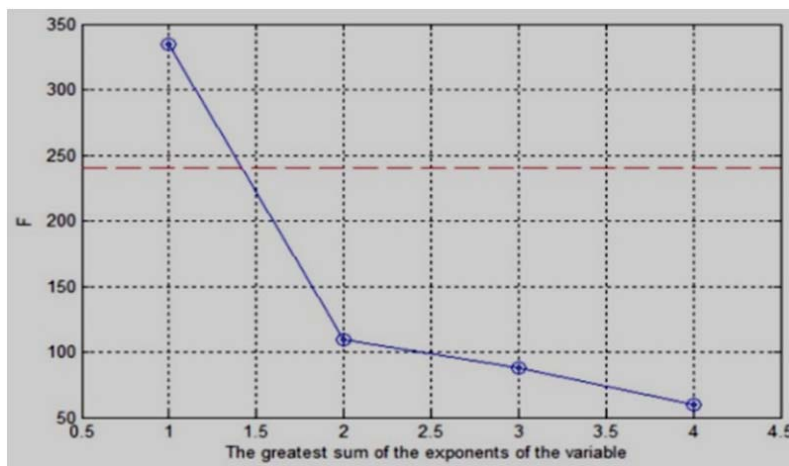


Fig. 3 The values of F of different greatest sum of the exponents of the variable in the polynomial equation for s_2 and s_3

TABLE VI
THE EVALUATION RESULT AND INDICATORS OF REGRESSION MODEL FOR s_2 AND s_3

Parameter	Estimator of parameter
α_0	-7.7657
α_1	1.3313
$R^2=0.9738$	$F=334.8291$ $p=0$

IV. LITERATURE REVIEW

CI is described as “a huge element of China’s great plan of international publicity” [11] and “an important brand of international Chinese language education and a significant platform for educational and cultural exchanges” [12]. As so far there are plenty of researches in CI from different kinds of perspectives. Reference [13] concludes that with the increase in cultural influence, it argues that China’s “soft power” is also in ascendancy. While [14] concludes that even though Beijing’s growing ability to shape other people’s worldview,

soft power remains Beijing’s underbelly and China still has a long way to go to become a true global leader. And CIs are connected to the rise of China and a unique member of the family of national culture institutes considering the case study of German CI [15]. And from the view of educational market, the article studies the evolution of the curriculum policy and shows that it facilitates the rapid growth of CI by analyzing the media sources including government policy, CI, newspaper reports from the Internet, teachers’ blogs. It indicates that it is not likely that Chinese will replace English as the most widely used language in the foreseeable future, but the Chinese language is a necessary element in the unity of the world [16]. Reference [17] analyzes the differences between Chinese support for higher education and ‘traditional’ partnerships, and the effect on the chances of producing locally relevant knowledge in Africa. In the fields of economics and finance, CI also has an impact. Reference [1] employs gravity models to analyze the influence of CIs on

outward trade and Foreign Direct Investment flows from China, indicating that CI commands stronger impacts on Foreign Direct Investment than on outward trade. While [18] also uses the trade gravity model to examine the effects of CIs on the exports of US states to China between 2006 and 2010. It reveals that CIs provide direct economic benefits to the US. Additionally, CI affects the international travel to China. Reference [19] estimates a panel gravity model of inbound tourism flows to China between 2004 and 2010. It finds that the presence of CI in the source country increases overall tourism in general and business and worker tourists in particular. For the overall image of CI, there are different viewpoints. By investigating the media's reports from overseas countries, especially the US, it finds that the support accounts for larger proportions [20]. However, the scale of news data is limited to the researches. To solve the problem, this paper collects all the news reports that can be accessed from the Internet. Besides, the paper analyzes the attention to CI by quantizing the number of news reports published in the mainstream media all over the world.

V. CONCLUSIONS

As a significant symbol of advertising Chinese culture and language, CI attracts more and more attention all over the world. Usually, mainstream media represents the main opinion of the public. Under this backdrop, this paper contributes on two aspects: 1) The paper discovers that there is a similar trend among the mainstream media in domestic and overseas countries in terms of the attention to CI by analyzing the correlation coefficient. 2) The paper reveals the functional relationship among the mainstream media in SARs and overseas countries by means of fitting the time-stamped data of news reports. The experiments indicate that there are high correlations among the mainstream media from the mainland, SARs and overseas countries, and the linear relation between the mainstream media from overseas countries and SARs based on the amount of news reports about CI from 2004 to 2014.

Expectations for future works will also analyze the main topics of concern by the public and the attitudes based on the news reports about CI. Additionally, universal software will be designed and developed, analyzing public news reports.

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