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## A Note on Association for Korean Markets Using Correspondence Analysis

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### Abstract

**Purpose** - In this paper, we consider more segmented types of markets than conventional version of ones in South Korea and explore the degree of relations between these markets and the related factors with them. In this case, ten attributes of types of markets mentioned above will be considered. To be more specific, the numerical strength is evaluated and graphical approach is expressed on two-dimensional plane, if the association exists between the considered variables.

**Research design, data, and methodology** - This work is done by the 2013 report on the commercial building lease offered by Small Businessmen Promotion Institute (May/2013~August/2013) and exploited by statistical analyses such as correspondence analysis and a chi-squared test in IBM SPSS 23.0.

**Results** - Findings of this paper indicate that a variable Korean market, including traditional markets, are closely connected with variables administrative district, sales and occupation instead of company, age group and business duration and the detailed associations between variables can be obtained by inspecting results of correspondence analysis.

**Conclusions** - We can understand where the status of the Korean markets stands now through this work and also government authority and local autonomy can take advantage of these findings to enhance the revitalization of Korean markets and other markets.

**Keywords:** Association, Attribute, Chi-squared Test, Correspondence Analysis, Types of Markets.

**JEL Classifications:** C12, M10, M30, N75, Q12.

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### 1. Introduction

Recently, traditional markets in Korea particularly tend to be a living space as well as a commercial place and provide people with cultural contents such as precious assets in domestic or local economy. A variety of research on revitalization of traditional markets and related distribution market with them are performed as follow.

Choo (2015) verified the perceived differences of service quality based on traditional market specialization and draw the clue that the perceived service quality of the cultural tourism market was, in general, higher than that of the non-cultural tourism market. And also he showed that convenience, empathy and reliability, among the service quality factors, produced meaningful effects on customer value, while convenience, reliability, responsiveness, and empathy had meaningful effects on the relationship quality.

The practical result of this work is that the perceived service quality, such as convenience, responsiveness, reliability and tangibles, was higher in the cultural tourism market than in the non-cultural tourism market. This implies that customer satisfaction is improved by governmental support such as hardware, software, communications technology and information.

Kim and Kwon (2013) investigated systematical review of the setting of the Korean distribution furtherance and distribution control policies, together with related regulations and policies. He concluded that both distribution promotion policy and distribution adjustment policy, in essence, are government distribution policies based on the preserving of the small and medium distribution companies. This work is stressed on the fact that it offers insight for the progression of up-to-date plans in the future and a chance to taking into consideration of the setting of the distribution measure by the government authority.

Lee and Kim (2015) analyzed consumption behavior concerning traditional retail markets and policy influences of traditional retail market plans backed by government authority through empirical study. They showed that

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convenience and facilities product a crucial effect on consumer satisfaction in agreement with the government's traditional retail market support. In addition, they found out that convenience, facilities, product and service have a significant influence on consumer satisfaction with respect to traditional retail market's service quality and consumer satisfaction. Moreover, their findings show that customers who are deeply satisfied at traditional markets have an important influence on both revisit and on recommendation intent.

Seo et al. (2014) examined how perceived benefits and costs of traditional market aid influence relationship quality and support for marketeers. They showed that marketeers, contented and believed by support programs of both traditional markets and government authority, would back the traditional market aid program, resulting in higher aid for the government. The relationship quality of support program of a traditional market has an effect on backing of a traditional market support program, and the relationship quality of government influences the support of government.

Associations between market and six major variables considered in this paper are examined by computing the quantitative strength and graphing their distances on a biplot.

The target variable market with ten attributes and the rest of six variables such as administrative district, sales, occupation, company, age group and business duration are comprehensively treated to make pairwise comparisons.

The main idea and concepts of correspondence analysis will be described in section 2. In section 3, data collection will be briefly expressed. Six variables bound up with MARKET will be epitomized as a boxplot and their connections will be graphed in section 4 by utilizing correspondence analysis. Based on this statistical method, both direction and strength of their association will be suggested. Finally, the summary and concluding remarks of this work will be stated.

## 2. Theoretical Reviews of Correspondence Analysis

For exploring details of this association, the main statistical analysis given below will be used. If there exists an association between two variables considered in this paper, correspondence analysis can be exploited for expressing the detailed association (Johnson & Wichern, 2007; Muirhead, 2014; Steven, 2009; Yang, 2013).

Correspondence analysis is a statistical technique that provides a graphical representation of cross tabulations (which are also known as cross tabs, or contingency tables). Cross tabulations arise whenever it is possible to place events into two or more different sets of categories, such as

product and location for purchases in market research or symptom and treatment in medical testing. The main goal of this technique is to transform cross tabulation into a visual representation, in which every row and every column is indicated as a point. A scaling of this display, called a biplot, is suggested which incorporates diagnostic directly into graphical representation, showing the major contributors and thus simplifying the graphical view considerably.

Let  $Y$  be an  $n \times m$  matrix of observed frequencies of rank  $q$  such that the row and column sums are nonzero and  $P = (1/n)N$  be the matrix of relative frequencies. Suppose  $D_r$ ,  $D_c$  and  $D_u$  be the diagonal matrix of row masses, the diagonal matrix of row masses, and  $q \times q$  diagonal matrix of generalized singular values, respectively.

Define  $A$  as an  $n \times q$  matrix whose columns are left generalized singular vectors and  $B$  as an  $m \times q$  matrix whose columns are right generalized singular vectors.

Then, the row and column coordinates are separate decompositions according to the following formulas:

$$F = D_r^{-1}AD_u = (D_r^{-1}P)(D_c^{-1/2})(D_c^{-1/2}B)$$

$$G = D_c^{-1}AD_u = (D_c^{-1}P)(D_r^{-1/2})(D_r^{-1/2}A)$$

The inertias  $D_u^2$  refer to both sets of points, since  $D_u^2 = \hat{F}D_rF = \hat{G}D_cG$ . Because  $D_c^{-1}P$  is the matrix of row profiles, the default row coordinates can be interpreted as scaled row profiles that are orthogonally rotated with  $D_c^{-1/2}B$  to a principal axis orientation. In a similar manner, the default column coordinates are column profiles  $D_c^{-1}P$  scaled by the factor  $D_r^{-1/2}$  and orthogonally rotated with  $D_r^{-1/2}A$  to a principal axis orientation (Benzecri, 1992; Brigitte, 2009; Clausen, 1988)

When the row and column coordinates are computed by the formulas given above, they are plotted on two dimensional plane, which is called a biplot (Anderson, 1958; Greenacre, 1983; 2007; Hair et al., 2007; Hoffman & Franke, 1986).

## 3. Data Collection

This work is performed by Small and Medium Business Administration in 2013 and examined small company samples. The samples are categorized into three groups, which are traditional markets, general commercial zones and central commercial zones.

The survey shows that samples consist of 10,490 small businesses by categorizing both 16 cities and provinces across country. The survey is conducted from May to August in 2013, supervised by Small Businessmen Promotion Institute and performed in an interview

#### 4. Research Results

##### 4.1. Association between administrative district and market

<Table 1> shows that ‘common stores along with a road’

accounts for about 60% of grand total and has the largest count among all types of markets regardless of administrative districts. After this market ‘single stores in residence area’, ‘commercial facilities in apartment complex’, ‘owner-driver taxis & small freight trucking’, ‘aggregate stores’ and ‘traditional markets’ are most selected occupations in numerical order.

<Table 1> Cross-tabulation of market\*administrative district

Administrative District	Market										Total
	1	2	3	4	5	6	7	8	9	10	
Seoul	11	40	9	7	1	1	15	2	14	0	100
Busan	12	50	5	4	0	1	13	5	8	2	100
Daegu	7	47	10	3	0	0	21	4	7	1	100
Incheon	7	48	2	24	0	1	13	3	3	1	102
Gwangju	2	74	8	5	0	1	4	0	4	0	98
Daejeon	3	55	11	9	0	0	14	1	8	0	101
Ulsan	6	69	6	3	2	0	9	0	6	1	102
Gyeonggi	5	54	9	11	0	1	9	2	10	1	102
Gangwon	3	66	7	5	0	1	12	0	5	1	100
Chungbuk	5	64	8	4	0	1	10	1	8	0	101
Chungnam	5	63	6	3	0	5	12	1	5	1	101
Chunbuk	6	64	14	2	1	1	6	0	6	1	101
Chunnam	2	74	10	2	1	0	4	1	6	1	101
Gyungbuk	6	63	6	5	0	0	11	1	7	1	100
Gyungnam	9	67	9	5	0	0	5	2	6	1	104
Jeju	0	65	2	4	2	1	14	1	7	1	97
Total	89	963	122	96	7	14	172	24	110	13	1610

\*\* The numerical values in the second row stand for the following:

- 1: traditional markets 2: common stores along the road 3: commercial facilities in apartment complex 4: aggregate stores 5: departments & discount stores
- 6: underground shopping centers 7: single stores in residence area 8: industrial complex 9: owner-driver taxis & small freight trucking 10: others

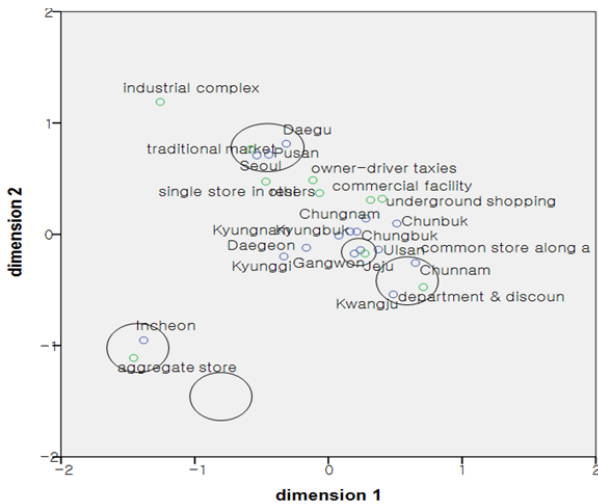
<Table 2> Summary on administrative district

Dimension	Singular Value	Inertia	Chi Square	P value.	Proportion of Inertia		Confidence Singular Value	
					Accounted	Cumulated	Standard Deviation	Correlation 2
1	.246	.061			.395	.395	.029	.257
2	.193	.037			.243	.638	.028	
3	.138	.019			.124	.762		
4	.115	.013			.087	.849		
5	.104	.011			.070	.919		
6	.081	.007			.043	.962		
7	.057	.003			.021	.983		
8	.040	.002			.010	.994		
9	.031	.001			.006	1.000		
Total		.154	245.79	<.001	1.000	1.000		

From <Table 2> given above, the value (15.4%) in the total Inertia column indicates that knowing something about type of administrative districts explain 15.4% of something types of markets and vice versa. The association between markets and administrative districts is still highly significant as shown by the value of the chi square statistic (p-value<0.001).

Dimension 1 gives an account of 6.1% while dimension 2 explains 3.7% of the total 15.4% of variance accounted for in the model. Dimension 1 gives an explanation of 39.5% of the total 15.4% of variance explained in the model and also dimension 2 elucidates 24.3% of the total 15.4% of variance explained in the model.

A biplot on <Figure 1> indicates a visual display of all values plotted with their two axes and a comprehensive view of a tendency with the data. When utilizing a biplot, the chi-squared test turns out the strength of tendencies within the data.



<Figure 1> Row and column points with symmetric normalization between market and administrative district

Since the distance between any column points (or row points) offers a measure of their similarity, we can get the <Table 4> Summary on sales

Dimension	Singular Value	Inertia	Chi Square	P value.	Proportion of Inertia		Confidence Singular Value	
					Accounted	Cumulated	Standard Deviation	Correlation 2
1	.357	.127			.766	.766	.040	.391
2	.175	.031			.185	.951	.036	
3	.071	.005			.030	.981		
4	.041	.002			.010	.991		
5	.034	.001			.007	.998		
6	.018	.166			.002	1.000		
Total			116.43	<.001	1.000	1.000		

evidence that points mapped close to one another have similar alignments. In contrast, points mapped remote from one another have very different alignments.

As we can see on <Figure 1>, 'traditional markets' among 10 attributes of markets are particularly associated with 'Seoul', 'Pusan' among administrative districts. In the similar manner, 'aggregate stores' are closely related to 'Incheon' and 'departments & discount stores' appear to have a marginal connection with both 'Chunnam' and 'Gwangju'. On the other hand, 'industrial complex' is far away from most of markets and, in particular, most remote from 'Incheon'.

#### 4.2. Association between sales and market

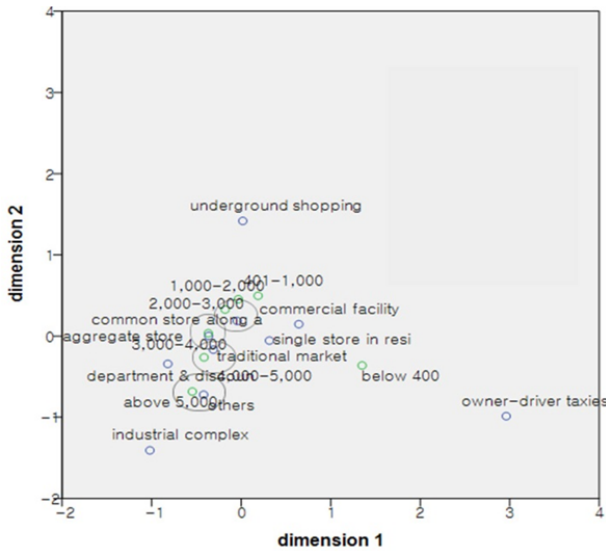
'Common stores along the road', 'traditional markets', 'aggregate stores' and 'single stores in residence area' are most selected markets in numerical order. Similarly, 'common stores along with a road' explains about 58% of grand total and has bigger count than any other markets (see <Table 3>).

<Table 3> Cross-tabulation of market\*sales

Sales (Mann won)	Market										Total
	1	2	3	4	5	6	7	8	9	10	
below 400	6	51	9	4	0	0	13	1	15	1	100
400-1,000	5	64	8	8	0	1	9	1	3	1	100
1,000-2,000	7	65	5	8	1	2	9	3	2	1	103
2,000-3,000	10	62	4	9	1	1	9	3	1	1	101
3,000-4,000	10	60	3	10	2	1	7	6	0	1	100
4,000-5,000	9	55	3	11	1	1	9	9	0	1	99
above 5,000	10	54	4	9	2	0	8	13	0	2	102
Total	57	411	36	59	7	6	64	36	21	8	705

The chi-squared test reveals the highly association between variable sales and markets. The first dimension accounts for 76.6 and the first two explains 95.1% of total inertia (see <Table 4>)

We can find out that ‘aggregate stores’, ‘others’, ‘common stores along with a road’, and ‘owner-driver taxies & small freight trucking’ are closely connected with ‘3,000-4,000’, ‘above 5,000’, ‘2,000-3,000’ and ‘below 400’, respectively. ‘Traditional markets’ among markets seem to have a marginal association with both ‘3,000-4,000’ and ‘4,000-5,000’ and ‘underground shopping’ has a marginal connection with lower sales such as ‘401-1,000’ and ‘1,000-2,000’ (see <Figure 2>).



<Figure 2> Row and column points with symmetric normalization between market and sales

4.3. Association between occupation and market

‘Common stores along the road’, ‘single stores in residence area’, ‘owner-driver taxies & small freight trucking’ and ‘aggregate stores’ are most chosen markets in numerical

order (see <Table 5>) of the total of the column. In case of ‘owner-driver taxies & small freight trucking’, only transportation industry is chosen among types of occupations.

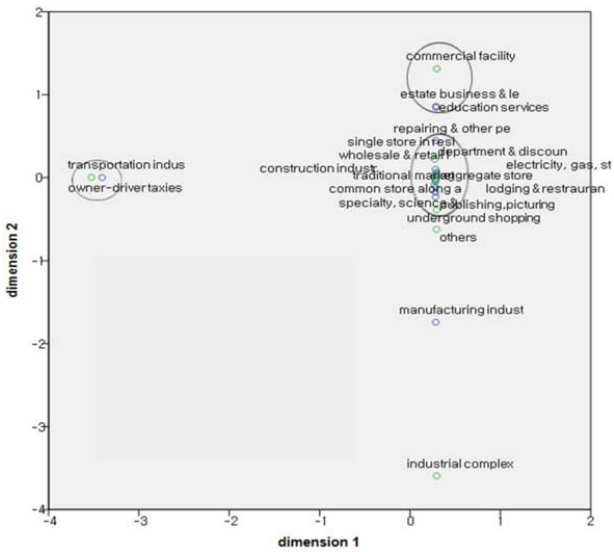
<Table 5> Cross-tabulation of market\*occupation

Occupation	Market										Total
	1	2	3	4	5	6	7	8	9	10	
a	2	62	1	6	0	1	10	17	0	1	100
b	7	74	4	4	0	0	11	0	0	0	100
c	3	73	6	4	0	0	13	0	0	0	99
d	19	53	7	8	1	2	9	1	0	1	101
e	0	5	0	0	0	0	1	0	94	0	100
f	7	68	4	6	0	1	13	1	0	1	101
g	1	76	2	10	0	0	7	1	0	2	99
h	2	58	27	6	0	0	9	0	0	0	102
i	3	77	4	10	1	0	4	2	0	1	101
j	1	81	4	6	1	0	6	0	0	0	99
k	1	49	25	10	0	0	16	0	0	1	102
l	1	77	2	12	0	3	4	0	0	1	100
m	2	58	15	4	0	0	19	1	0	0	99
Total	48	811	101	86	3	7	122	23	94	8	1303

\* The numerical values in the second row stand for the following:  
 a: manufacturing industry b: electricity, gas, steam & water services  
 c: construction industry d: wholesale & retail industry  
 e: transportation industry f: lodging & restaurant business  
 g: publishing, picturing business, broadcasting & communication, information services h: estate business & leasing services  
 i: specialty, science & technology services  
 j: facilities management & business support services  
 k: education services l: art, sport & services related to leisure  
 m: repairing & other personal services

<Table 6> Summary on occupation

Dimension	Singular Value	Inertia	Chi Square	P value.	Proportion of Inertia		Confidence Singular Value	
					Accounted	Cumulated	Standard Deviation	Correlation
								2
1	.967	.934			.738	.738	.013	.000
2	.370	.137			.108	.846	.035	
3	.297	.088			.069	.915		
4	.248	.062			.049	.964		
5	.154	.024			.019	.983		
6	.105	.011			.009	.991		
7	.084	.007			.006	.997		
8	.058	.003			.003	.999		
9	.029	.001			.001	1.000		
Total		1.267	1646.5	<.001	1.000	1.000		



<Figure 3> Row and column points with symmetric normalization between market and occupation

Examining the chi-squared test (p-value<0.001), from <Table 6> given above, presents that the assertion that the two variables (or occupation and markets) are closely linked to each other is strongly justified. Note that the first dimension explains about 74% of the 126.7% of the variance accounted for by the given model.

We can see, from <Figure 3>, that 'industrial complex', 'underground shopping centers' and 'single stores in residence area' are closely associated with 'manufacturing industry', 'publishing, picturing business, broadcasting & communication, information services' and 'repairing & other personal services', respectively.

'Traditional markets' appear to have a marginal

<Table 8> Summary on company

Dimension	Singular Value	Inertia	Chi Square	P value.	Proportion of Inertia		Confidence Singular Value	
					Accounted	Cumulated	Standard Deviation	Correlation
								2
1	.275	.275			.928	.928	.043	-.016
2	.076	.006			.072	1.000	.056	
Total		.081	24.379	.143	1.000	1.000		

Automatically, correspondence analysis does not need any more due to no existence of an association between them, (see <Figure 8>).

4.5. Association between age group and market

<Table 9> reports that 'common stores along the road' cover 59% of the grand total and also take up more than 50%

restaurant business' and 'facilities management & business support services'. 'Owner-driver taxis & small freight trucking' has to do with too much 'transportation industry', with apart from the others.

4.4. Association between company and market

As we can see above, 'common stores along the road' have the largest count in all types of company, and also they account for 62.3% of the grand total. In case of both 'owner-driver taxis & small freight trucking' and 'others', only 'independent stores' are selected among the types of company (see <Table 7>).

<Table 7> Cross-tabulation of market\*company

Business	Market										Total
	1	2	3	4	5	6	7	8	9	10	
a	6	57	8	6	0	1	11	2	8	1	100
b	6	63	12	8	3	1	7	1	0	0	101
c	4	67	8	9	2	1	7	1	0	0	99
Total	16	187	28	23	5	3	25	4	9	1	300

\*\* The numerical values in the second row stand for the following:  
 a: independent stores b: franchisee in conglomerate subsidiary  
 c: franchisee in smaller firms

The value of total inertia, from <Table 8> given below, shows that knowing something regarding type of company accounts for 8.1% of something type of market and vice versa. However, this connection is very weak by checking the chi-squared test (p-value=0.143), so that we can obtain the clue that the association between company and market does not exist.

for all age groups. Furthermore, 'departments & discount stores', 'underground shopping centers', 'industrial complex and 'others' have even smaller count than any other markets for each age group. On the other hand, 'above 60s' has the biggest count (i.e., about 53%) of 'owner-driver taxis & small freight trucking'.

<Table 9> Cross-tabulation of market\*age group

Age Group	Market										Total
	1	2	3	4	5	6	7	8	9	10	
20s	4	63	6	14	1	3	6	0	1	1	99
30s	4	64	10	8	1	1	9	1	2	1	101
40s	5	62	8	7	1	1	10	2	3	1	100
50s	7	56	8	6	0	1	12	2	9	0	101
above 60s	9	51	5	4	0	1	12	1	17	1	101
Total	29	296	37	39	3	7	49	6	32	4	502

The chi-squared test shows no significant association between age group and market (p-value=0.610) and correspondence analysis is not necessary to visualize the association between two variables (see <Table 10>).

<Table 10> Summary on age group

Dimension	Singular Value	Inertia	Chi Square	P value.	Proportion of Inertia		Confidence Singular Value	
					Accounted	Cumulated	Standard Deviation	Correlation 2
1	.287	.082			.814	.814	.043	.201
2	.129	.017			.165	.979	.043	
3	.043	.002			.018	.997		
4	.018	.000			.003	1.000		
Total		.101	50.507	.610	1.000	1.000		

#### 4.6. Association between business duration and market

As we can see in section 4.5, 'departments & discount stores', 'underground shopping centers' and 'others' have much smaller count than any other markets, and also 'common stores along the road' take up approximately 58% of all sales duration.

In addition, we can find that 'above 60s' dominantly takes up about 41% of 'owner-driver taxies & small freight trucking' (see <Table 11>).

<Table 11> Cross-tabulation of market\*business duration

Business Duration (years)	Market										Total
	1	2	3	4	5	6	7	8	9	10	
below 3	5	62	8	8	1	1	11	1	3	1	101
3-6	4	62	8	8	0	1	10	1	5	1	100
6-9	7	57	9	8	1	1	11	2	5	0	101
9-12	6	57	8	7	0	1	12	2	7	1	101
above 12	9	53	6	4	0	1	12	2	14	0	101
Total	31	291	39	35	2	5	56	8	34	3	504

As shown in <Table 12>, the value of chi-square statistic indicates that there does not exist an association between business duration and market (p-value=0.994). Therefore, we do not have to perform the correspondence analysis.

<Table 12> Summary on business duration

Dimension	Singular Value	Inertia	Chi Square	P value.	Proportion of Inertia		Confidence Singular Value	
					Accounted	Cumulated	Standard Deviation	Correlation 2
1	.178	.032			.879	.879	.048	-.012
2	.053	.003			.078	.956	.043	
3	.033	.001			.030	.986		
4	.022	.000			.014	1.000		
Total		.036	18.119	.994	1.000	1.000		

## 5. Concluding Remarks

Correspondence analysis (CA) is a technique for visually displaying cross-tabulation by computing coordinates denoting its rows and columns. These coordinates are similar to factors in a principal components technique of multivariate analysis (utilized for quantitative data), except that they separate the value of chi square statistic exploited in testing independence instead of the total variance.

In summary, traditional markets have to do with much Seoul and 'Pusan' among attributes of a variable administrative district, have a marginal association with both '3,000-4,000' and '4,000-5,000' mann won among attributes of a variable SALES, and marginal connection with 'wholesale & retail industry', 'lodging & restaurant business' and 'facilities management & business support services'. However, traditional markets have nothing to do with any attributes of variables company, age group and business duration.

In addition, 'common stores along the road', which have the most count among a variable MARKET, have a marginal connection with 'Gwangwon' and 'Jeju' of a variable administrative district, and 'lodging & restaurant business', 'facilities management & business support services', and 'electricity, gas, steam & water services' of a variable occupation, and also are deeply tied to '2,000-3,000' of a

variable sales. Similarly, common stores along the road' have nothing to do with any attributes of variables company, age group and business duration.

Finally, 'owner-driver taxies & small freight trucking' have the distinct characteristics that are closely associated with 'transportation industry', 'below 400' mann won of variables occupation and sales, respectively.

We perceive that the Korean government should selectively support traditional retail markets in both major cities and small and medium-sized cities. To that end, the Korean government authority requires to choose a concentrative strategy for the invigoration of the Korean traditional markets (Lee & Kim, 2015).

We can make sure that support program of traditional markets will augment backing for the Korean government authority. Therefore, policy makers, who design support programs of traditional markets, have to give an explanation to marketeers concerning benefits and costs of progression of traditional markets environmentally, economically, and socially (Seo et al., 2014).

However, the subject of this work is nothing but limited to association between markets and related factors. For the deep and detail consideration of their relationship, the mathematical or economic model should be analyzed and evaluated in the future.

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