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Spatial heterogeneity of country-of-origin effects within a country: analysis of online review ratings in the US car market

Minyoung Kim[1] · **Sunghoon Kim**[2] · **Jongkuk Lee**[3]

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Abstract We investigate spatial heterogeneity of country-of-origin effects (COEs) within a country and its determinants. Drawing on the literature of COEs and information economics, we maintain that COEs are heterogeneous across regions within a country, which bears important implications to better understand subnational heterogeneity of consumer preferences. We employ a geographically weighted regression model, a spatial analysis to estimate varying COEs across regions in the USA, and analyze online review ratings of US and foreign car bands in the US market during the 2008–2014 period. The results show that (1) COEs of car brands from Germany, Japan, Korea, and the UK are heterogeneous across regions in the USA; (2) geographic distance from the country-of-origin exerts negative influences on COEs; and (3) the proportion of population born in the country-of-origin positively influences COEs.

Keywords Country-of-origin effects · Spatial heterogeneity · Spatial analysis · Geographic distance · Car market

Minyoung Kim, Sunghoon Kim and Jongkuk Lee contributed equally to this work.

✉ Jongkuk Lee
jongkuk@ewha.ac.kr

Minyoung Kim
mkim@ku.edu

Sunghoon Kim
skim348@asu.edu

[1] School of Business, The University of Kansas, Capitol Federal Hall, 1654 Naismith Drive, Lawrence, KS 66045, USA

[2] W.P. Carey School of Business, Arizona State University, PO Box 874106, Tempe, AZ 85287-4106, USA

[3] Ewha School of Business, Ewha Womans University, 11-1 Daehyun-Dong, Suhdaemoon-Ku, Seoul, South Korea

1 Introduction

Extant studies on international marketing and consumer psychology examine country-of-origin effects (COEs) and their implications on product evaluations (Bilkey and Nes 1982; Martin et al. 2011, inter alia). As a stereotype (Devine 1989; Maheswaran 1994), COEs are typically communicated in the phrase of "Made in (country name)" and can exert positive or negative influences on product evaluation of consumers (Bilkey and Nes 1982; Hong and Wyer 1989). As such, COEs have important managerial implications (Bilkey and Nes 1982).

Despite a plethora of studies on COEs, less is illuminated on the spatial heterogeneity of COEs within a country and its determinants. Investigating spatial heterogeneity of COEs bears theoretical and managerial implications. First, it could shed new light on one of the theoretical explanations for spatially varying consumer preferences, since COEs could exert positive or negative influences on product evaluation. For instance, the *IHS Automotive* data show regional heterogeneity in consumer preferences: top-five selling vehicles in California are either Honda or Toyota, while Ford and Chevy dominate in Midwest regions (Yahoo Autos).[1] Consequently, illuminating on spatial heterogeneity of COEs can help us better understand one of the important mechanisms delineating the spatial pattern of consumer preferences within a country. Second, it could help managers make more educated decisions when developing and implementing international expansion strategies into countries with spatially varying consumer preferences (Beugelsdijk et al. 2010).

Drawing on the literature in COEs (Bilkey and Nes 1982; Maheswaran 1994) and information economics (Akerlof 1970; Stiglitz 2000), we first advance a theoretical framework explaining the heterogeneity of COEs within a country and its determinants, focusing on spatial dependence and information asymmetry. We then test the theoretical predictions with online review data of the US and foreign car brands in the US market. To account for the spatial dependence fundamental to our theoretical focus and also intrinsic in empirical nature of the phenomenon, we employ *geographically weighted regression* (GWR) model and estimate spatially varying COEs (Brunsdon et al. 1998). We find that COEs on online satisfaction ratings of foreign car brands from Germany, Japan, Korea, and the UK are spatially heterogeneous in the US car market and that geographic distances from the respective countries-of-origins and the proportions of population born in the countries-of-origins are two of the determinants leading to spatial heterogeneity.

The current study contributes to the literature in at least three ways. First, it extends the literature on COEs by demonstrating spatial heterogeneity of COEs within a country. Complementing the extant literature that has largely focused on micro-level consumer psychology studies, the current study employs a macro-level, exploratory spatial analysis and investigates online review data to reveal geographic pattern of COEs. Second, it contributes to broader international marketing literature by shedding new light on the role of subnational heterogeneity of consumer preferences in influencing decisions in the process of internationalization. Third, it highlights the benefits of

[1] https://www.yahoo.com/autos/bp/the-most-popular-new-vehicle-in-each-state–not-what-you-might-expect-181118005.html

employing spatial models when testing international marketing theories, many of which are constructed in geographic space.

2 Spatial heterogeneity of COEs within a country

A product can be conceived as consisting of a bundle of information cues, which provides consumers with a basis to evaluate the product (Bilkey and Nes 1982). These information cues can unconsciously and automatically activate a stereotype (Devine 1989). As a stereotype (Maheswaran 1994), COEs can be activated by the presence of information on the country-of-origin (Liu and Johnson 2005). Exposure to the positive information would lead to more favorable evaluations, while exposure to negative information would trigger biased judgments (Devine 1989; Martin et al. 2011; Verlegh and Steenkamp 1999). Extending the extant literature, we submit that the extent of positivity and negativity can be spatially heterogeneous within a country. In the following subsections, we develop our theoretical framework and hypotheses on spatial heterogeneity of COEs and its determinants.

2.1 Spatial dependence and information asymmetry

Fundamental to spatial heterogeneity is the spatial dependence of human interactions, or stronger relationships in closer distances (Florax and Van der Vlist 2003; Goodchild et al. 2000). First, the flow of information tends to be localized in its geographic scope (Almeida and Kogut 1999; Cantwell and Mudambi 2011), due largely to the spatial dependence of human interactions. Specifically, transfer of information can be facilitated by close personal contacts or direct interpersonal communications (Laursen et al. 2012; Szulanski 1996), which are typically spatially dependent. In addition, the information can be relationship-specific (Johanson and Vahlne 2009) and reside in human and social capital (Laursen et al. 2012; Sölvell and Zander 1998), because the multiple-level relationships in human and social capital influence the fluidity and trustworthiness of information (Malmberg et al. 1996; Sölvell and Zander 1998). But these relationships are historically bound and primarily embedded in local networks (Malmberg et al. 1996; Sölvell and Zander 1998), thus merging within local areas (Saxenian 1994). As such, flow of information is geographically confined in many cases (Malmberg et al. 1996).

Second, as a consequence of the localized flow of information, geographically proximate locations tend to share similar information, because geographic proximity enhances knowledge spillovers to co-located actors (Marshall 1890). Indeed, studies show that more information and knowledge are available in geographically proximate locations (Grote and Umber 2006; McCann et al. 2016). This is consistent with Tobler's first law of geography that "everything is related to everything else, but near things are more related than distant things" (Tobler 1970: 236). As such, information in a particular location might not be available in geographically distant locations, creating information asymmetry between geographically distant regions within a country (Arrow 1974). Such asymmetric information across regions would, in turn, activate spatially heterogeneous COEs.

2.2 Spatial heterogeneity in COEs

To empirically test spatial heterogeneity of the COEs within a country, we apply our theoretical framework to the US car market, focusing on the COEs of car brands from Germany, Japan, Korea, and the UK, referenced by US car brands.

Our theoretical framework suggests that the carmakers from the four countries would face heterogeneity in COEs across regions within the USA. Due to the localized flow of information, geographically proximate locations tend to share similar information. Therefore, consumers in geographically distant locations would process different types or levels of information on the country-of-origin from those in neighboring locations, thereby unconsciously and automatically activating heterogeneous stereotypes even toward the same country-of-origin. As such, consumers in neighboring locations would develop comparatively more homogenous evaluations toward a country-of-origin than those in geographically distant locations, resulting in spatially dependent consumer evaluations for foreign cars. The foregoing discussion leads to the following hypothesis.

Hypothesis 1: COEs of the four countries are spatially heterogeneous within the USA.

2.3 The effect of geographic distance from the country-of-origin

The theoretical framework advanced in the current study suggests that geographic distance is fundamental to spatial heterogeneity. Due largely to the localized nature of information flow, increasing geographic distance from the source of information is more likely to aggravate the consequence of information asymmetry when providing information cues on and activating the stereotype of the country-of-origin. Specifically, geographic distance from the country-of-origin can increase information asymmetry, creating "geographic bias" (Grote and Umber 2006; Ragozzino and Reuer 2011) in consumer perception in such a way that consumers may evaluate "familiar" local products more favorably (Huberman 2001). In sum, lack of information (or perception of the lack of information) due to information asymmetry from geographic distance and subsequent product unfamiliarity could increase unwillingness to consider the product and hesitation to purchase (Johansson et al. 1994).[2] As such, we expect that, as the geographic distance from the country-of-origin increases, information asymmetry and geographic bias would be greater, exerting detrimental influences on COEs. The foregoing discussion leads to the following hypothesis.

Hypothesis 2: Geographic distance from the country-of-origin negatively influences COEs.

[2] Although we take the information processing perspective, we also recognize alternative perspectives. For instance, in psychology literature, the construal level theory (Trope and Liberman 2000) suggests that geographic distance is strongly associated with psychological distance and, thus, geographic distance increases the abstractness level of products, which increases unfamiliarity of products.

2.4 The effect of population born in the country-of-origin

The population born in the country-of-origin can provide information on the country and, thus, influences local consumers in terms of their perceptions, attitudes, and behaviors toward the brands from the country-of-origin. As the activation of stereotype is an unconscious and automatic process (Banaji and Hardin 1996; Devine 1989; Greenwald and Banaji 1995), the presence of rich information cues on the country-of-origin can spontaneously facilitate the process of activating a stereotype of the country-of-origin (Liu and Johnson 2005; Maheswaran 1994). In addition, through interactions with the people born in the country-of-origin, local consumers will become more familiar with and better understand the brands from the country-of-origin, favorably evaluating the brands from the country-of-origin. The foregoing discussion leads to the following hypothesis.

Hypothesis 3: Population born in the country-of-origin positively influences COEs.

3 Spatial analysis method and data

3.1 Methodology for spatial analysis

Investigating spatially varying patterns of COEs involves intrinsic modeling challenges. A naive OLS approach can be limited to appropriately analyze the phenomenon, because it aggregates spatial information and, thus, simply ignores potential spatial heterogeneity and its dependence. In addition, running the OLS regressions multiple times across small spatial units (e.g., zip codes) can cause small sample size issues in geographic units with a limited number of observations. A series of spatial models have been developed in marketing to account for the omitted underlying mechanisms driving spatial dependence in marketing data (Bronnenberg and Mahajan 2001; Bronnenberg and Sismeiro 2002, inter alia). For instance, Yang and Allenby (2003) apply a spatial modeling framework using a weight matrix to measure the individual choice interdependence based on demographic/geographic distances. In addition, Bronnenberg et al. (2007) open a discussion on persistent geographic heterogeneity in market share for national brands. However, traditional spatial models (e.g., *Spatial Autoregressive Regression*, *Conditional Autoregressive Model*) focus on the structure of spatial dependence on the dependent variable or the error term, rather than variations in the parameter estimates, which are the main interest of the current study. To address the intrinsic modeling challenges, we employ the GWR model when estimating spatially varying coefficients of regression (Brunsdon et al. 1998).

Marketing scholars employ the GWR to estimate spatially heterogeneous variables over geographic space (Govind et al. 2017; Mittal et al. 2004). The GWR accommodates spatial dependence, which underscores that data in locations near the focal location are more informative when understanding the relationship between independent and dependent variables in the focal location. For this reason, the GWR gives more weights to observations in closer locations via a weighting matrix. The model set up for estimating varying coefficients is:

$$\mathbf{W_i^{1/2}Y=W_i^{1/2}X}\beta_\mathbf{i}+\varepsilon_\mathbf{i},\ \mathbf{i=1,\ldots,n} \tag{1}$$

where $\boldsymbol{W}_i$ represents an $\mathrm{n}\times\mathrm{n}$ weight diagonal matrix at location i which contains the diagonal vector $\boldsymbol{w}_{ij}$ of geographically characterized weights for location i; $\boldsymbol{X}$ is a $\mathrm{n}\times P$ matrix of the independent variables (including an intercept) for the entire observation map; ε_i is a random error term at location i and normally distributed as $\mathbf{N}\left(\mathbf{0},\sigma_\mathbf{i}^\mathbf{2}\mathbf{I}\right)$; and $\boldsymbol{\beta}_i$ indicates a P column vector of regression coefficients at location i. The local weight matrix, $\boldsymbol{W}_i$ is calculated by placing more weights on locations that are closer in geographical space. The weight for observation j relative to observation i changes as a function of the distance d_{ij} and a parameter γ that controls the range and decay of spatial correlation such that $W_{ij}=\exp\left(-\frac{d_{ij}}{\gamma}\right)$, where the bandwidth parameter γ can be determined using model selection criteria (e.g., AIC) or cross-validation technique, unless model users have prior knowledge (Brunsdon et al. 1998; Mittal et al. 2004).

To further illuminate the distance effect at each location, Eq. (1) can be reformulated as:

$$\mathbf{Y=X}\beta_\mathbf{i}+\tilde{\varepsilon}_\mathbf{i} \tag{2}$$

where $\tilde{\varepsilon}_\mathbf{i}\sim\mathbf{N}\left(\mathbf{0},\mathbf{W_i^{-1}}\right)$ is an error term at location i. Since the variance $\mathbf{W_i^{-1}}$ is a diagonal matrix whose j^{th} diagonal element is $\exp\left(\frac{d_{ij}}{\gamma}\right)$, the model essentially assumes that, from the i^{th} location, the observation uncertainty is exponentially increasing as the distance from the j^{th} location is increasing. This leads to the weighted least square estimator $\widehat{\beta}_\mathbf{i}=\left(\mathbf{X^TW_iX}\right)^{-1}\mathbf{X^TW_iY}$, which is the best linear unbiased estimator under the model in Eq. (2). This is a traditional regression approach estimated with generalized least squares, where a weighting scheme operationalizes spatial dependence. Thus, the GWR model accommodates spatial dependence by using a weighting matrix, which gives more weights to observations to closer locations. As such, the GWR model enables us to estimate spatially varying coefficients (e.g., COEs), while accounting for spatial dependence.

3.2 Data

We test the hypotheses with online consumer review data from the *Cars.com*, an online advertising and research service company. We collect the review data from January 2008 to April of 2014 across 28 car brands from four major car manufacturing countries: 4 brands from Germany (Audi, BMW, Mercedes-Benz, and Volkswagen), 10 brands from Japan (Acura, Honda, Infiniti, Lexus, Mazda, Mitsubishi, Nissan, Subaru, Suzuki, and Toyota), 2 brands from Korea (Hyundai and Kia), 1 brand from the UK (Land Rover), and 11 brands from the USA (Buick, Cadillac, Chevrolet, Chrysler, Dodge, Ford, GMC, Jeep, Lincoln, Pontiac, and Saturn). In addition to the *Overall Satisfaction Rating*, each review includes location information of each review posting, which enables us to employ spatial analysis methods. Initially, we collected 30,726 review postings. Among these, we removed the reviews from Canada, Alaska, and Hawaii, as the current study focuses on the geographical heterogeneity in the continental US. This process reduces the number of reviews for the analysis of COEs to 18,911.

To find determinants of the spatial heterogeneity of COEs, we further collected various sociometric data (e.g., age proportions, ethnicity proportions, commuting hours per zip code-level region) from *American Community Survey 2008–2012* published by *the US Census Bureau*, geographical distance information from the central locations of originating countries to the reviewers' locations in the USA. We also collected dealership information data from *LeaseTrader.com* (www.leasetrader.com), weather information from *National Climate Data Center* (www.ncdc.noaa.gov), and political ideology data from the websites of the *Secretaries of State or the Boards of Elections* of each state in 2010. Among the 18,911 observations with the review information, we eliminate observations with missing values from these various data sources. Our sample to analyze determinants of spatial heterogeneity of COEs includes 17,387 observations.

3.3 Model specification

For the GWR analysis, we employ as a dependent variable the overall satisfaction ratings of the online review data. We specify as independent variables four dummy variables of German cars, Japanese cars, Korean cars, and UK cars, referenced by US cars. The coefficients of country-of-origin dummies represent the mean difference of the consumer satisfaction scores between the cars from each country-of-origin (i.e., Korea, Japan, Germany, and the UK) and those from the USA. As such, the estimated coefficients are interpreted as an estimate of COEs on the consumer ratings. Specifically, a positive coefficient of a country-of-origin dummy in a certain location suggests positive COEs of the country in that location when referenced by US cars.

In addition to the four dummy variables, we specify three control variables. First, we control for the review years to account for the temporal dimension in the review data. In addition, to address potential confounding effects of car quality and price, we include two additional control variables of *Overall Test Score*, an objective car quality test scores from *Consumer Report*, and local average market prices that consumers actually paid for each model by location from *TRUECar.com*. The GWR analysis provides 18,911 vector sets of location-wise estimated coefficients, which represent regional COEs of each country-of-origin in each observation location. The location-wise coefficients of a country-of-origin are expected to be positive in certain locations in the USA, while they can be negative in other locations, capturing spatial heterogeneity of COEs in the USA.

4 Empirical analysis for spatial heterogeneity of COEs and its determinants

4.1 Results of spatial heterogeneity analysis of COEs (hypothesis 1)

We first try to apply an aggregate OLS. As shown in Table 1, the aggregate COEs of both Japanese cars ($\beta = 0.133$) and Korean cars ($\beta = 0.045$) are positive ($p < 0.01$ for Japanese cars; $p = 0.139$ for Korean cars). The aggregate COEs of German cars are negatively but statistically insignificant ($\beta = -0.004$, $p = 0.877$). Lastly, the aggregate COEs of UK cars are negative with statistical significance ($\beta = -0.307$, $p < 0.01$). Overall, the results of aggregate OLS show that Japanese cars enjoy positive COEs in the US market and UK cars suffer from negative ones, while German and Korean cars have neutral COEs that are not different from US brands. However, as discussed earlier, the results from the aggregate OLS are limited to reveal potential spatial heterogeneity of COEs across regions in the USA.

Moran's *I* test enables us to detect the existence of spatial autocorrelation (Mittal et al. 2004; Moran 1950). If the test statistic is statistically significant, researchers should consider spatial analysis methods. Moran's *I* test statistic for consumer satisfaction scores, the dependent variable for the GWR analysis, is 0.0009, which is greater than the expected value of -0.00005 ($= -1/(N-1)$, here $N = 18{,}911$) with statistical significance ($p < 0.001$). This result indicates a statistically significant and positive spatial autocorrelation in the consumer satisfaction scores across regions in the USA. Namely, consumer ratings in geographically neighboring locations are more similar (i.e., dependent) to each other than to those in distant locations.

Figure 1 includes four panels showing the coefficients estimated by the GWR. Each panel illustrates heterogeneous patterns of COEs of German cars, Japanese cars, Korean cars, and UK cars, respectively. Specifically, as shown in Fig. 1a, the COEs map of Korean cars shows a heterogeneous pattern between positive effect and negative COEs depending on the geographical regions. For instance, COEs of Korean cars are positive in the West Coast areas (e.g., Washington, Oregon, and northern California)

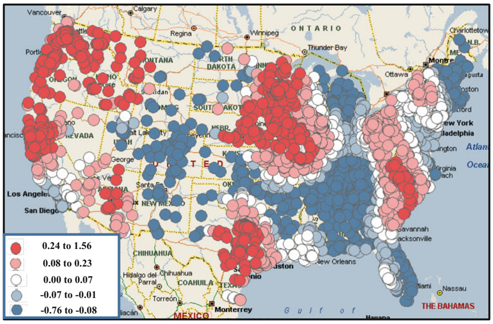
Table 1 Aggregate linear regression results

Variables	Coefficients	Standard error	p value
Constant	1.570	2.743	0.567
Japanese cars	0.133**	0.018	< 0.01
Korean cars	0.045	0.031	0.139
German cars	− 0.004	0.024	0.877
UK cars	− 0.307**	0.069	< 0.01
Objective performance (*Test scores* in consumer report)	0.001*	0.001	0.044
Average market price	0.125**	0.008	< 0.01
Observations	18,911		
F-statistics	49.39		

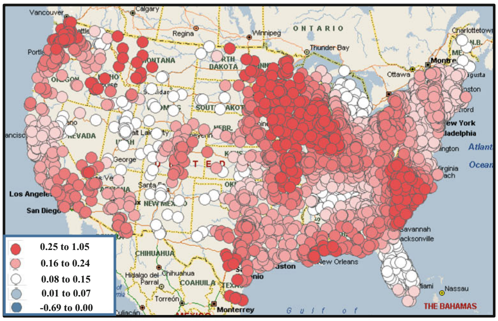
*$p < 0.05$, **$p < 0.01$

Fig. 1 Four maps of COE patterns showing coefficient values from GWR referenced by US cars. **a** COEs of Korean cars. **b** COEs of Japanese cars. **c** COEs of German cars. **d** COEs of UK cars

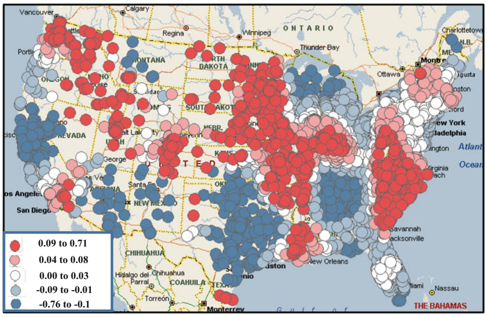
(a) COEs of Korean cars



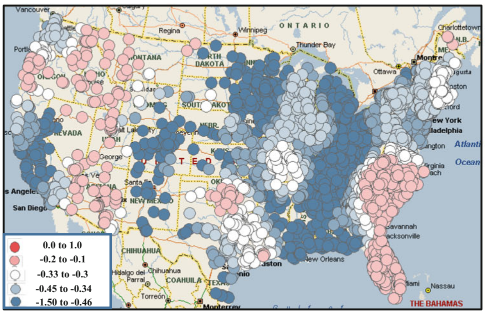
(b) COEs of Japanese cars



(c) COEs of German cars



(d) COEs of UK cars



and the Midwestern area (e.g., Wisconsin and Minnesota), while negative in certain parts of the Southeastern area (e.g., Alabama, Georgia, and Tennessee). From Fig. 1b, COEs of Japanese cars appear to be positive when compared with US cars in most areas of the US territory except the Mountain division (e.g., Colorado, Utah, and Wyoming), Main state, and the southern part of Florida. Figure 1c illustrates the COEs pattern of German cars, which is different from the aforementioned two patterns of Korean cars and Japanese cars. Unlike the Korean or Japanese cars, German cars show negative COEs in the southern area of the USA (e.g., Texas and Tennessee) and northern California. Lastly, Fig. 1d illustrates negative COEs of UK cars, conspicuously in California and the Midwestern areas (e.g., Minnesota, Michigan, and Indiana).

In addition to the GWR analysis, we conduct ANOVA tests to examine whether the extent to which COEs are spatially heterogeneous across regions in the USA is statistically significant as advanced in Hypothesis 1. Toward this end, we utilize as comparison groups the 50 states and the standard federal nine divisions' classification of regions in the USA, which was established in *Office of Management and Budget Circular A-105*, "Standard Federal Regions" published in April 1974. The results corroborate that the estimated local COEs are statistically different across the nine divisions and the 50 states ($p < 0.01$ for all nine divisions and the 50 states, and for four countries' COEs). In sum, the graphical patterns and statistical findings provide evidence to support Hypothesis 1 that COEs of the four countries-of-origins are spatially heterogeneous within the USA.

4.2 Determinants for the spatial heterogeneity of COEs (Hypotheses 2 and 3)

We further employ the four sets of spatial coefficients (i.e., spatial COEs measured by the GWR model) as dependent variables and examine the potential determinants of spatial heterogeneity. We consider various covariates that may affect the spatial heterogeneity of COEs. As advanced in Hypotheses 2 and 3, geographic distance from the countries-of-origins and the proportion of population born in the countries-of-origins can be two of the determinants driving spatial heterogeneity. We measure geographic distance in 1000 miles between the country-of-origin and the central point of each ZIP code area by using the great circle distance. We calculate the proportion of population born in the countries-of-origins for each ZIP code area, based on *American Community Survey* 2008–2012. We also include characteristics of demographics, transportation, weather, and political ideology that might affect the spatial heterogeneity of COEs. For demographics, we include the median household income (in million US dollars), the percentage of males, and the percentage of people with a bachelor's or higher degree in each ZIP code-level region. For transportation, we consider the average commute to work (in minutes), the percentage of people using public transportation to work in each ZIP code-level region, and the average gas price (in US dollars) in each state. For weather conditions, we include monthly mean temperature and total precipitation (in hundreds) in each ZIP code-level region. In addition, we employ each state's party registration data in 2010 and measure political ideology as conservative if a majority of registered voters identified themselves as republican. Lastly, we include the total number of dealerships (in thousands) in each state as a control variable.

Table 2 presents pair-wise correlations and the descriptive statistics. Table 3 presents the results of four liner regressions for each of the four countries. The results show that

Table 2 Pair-wise correlations and descriptive statistics

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. COEs of Korean cars	1.00																					
2. COEs of Japanese cars	0.54	1.00																				
3. COEs of German cars	0.08	0.39	1.00																			
4. COEs of UK cars	0.13	−0.15	−0.05	1.00																		
5. Distance from Korea	−0.37	−0.26	−0.07	0.18	1.00																	
6. Population born in Korea (%)	0.10	0.14	0.12	−0.19	−0.11	1.00																
7. Distance from Japan	−0.39	−0.26	−0.02	0.14	0.99	−0.10	1.00															
8. Population born in Japan (%)	0.02	0.07	−0.02	−0.01	−0.11	0.15	−0.10	1.00														
9. Distance from Germany	0.30	0.09	−0.29	0.13	−0.43	0.00	−0.57	0.00	1.00													
10. Population born in Germany (%)	0.03	−0.07	−0.02	0.04	0.09	−0.03	0.10	0.19	−0.10	1.00												
11. Distance from UK	0.30	0.09	−0.29	0.13	−0.45	0.00	−0.58	0.00	1.00	−0.10	1.00											
12. Population born in UK (%)	−0.08	−0.20	0.02	0.23	0.09	0.00	0.10	0.19	−0.08	0.37	−0.08	1.00										
13. Median household income	0.04	−0.09	0.00	0.06	−0.03	0.09	−0.02	0.26	−0.08	0.21	−0.08	0.32	1.00									
14. Male (%)	0.18	0.08	−0.09	0.06	0.00	0.14	−0.03	−0.06	0.18	−0.01	0.18	−0.05	−0.12	1.00								
	0.08	−0.07	0.04	0.05	−0.03	0.17	−0.01	0.27	−0.06	0.37	−0.06	0.46	0.67	−0.17	1.00							

Table 2 (continued)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
15. Bachelor's or higher degree (%)																						
16. Average commute to work	−0.11	−0.15	−0.10	0.06	0.04	−0.05	0.04	0.14	−0.01	−0.08	−0.01	0.02	0.30	−0.23	−0.15	1.00						
17. Public transportation to work (%)	−0.08	−0.12	0.00	−0.01	0.03	0.07	0.07	0.26	−0.24	0.09	−0.24	0.18	−0.11	0.02	−0.16	0.41	1.00					
18. Monthly mean temperature	0.03	−0.20	−0.40	0.40	0.36	−0.07	0.24	−0.04	0.56	−0.02	0.55	0.09	−0.06	0.14	−0.09	0.14	−0.03	1.00				
19. Total precipitation	−0.07	0.00	0.16	−0.01	0.29	−0.04	0.34	−0.01	−0.46	0.08	−0.46	0.13	0.08	−0.09	0.10	0.08	0.17	−0.17	1.00			
20. Average gas price	0.13	−0.04	−0.01	−0.02	−0.68	0.10	−0.67	0.17	0.33	−0.03	0.35	0.18	0.18	−0.09	0.04	0.17	0.14	−0.07	−0.17	1.00		
21. Conservative	0.16	0.00	−0.20	0.05	0.19	−0.13	0.13	−0.14	0.20	−0.01	0.19	−0.20	−0.11	0.11	−0.05	−0.12	−0.18	0.26	−0.10	−0.44	1.00	
22. Number of dealership	0.16	−0.14	−0.22	0.05	−0.16	0.05	−0.23	0.16	0.48	0.04	0.48	0.12	0.12	0.05	−0.04	0.28	0.13	0.40	−0.22	0.55	−0.17	1.00
Mean	0.06	0.14	0.00	−0.31	6.64	0.00	6.37	0.00	4.66	0.00	4.22	0.00	0.06	0.50	0.60	24.54	0.07	0.57	0.39	2.33	0.33	0.34
Std. dev.	0.18	0.12	0.12	0.31	0.51	0.01	0.58	0.00	0.57	0.00	0.58	0.00	0.02	0.05	0.16	5.81	0.13	0.08	0.14	0.09	0.47	0.25

the geographic distance from the country-of-origin exerts negative influences on COEs of auto brands from Korea, Japan, and the UK with statistical significance: Korea ($\beta = -0.2598$, $p < 0.01$), Japan ($\beta = -0.1098$, $p < 0.01$), and the UK ($\beta = -0.0553$, $p < 0.01$). However, the effect of geographic distance from Germany is insignificant, albeit negative ($\beta = -0.0038$, $p = 0.13$). Therefore, Hypothesis 2 that geographic distance from the country-of-origin negatively influences COEs is supported for the COEs of Korean, Japanese, and UK cars.

Model 1 in Table 3 also shows that the proportion of population born in Korea exerts positive influences on COEs of Korean cars ($\beta = 0.6897$, $p < 0.01$). Similarly, models 2 and 4 show that the proportion of population born in Japan and the UK increases COEs of Japanese cars ($\beta = 7.0979$, $p < 0.01$) and UK cars ($\beta = 22.0650$, $p < 0.01$), respectively. In contrast, model 3 indicates a negative effect of population born in Germany on German COEs ($\beta = -1.6938$, $p < 0.01$). Overall, the COEs of German cars exhibit different patterns than those of Korean, Japanese, and UK cars. One possible explanation for the discrepancy could be the fact that German cars tend to position themselves as premium brands in the US market. The high reputation of German cars as a premium brand might be particularly influential to people other than German-born population, and, therefore, COEs of German cars can be higher in areas with more people from other than Germany. As such, Hypothesis 3 that population born in the country-of-origin positively influences COEs is supported for the COEs of Korean, Japanese, and UK cars.

5 Discussion

The findings of the current study have important implications on the process of firm internationalization, especially in the choices for location and entry modes. First, the current study suggests that spatial heterogeneity of COEs within a country should be considered as one of the important criteria when choosing locations for investment by foreign firms. Second, the current study highlights that the liability of foreignness, especially from the demand side, can vary across regions within a country: being foreign can be a *liability* in one location within a country, while an *asset* in other locations. Finally, the current study underscores the importance of employing spatial analysis frameworks in international marketing studies. Many of the constructs in international marketing theories are built in geographic space, which may require empirical testing with spatial analysis, rather than traditional methods.

The current study is not without limitations, which provide promising avenues for future studies. First, in the current study, we do not differentiate the country-of-ownership and country-of-manufacturing (Chao 1993; Han and Terpstra 1988). Future studies differentiating the two types of country-of-origins can illuminate the nuanced implications of COEs. Second, we also find that COEs of German cars exhibit different patterns compared to those of Korean, Japanese, and UK cars. Future research can investigate the mechanisms driving the different patterns among car brands from different countries. For instance, the unique position of German cars as premium brands could suggest that, on average, being foreign could be an *asset* for German cars, while a *liability* for Japanese, Korean, and UK cars. Future studies examining these different positions as one of the mechanisms leading

Table 3 Determinants of COEs of carmakers from Korea, Japan, Germany, and the UK

Variables	COEs of Korean cars Model 1		COEs of Japanese cars Model 2		COEs of German cars Model 3		COEs of UK cars Model 4	
Korean cars								
Distance to Korea	−0.2598**	(0.0040)						
Population born in Korea (%)	0.6897**	(0.0851)						
Japanese cars								
Distance to Japan			−0.1098**	(0.0023)				
Population born in Japan (%)			7.0979**	(0.3979)				
German cars								
Distance to Germany					−0.0038	(0.0025)		
Population born in Germany (%)					−1.6938**	(0.3335)		
UK cars								
Distance to UK							−0.0553**	(0.0061)
Population born in the UK (%)							22.0650**	(0.9335)
Median household income	0.8703**	(0.0889)	0.4959**	(0.0619)	−0.0306	(0.0643)	0.2598	(0.1605)
Male (%)	0.3181**	(0.0255)	0.0198	(0.0174)	−0.1029**	(0.0181)	0.3380**	(0.0452)
Bachelor's or higher degree (%)	0.0089	(0.0119)	−0.1554**	(0.0083)	−0.0054	(0.0088)	−0.0306	(0.0225)
Average commute to work	−0.0039**	(0.0003)	−0.0026**	(0.0002)	−0.0014**	(0.0002)	0.0027**	(0.0005)
Public transportation to work (%)	0.0212*	(0.0107)	−0.0556**	(0.0078)	−0.0081	(0.0082)	−0.1647**	(0.0207)
Monthly mean temperature	0.3636**	(0.0210)	−0.0749**	(0.0137)	−0.4909**	(0.0153)	2.0676**	(0.0396)
Total precipitation	0.2306**	(0.0092)	0.1088**	(0.0064)	0.0668**	(0.0066)	−0.0315+	(0.0165)
Average gas price	−0.9036**	(0.0271)	−0.5916**	(0.0182)	−0.0523**	(0.0153)	0.4678**	(0.0388)
Conservative	0.0533**	(0.0030)	−0.0235**	(0.0021)	−0.0339**	(0.0021)	−0.0102+	(0.0053)

Table 3 (continued)

Variables	COEs of Korean cars		COEs of Japanese cars		COEs of German cars		COEs of UK cars	
	Model 1		Model 2		Model 3		Model 4	
Number of dealership	0.2141**	(0.0068)	0.0040	(0.0047)	−0.0225**	(0.0048)	−0.2666**	(0.0120)
Constant	3.3728**	(0.0852)	2.3322**	(0.0557)	0.5106**	(0.0383)	−2.5128**	(0.0988)
Observations	17,387		17,387		17,387		17,387	
Adjusted R^2	0.3140		0.2096		0.1912		0.2290	

Standard errors in parentheses

+$p < 0.10$, *$p < 0.05$, **$p < 0.01$

to the different patterns can provide a richer understanding on the spatial heterogeneity of COEs.

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