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SPATIAL PROCESSES IN THE EUROPEAN MOTOR INSURANCE MARKET

Codruta Mare, Simona Laura Dragos, Gabriela Mihaela Muresan

Abstract:
Using the motor insurance density for 31 European countries, we evaluate the presence of spatial processes and the influence of different factors upon their intensity. Spatial panel regressions point out significant spatial autoregressive influences, both for dependent variables and for GDP/cap. While diffusion is confirmed by the positive coefficient of the spatial lag, the average GDP/cap value of the neighbours has a negative impact, coming from the multidirectional interactions that characterize space. A positive impact of road fatalities is pointed out, both in the economy of each spatial unit and internationally. Consequently, significant spillover effects are emphasized by our analysis.

Keywords: motor insurance demand, spatial panel, spatial effects, Hofstede's cultural dimensions, governance indicators

JEL Classification: G22, C23

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1. INTRODUCTION

In recent decades, the motor insurance market has seen considerable growth, significantly influenced by the increased use of cars, especially within Europe. This rise is largely attributed to the greater mobility of people and goods, a result of the harmonized rules and regulations established by the European Union, which also extends its influence to associated countries such as Iceland and Turkey. Despite the cross-dependence and the need for a spatial approach pointed out by different studies (Baltgai & Pesaran, 2007; Pesaran, 2021; Mare et al., 2016), sector-specific literature often examines these phenomena in isolation, overlooking the potential spatial effects and interactions.

The concept of spatial spillover effects, as discussed by Du et al. (2022), sheds light on the mutual reinforcement between supply and demand across geographical boundaries. According to Krugman (1991), the spatial spillover effect states that the market potential of a region will have a strong driving influence over contiguous areas (its neighbours). This theory is particularly applicable to cross-border insurance activities, where foreign premiums play a crucial role. The European Systemic Risk Board (2017) notes that cross-border activity in the European Union's insurance sector outperforms that of its banking sector (36% in insurance compared to 25% in banking, in line with Schoenmaker and Sass (2014), underscoring the prevalence and potential impact of spillover effects, especially in scenarios involving insurer failure.

Furthermore, research by Eckert et al. (2020) emphasizes that contagion effects, where disturbances in one market impact others, are more significant within the insurance sector than competitive factors. This highlights the complexities faced by insurance companies operating across different regulatory jurisdictions, which makes the regulatory harmonization efforts within the European Union even more important for the competitiveness of the motor insurance market. Expensive international claims management, different national contract laws, and risk assessments led to varying prices from one E.U. country to another. One more notable difference between countries is the way of applying the bonus-malus system, as well as the

insurance terms and conditions (a policy limited in time, space and risks). However, compulsory insurance is valid in all E.U. countries and additional contracts have no generally E.U-wide rules (see E.U. legislation).

In our study, we take motivation from the rather new field of economic geography, from the intense cross-border activity in the insurance sector, and the lack of cross-country research for the motor insurance sector. Considering the core-periphery model of Krugman (1991), we examine to what extent the cultural and psychological features, which proved to be significant at the individual level, may generate convergence or divergence in the European motor insurance demand.

The aim of this article is twofold: to investigate if the models of economic geography explain regional divergence or convergence in the European motor insurance market, and to bridge a gap in the existing literature on motor insurance demand within a cross-country approach. To explain the regional divergence (dominant dispersion forces) or convergence (dominant agglomeration forces) on the European motor insurance market, we introduce spatial methodology, which is to our knowledge a novelty in the field's research. The necessity of studying the spatial effects resides in the increasing connectedness of European countries in terms of infrastructure development, sustained through the European structural funds. However, national specificities, such as the governance system, the culture, the traditions, and people's beliefs may condition the general convergence or diffusion processes. To address the literature gap, we start from the fact that most of the studies explore this issue from a national perspective, at the country level, as aggregated national data are characterized by scarcity and quality problems. Based on the results of previous country-level studies, we extend the analysis of the determinants of motor insurance at the cross-section level for European countries, using spatial panel econometrics.

Emphasizing the cultural and psychological variations across regions poses questions about the uniqueness and culture-specific nature of countries versus their universality and susceptibility to influences from neighbouring countries regarding motor insurance purchasing behaviours. This distinction is crucial for understanding and strategizing in the competitive landscape of the motor insurance market, as it determines whether regional strategies should be tailored to distinct cultural contexts or aligned with broader, cross-border trends.

Additionally, we consider institutional factors important for the motor insurance demand, because driving a car in the European Union requires an appropriate insurance contract. Recognizing income as a primary driver of the motor insurance market (Sherden, 1984), we employ GDP per capita as a representative metric. Given that insurance premiums are calculated based on the likelihood of insured events occurring, we also include the number of road fatalities as an explanatory variable. To finely control the impact of these factors and to account for national specificities, we incorporate measures of governance quality (world governance indicators) and cultural characteristics (Hofstede's cultural indicators), enhancing our competitive analysis of the motor insurance sector. While the first group conditions the spatial effects and sustains the spillover effects, we emphasize that culture is, indeed, an internal characteristic that alters any spatial effect previously found and turns it insignificant. In the existing literature, there is a growing trend of associating motor insurance demand with mental health issues such as anxiety, as evidenced by studies at the country level (Dula et al., 2010; Vassallo et al., 2008). We extend this approach to a broader, cross-country analysis by incorporating the mental health index as a control variable in our study.

The analysis of the European motor insurance market's dynamics was conducted on a comprehensive scale, with a limitation in distinguishing between compulsory and voluntary motor insurance products, due to constraints in data availability. This limitation affects the ability to fully evaluate the competitive landscape between these two segments of the market.

The rest of the paper is structured as follows. Section 2 presents the main issues found in the literature. Section 3 describes the database and the methodology used. Section 4 presents and discusses the results, while Section 5 concludes.

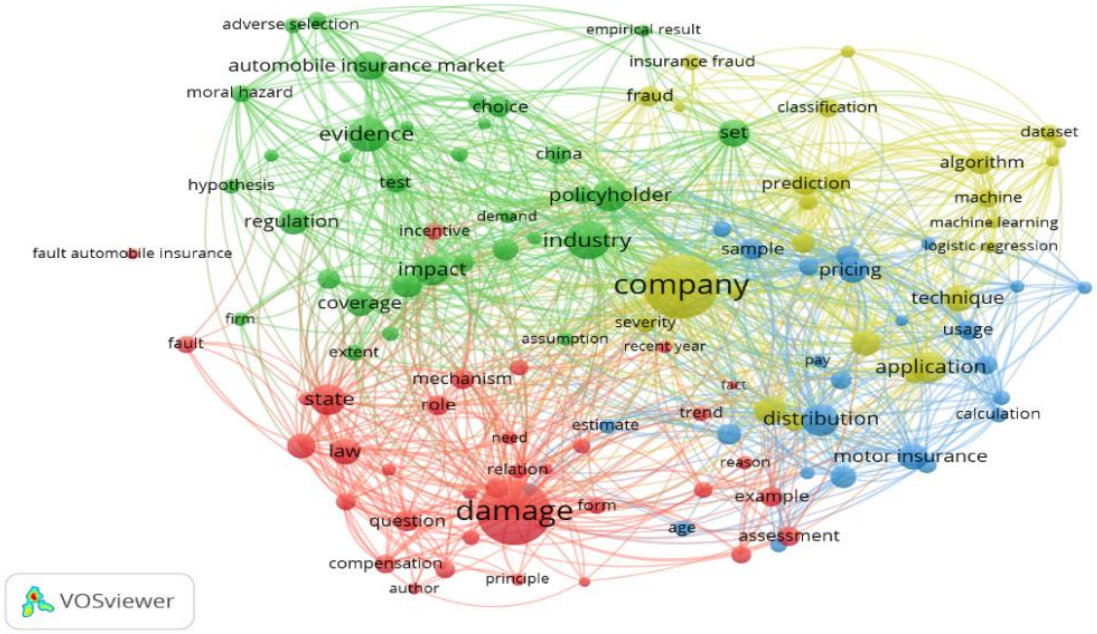
2. LITERATURE REVIEW

Over time, the motor insurance market has been studied in terms of demand and supply, risk and price, behaviour, and fraud. Using keywords such as motor insurance, car insurance, or auto insurance, we found, in April 2021, 680 Web of Science indexed articles containing the mentioned phrases in the title.

We ran the database in the VOSviewer bibliometric program. Figure 1 presents an overview of the co-occurrence map based on text data from scientific articles. In our map, the adjacent clusters indicate the existence of a close link between them, e.g., the term damage is correlated with fault, compensation, law, and so on.

While machine learning methods are mainly used to analyse motor insurance claims or fraud (Alamir et al., 2021), logistic regression is used to analyse the motor insurance demand at the individual level.

Figure 1. Map of co-occurrences and links for motor insurance



Source: Authors' processing in VOSviewer version 1.6.16

However, given the methodology of applications (see Figure 1), in the field's literature, the motor insurance demand has been mostly addressed at the individual level in close connection with the behaviour of the insured, using either survey data or customer data from the insurance companies. In this regard, Dragos and Dragos (2017) show, using logistic regression, that the probability of purchasing motor damage insurance (MDI) is significantly influenced by the ratio between the car value and the person's income, the annual number of travelled kilometres, the risk aversion, and the education level. Furthermore, using a mixed logit model, Hsu et al. (2014) examined the impact of policyholders' characteristics and insurance policies on automobile insurance claims, both being significant. Moreover, Peng et al. (2016) found that the liberalization of the automobile insurance market in Taiwan fosters competition among insurers, determining them to reduce the associated premiums. Gilenko and Mironova

(2017) suggested that Russian insurance companies should provide discounts for female drivers for motor-own-damage premiums because women are generally more cautious and more careful compared to male drivers. In the Netherlands, Bolderdijk et al. (2011) tested a new type of car insurance called pay-as-you-drive (PAYD), in five insurance companies. They argue that their product is a tool for changing driving behaviour. Thus, young drivers can get financial discounts if they keep the speed limit, while adopting risky and inappropriate behaviour could lead to financial penalties. Dionne et al. (2013) concluded that, even if fatality rates due to road traffic accidents have decreased in developed countries since the 1970s, the social cost of road safety remains high, especially in emerging countries.

Dula et al. (2010) emphasize that driving anxiety has been frequently studied in the literature to the detriment of general anxiety. Their study included 1,121 participants from all over the world, and they found a positive relationship between general anxiety and the likelihood of adopting a dangerous driving behaviour. Moreover, highly anxious drivers cause more crashes than less anxious. Although the results on the effects of anxiety are mixed, Vassallo et al. (2008) found no links between anxiety and risky driving. In this line, Atchley, Shi, and Yamamoto (2014) focused their attention on the three largest automobile markets: the United States, Japan, and China, and highlight the importance of understanding how culture influences traffic safety.

Anxiety can be partially linked to a cultural dimension defined by Hofstede et al. (2005), namely, indulgence, which is the extent to which people try to control their desires and impulses, based on the way they were raised. So, relatively weak control is called indulgence and relatively strong control is called restraint. Indulgent societies are likely to host more extroverted individuals, leading to fewer people with anxiety.

Internationally, at cross-country level, there are no studies on motor insurance demand, but still, the non-life insurance demand has been studied in terms of density (Trinh et al. 2016) and/or penetration (Petkovski & Jordan, 2014). One of the first studies identified in the literature that focuses on motor insurance is by Sherden (1984). In a cross-sectional analysis of insurance consumption in 359 towns and cities in the state of Massachusetts in 1979, he proved that urbanization rate and income have a significant effect on motor insurance consumption.

Other factors often proven to be determinants of non-life insurance demand are institutional and cultural factors. Because there are no cross-country studies on motor insurance demand, we present their influence over the non-life insurance demand (as motor insurance is part of non-life insurance). In this line, institutional factors as explanatory variables for non-life insurance demand have been previously investigated at the cross-country level (Browne et al., 2000; Esho et al., 2004; Kjosevski & Petkovski, 2015). Park et al. (2010) used the principal components analysis to create a maturity index of insurance and a regression analysis to demonstrate the influence of cultural determinants, such as uncertainty avoidance for 16 Asian consumers.

Cultural factors have also received the attention of researchers such as Treerattanapun, (2011), Park and Lemaire (2012), and Trinh et al. (2021), proving it relevant to the non-life insurance demand. According to Hofstede (1980) and Hofstede et al. (2005), the cultural dimension paradigm about the value differences between countries is measured by the following dimensions: power distance (large versus small), individualism versus collectivism, masculinity versus femininity, uncertainty avoidance (strong versus weak), long versus short term orientation, and indulgence versus restraint. Park and Lemaire (2012) revealed that, in countries with high individualism and uncertainty avoidance, low power distance is related to higher growth rates compared to other countries. In a comprehensive study of the determinants of non-life insurance markets across 31 developing countries and 36 developed countries for the 2000–2011 period, Trinh et al. (2016) showed that income, economic freedom, law, urbanization, bank development, power distance, long-term orientation, and masculinity are the

key factors of the non-life market. The effects also differ according to the level of development of the countries included in the panel. Thus, Trinh et al. (2021) found that, for emerging economies, low governmental spending and the protection of property rights promote non-life insurance consumption.

3. DATA AND METHODOLOGY

Data consists of observations related to the motor insurance market for 31 European countries (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Italy, Latvia, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden, Spain, Switzerland, Turkey, and the United Kingdom), for the 2004 – 2016 period. This leads to a total number of 372 observations to be used in the estimations.

Table 1. Variables' description, source, and descriptive statistics

Variable	Description and source	Mean	Std. Dev.	Min.	Max.
MOTOR_DENS	**Motor Insurance Density:** Total premium per capita Source: Insurance Europe (https://www.insuranceeurope.eu/statistics)	235.27	155.49	0.4	764.67
GDP_cap	**Gross Domestic Product:** per capita at purchasing power parity. Source: Insurance Europe (https://www.insuranceeurope.eu/statistics)	27390.3	18526.31	2723.38	95214.05
Death_road	**Road fatalities per million population** Source: European Commission (https://ec.europa.eu/transport/road_safety/road-safety-facts-figures-1_en)	1702.31	2191.3	13.13	8726.5
Mental_health	**Prevalence by mental and substance use disorder:** share of the total population with a given mental health or substance use disorder. Source: Our World in Data https://ourworldindata.org/mental-health	14.05	2.01	10.82	18.73
Contr-cor	**Control of corruption:** perceptions of the extent to which public power is exercised for private gain, ranges from roughly -2.5 (weak) to 2.5 (strong) control of corruption. Source: Worldwide Governance Indicators (https://info.worldbank.org/governance/wgi)	1.11	0.85	-0.8	2.47
Gov-eff	**Government effectiveness:** perceptions of the quality of public services and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies, range from roughly -2.5 (weak) to 2.5 (strong) governance performance. Source: Worldwide Governance Indicators (https://info.worldbank.org/governance/wgi)	1.15	0.71	-1.13	2.35

Pol-stab	**Political Stability and Absence of Violence:** measures perceptions of the likelihood of political instability and/or politically motivated violence, ranges from roughly -2.5 (weak) to 2.5 (strong) political stability. Source: Worldwide Governance Indicators (https://info.worldbank.org/governance/wgi)	0.74	0.54	-2.01	1.62
Reg-qual	**Regulatory quality:** perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development, ranges from roughly -2.5 (weak) to 2.5 (strong) regulatory quality. Source: Worldwide Governance Indicators (https://info.worldbank.org/governance/wgi)	1.14	0.61	-1.62	1.98
Rule-law	**Rule of law:** perceptions of the extent to which agents have confidence in and abide by the rules of society, the quality of contract enforcement, property rights, the police, and the courts, ranges from roughly -2.5 (weak) to 2.5 (strong) law conformation. Source: Worldwide Governance Indicators (https://info.worldbank.org/governance/wgi)	1.15	0.73	-1.33	2.1
Voice	**Voice and accountability:** perceptions of the extent to which a country's citizens are able to participate in selecting their government, ranges from roughly -2.5 (weak) to 2.5 (strong) freedom of expression. Source: Worldwide Governance Indicators (https://info.worldbank.org/governance/wgi)	1.06	0.63	-1.77	1.8
Power_dist	**Power distance** score – dependence relationships in a country, ranging from 0 (limited dependence of subordinates in bosses) to 100 (preference for consultation) Source: https://geerthofstede.com/research-and-vsm/dimension-data-matrix/	50	20.6	11	100
Individualism	**Individualism Index**- the relative importance of individual versus group interests, ranging from 0 (power of the group, collectivist societies) to 100 (individualist societies) Source: https://geerthofstede.com/research-and-vsm/dimension-data-matrix/	57.48	17.18	27	89
Masculinity	**Masculinity vs. Feminity** - the distribution of roles between men and women, ranging from 0 (feminine societies, modesty, cooperation, quality of life are important) to 100 (masculine societies, assertiveness, competition and reward are important). Source: https://geerthofstede.com/research-and-vsm/dimension-data-matrix/	44.94	23.51	5	100
Uncertainty_av	**Uncertainty Avoidance** - the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity, ranging from 0 (relaxed attitude, tolerance for ambiguity, few rules to constrain uncertainty) to 100	68.94	22.5	23	100

	(rigid behaviours, intolerance to unorthodox ideas, many rules to constrain uncertainty) Source: https://geerthofstede.com/research-and-vsm/dimension-data-matrix/				
Long_term_or	**Long-term orientation vs. short-term orientation**, ranging from 0 (short-term - fostering virtues related to the past and present, respect for traditions, fulfilling social obligations) to 100 (long-term - fostering virtues oriented toward future rewards, perseverance and thrift) Source: https://geerthofstede.com/research-and-vsm/dimension-data-matrix/	53.71	17.27	24	83
Indulgence	**Indulgence vs. Restraint dimension**: the extent to which people try to control their desires and impulses, ranging from 0 (Restraint– gratification needs to be regulated by strict social norms) to 100 (Indulgence – allow relatively free gratification of basic and natural human desires related to enjoying life and having fun) Source: https://geerthofstede.com/research-and-vsm/dimension-data-matrix/	47.61	18.27	13	78

Source: authors' construction

Descriptive analysis (see Table 1) has pointed out the need for logarithmic transformation in the dependent variable, GDP/cap, and road fatalities, to reduce variation. Maps were constructed in different forms. The ones based on quartiles are presented for 2016 for the motor insurance market, and the GDP/cap and road fatalities are considered the main factors in our models.

Given that there are islands among our countries, we employed the spatial weights matrix based on inverse distance. We opted for this approach, as it better encompasses the idea that nearer countries have more influence upon each other. We started from the minimum threshold required so that each spatial unit has at least 1 neighbour, and we specified different spatial weight matrices (both in the distance threshold and full versions, with different normalization methods). The results turned out to be similar from one matrix to another, emphasizing the stability and validity of the effects and relationships obtained.

Spatial panel econometrics methods were employed to properly assess the interdependencies characterizing our sample. This is because we are assessing European countries that are highly interdependent and, consequently, neighbouring effects may appear. The latter leads to important cross-dependence effects in the form of spatial processes (Baltagi & Pesaran, 2007; Pesaran, 2021). Not including spatial effects in the estimation method would imply ignoring an important part of the relationships and, consequently, obtaining biased results.

We started with the evaluation of the impact of the GDP_cap, used as a proxy for income and development level, and the incidence of road fatalities upon the development of the motor insurance market. As several studies have pointed out significant convergence processes with respect to income, on the one hand (see, e.g., Feldkircher, 2006; Dall'Erba & LeGallo, 2008), or on insurance markets, on the other hand (Mare et al., 2016), we have included spatial effects both for the dependent (in the autoregressive and moving average forms) and for the GDP_cap. The initial regression was, thus, constructed as a fixed effects model, in the following form:

$$\mathbf{MOTOR\_DENS} = \boldsymbol{\rho}\mathbf{WMOTOR\_DENS} + \mathbf{GDP\_cap}\boldsymbol{\beta_1} + \mathbf{Death\_road}\boldsymbol{\beta_2} + \mathbf{WGDP\_cap}\boldsymbol{\theta} + (\boldsymbol{\mu} + \mathbf{a_t l_n}) + \mathbf{u_t}$$

With $\mathbf{u} = \boldsymbol{\lambda}\mathbf{W}\mathbf{u} + \boldsymbol{\varepsilon}$ eq. (1)

But, in all specifications, lambda turned out to be insignificant, so we can conclude that the final form is a Spatial Durbin Model, with a spatial lag for the GDP_cap. However, since the spatial error term shows if significant spatial effects are coming from other factors, not considered in the model, we considered it appropriate to show that such effects do not appear and opted for the 'keep as general as possible' approach to present the results.

The fixed effects approach was chosen, first, based on the idea that we have a clear group of European countries that we assess, so high cross-dependence exists that has to be dealt with. Second, we have also tested this using both the Hausman and the likelihood ratio tests. They both confirm that the fixed effects model is more efficient in this case than the random effects one (e.g., the Hausman test: $Chi^2 = 8.35$, p-value = 0.0154 for eq. (1)). The same type of result was obtained for specifications of Eq. (2) in Table 2. Additionally, we present the information criteria for the fixed and random effects for the main model in Eq. (1) in Table 2.

Table 2. Information criteria for the fixed and random effects specifications of Eq. (1) – main model

Model	LL model	Df	AIC	BIC
Fixed effects	119.50	6	-227.01	-203.5
Random effects	27.72	8	-39.43	-8.08

Source: authors' calculation in STATA 15

Following the field's literature, we conditioned the relationships found by mental health level, quality of the governance process and culture and traditions. Each of these factors was independently introduced in the estimations to avoid multicollinearity. Consequently, eq. (1) became:

$$\mathbf{MOTOR\_DENS} = \boldsymbol{\rho}\mathbf{WMOTOR\_DENS} + \mathbf{GDP\_cap}\boldsymbol{\beta_1} + \mathbf{Death\_road}\boldsymbol{\beta_2} + \mathbf{WGDP\_cap}\boldsymbol{\theta} + \boldsymbol{\gamma}\mathbf{X}\boldsymbol{\beta} + (\boldsymbol{\mu} + \mathbf{a_t l_n}) + \mathbf{u_t}$$

With $\mathbf{u} = \boldsymbol{\lambda}\mathbf{W}\mathbf{u} + \boldsymbol{\varepsilon}$ eq. (2)

However, while for mental health and governance indicators, the models were specified with fixed effects (see results in Table 2), due to the fact that culture and traditions were proxied by Hofstede's indicators, which are constant in time, Eq. (2) was specified with random effects in their case (see results in Table 4). For the random effects models, the orthogonality of the random effects with the regressors was assessed post-estimation, to ensure the validity of the model specifications.

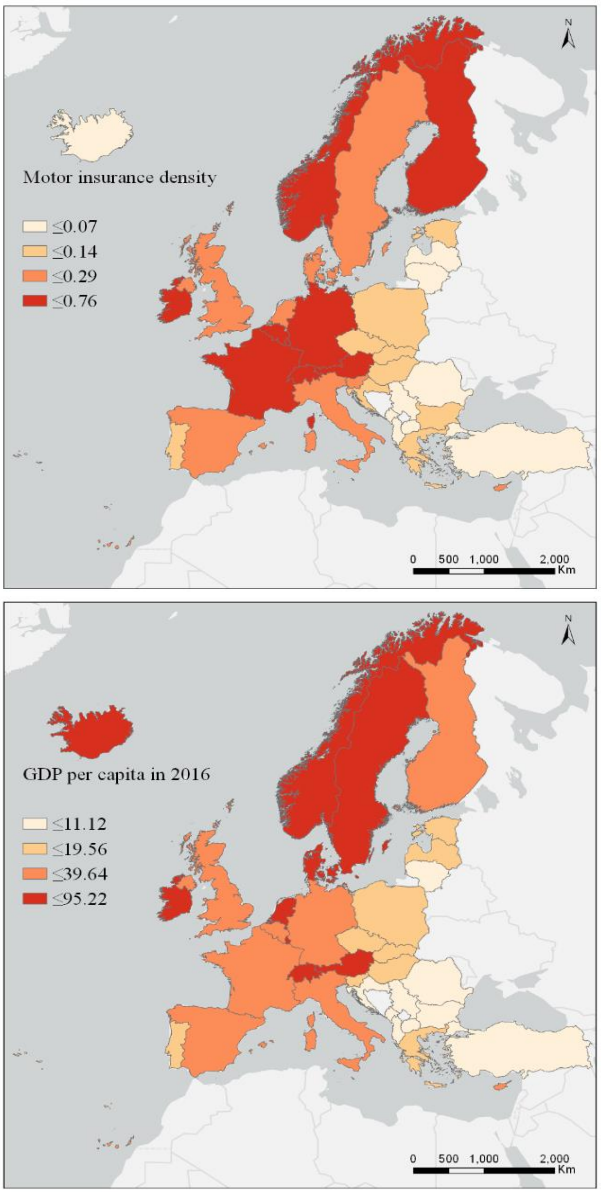
Following the methodological procedures, as the lag of MOTOR_DENS turned out to be significant, we proceeded with the assessment of the direct, indirect, and total effects. Direct effects evaluate the impact of each variable in the own, internal economy of each spatial unit. What is interesting from the spatial point of view is to depict if spatial spillover effects (neighbouring effects) exist, namely, if the indirect effects (international effects) are significant.

We employed GeoDa 1.14, ArcGis Pro 2.2.0 and STATA 15 for the analyses, namely the spxtregress package.

4. RESULTS AND DISCUSSIONS

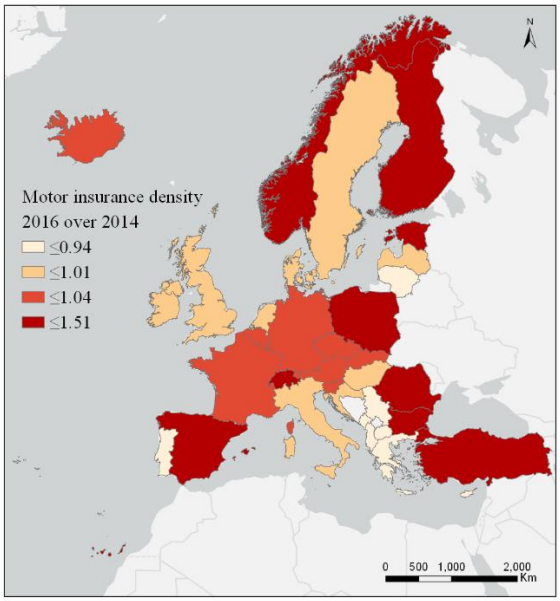
Results presented in Figure 2 show that the clustering patterns observed for the GDP_cap also characterize the motor insurance market in Europe for the last year of analysis (2016). The East-West direction is clear, with older E.U. members having higher motor insurance densities. This is true for the entire analysed period. When constructing the raw rate quartile map between the initial motor insurance density in 2004 and the final one in 2016, we see the convergence process, most of the high-value rates being located in the Eastern part of Europe (Figure 3). Consequently, we expect a direct relationship to be revealed by the regression analysis between the two variables. Additionally, Figure 4 points out a similar East-West pattern in respect to road fatalities, but this time reversed in intensity, with the Eastern part of Europe having much higher values. This may be due mostly to the poor road infrastructure and lack of traffic education, on one hand, or to the cultural portrait of these countries, on the other. However, we do not expect a reverse relationship between MOTOR_DENS and Death_road, as Figure 5 shows a clear diffusion process conditioned by the later.

Figure 2. Motor insurance density (upper) and GDP per capita (lower) in 2016 – quartile maps



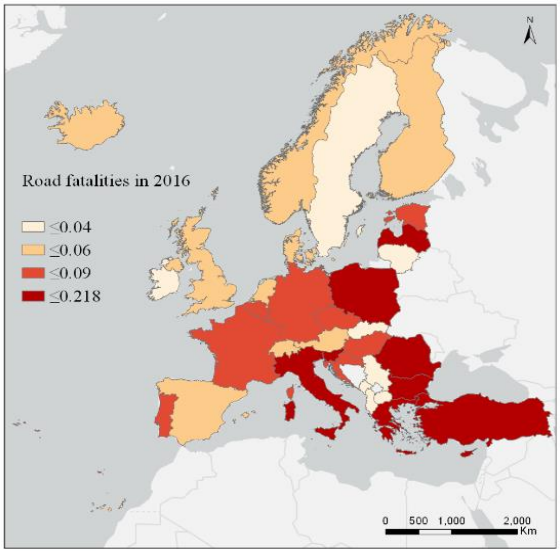
Source: authors' construction in ArcGis Pro 2.2.0

Figure 3. Raw rate quartile map – motor insurance density 2016 over 2014



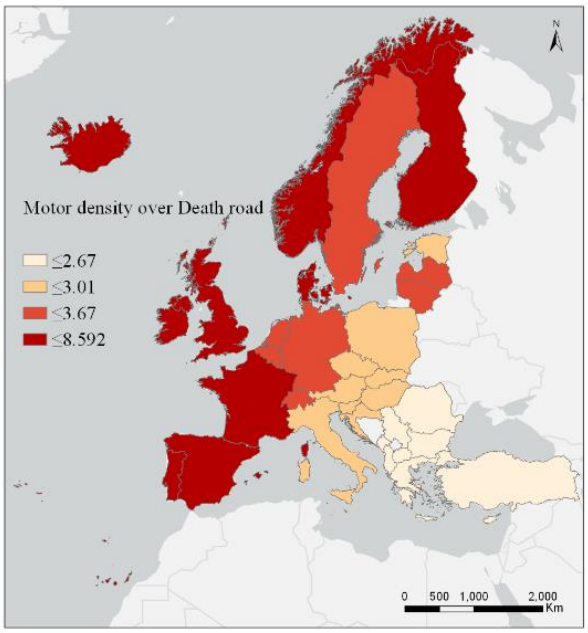
Source: authors' construction in ArcGisPro 2.2.0

Figure 4. Road fatalities in 2016 – quartile map



Source: authors' construction in ArcGis Pro 2.2.0

Figure 5. MOTOR_DENS over Death_road – spatially smoothed rate map for 2016



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Source: authors' construction in ArcGisPro 2.2.0

Regression results confirm what map analysis has emphasized. The coefficients of GDP_cap are always positive and highly significant, not only in the main model (Eq. (1) – see Table 3) but also in the other specifications related to Eq. (2) (Tables 3 and 5), regardless of the types of effects. The same is valid for the influence of road fatalities. But when comparing the coefficients, we can see that the impact of GDP_cap is much higher than the one of Death_road.

The positive and significant influence of GDP_cap over the motor insurance density confirms the fact that income is the main determinant of insurance purchasing. Also, the road fatalities per million population (Death_road) are a strong incentive for motor insurance purchasing, even if those rates have decreased in developed countries in the last decades.

Table 3. Regression results – fixed effects models

Variable	Eq. (1)	Eq. (2.1)	Eq. (2.2)	Eq. (2.3)	Eq. (2.4)	Eq. (2.5)	Eq. (2.6)	Eq. (2.7)
GDP_cap	0.902*** (10.71)	0.945*** (10.38)	0.925*** (10.34)	0.974*** (11.45)	0.908*** (10.79)	0.872*** (9.51)	0.842*** (9.8)	0.871*** (9.98)
Death_road	0.189*** (4.1)	0.176*** (3.71)	0.194*** (4.21)	0.190*** (4.21)	0.196*** (4.17)	0.18*** (3.8)	0.186*** (4.05)	0.186*** (3.99)
Mental_health	-	0.245 (1.24)	-	-	-	-	-	-
Contr-cor	-	-	-0.057 (-0.78)	-	-	-	-	-
Gov-eff	-	-	-	-0.263*** (-3.79)	-	-	-	-
Pol-stab	-	-	-	-	-0.057 (-0.94)	-	-	-
Reg-qual	-	-	-	-	-	0.064 (0.82)	-	-
Rule-law	-	-	-	-	-	-	0.247*** (2.7)	-
Voice	-	-	-	-	-	-	-	0.151 (1.27)
WMOTOR_DENS	0.338** (1.97)	0.350** (2.07)	0.359** (2.12)	0.394** (2.15)	0.33* (1.86)	0.342** (1.99)	0.338* (1.94)	0.33* (1.78)
Λ	-0.268 (-0.88)	-0.299 (-0.97)	-0.302 (-0.97)	-0.345 (-1.14)	-0.23 (-0.75)	-0.268 (-0.88)	-0.279 (-0.91)	-0.159 (-0.51)
WGDP_cap	-0.489*** (-3.33)	-0.513*** (-3.47)	-0.514*** (-3.45)	-0.601*** (-4.11)	-0.485*** (-3.29)	-0.475*** (-3.23)	-0.477*** (-3.31)	-0.427*** (-2.7)
Sigma_e	0.1696***	0.1691***	0.1693***	0.1659***	0.1695***	0.1694***	0.1678***	0.1694***
Log-likelihood	119.5	120.27	119.8	126.56	119.95	119.84	123.11	120.33
AIC	-227.01	-226.55	-225.61	-239.12	-225.9	-225.68	-232.21	-226.65
Wald Chi^2 (Prob)	162.02 (0.000)	165.66 (0.000)	163.6 (0.000)	188.03 (0.000)	161.91 (0.000)	163.02 (0.000)	174.84 (0.000)	159.02 (0.000)
Wald test of spatial terms Chi^2 (Prob)	11.99 (0.007)	13.02 (0.005)	12.98 (0.005)	17.6 (0.000)	11.79 (0.008)	11.48 (0.009)	11.74 (0.008)	9.62 (0.022)
N	372	372	372	372	372	372	372	372

Coef. (z-stat) ***, **, * denote significance at 1%, 5%, 10%
Source: authors' calculation in STATA 15

When we respecify Eq. (1) into Eq. (2) by introducing control factors, we observe that the mental health index that we considered is insignificant (Table 3, Eq. (2.1)). Despite these findings for our sample, the fostering of a healthier and less anxious society from an early age (Milon and Slicaru, 2017) would enhance driving behaviours and improve traffic safety. This insignificance may be due to the fact that we are conducting a cross-country assessment, and the aggregation at such a level may significantly alter mental problems at the individual level.

If we refer to Kaufmann's governance indicators (Table 3, Eq. (2.2) to Eq. (2.7)), among the six dimensions of governance, only two of them influence the motor insurance demand. Government effectiveness (Gov-eff) exerts a significant and negative effect over the purchasing of motor insurance. This can be explained through the fact that government effectiveness also captures perceptions on excessive bureaucracy, quality of road infrastructure, satisfaction with roads and highways, and infrastructure disruption (the likelihood of disruption to inadequacy of transport infrastructure). This result is in line with our assumptions related to the map analysis, speaking about the poor road infrastructure in the Eastern part of Europe compared to the Western part. The second significant governance indicator, exerting a positive influence on the motor insurance demand, is the rule of law (Rule-law). Because the document setting forth the obligations of the insurer and the insured is the insurance contract, the quality of contract enforcement and the property rights from a country become basic elements in explaining the insurance demand. The rule of law governance indicator measures perceptions on the fairness and timeliness of judicial process, efficiency of property rights protection in case of conflict, and risk that the judicial system will fail to enforce contractual agreements between private entities, due to inefficiency, corruption, or inability to apply rulings promptly.

Based on the features of the analysed countries, along with the possible cross-border spillover effects pointed out by the field's literature (see, for example, ESRB (2017), or Eckert et al. (2020)), we hypothesized significant spatial effects on the motor insurance market. The contagion and diffusion effects are confirmed by the positive and significant autoregressive term of MOTOR_DENS. An increase in the motor insurance market proxied by the insurance density in the neighbours leads to an increase in the national motor insurance market of each spatial unit. This result confirms the conclusions of Eckert et al. (2020), which emphasized significant and more intense contagion effects faced by insurers. We add to their results by proving the existence of such spatial processes using spatial methodology.

Another important explanation of the diffusion process obtained for the motor insurance market may come from the fact that, usually, the most important insurers in developing European countries are, actually, the main actors in the developed ones. Consequently, their market behaviour, along with product development strategies and policies are transferred to the new markets, contributing to contagion and diffusion.

Among the factors considered, GDP_cap also presents spatial effects. The WGDP_cap is highly significant, but negative. As the spatial lag of the motor insurance density turned out to be significant, we followed the methodology and evaluated the direct and indirect effects. We did this for a global model, encompassing both institutional factors that significantly influence the development of this market (Table 4).

Table 4. Direct and indirect effects assessment

Delta-Method						
	dy/dx	**Std. Err.**	**z**	**P>z**	**[95% Conf. Interval]**	
Direct effects						
GDP_cap	0.892	0.081	10.95	0.000	0.732	1.051
Death_road	0.180	0.043	4.25	0.000	0.097	0.264
Gov-eff	-0.421	0.075	-5.61	0.000	-0.567	-0.274
Rule-law	0.477	0.097	4.93	0.000	0.287	0.667

Indirect effects						
GDP_cap	-0.436	0.135	-3.22	0.001	-0.701	-0.170
Death_road	0.088	0.047	1.87	0.062	-0.004	0.181
Gov-eff	-0.205	0.133	-1.54	0.123	-0.466	0.056
Rule-law	0.233	0.152	1.53	0.126	-0.066	0.531
Total effects						
GDP_cap	0.456	0.114	3.99	0.000	0.232	0.679
Death_road	0.269	0.059	4.54	0.000	0.153	0.384
Gov-eff	-0.626	0.173	-3.62	0.000	-0.964	-0.287
Rule-law	0.710	0.207	3.43	0.001	0.304	1.116

Source: authors' calculation in STATA 15

While all four factors have a significant direct average impact on the internal market of each country, at the international level, only the main ones are significant. The spillover effects are given by the GDP_cap and Death_road. The later has a positive impact, confirming the spatial clustering of countries with similar behaviour in respect to road fatalities and their influence upon motor insurance density. The first, GDP_cap, has a negative coefficient. The change in sign may be explained by the fact that spatial interactions are characterized by multidirectionality among the variables considered. The significant and positive spatial lag of the dependent variable may change the typology of the influence of the factors at international level. Additionally, this negative coefficient in the neighbours' GDP_cap stands for an average repressive/inhibitory effect of the motor insurance market in the considered spatial unit. This is a logical effect, as more developed countries have more developed motor insurance markets of which insurers will want to take advantage.

As explained in the methodological part, we also wanted to control how culture and traditions impact the development of the motor insurance market. To do this, we opted for Hofstede's cultural dimensions, as they are the most famous and used indicators for such an assessment. But, they are constant in time, so the fixed effects model could not be applied anymore but had to be replaced by the random effects one. Table 5 shows that spatial effects do not stand anymore, and in all cases, all spatial terms are insignificant. Consequently, we can conclude that culture and traditions alter the spatial interactions and the effects between neighbours in respect to this market.

The fact that cultural aspects were omitted in the first model is justified by the idea that institutions follow mental programs, and in their functioning, they adapt to local culture (Hofstede et al., 2010). As a result, similar laws work out differently in different countries, even if we refer to the European Union. So, because institutions and culture are much interconnected, understanding culture implicitly involves deep insight into institutions functioning. Hofstede et al. (2010) support the idea that economic systems are not culture free by giving the example of European former communist countries, which imported foreign institutions after the fall of communism, generating a strong local resistance, because they were not adapted to "the software of its people's minds."

Out of the 6 cultural dimensions, only one turned out to be significant – indulgence. According to Hofstede et al. (2010), indulgence refers to the perception that one can act as they please, spending money and indulging in leisurely and fun activities. At the opposite pole, there is the perception that one's actions are restrained by social norms and the feeling that enjoying life, spending, and doing other types of indulgence are not appropriate. Our results show that more indulgent cultures, which usually take advantage of opportunities to satisfy their desires, are more likely to buy motor insurance. Considering the fact that there is a weak positive relationship between indulgence and national wealth, this result is not surprising.

Table 5. Regression results – random effects models for cultural factors

Variable	Eq. (2.8)	Eq. (2.9)	Eq. (2.10)	Eq. (2.11)	Eq. (2.12)	Eq. (2.13)
GDP_cap	0.59*** (8.47)	0.608*** (8.86)	0.609*** (9.04)	0.608*** (8.92)	0.609*** (8.97)	0.586*** (8.32)
Death_road	0.234*** (6.06)	0.239*** (6.18)	0.241*** (6.29)	0.237*** (6.19)	0.239*** (6.25)	0.232*** (6.02)
Power_dist	-0.015* (-1.67)	-	-	-	-	-
Individualism	-	0.0008 (0.06)	-	-	-	-
Masculinity	-	-	-0.012 (-1.42)	-	-	-
Uncertainty_av	-	-	-	-0.006 (-0.67)	-	-
Long_term_or	-	-	-	-	-0.006 (-0.54)	-
Indulgence	-	-	-	-	-	0.189* (1.84)
Constant	-10.02*** (-5.16)	-11.35*** (-6.19)	-10.92*** (-6.09)	-10.73*** (-5.41)	-11.03*** (-5.88)	-11.49*** (-6.08)
WMOTOR_DENS	0.218 (1.15)	0.209 (1.1)	0.211 (1.12)	0.212 (-1.16)	0.207 (1.09)	0.217 (1.14)
λ	-0.073 (-0.27)	-0.06 (-0.22)	-0.061 (-0.23)	-0.064 (-0.24)	-0.058 (-0.21)	-0.073 (-0.27)
WGDP_cap	-0.054 (-1.15)	-0.05 (-1.03)	-0.046 (-0.97)	-0.056 (-1.16)	-0.048 (-1.01)	-0.057 (-1.21)
Sigma_u	1.033***	1.098***	1.063***	1.091***	1.093***	1.019***
Sigma_e	0.174***	0.173***	0.173***	0.173***	0.173***	0.174***
Log likelihood	29.02	27.72	28.71	27.94	27.86	29.28
AIC	-40.03	-37.44	-39.41	-37.88	-37.72	-40.56
Wald Chi^2 (Prob)	89.30 (0.000)	94.61 (0.000)	97.08 (0.000)	93.97 (0.000)	95.13 (0.000)	87.36 (0.000)
Wald test of spatial terms Chi^2 (Prob)	2.01 (0.57)	1.84 (0.61)	1.84 (0.61)	2 (0.572)	1.8 (0.615)	2.09 (0.554)
N	372	372	372	372	372	372

Coef. (z-stat)
***, **, * denote significance at 1%, 5%, 10%
Source: authors' calculation in STATA 15

5. CONCLUSIONS

The main goal of our research was to study the motor insurance market in Europe from a spatial perspective. Our motivation came from the fact that the analysed countries are characterized by high cross-dependence and intensified interactions given by the high mobility of people and goods, on the one hand, and by the general common rules and regulations of the European Union, on the other hand. The novelty that our research brings is twofold: first, it is the first cross-sectional study analysing, by using panel regressions, the drivers of the demand for European motor insurance, and second, it highlights spillover effects, contagion, and diffusion processes on this specific market. Our conclusions can be divided into two main categories –

spatial and general. From a spatial perspective, we have identified significant spatial effects in the motor insurance market in Europe, in the form of SDM. Neighbourhood interactions in the form of spatial autoregression come both from the dependent variable and the GDP. Thus, we can conclude that the motor insurance market is better assessed at cross-country level when spatial methods are employed. The positive coefficient of the spatial lag of the motor insurance density points out significant contagion and diffusion processes on this market. These spatial processes are positively conditioned by income and level of development proxied by the GDP per capita, and by the incidence of road fatalities, but negatively conditioned by the average income and level of development of the neighbours. Spillover effects were depicted, as indirect effects are significant even in the presence of institutional factors.

As expected, institutional quality and cultural features have an important influence only in the economy. Results show that the motor insurance market is positively conditioned by law enforcement and negatively by the efficiency of the governance process, with a higher impact from the latter. Public authorities should prioritize improvements in road infrastructure and traffic education, particularly in Eastern European countries, to address the high road fatality rates, which negatively impact motor insurance costs and market competitiveness. Insurance companies are encouraged to adapt their product development strategies and policies to foster innovation and competitiveness, taking into account the significant influence of GDP and road fatalities on insurance demand, as well as the contagion and diffusion effects identified across markets. Considering the negative effect of government effectiveness on motor insurance purchasing, insurers should advocate for regulatory reforms that streamline bureaucracy and improve the quality of road infrastructure, enhancing market attractiveness and efficiency. The findings suggest that fostering a culture of lawfulness and contract enforcement can positively influence motor insurance demand, implying that both insurers and public authorities should support initiatives that strengthen the rule of law and property rights protection. Finally, understanding cultural nuances, such as the degree of indulgence, can help insurers tailor their offerings to meet the preferences of different consumer segments, potentially increasing insurance uptake and enhancing market competitiveness.

The impact of national culture and traditions is so intense that it alters the spatial process. No significant spatial component or indirect effects in the models comprises these variables.

Among the general conclusions of our study is a reconfirmation of the fact that income is the main determinant of the motor insurance purchasing process. Even if road fatalities have decreased in developed countries, they are still a strong incentive for the development of the motor insurance market.

As any research, ours also has some limitations. The most important is the data quality and availability at a macroeconomic level. We assessed the motor insurance market at a global level, without being able to discriminate between the types of motor insurance products (compulsory or not, for example). If such data were available, more important features could be depicted, to help policymakers in developing specific market strategies for different types of motor insurance products.

Conflicts of interest/Competing interests

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Contact information

Codruta Mare
https://orcid.org/0000-0002-4920-7462
Babes-Bolyai University
Faculty of Economics and Business Administration
The Interdisciplinary Centre for Data Science
Romania

Simona Laura Dragos
https://orcid.org/0000-0002-3037-3401
Babes-Bolyai University
Faculty of Economics and Business Administration
Romania

Gabriela Mihaela Muresan - Corresponding author
https://orcid.org/0000-0001-6715-7406
Babes-Bolyai University,
Faculty of Economics and Business Administration
Romania
E-mail: gabriela.muresan@econ.ubbcluj.ro