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New mobility technologies and regional status in the automotive industry value chain: The case of Spain and Portugal

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ABSTRACT

New mobility technologies related to autonomous, connected, and shared vehicles have prompted the entry of new players into the automotive industry, which has influenced the industry's traditional configuration of regional status. Under the global value chain (GVC) approach, this research proposes a new framework for defining a 'core–periphery' spatial model of the automotive industry. Under that model, based mainly on the key variables of domestic firms linked to new mobility technologies, analysis is made of the comparative status of regions of the European automotive industry traditionally regarded as peripheral (Portugal) and semi-peripheral (Spain). Results indicate that domestic firms located in each of those two regions do not differ in terms of decision-making power, first-level supply positioning, added value of activities, and technological innovation. This implies that the two regions now share the same status within the new (autonomous, connected, and shared) mobility value chain. This has relevant implications for public policies throughout the European automotive industry. Policies should focus on innovation in new mobility technologies and on the creation of an ecosystem adequate to develop strong domestic capabilities around these new mobility technologies, in order to ensure more favourable regional status in the spatial model of this competitive industry.

1. Introduction

Changes in value chains are a topic of interest because of their implications for the firms and regions involved [1]; [2]. Among the numerous theoretical approaches used in examining such changes within the automotive industry, the global value chain (GVC) approach continues to be widely employed [3,4]. Under this approach, studies have focused on explaining how firms and regions are positioned within the global value chain of a given industry [5,6]. It should be noted that the concept 'region' in this research refers to country level as in some of other previous studies [7,8].

The traditional automotive industry value chain is governed by automotive manufacturers and by Tier-1 suppliers positioned on the first levels of the value chain. These have maintained control over value-added activities and also over other suppliers by way of asymmetrical power relationships [5]. In this context, the GVC approach, supported by the spatial division of labour, provides a model for geographical organisation in which 'core' regions possess the power to decide on the distribution of production activities in other regions (both 'peripheral' and 'semi-peripheral') [8]. Core regions are characterised by spatial concentration of high-value-added activities linked to high-tech capabilities and knowledge. At the same time, the manufacture of low-value-added and labour-intensive components, combined with limited R&D, are characteristic of peripheral regions [8]. This spatial model further includes regions of intermediate status known as semi-peripheral [9,10].

The automotive industry is undergoing intense changes that continue to influence the types of links, positioning of firms, and distribution of power along the global value chain. These changes are especially being derived from the entry of new players linked to autonomous, connected, and shared vehicles [11–14]. Most new players are related to the provision of products and technologies such as automation systems for vehicles (e.g., advanced driver assistance systems) [13], connectivity and mobile applications (e.g., tracking and tracing of vehicles) [12,14], and technologies that determine position (e.g., navigation systems) Youssefi et al. [15], among others. Relatively few studies have analysed

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the impacts of these new players on the automotive industry's value chain [16]. Among the main findings of impact-oriented studies are that players related to new mobility technologies have been positioning themselves on the first level of supply, acquiring relative power of decision and undertaking activities of greater added value within the automotive industry.

Despite those findings, such studies have not deeply considered the implications of new mobility technologies and associated players on the automotive value chain's geographical model. The main objective of the present research is to propose a framework for the analysis of shifting regional status within the industry's 'core–periphery' spatial model as driven by the irruption of new mobility technologies. Our results contribute to a better understanding of the role played by firms linked to such technologies, which are gaining power of decision and increased control over the value-added activities in the value chain. Several implications can be derived from our findings, which suggest that, in a region with a strong automotive industry presence, policy initiatives to favour the development of new mobility technologies and to promote human capital training related to such technologies will serve to define that region's status within the spatial model of the automotive global value chain.

In order to achieve the objective, the article is organised into four sections. Section 2 reviews the main elements of the GVC approach as applied to the global value chain for both the traditional automotive industry and new mobility. Further, a framework is defined for the analysis of regional status within the core–periphery spatial model of the value chain. Next, section 3 presents the empirical study, in which that model is employed to analyse two regions of distinct traditional status: one semi-peripheral region (Spain) and one peripheral region (Portugal). Section 4 offers a discussion of the results of analysis, and section 5 reflects on the theoretical and practical implications of the findings, also proposing directions for future research.

2. Literature review

2.1. From the traditional automotive industry to the new mobility value chain

Among the different theoretical approaches, the GVC approach has been the most used to analyse the automotive industry value chain [2,5]. The main result highlighted by studies based on this approach has been the high concentration of control of the value-added activities into a few multinational leading firms (both automobile manufacturers and Tier-1 suppliers) [17]; [8]. These leading firms have exercised control over an extended network of suppliers through asymmetrical power relationships, with the capacity to decide upon the conditions of supply [4]. This traditional value chain is based on the product (vehicle) as well as the architecture of the modules, systems, and components that comprise it, and this arrangement has resulted from both vertical disintegration and outsourcing, where a significant portion of activity is developed by component suppliers hierarchically organised on distinct supply levels [18]. Furthermore, the GVC approach concedes a relevant role to institutions, especially to prioritise greater domestic content within the country value chain [7,8]. Public administrations try to influence the economic development in their territories [19]. Public policies to support technological innovation and the availability of highly skilled human resources, investment incentives or subsidies for creating jobs, have been identified as relevant to achieve greater domestic content [17]; [20].

The GVC approach also provides a spatial model of reference for the characterisation of geographical organisation within the automotive industry [18,21]. A spatial model that includes 'core' regions noted for their spatial concentration of high-added-value activities linked to high-tech capabilities. Other 'peripheral' regions have been distinguished by the production of simple components, mainly based on labour, while 'semi-peripheral' regions are accorded intermediary status ([21]; Pavlìnek, 2018). According to Pavlìnek (2018), high levels of foreign ownership and a lack of domestic automobile manufacturers characterise the semi-peripheral regions, although production costs remain relatively high. Additional indicators that help distinguish the core, semi-peripheral, and peripheral regions of the traditional spatial model of the automotive industry include the degree of foreign ownership and control, the presence of vehicle assembly firms, the capabilities of suppliers, or wage-adjusted labour productivity [2,9]. In such a core-periphery configuration, it is implicitly assumed that core regions possess the power to decide on the distribution of production and technological activities of the other type of regions [18,21,22].

Changes in the location of production among the disparate regions posited by this model have been explained through the territorial division of labour, related mainly to the search for locations offering lower labour costs [23]. Although automotive firms use various strategies to ensure profitability, they always strive to minimize production costs through the location of production in peripheral regions with relatively cheap labour [24].

Currently, aspects such as connectivity, autonomous vehicles, and new rules for using vehicles (shared mobility) have led to the entry of new players into the industry to meet emerging needs [11,13]. Firms linked to connected, autonomous, and shared mobility base their products, technologies, and activities far from the traditional production processes of the automotive industry, generating technologies, products, and activities related to vehicle automation (e.g., telematic control units) [25]; [13], connectivity (e.g., data-exchange systems) [12,14], and shared mobility systems (e.g., digital platforms) [26].

From the product/service perspective, the entry of these new players has been configuring a new value chain that partially maintains the structure of the traditional value chain in which automobile manufacturers coordinate a network of component suppliers focused on product (vehicles). New mobility technologies likewise require physical components to create the automation needed for vehicles [13]. However, the focus of these new players is on services rather than production. In particular, activities related to digitalisation and connectivity have become key in the vehicle operation [27]; [11,26].

As regards the factors that determine regional status in the spatial model, new players have gained special relevance. In terms of decision-making power, the new players have stemmed from industries other than the automotive, especially the information and communication technology (ICT) industry [28]. Activities undertaken by these new players are not the result of a prior vertical disintegration process or of outsourcing compelled by automobile manufacturers, thus implying relatively lower dependence on the traditional leading automotive firms. Leading automotive firms are therefore limited in their capability to exert control over these new players, unlike in the traditional value chain [5,18].

Decision-making power is closely linked to positioning in the top levels of the value chain [22]. In terms of the product architecture of a vehicle, most firms linked to new mobility technologies directly supply their physical components for modules to automobile manufacturers, and so these firms can be considered Tier-1 suppliers. Furthermore, and more importantly, activities offered by the new players are generally services aimed at developing functions for automation, connectivity, and vehicle sharing (e.g., software or applications for exchanging data), that are key to performing these functions [12,14,29].

In terms of added value, the new players develop knowledge-based activities with strict requirements in terms of technological capabilities. It has been found that ICT firms operating in the mobility industry demand of their personnel strong engineering skills and high-level qualifications [27]. As regards technological innovation, the traditional innovations related to product and manufacturing processes remain relevant [8]; however, emerging technologies related to autonomous, connected, and shared mobility are currently undergoing an accelerated process of innovation [30]. This technological development is not only concentrated within automobile manufacturers but is undertaken especially by new players [31,32].

2.2. Theoretical framework to analyse regional status within the core–periphery model

To explain the ongoing reconfiguration of the traditional automotive industry value chain, a specific theoretical framework is required. The core–periphery model of the traditional automotive industry has been defined as networks of relations that link integrated production activities to the global value chain [2]. The relevant theoretical approach defining this traditional model was the GVC approach [7,8], along with the identification of certain key elements supported by the spatial division of labour [33]. In that structure, control over value-added activities of the value chain [7] and the territorial division of labour [33] are crucial, to define the regional status.

A theoretical framework to define the core–periphery spatial model of the new (autonomous, connected, and shared) mobility value chain can be configured using elements of the traditional model. In fact, recent works have opted for the GVC approach in the analysis of certain aspects of the new mobility value chain, including the adoption of digital mobility services [34,35], changes to value-added and innovation activities and the relationships established by mobility firms within the value chain [36]. The focus of these analyses remains on the control of value-added activities, the decision-making power, and the positioning of firms along the value chain.

On the other hand, the spatial division of labour related to the activities required to produce a vehicle [24,37] has lost relevance in favour of the spatial division of value-added and innovation activities linked to digitalisation and autonomous and connected technologies. The new mobility value chain is focused mainly on digital mobility services and on the technologies that support those services [34], diminishing the importance of traditional production processes related to vehicle manufacture.

In this context, the key actors that define the status of a given region are firms linked to autonomous, connected, and shared mobility, which now wield significant control, decision-making power, and the capacity to develop value-added activities around new mobility technologies. Moreover, the ownership of these firms now plays an important role in a region's ultimate status. The headquarters (and thus the decision-making centres) of domestically owned firms are connected to the regions where they operate and develop their activities [38]. Fig. 1 summarises the theoretical framework used for analysis of regional status in the spatial models of both the traditional automotive industry and the new mobility value chain.

3. Empirical study

The traditional European automotive industry is configured by diverse regions that develop, produce, and commercialize components and vehicles. Recent studies consider Germany and France to be traditional core regions; Spain, Belgium, the UK, and Sweden are seen as traditional semi-peripheral regions; and Portugal, Romania, the Czech Republic, and Slovenia are traditional peripheral regions [2,9].

To validate the proposed framework, two types of traditional automotive regions have been selected: one semi-peripheral (Spain) and one peripheral (Portugal). Spain is recognised as a semi-peripheral region [2] that acquired its status through the strong presence of domestic yet globalised Tier-1 multinationals with tech centres [8,22] developing activities based on capital-intensive production technologies [1]; [6]. This industry (automobile and component manufacturers) represents 6 % of Spain's GDP and 18 % of its total exports. Sixteen vehicle assembly plants are currently operating in Spain, and these produced 2.82 million units (or 3 % of world total) in 2019 [39]. The automotive component industry is configured by approximately 1,000 firms employing 201,000 workers (78 % of the country's automotive industry) [40], placing Spain in the sixth position worldwide and third in Europe, exceeded only by Germany and France.

This industry has allocated €1.46 billion to R&D, and autonomous, connected, and shared mobility technologies accounted for a large part of those investments in 2021 [40]. In 2021, some 24 initiatives were

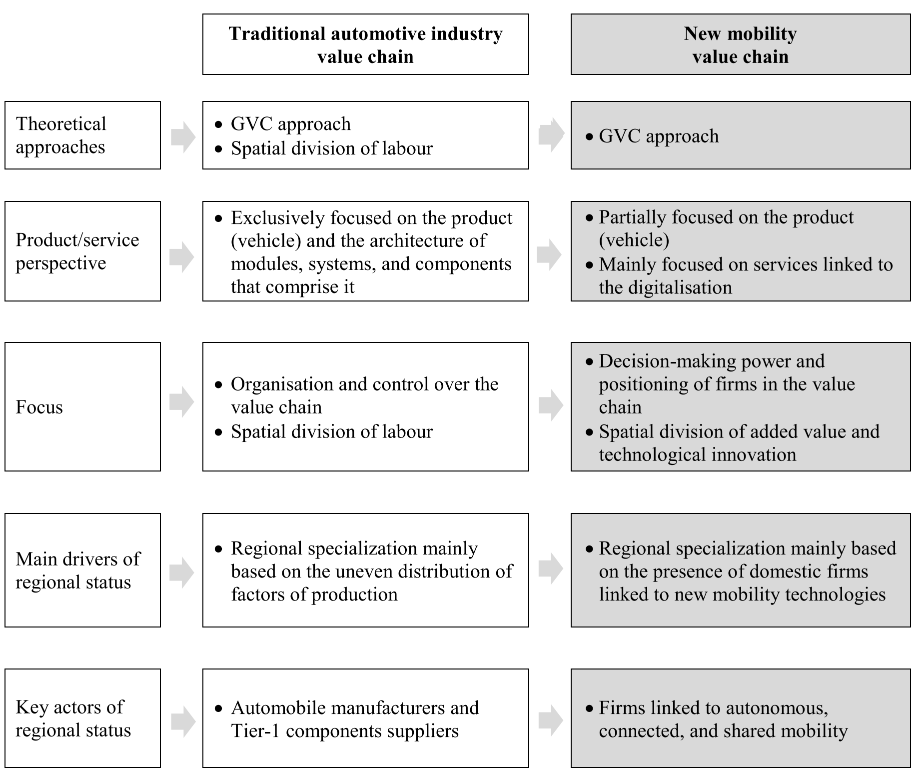

Fig. 1. Theoretical framework for analysis of regional status in the core–periphery model.
Source: Own elaboration.

focused on the development of these new technologies, including projects such as *Anyverse* to improve the operation of autonomous vehicles based on Artificial Intelligence (see Tracxn [64]) and *M2F* [60] *Move to Future,* a mobility technology platform for the development and monitoring of innovations by mobility players (in which around 200 firms and innovation organisations are involved – see M2F Move to Future [60]).

Portugal, meanwhile, is considered a peripheral region in the traditional automotive industry [23]; [2,9]. The manufacturing of low-value-added and labour-intensive components and limited R&D are all characteristic of its peripheral status [57]. Ownership of firms is overwhelmingly foreign, meaning that all important investment decisions are taken outside Portugal, and dependence on the transfer of technology remains strong [41]. Moreover, Portugal's industrial structure is characterised by small domestic firms that rely on limited resources [62].

This industry annually generates some €33.7 billion (21 % of the country's total revenue) and accounts for 11 % of Portugal's total exports. Four vehicle assembly plants are operative, and the region's annual vehicle output surpassed 300,000 units for the first time in 2019. The automotive components industry in 2020 registered a turnover of around €11.2 billion from over 350 automotive supplier firms, engaging a workforce of over 62,000 people (9.1 % of manufacturing employment in Portugal) [42].

One interesting feature is Portugal's strong foreign investment in new mobility technologies by automobile manufacturers. In 2018, BMW, Volkswagen, and Mercedes-Benz opened their first centres outside Germany to develop user/driver-centric software and to provide mobility services in Portugal [43]. At the same time, young (but world-class) start-ups in mobility tech are present in the country, especially in the area of software solutions [63]. These Portuguese firms provide cloud-computing solutions to interconnect vehicles, cutting-edge safety-test software for critical systems, and sensors for automated vehicles or navigation systems [43].

3.1. Methodology and data

Given the novelty of this research, an original quantitative study was developed. A particular comparative quantitative analysis was used [44]. This approach permits analysis of the key variables of our two samples: one of Spanish firms and another of Portuguese firms, both related to autonomous, connected, and shared mobility. Determining the universe of these domestic firms in the two regions proved difficult, as databases record the firms using different SIC (Standard Industrial Classification) codes. This implies that other information sources were required: in particular, new mobility project databases, reports and studies undertaken by sectorial organisations, and the specialist press. For the case of Spain, firms were identified through Tracxn, M2F Move to Future [60], and AEVAC [56]. The number of Spanish companies forming part of this universe totalled 36. For Portugal, firms were identified through Tracxn and BESTSTARTUP.EU [59]. The number of Portuguese companies comprising that universe totalled 23.

To collect data, a tailored survey and databases were used, with the survey permitting collection of specific information from the target population. Databases (AMADEUS and PATENTSCOPE [58]) offered data related to value-added and innovation activities. The research team carried out collection from the databases, while an external company conducted the survey to maximize the response ratio. In this research, data used in the survey represented a portion of the total data collected. The survey was undertaken from January 2022 to February 2023. Given the relatively small number of cases in the two universes, this lengthy period allowed for a greater number of questionnaires to be collected. The questionnaire was sent to all companies. In the case of Portugal, the questionnaire was sent to the 36 companies, and 18 replies were received (response rate of 52.8 %). In the case of Spain, the questionnaire was sent to the 23 companies, and 19 replies were received (response rate of 78.3 %).

It is worth reflecting on the size of the samples in this research. With respect to recent previous work on the position of regions in this context of new technologies related to connected, automated, and shared vehicles, the number of companies identified and analysed is relatively similar. For example, Trippl et al. [32], in their paper "Automotive regions in transition: Preparing for connected and automated vehicles", analyse two regions in Canada and Austria, in which they identify 13 and 12 companies related to these technologies located respectively in each of these regions. Gorachinova and Wolfe [45], in their paper "New path development in a semi-peripheral auto region: The case of Ontario", identify 13 firms in the region analysed. These data reflect, on the one hand, that the process of identifying the universe carried out in this research has been appropriate, and on the other hand, that the sample size can be considered, comparatively with respect to other studies, adequate for analysing the regional status.

In order to characterise the two samples, Table 1 and Table 2 summarize the information of some relevant variables. This information includes the products, activities, or technologies supplied by the company, the age (number of years) the company has operated in the automotive industry, the size (number of employees), and the international presence of the company (having any subsidiary in another country).

Portuguese and Spanish companies can be considered young, 83.3 % and 78.9 % of companies in each sample respectively have been operating in the automotive industry for 10 or fewer years. In terms of size, most of the companies are small. 63.2 % of Spanish firms have 50 or fewer employees. In the case of Portuguese companies, the small size is even more characteristic, 83.3 % have 50 or fewer employees, and 33.3 % have fewer than 10 employees. Regarding the international presence of these companies, a significant number of them have a subsidiary in another country, 47.4 % of Spanish and 38.9 % of Portuguese companies.

Regarding the respondents of the survey, they were Supply Chain

Table 1
Characterisation of the Portuguese firm sample.

Products, activities or technologies	Number of cases	%
Connectivity and data exchange (vehicle communication systems, critical software)	5	27.8 %
Shared mobility (mobile applications, digital platforms)	4	22.2 %
Position and location technologies (navigation software, real-time location systems)	3	17.7 %
Systems for automation of vehicles (Advanced Driving Assisted System (ADAS) parts, electronic devices)	2	11.1 %
Others (energy management tools, facial identification software, intelligent maintenance software)	4	22.2 %
Age (number of years operating in automotive industry)		
From 11 to 25 years	3	16.7 %
From 5 to 10 years	6	33.3 %
Fewer than 5 years	9	50.0 %
Size (number of employees)		
More than 250 employees	1	5.6 %
From 51 to 250 employees	2	11.1 %
From 11 to 50 employees	9	50.0 %
Fewer than 10 employees	6	33.3 %
International presence		
Multinational (the company has a subsidiary in another country)	7	38.9 %
Not multinational (the company does not have a subsidiary in another country)	11	61.1 %

Table 2
Characterisation of the Spanish firm sample.

Products, activities, or technologies	Number of cases	%
Systems for automation of vehicles (Advanced Driving Assisted System (ADAS) parts, light detection and ranging, sensing applications, artificial vision)	6	31.6 %
Connectivity and data exchange (telematics control units, smart connectivity modules)	4	21.1 %
Position and location technologies (GPS portable solutions, navigation software)	3	15.8 %
Shared mobility (mobile applications, digital platforms)	2	10.4 %
Others (cybersecurity, software for road infrastructures)	4	21.1 %
Age (number of years operating in automotive industry)		
From 11 to 25 years	4	21.1 %
From 5 to 10 years	7	36.8 %
Fewer than 5 years	8	42.1 %
Size (number of employees)		
More than 250 employees	3	15.8 %
From 51 to 250 employees	4	21.0 %
From 11 to 50 employees	11	57.9 %
Fewer than 10 employees	1	5.3 %
International presence		
Multinational (the company has a subsidiary in another country)	9	47.4 %
Not multinational (the company does not have a subsidiary in another country)	10	53.6 %

Managers. Those managers know the key aspects of the buyer-supplier relationships and have information about the buyer position of the company in the value chain. Thus, they know about the specific information contained in the questionnaire. Table 3 summarises the demographic profile of respondents. This profile is presented jointly for respondents from the two samples of Portuguese and Spanish companies.

3.2. Variables

3.2.1. Dependent variable

As this methodology is based on the comparison of Portuguese and Spanish new mobility firms, the variable *firm type* was used, defined as a dummy, assigning values of 1 to Portuguese firms and 0 to Spanish firms. This variable was obtained from the AMADEUS database [58].

Table 3
Demographic profile of the respondents of the survey.

Demographic variables	Number of respondents	%
Gender		
Male	24	64.9 %
Female	13	35.1 %
Age		
More than 40 years	14	37.8 %
From 30 to 40 years	20	54.1 %
Under 30 years	3	8.1 %
Education level		
Doctorate	1	2.7 %
Master	25	67.6 %
Bachelor	9	24.3 %
Other	2	5.4 %
Experience as Supply Chain Manager		
More than 10 years	13	35.1 %
From 5 to 10 years	19	51.4 %
Under 5 years	5	13.5 %

3.2.2. Independent variables

Variables were related to the main elements of the GVC approach (decision-making power and positioning) and to the spatial division of value-added and technological innovation.

- *Decision power* was measured using a scale of 1–3, with 3 indicating that a supplier has all the power of decision and 1 that it has none. This is determined as the average decision-making power within each of the strategic elements of buyer-supplier contracts in the automotive industry: (a) acquisition of specific assets; (b) price; and (c) location ([46]; Jamil et al., 2013). This variable was obtained from the survey.
- *Positioning* was defined as the level of the value chain on which a firm is positioned. The values for this variable were: 1 if the firm is Tier-1 (the firm supplies an automobile manufacturer); 2 if the firm is Tier-2 (the firm supplies Tier-1); and so on to *n* if the firm is a Tier-*n* supplier [6]. This variable was obtained from the survey.
- *Value-added* was defined as the added value per employee [23], expressed in thousands of euros. This variable was obtained from the AMADEUS database [58].
- *Innovation* was defined as the number of patents [47] issued during the past five years. This variable was obtained from the PATENTSCOPE database [61].

3.2.3. Control variables

Two control variables were included in the analysis. A variable related to the international presence and a variable related to the financing capacity.

- *Multinational* is defined as a dummy variable, which is 1 if the firm is a multinational (the firm has at least one subsidiary in another country); 0 if it not [48]. This variable was obtained from the AMADEUS database [58].
- *Financing capacity* is defined as the ratio of total financial debts (short-term and long-term liabilities) and total assets [49]. This variable was obtained from the AMADEUS database [58].

Table 4 summarises the definitions of the variables and the data sources from which they were collected.

3.3. Analysis

Because the dependent variable shows a binary response (1/0; Portuguese firm/Spanish firm), a logit model was used to estimate the probability of a positive outcome given a set of regressors (independent variables). This logistic regression made it possible to identify the significant independent variables that characterise the type of firm

Table 4
Variables, definition and data sources.

Variable	Definition	Data source
Firm type	Dummy, value 1 if the firm is a Portuguese new mobility firm; value 0 if the firm is a Spanish new mobility firm	AMADEUS database [58]
Decision power	Values from 1 (if the firm does not have power of decision) to 3 (if the firm has all the power of decision)	Survey
Positioning	Level of the value chain where the firm is positioned	Survey
Value-added	Valued added/Number of employees	AMADEUS database [58]
Innovation	Number of patents in the past five years	PATENTSCOPE database [61]
Multinational	Dummy, value 1 if the firm is multinational and 0 if it is not	AMADEUS database [58]
Financing capacity	Total financial debts/Total assets	AMADEUS database [58]

(Portuguese firm or Spanish firm).

The assumptions that must be met to apply the logit model (Field et al., 2012) are: linearity, independence of errors, and non-multicollinearity. Regarding linearity, it is assumed that the response variable has a linear relationship with the predictor variables. In this case, there is a linear relationship between each predictor variable and the logarithm of the response variable. The independence of the errors means that cases analysed should not be related, as in this research, where each firm is independent of the others. In terms of non-multicollinearity, to guarantee this assumption, the Variance Inflation Factors (VIFs) were analysed.

The performance of the logit model was analysed in terms of its predictive capacity and goodness of fit (Pseudo-R^2). In particular, the *McFadden Pseudo-R^2* was used because it reflects the criterion being minimised in the logistic regression estimation as well as the variance accounted for by the logistic regression model [50]. The *IBM SPSS Statistics* software, version 28, was used to perform the logit model and to analyse goodness of fit.

Additionally, a descriptive analysis was presented separately of the variables for the two samples of firms. The results of the logit model are reported in Table 5. The linear correlations between variables are shown in Table 6. In order to check potential problems of multicollinearity, Variance Inflation Factors (VIFs) were computed and are reported in Table 6. All values of the VIFs are close to 1, confirming that multicollinearity is not a serious concern. The descriptive statistics of the variables for the two samples are presented in Table 7.

4. Discussion of results

In terms of the model's goodness of fit (Table 5), the *McFadden Pseudo-R^2* value is 0.449. Considering that a *McFadden Pseudo-R^2* value ranging from 0.200 to 0.400 indicates a 'good' model fit and >0.400 an 'excellent' model fit [50], the model performed can be said to have an 'excellent' goodness of fit. Moreover, in terms of predictive capacity (86.5 %), results again confirm this goodness of fit. These results indicate that the proposed framework to support this model based on key variables of domestic new mobility firms is valid for analysis of the regional status in the core–periphery spatial model of the new mobility value chain.

Regarding the key variables included in the GVC approach to characterising regional status, the *decision power* variable was not significant in the logit model (p-value = 0.651), meaning no differences were found in terms of decision-making power between Spanish and Portuguese firms. Furthermore, the mean values of this variable were at 2.35 and 2.42 for Portuguese and Spanish firms, respectively, from a maximum value of 3 (Table 7). These results indicate that new mobility firms mostly make their own decisions around supply-contract clauses (the acquisition of specific assets, locations, and prices), suggesting that these firms have decision -making power over other firms in the automotive value chain (e.g., traditional component manufacturers).

Similarly, the *positioning* variable proved not significant in the logit model (p-value = 0.407), indicating that both Portuguese and Spanish new mobility firms are positioned on the same level of the value chain. The mean values of this variable (Table 7) were 1.21 and 1.32 for Portuguese and Spanish new mobility firms, respectively, indicating that practically all of these firms are Tier-1 suppliers and highlighting the finding that new mobility players are positioned in the first levels of the chain that is currently leading activities in the industry's reconfiguration. The high values found for these two variables (*decision power* and *positioning*) confirm the role of domestic new mobility firms as key actors in the determination of regional status (as stated in the proposed theoretical framework).

As regards the territorial division of added value and technological innovation, the *innovation* variable was not significant in the logit model (p-value = 0.454), with a similar number of patents generated over the previous five years. These results suggest few differences in terms of technological innovation between Spanish and Portuguese firms. On the other hand, the *value-added* variable did prove significant at a confidence level of 95 % (p-value = 0.049). The negative sign of the regression coefficient (β = −1.261) indicates that the added value of Portuguese firms is relatively lower than that of Spanish firms. In fact, the average added value in thousands of euros per employee for Spanish firms was at 59.62, compared with 42.03 for Portuguese firms (Table 7). This can be explained by the difference in capital intensity of the products and activities of the two samples (Tables 1 and 2). For Spanish firms, physical components and parts related to automation of vehicles (e.g., ADAS) or to connectivity (e.g., telematics control units) represent a significant part of the sample. For Portuguese firms, software services such as mobile applications for shared mobility and for critical, or navigation software were more characteristic of the sample. In summary, except for the *value-added* variable, results for the key variables analysed indicate that these two regions share the same status, unlike in the traditional spatial model [23]; [2].

Regarding the control variables, the *multinational* variable was not significant (p-value = 0.757), with a similar relevant percentage of companies with subsidiaries in other countries in the two samples (38.9 % and 47.4 %) (Tables 1 and 2). This implies that Portugal and Spain have influence in other regions through their decisions on the location of production and technological activities of subsidiaries. The *Financing capacity* variable is significant at a confidence level of 95 % (p-value = 0.011). The average of financial debts-to-assets of Spanish firms is 0.46, compared with 0.16 of Portuguese firms (Table 7). This indicates that the Spanish firms' ability to finance is significantly higher than that of Portuguese firms. This result is relevant, because financing in the automotive industry is key, especially related to the financing of the productive activity [51], internationalisation [52], work capital [53]; [54], or R&D investments [20,55]. In our case, this financing capacity of domestic firms may condition the growth opportunity in the development of new mobility technologies, and thus the upgrading of the regional status.

Table 5
Results of the logit model.

Variables	Coefficient (Standard error)	*P*-value
Decision power	0.263 (0.581)	0.651
Positioning	−0.417 (0.503)	0.407
Value-added	−1.216** (0.620)	0.049
Innovation	−0.715 (0.955)	0.454
Multinational	0.169 (0.547)	0.757
Financing capacity	−3.447** (1.348)	0.011
Number of observations	37 [18 + 19]	
Predictive capacity (%)	86.5	
McFadden Pseudo-R^2	0.449	

***P-value<0.01; ** p-value<0.05; * p-value<0.1.

5. Conclusions

5.1. Theoretical contributions

The introduction of new players linked to autonomous, connected, and shared technologies has provoked a reconfiguration of regional status along the automotive industry value chain. In this new context, a new theoretical framework based on the GVC approach has been proposed to analyse the updated core–periphery spatial model. This model focuses mainly on decision-making power and the positioning of domestic firms linked to new mobility technologies. In this model, the traditional spatial division of labour among regions loses relevance in favour of the spatial division of value-added and innovation activities related to autonomous, connected, and shared technologies. Under this framework, the new status of regions within the European automotive industry value chain were analysed. In particular, comparison has been made between one traditional semi-peripheral region (Spain) and one

Table 6
Correlations between variables.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	VIF
(1) *Decision power*	1						1.048
(2) *Positioning*	0.034	1					1.056
(3) *Value-added*	−0.186	−0.099	1				1.269
(4) *Innovation*	−0.051	−0.053	−0.075	1			1.048
(5) *Multinational*	0.063	0.182	−0.104	0.171	1		1.198
(6) *Financing capacity*	−0.001	−0.067	0.364**	0.070	0.258	1	1.304

Pearson's correlation coefficient between pairs. VIF is the Variance Inflation Factor. *** *P*-value<0.01; ** p-value<0.05; * p-value<0.1.

Table 7
Descriptive statistics of the variables for each sample.

Variable	Sample	N	Mean	Min.	Max.	S.D.
Decision power	Portuguese firms	18	2.42	1.75	3.00	0.364
	Spanish firms	19	2.35	1.75	3.00	0.299
Positioning	Portuguese firms	18	1.22	1	2	0.428
	Spanish firms	19	1.32	1	3	0.582
Value-added	Portuguese firms	18	42.03	20.00	94.40	17.822
	Spanish firms	19	59.62	32.57	95.92	20.421
Innovation	Portuguese firms	18	0.67	0	4	1.328
	Spanish firms	19	1.79	0	14	3.172
Multinational	Portuguese firms	18	0.39	0	1	0.501
	Spanish firms	19	0.47	0	1	0.513
Financing capacity	Portuguese firms	18	0.16	0.01	0.53	0.132
	Spanish firms	19	0.46	0.00	2.16	0.445

traditional peripheral region (Portugal). The analysis indicates that both regions can be framed as sharing the same status. This implies that the traditional spatial model of the automotive value chain has been reconfigured, and changes have been driven mainly by new players linked to autonomous, connected, and shared technologies.

5.2. Practical implications

In terms of managerial implications, this research offers interesting insights related to the strategies of the traditional automotive firms. In the current transition of the automotive value chain, these firms related to production of the components, systems, and modules can refocus around digital and connectivity activities. In fact, recent examples suggest that just such a change of strategy is being carried out by certain firms – for example, a leading emission systems manufacturer that has evolved into a company offering digital control and diagnostic apps for these systems. This refocusing of strategy allows traditional automotive firms to lead certain activities linked to key emergent technologies.

Considering the relevance of institutions in the GVC approach, due to the institutional influence of public administrations in the development of their territories, public policies are key. Regions with presence in the automotive industry can derive from this research various practical implications for public policies. Firms associated with new mobility technologies play a pivotal role in regional status, providing an opportunity for some regions to improve their traditional status in the new spatial model. Public policies focused on support to domestic firms linked to new mobility technologies favour the development of activities of high added value, offering a region significantly greater power of decision in the European automotive value chain. Moreover, the development of human capital and technological capabilities related to these new mobility technologies should be at the centre of public policies implemented by the governments. Policies to promote the acquisition of knowledge and technological competencies related to autonomous vehicles as well as to digitalisation, connectivity, and data-exchange technologies favour the upgrading of a region's status in the new context. Finally, regarding how the development of these new mobility technologies is financed, public policies should be designed with the target of supporting related investments. Different sets of incentives (e.g., contribution to cover financial interests, granting of public guarantees on external financial resources) can be introduced by the policy makers to support domestic firms in collecting external financial resources on the capital market to fund these investments. These incentives are relevant since, as we have observed, many domestic companies linked to new mobility are small and medium-sized companies with a low financing capacity.

5.3. Limitations and future research

Our research focuses on only two European regions representing two types of regional status: peripheral and semi-peripheral. In future research, other European regions of relevance in the automotive industry should be included in the analysis; for example, Sweden or Belgium representing the traditional semi-periphery, the Czech Republic or Romania as traditional periphery, and especially traditional core regions such as France and Germany. This would allow validation of the proposed theoretical framework. Moreover, although the process of identifying the universe and determining the sample has been adequate and, compared to other studies, the number of cases analysed is similar, it would be advisable to carry out the empirical work in the future. The automotive industry is in transition, and it is expected that firms related to new mobility will be created in these traditional automotive regions. This will allow a larger number of cases to be included in the sample.

CRediT authorship contribution statement

Jesús F. Lampón: Writing – original draft, Validation, Supervision, Investigation, Funding acquisition, Conceptualization. **Hugo Pérez-Moure:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Francisco Carballo-Cruz:** Writing – original draft, Validation, Supervision, Methodology, Investigation, Conceptualization. **M. Elena Velando-Rodríguez:** Writing – original draft, Methodology, Investigation, Conceptualization.

Data availability

The data that has been used is confidential.

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