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DIFFERENCES OF ABSORPTIVE CAPACITY BETWEEN FIRMS WITHIN A CLUSTER

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ABSTRACT**. **Firms located within a cluster have access to tacit, complex and specific local knowledge which allow them to develop competitive advantage. However, firms have no equal ability to access and to apply that knowledge, meaning that not all have a similar knowledge absorptive capacity. Using a sample of the largest Portuguese firms within a footwear cluster, this paper examine whether there are significant differences in firm's absorptive capacity and whether such differences within a cluster are related to firms' specific characteristics. The results suggest that absorptive capacity is significantly associated with the firms' characteristics, namely size, export intensity and position within the cluster.

***KEYWORDS**: absorptive capacity, cluster, size, export, position, Portugal.

***JEL classification**: L14, L25.

Introduction

Firms located within a cluster have access to a set of shared resources which are not available for firms outside the cluster (Molina, 2001). This makes such resources valuable and difficult to imitate (Molina, Martinez, 2004) and, as such, capable of creating competitive advantage to firms (Barney, 1991).

According to Enright (1998), such advantages come from tacit, complex and specific local knowledge. However, this is not enough for firms to achieve competitive advantage; they need to absorb that available knowledge. The absorptive capacity is a concept introduced by Cohen, Levinthal (1989) which refers to the ability a firm possesses to recognize, assimilate and apply new knowledge to their activities. Obviously, it is expected that firms have different absorptive capacities, even when they share the same location within a cluster. Thus, it is important to understand which factors explain firm's differences in terms of their absorptive capacity, particularly when they are located in the same cluster.

The aim of this paper is twofold. Firstly, it aims to analyse the differences in the absorptive capacity of firms in a given cluster. Second, it evaluates how firms' characteristics are associated to the absorptive knowledge capacity. To accomplish these goals, we have undertaken a study in the largest Portuguese footwear cluster, located in the counties of Felgueiras, Guimarães (2008 and 2009), in the north of the country.

This paper is structured as follows: the next section reviews the literature on absorptive capacity; the third section describes the method used in the empirical study; then, fourth section discusses the results of the study; and, finally, we summarise the main conclusions.

1. Absorptive Capacity

Cohen and Levinthal (1989, p.569) introduced the concept of "learning" or "absorptive" capacity as being "the ability of a certain firm to recognize, assimilate and exploit knowledge from the environment". For these authors, a key factor for a firm's absorptive capacity is the existence of prior related knowledge (Cohen, Levinthal, 1990) because it facilitates learning. At an elementary level, this prior knowledge includes the basic

capacities or even a shared language, but it can also include the recent scientific and technological knowledge in a given field, or even, learning skills (Cohen, Levinthal, 1990). In this view, the experience in performing a certain task can influence and increase the performance in other subsequent learning tasks (Ellis, 1965).

The success in sharing knowledge between firms depends on the cognitive and technological proximity that exist between them (Lane and Lubatkin, 1998) but also on the existence of an advanced knowledge processing system, known as absorptive capacity (Cohen and Levinthal, 1990). The absorptive capacity concept has been widely used in several studies (Cohen and Levinthal, 1994; Mowery *et al*., 1996; Veugelers, 1997; Cockburn, Henderson, 1998; Stock *et al*., 2001; Tsai, 2001; Deeds, 2001; Nieto, Quevedo, 2005; Boschma e ter Wal, 2007). However, according to Liao *et al.* (2003), its use has not been reflected into analysis about the capacity of organizational adaptation to the surrounding environment, especially for small and medium firms.

In a cluster, where the relations that enhance learning between firms assume an important role, it is relevant to analyse how the absorptive capacity varies by different firms of the cluster. Those firms which have a higher recognition, assimilation and absorptive capacity of the cluster's knowledge will be better prepared and will have better resources. Thus, it is important to verify if the differences in absorptive capacities of different firms located in a cluster are associated to their characteristics.

The absorptive capacity is a multidimensional concept and, as such, it should be operationalized with more than one variable. However, there are studies that do not capture all the dimensions of the concept and make use of only one single variable to operationalize it. It is the case of Cohen and Levinthal (1990) who have just used the research and development intensity as an explanatory variable of the absorptive capacity.

From the definition given by Cohen, Levinthal (1989), it is possible to verify that the absorptive capacity entails three dimensions: the ability to recognise knowledge coming from the exterior; the ability to assimilate this knowledge, and the ability to apply it. Zahra, George (2002), taking Cohen, Levinthal's definition as a base, went a bit further and considered that the absorptive capacity can be divided into potential absorptive capacity, which entails the acquisition and assimilation of knowledge, and the realised absorptive capacity, which entails the transformation and exploitation of that knowledge. Our study follows Zahra and George's (2002) and evaluates the potential and realised absorptive capacity of firms located within the same cluster.

The *potential absorptive capacity* is the ability each firm has to acquire and assimilate relevant knowledge for their activities.

At the knowledge acquisition level, Zahra, George (2002) recognised that the intensity and speed of the efforts made by the firm to achieve knowledge determine the quality of its knowledge acquisition capacity. On the other hand, the direction of these efforts influences the way the firm obtains external knowledge.

In what concerns to knowledge assimilation, this capacity is directly related to the routines and procedures of the firm which allow interpretation of the knowledge that emanates from the exterior (Szulanski, 1996). In this view, external knowledge is specific of a certain context and that only the firms which integrate that context can understand and replicate it. Thus, if we consider the existing knowledge in a cluster, it is expected that these firms have a high capacity of understanding and replicating it. However, do they all have the same potential absorptive capacity? This paper adds to the literature by studying the differences that may exist between firms which integrate the same cluster.

On its turn, *realised absorptive capacity* involves knowledge transformation and exploitation (Zahra, George, 2002). Knowledge transformation is expressed by the firm's ability to develop routines which allow the integration of the already existing knowledge with the assimilated knowledge (Zahra, George, 2002). As a result, this kind of capacity allows the firm to identify the way it can adapt the new knowledge to their specific needs.

The knowledge exploitation refers to the firm's capacity to apply the external knowledge in order to reach its goals (Lane, Lubatkin, 1998). Zahra, George (2002) referred to routines that allow firms to develop their already existing competences or create new ones through the incorporation of acquired and then internally transformed knowledge.

The exploitation reflects the firm's capacity to incorporate new knowledge in its operations (Van den Bosch *et al.*, 1999) and the results of a systematic exploration can translate, for example, in the persistent creation of new products (Spender, 1996). Thus, in this paper we will analyse which firms within a cluster show higher realized absorptive capacity, and which characteristics have such firms.

2. Method

2.1 Research Questions, Sample and Data

As it was mentioned before, the literature suggests that firms with higher knowledge absorptive capacity are those which are better prepared to act in the market. In the case of firms within clusters, there is a tacit, complex and specific knowledge which results from the relationships established between several actors and that knowledge allows firms to acquire competitive advantages (Enright, 1998). In this context, the concept of absorptive capacity should be addressed at the cluster level, to understand the differences between firms within a cluster.

Accordingly, this paper aims to answer to the following research questions: i) does geographic location within a cluster allow, on average, different levels of absorptive capacity among firms? ii) is firm's absorptive capacity correlated with its specific characteristics?

The empirical analysis took place in a footwear cluster from the north of Portugal, more specifically in the neighbouring counties of Felgueiras, Guimarães. This choice was motivated by several factors. Firstly, previous studies showed the importance of local inter-firm relationships in the individual and collective strategy of the Portuguese footwear firms located in that cluster (see, Eiriz, Barbosa, 2007). Second, the footwear industry has an important economic value for the Portuguese economy and for the counties where it is located. Finally, according to the Portuguese Footwear, Components, Leather Goods Manufacturer's Association (APICCAPS, 2007, p.27), this cluster "has been consolidating its position as centre of the Portuguese footwear industry, being, in the last years, the county where the job market evolution was more favourable." Further, these two counties were chosen because they have a higher presence of firms from the NACE code C15.2.0 - Manufacture of footwear.

In order to establish the study's population, we acquired a database (Belém database) from the Portuguese public body in-charge for statistics (INE), which holds a set of physical and economic variables of each footwear firm located in Felgueiras and Guimarães, regarding the year 2005. From the analysis of this database, which contains 541 firms, we have selected firms with 10 or more employees. Thus, the sample encompasses 344 firms.

Looking at the geographic location of the sampled firms, we found that 77.3% (266 firms) of firms are located in Felgueiras, while only 22.7% (78 firms) are located in Guimarães. In terms of size, there is a noticeable high proportion of small and medium firms, given that the majority of firms (75%) employ less than 49 employees, in 15.1 % of firms the number of employees range from 50 to 99 and only 1.2% of firms employ more than 250 employees.

Data related to absorptive capacity was collected through a questionnaire. In September 2008 we conducted pre-tests to the questionnaire in four firms selected from the population. Later on, the questionnaire was sent out to the remaining 340 firms, between October 2008 and July 2009. Afterwards, we have received 200 valid questionnaires for data treatment, from which 78.0% comes from firms located in Felgueiras and 22.0% from firms located in Guimarães. The sample emulates in a very close way the geographical distribution of footwear firms.

The sample also replicates adequately the population in terms of firms' size. There is a large predominance of small and medium firms, in both counties, as only 23 firms in the sample (16 in Felgueiras and 7 in Guimarães) have 100 or more employees. Interestingly, the firms' average size in Felgueiras (48 employees) is lower than the firms' average size in Guimarães (64 employees).

In the majority of the firms, the questionnaires were answered by the general manager/administrator (134 firms, 67%) or by some director (40 firms, 20%). In terms of experience of the respondents, 146 of them (73%) had at least five years of experience in the firm, and 175 (87,5%) had at least five years of experience in the footwear industry. This profile of respondents and the method of the data collection give us high confidence about the reliability of the data.

2.2 Variables and Data Analysis

According to Zahra, George (2002), the "absorptive capacity" concept was operationalized in a non-aggregated way through the variables "potential absorptive capacity" and "realized absorptive capacity".

Potential absorptive capacity. The potential absorptive capacity is the capacity of the firm to acquire and assimilate knowledge. Based on Jasen *et al.* (2005), this variable was operationalized using four questions to verify the intensity and the efforts applied in the acquisition, and three questions to check in what ways a firm is capable of analysing and understanding the new external knowledge. *Table 1* lists the questions formulated to measure variables related to absorptive capacity.

Realized absorptive capacity. The realized absorptive capacity entails the firm's capacity to transform and exploit the new acquired knowledge. In this sense, the firm's capacity to recognise opportunities and consequences of the new external knowledge for their present operations was put in practice by three questions based on Zahra and George (2002) and Jasen *et al.* (2005). In what concerns to the capacity to explore a new knowledge, this was also achieved through three questions based on Jasen *et al.* (2005).

Table 1. List of questions formulated to measure firm's absorptive capacity

Potential absorptive capacity	
Details in analysis	Questions
New knowledge acquiring intensity	1. My firm has frequent interactions with other local footwear firms in order to acquire new knowledge. 2. The firm employees regularly visit other local footwear firms. 3. My firm gathers information through informal channels (i.e. informal contacts with local firm owners). 4. My firm regularly participates in the initiatives promoted by local institutions.
Capacity of analyzing and understanding new knowledge	5. From the group of footwear firms in the region, mine is one of the fastest in what concerns recognizing the market changes. 6. My firm understands new opportunities to quickly answer clients' needs. 7. My firm quickly analysis and interprets the market changes
Realized absorptive capacity	
Details in analysis	Questions
Capacity of transforming new knowledge	1. My firm regularly analysis the consequences of the market changes in what concerns new products. 2. In my firm we establish regular meetings to discuss the consequences of the market tendencies and the development if new products. 3. My firm quickly recognizes the utility of the information collected in the exterior to its current activity.
Capacity to exploit new knowledge	4. My firm knows quite clearly how it can improve its activities. 5. In my firm there is a clear division of tasks and responsibilities. 6. My firm has the ability to create new products.

Source: authors based on Zahra and George (2002) and Jasen *et al*. (2005).

All the questions related to the "potential absorptive capacity" and "realized absorptive capacity" were measured through a Likert scale, with five levels, where 1 means "strongly disagree" and 5 "strongly agree".

The remaining variables relate to firm's specific characteristics and were measured as follows:

Size. This variable was measured by the total number of firm's employees, using the Belém database, which was acquired from INE. The data was collected using five intervals for the number of employees. These intervals were 10-19; 20-49; 50-99; 100-249 e 250-499 employees. The empirical analysis uses the average value of each interval.

Firm age. This variable was created based on date of firm's foundation (available in the Belém database) and measures the number of years the firm has been operating in the footwear industry.

Export sales percentage. This variable was collected through the questionnaire sent out to firms, where the export sales percentage was asked for. It ranges between 0 and 100%.

Central position in the cluster. This variable was measured by a set of nine questions, where it was evaluated the role of the firm as partner in the cluster (Lorenzi, Baden-Fuller, 1995; Morrison, 2008; Boschma, Wal, 2007) and the centrality of the firm in the cluster (Lazerson, Lorenzoni, 1999; Malipiero *et al.*, 2005; Tsai, 2001). The questions were evaluated by a Likert scale, with five levels, being 1 the least favourable and 5 the most favourable and the aggregation of the nine questions was made by the calculation of the average result.

In terms of data analysis, we mainly apply statistical test to find out if the geographic location of firms in the cluster allows different levels of potential and realized absorptive capacity and whether absorptive capacity vary significantly across different groups of firms.

3. Method Empirical results

The "potential absorptive capacity", "realized absorptive capacity" and the "central position in the cluster" variables were operationalized by a set of questions measured by a Likert Scale. As such, we have used the Cronbach Alfa in order to validate the aggregation of these questions. The value of the Cronbach Alfa for all variables is above 0.6. In particular, these values are 0.620 for potential absorptive capacity, 0.766 for realized absorptive capacity, and 0.866 for central position in the cluster. They provide evidence of admissible internal consistence (Pestana, Gagueiro, 2003) of the variables. *Table 2* shows a set of descriptive statistics for all variables and whole sample.

Table 2. Descriptive statistics of all variables and whole sample

Variables	N	Minimum	Maximum	Mean	Standard Deviation
Potential absorptive capacity	*200*	*1.57*	*4.14*	*2.95*	*0.514*
Realized absorptive capacity	*200*	*1.67*	*5.00*	*3.60*	*0.590*
Central position in the cluster	*200*	*1.00*	*5.00*	*2.88*	*0.669*
Size	*200*	*14.50*	*374.50*	*51.80*	*58.238*
Age	*199*	*4.00*	*75.00*	*14.91*	*10.305*
Sales export percentage	*199*	*0.00*	*100.00*	*53.11*	*43.742*
N valid (listwise)	*198*				

Source: own calculations.

On average, the inquired firms report to have a higher realized absorptive capacity than a potential absorptive capacity. This result suggests that firms appear to give little value to the acquisition and analysis of the knowledge that emanates from the cluster. In a detailed analysis, we verify that the less valued aspects are (1) the acquisition of knowledge by regular visits to other firms (mean = 2.15) and (2) the participation in the initiatives promoted by local institutions (mean = 2.26).

The variable "central position in the cluster" shows that, on average, the sampled firms are not at central positions in the cluster, as the mean value (2.88) of this variable is below the central value of the used scale (1 the 5). However, the standard deviation indicates that there is considerable dispersion with respect to firm's central position in the cluster. Moreover, looking at the variation coefficient (standard deviation divided by mean) firms seem to be more dissimilar in terms of their position in the cluster than in terms of their assessment of absorptive capacity.

Regarding the remaining variables, on average, the firms employ 52 employees. They have been operating in the Portuguese footwear industry for approximately 15 years and 53% of their sales are for external markets. It is also important to point out that overall these variables show a large dispersion but it is mainly due to the nature and the scales used to measure those variables. For that reason, the variation coefficient is a better indicator to compare variation among variables measured by different scales. Using this indicator, firm's size is the firm's specific characteristic that provides great differentiation among the sampled firms.

Looking at how firms' absorptive capacity is distributed among geographic location, we see that, on average, firms located in Guimarães appear to reach higher levels of absorptive capacity than firms located in the other county (see *Table 3*). However, the mean values are quite close, suggesting that the differences may not be statistically significant.

Table 3. Descriptive statistics for absorptive capacity break by county

Variable	County	N	Mean	Standard Deviation
Potential absorptive capacity	Felgueiras	156	2.921	0.528
	Guimarães	44	3.052	0.449
Realized absorptive capacity	Felgueiras	156	3.592	0.628
	Guimarães	44	3.645	0.433

Source: own calculations.

In order to evaluate whether geographic location may affect firms' absorptive capacity within a cluster, we perform t test for equality of means. *Table 4* reports t test for equality of means for firms' absorptive capacity break by count. The tests provide evidence that there is no significant difference between the means of firms' absorptive capacity in the two counties, suggesting that the geographic location of firms within the cluster do not have impact on firm's absorptive capacity. Nonetheless, the Levene test indicates that the realized absorptive capacity have no similar dispersion among the two county, hinting that firms located in Guimarães and in Felgueiras may be more heterogeneous with respect to the realized than the potential absorptive capacity.

Other important issue in this study is to assess whether firm's specific characteristics affect firm's absorptive capacity within a cluster. Based on the Spearman correlation matrix (see *Table 5*), we conclude that, overall, firm's specific characteristics are positive and significantly correlated with absorptive capacity.

Table 4. t Tests for equality of means for firms' absorptive capacity break by county

Variables		Levene Test		t Test for Equality of Means				
		F	Sig.	t	df	Sig. (2 tailed)	95% Confidence Interval of the Difference	
							Lower	Upper
Potential absorptive capacity								
	Equal variances	2.085	0.150	-1.496	198	0.136	-0.3031	0.0416
	Different variances			-1.639	79.805	0.105	-0.2895	0.0280
Realized absorptive capacity								
	Equal variances	6.138	0.014	-0.521	198	0.603	-0.2515	0.1463
	Different variances			-0.639	99.452	0.525	-0.2160	0.1108

Source: own calculations.

Table 5. Spearman correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Potential absorptive capacity	1.000					
(2) Realized absorptive capacity	0.580**	1.000				
(3) Central position in the cluster	0.596**	0.490**	1.000			
(4) Size	0.290**	0.368**	0.319**	1.000		
(5) Age	0.119	0.153*	0.008	0.461**	1.000	
(6) Export sales percentage	0.297**	0.465**	0.357**	0.426**	0.294**	1.000

Notes: ** and *indicate that the correlations are statistically significant for the significance levels of 1% and 5% respectively.

Source: own calculations.

The highest correlation levels (0.596 and 0.490) were attained for the correlation between absorptive capacity and central position in the cluster, suggesting that firms with more central positions are, likewise, the ones more likely to attain high levels of absorptive capacity. On the other hand, firm's age seems to have the lowest correlation level with absorptive capacity, indicating that past experience of operating in the Portuguese footwear industry, per se, may not be a compelling determinant of firm's absorptive capacity. Finally, the two types of absorptive capacity are positively correlated, as it was expected. Nonetheless, the relatively small correlation coefficient appears to indicate that firms report different evaluations of their potential and realized absorptive capacity.

Looking at differences on absorptive capacity for group of firms, we have classified firms accordingly its size and export orientation. A firm was classified in the group of small firms if it employs less than 50 employees. The remaining firms were classified in the medium or large firms group. With respect to export-orientation, a firm was classified as export firm if it reports an export sales percentage higher than zero. *Table 6* shows some descriptive statistics of absorptive capacity for those groups of firms, while *Table 7* report t tests for equality of means of absorptive capacity for groups of firms.

Table 6. Descriptive statistics for firms' absorptive capacity break by group of firms

Variables		N	Mean	Standard Deviation
Potential absorptive capacity				
SIZE	Small firms	140	2.862	0.509
	Medium or large firms	60	3.155	0.468
EXPORT ORIENTATION	Export firms	134	3.045	0.482
	Non-export firms	63	2.755	0.536
Realized absorptive capacity				
SIZE	Small firms	140	3.471	0.577
	Medium or large firms	60	3.914	0.501
EXPORT ORIENTATION	Export firms	134	3.786	0.496
	Non-export firms	63	3.239	0.607

Source: own calculations.

Table 7. t Tests for equality of means for firm's absorptive capacity break by group of firms

Variables		Levene Test		t Test for Equality of Means				
		F	Sig.	t	df	Sig. (2 tailed)	95% Confidence Interval of difference	
							Lower	Upper
Potential absorptive capacity								
SIZE	Equal variances	.255	0.614	-3.815	198	0.000	-0.444	-0.141
	Different variances			-3.946	120.8	0.000	-0.439	-0.146
EXPORT ORIENTATION	Equal variances	1.646	0.201	3.792	195	0.000	0.139	0.440
	Different variances			3.653	110.9	0.000	0.133	0.447
Realized absorptive capacity								
SIZE	Equal variances	4.998	0.026	-5.174	198	0.000	-0.612	-0.274
	Different variances			-5.473	127.5	0.000	-0.603	-0.283
EXPORT ORIENTATION	Equal variances	5.348	0.022	6.712	195	0.000	0.387	0.709
	Different variances			6.244	102.4	0.000	0.374	0.722

Source: own calculations.

Overall, absorptive capacity differs significantly between small and medium or large firms and between export and non-export firms. The larger and the export firms are on average the ones which present higher mean values for absorptive capacity. We have to underline that in the case of the realized absorptive capacity all the average values observed are bigger than 3 (the central value in the scale), suggesting that firms from the sample show a relevant capacity for transforming and exploring the knowledge coming from the cluster or underestimate their potential absorptive capacity.

The t tests for equality of means confirm the evidence that potential absorptive capacity and realized absorptive capacity are different when comparing: (1) the smaller firms with the medium and larger ones; and (2) the export firms with the non-export ones. In particular, firms which show higher absorptive capacity, whether potential or realized, are medium and larger firms and firms that export a positive percentage of their sales.

Conclusions

In this paper we investigated the absorptive capacity of firms located within a footwear cluster, aiming at finding out, firstly, if the geographic location within the cluster allows, on average, different absorptive capacity levels; secondly, if the absorptive capacity is correlated with firm's specific characteristics; and, finally, if there are differences in the absorptive capacity between groups of firms.

Our results showed that the absorptive capacity of the firms in the studied cluster does not depend on their location. One of the characteristics of the cluster is the physical proximity of firms. The counties where the firms are located have specific characteristics that would justify different absorptive capacities. However, from the analysis of the data, it was not possible to find this connection.

Additionally, we concluded that, although inter-firm relationships established between firms in a cluster produce knowledge which is relevant for these firms' activities, not all the firms possess a similar absorptive capacity. The results indicate that absorptive capacity is significantly associated with firm's specific characteristics. Specifically, we have found that the firm's central position in the cluster, its size and export intensity are strongly correlated with the capacity to acquire, assimilate, transform and explore the knowledge coming from the cluster.

The results also showed that medium and larger firms, on average, show a higher knowledge absorptive capacity, when compared with smaller firms. The same is true for the export firms when compared with those which do not have this characteristic.

This paper showed that there are significant differences in the absorptive capacity between firms in a cluster. Thus, it can be concluded that not all the firms have the same probability to develop competitive advantage from learning within a cluster. In this sense, we suggest, in a future research, to explore the possible relationship between the absorptive capacity of firms located in clusters and their individual performance.

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ŽINIŲ ĮSISAVINIMO SKIRTUMAI TARP ĮMONIŲ KLASTERIO VIDUJE

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SANTRAUKA

Įmonės, esančios klasteryje, turi prieigą prie numanomų, sudėtingų ir specifinių žinių, kurios leidžia joms plėtoti konkurencinį pranašumą. Tačiau įmonės turi ne vienodą galimybę naudotis ir taikyti šias žinias, o tai reiškia, kad ne visų įmonių žinių įsisavinimo pajėgumai yra vienodi. Remiantis didžiausiu Portugalijos avalynės klasteriu, t.y. jame esančių įmonių pavyzdžiu, straipsnio autoriai siekia patikrinti, ar įmonių žinių įsisavinimo pajėgumai yra skirtingi ir ar tie skirtumai klasteryje yra susiję su kitais įmonės bruožais. Tyrimo rezultatai rodo, kad žinių įsisavinimo pajėgumai reikšmingai susijęs su įmonių savybėmis, t.y. dydžiu, eksporto intensyvumu ir vieta klasteryje.

REIKŠMINIAI ŽODŽIAI: žinių įsisavinimo pajėgumai, klasteris, dydis, eksportas, pozicija, Portugalija.