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Boosting Regional Socioeconomic Development through Logistics Activities: A Conceptual Model

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Abstract

Background: Regional Development (RD) allows countries to balance regional differences by providing economic and social benefits to communities. This research highlights the importance of logistics activities to regional social development, and a framework to assess these connections is proposed. **Objectives:** How to boost regional socioeconomic development through logistics. **Methods/Approach:** The contributions of logistics to socioeconomic development are analysed based on the previous research, and the case of the Alto Minho (AM) region in Portugal was used to illustrate the connection between logistics and regional development. Results showed that logistics had created jobs, increased company turnover and exports, and increased GDP growth in several regions. For the AM region, results indicate that many companies are operating in this area, contributing to supporting municipalities to reduce regional disparities. **Conclusions:** A framework for assessing regional logistics performance is proposed together with several logistics performance indicators. This approach is essential for future developments integrating logistics into socioeconomic development.

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Introduction

Over the last decades, regional well-being has become a common concern for several countries worldwide. Regional Development (RD) allows countries to balance regional differences by providing communities with the means to prosper (Ságі and Engelberth, 2018). According to OECD (2020), RD is a broad term. Still, it can be seen as a general effort to reduce regional disparities by supporting economic activities (employment and generating wealth) in the regions. This definition is corroborated by Bœrenholdt (2009), who states that RD is the effort to develop countries in a socioeconomic context.

The Council of Supply Chain Management Professionals (SCMP)defends that Supply Chain Management (SCM) encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities, including the coordination and collaboration with channel partners, namely suppliers, intermediaries, third-party service providers, and customers. In this context, supply chain management integrates supply and demand management within and across companies (CSCMP, 2013). The SCMP also defines Logistics Management as a "part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption to meet customers' requirements".

According to Karayun et al. *(*2012), logistics is considered one of the most important strategic sectors of the 21st century. This sector has contributed to RD by providing a competitive advantage to companies in their supply chains. In doing so, logistics can be considered activities that promote a region's development. In a simplified way, Chankov et al. (2014) state that logistics is about ensuring the availability of the right goods, in the right quantity, in the right conditions, in the right place, at the right time for the right customer, and at the right costs.

Economic globalisation and the social division of labour have transformed logistics into a sophisticated organisation and an increasingly important and strategic management technology in the region's economic development (Wang, 2010). Logistics is today an instrument for RD, allowing the synchronisation of various activities developed in different locations (Egler and Becker, 1993).

Thus, this work aims to answer the following research question (RQ1):

- RQ1: What are the key logistics indicators which can contribute to socioeconomic development?

This work aims to identify the key logistics aspects of socioeconomic development, resorting to the case of the Alto Minho region in Portugal. This paper is divided as follows. Literature Review presents the definition of RD and the connection of logistics to the regional context and its advantages for the competitiveness of local companies. Subsequently, it is described the methodological approach used in the development of this study. Afterwards, an overview of the Alto Minho Region is presented, followed by a description of the Regional Logistics Performance Analysis Model. Finally, the last section presents the conclusions and suggestions for future lines of research.

Literature Review

The emerging debate about developing policies and initiatives devoted to RD has been increasing over the years. It can be justified because available policies did not respond effectively to the current needs of different regions.

In this regard, it is imperative to consider the characteristics of each region as well as the goals to be achieved. According to Pike et al. (2007), economic development is not an objective but only a way to achieve well-being.

RD can be used as a prompt answer to achieving economic and social development. It can also contribute to well-being (Šabić and Vujadinović, 2017; Sági and Engelberth, 2018).

Regional Development: An Overview

As an attempt to define RD, Pike et al. (2007) refer to this concept as an establishment of conditions and institutions that promote the realisation of the potential of the capacities and faculties of the human mind in people, communities, and places.

However, the term region does not have a specific delimitation, nor can it be measured in terms of area, number of inhabitants, number of companies, wealth per capita, and turnover, among other indicators. The region can then be classified as a place where it has history, legacies, institutions, and cultural customs that distinguish it from those of other regions and where the population shares a set of values and social, economic, political, and ecological perspectives (Dawkins, 2003; Pike et al., 2007; Šabić and Vujadinović, 2017).

According to Shenoy (2018), regional development is important for a country's balance. RD can also be seen as the general effort to reduce regional disparities, supporting economic activities that generate wealth and employment in the regions. Nowadays, the current policies adopted by some regions have failed to reduce regional disparities. It can be justified because they are based only on the development of infrastructure and the attraction of domestic investments.

Šabić and Vujadinović (2017) suggest that RD is closely linked to endogenous capacities and that the challenge for each region is to use its resources to remove competitive advantage and be attractive to the market. For the region's prosperity, cooperation between public and private institutions, universities, local industry, and government and local companies to take full advantage of the region.

In summary, RD can be defined as a joint effort between people, companies, and educational and research institutions. The government, who share the same cultural customs and the same concern for social, economic, ecological, and political values to enhance endogenous resources, enhancing and making the region attractive and competitive, reducing underdevelopment, without neglecting population well-being at a social and economic, cultural and environmental level (Pike et al., 2007, 2017; Bœrenholdt, 2009; Karayun et al., 2012; Šabić and Vujadinović, 2017; Sági and Engelberth, 2018).

Supply Chain Management and Regional Development

Supply chain sustainability has been receiving growing attention, especially for supply chains operating in emerging economies; however, the emphasis is given to supply chains that are composed of large multinational focal companies. To complement the existing literature, Silva et al. (2021) investigate the driving factors that support micro and small enterprises (MSE) supply chains to achieve sustainability, resilience, and regional development. Their results demonstrate that MSE supply chains have enhanced resilience to crises because they often focus on long-standing economic activities within the regional ecosystem.

The question of why one region is more vulnerable to economic shock than another impelled Palekiene et al. (2015) to analyse the resilience notion in the regional development context, and their research revealed that regional resilience is dependent on multidimensional aspects such as government capacity, strategic

insights capacity, knowledge, and innovation capacity, learning capacity, networking, and cooperation capacity and regional infrastructure and natural resources development capacity, which are directly related with resilient supply chains.

Recently, the interest in developing green supply chains has emerged in literature, and their impact on social, human, and environmental areas is analysed globally (Wang et al., 2022; Le et al., 2022). The research developed by Wu et al. (2022) analysed the economic impact of inland ports on regional development. It concluded that there exists a positive economic impact of the inland port on regional development, providing the basis for the policy of investing in these infrastructures.

As a springboard to economic development, logistics can be considered an important activity for regions' development. It can be justified that these activities have easy access to various modes of transport, economical transport services, and efficient logistics are essential to enhance the comparative advantages of the regions (Kumar et al., 2017). According to Egler and Becker (1993), logistics is also vital for economic restructuring, increasing flows, and reducing inventories in a spatial dimension that goes beyond the factory's location.

In the industrial sector, logistical clusters have several advantages, for instance, creating jobs, improving labour accessibility and mobility, providing greater access to intermediate goods and commodities, external and internal economies of scale, and to some extent, increasing productivity (Sheffi, 2010). According to Kumar et al. (2017), logistical clusters allow an improvement in accessibility and mobility of the workforce, which contribute to the increase in labour markets employment, greater access to goods and merchandise, and increased productivity, allowing companies in the cluster to benefit from economies of scale and grouping. Sheffi (2010) also adds knowledge sharing and the creation of knowledge centres, such as universities and consulting companies, to the importance of logistics clusters.

Logistical activities allow companies to have access to a range of different services, such as third-party suppliers, transporters, distributors, stockists, truck terminals, railways, ports and airports, allied manufacturing specialised information technology, high-quality workforce, and low qualification (Gafurov et al., 2014; Heijman et al., 2017), allowing the creation of auxiliary companies to their activities, such as truck maintenance companies, software suppliers, specialised law firms, financial service providers, among others (Heijman et al., 2017). The work developed by Gafurov et al. (2014) indicates that the creation of inter-regional logistics centres leads to reductions in transport costs of 7 to 20%, a reduction of 15 to 30% in the cost of handling and storing resources and final products, and accelerates the turnover of material resources by about 20 to 40%.

Logistics plays an important role in developing business worldwide as an industry's strategic sector. This sector can benefit companies through a rapid movement of goods and services, favouring the region in its development since they serve the various sectors of activity (Kumar et al., 2017).

Although logistics activities have several positive effects, it also has negative impacts, such as increasing environmental pollution, changing quality of life, road accidents, and noise pollution (Efimova and Gapochka, 2019). These aspects have drawn attention to the need to develop new strategies for both companies and governments to reduce these negative impacts related to logistics, providing a territorial ordering and a balance of all the activities involved. In this sense, Šabić and Vujadinović (2017) defend that each state must be concerned with balanced development, as it contributes to political and social stability and creates conditions

for dynamic and sustainable economic development at economic, social, and ecological objectives.

Logistics and Regional Development – Case Studies

As previously described, logistics can be a driver for RD (Egler and Becker, 1993; Kumar et al., 2017). However, despite bringing numerous positive aspects, its activities also have negative aspects (Efimova and Gapochka, 2019).

The experience discussed by Gafurov et al. (2014) shows that the creation of an interregional logistics centre in the interior of Russia, in Sviyazhsky, has provided the development of the industries of the region and strengthened the ties of cooperation between Russia's interregional strategy for the country's economic development, as well to a series of strategic objectives to improve the socioeconomic development of the regions.

Also, the work developed by Efimova and Gapochka (2019) highlights that Port activities also have an important role in the development of coastal regions. These activities positively influence job creation and gross regional product, accelerate RD, and create links between transport and logistics service providers, shipping operators, and authorities.

According to Kumar et al. (2017), transportation and logistics clusters in the US in 2014 provided 5.7 million jobs. They concluded that transportation clusters and logistics could benefit metropolitan and non-metropolitan regions.

The creation of clusters leads to the agglomeration of companies and people, which may bring social and economic development to the regions. Sheffi (2010) refers that the clusters offer a variety of jobs from executive positions, information technology, and other professionals and make economically viable the development of physical infrastructures (roads, bridges, wastewater systems), the energy system (generation and transmission of energy); information and communication infrastructures (broadband, mobile network, satellite), legal system and the development of all the infinity of basic and advanced services such as health, entertainment, culture, and education. In their work, the author suggests a set of examples of logistical clusters that boosted the development of different regions in the world, such as the ports of Singapore and Rotterdam, Memphis as a major logistics centre, the Panama Canal as a major logistics centre and the passage of large cargo ships and the logistics hub of Zaragoza in Spain, which functions as an inland port connecting the ports of Barcelona, Tarragona, Valence, Bilbao, Gijon and Sines, being connected to the European cargo rail network.

According to Heijman et al. (2017), there is a strong dependence on port activities and RD in the global business cycle near the port of Rotterdam, estimating for the period from 2011 to 2020, an increase in production by 20%, while GDP and employment increase by 10% and 7%, respectively.

The city of Memphis in the USA is an example of the contribution of logistics to regional development. This city is designated as "Aerotrópolis" with a huge airport logistics centre, where Memphis International Airport is responsible for more than 220154 jobs. Its surrounding area specialises in transport and storage, where it concentrates a series of commercial activities around the airport, such as shopping malls, hotels, hospitals, conferences, and exhibition centres, among other activities (Antipova and Ozdenerol, 2013).

According to Martinez et al. (2016), the Panama Canal is an important logistical centre for the passage of large cargo ships, reducing the maritime distance between the east and west coast of the USA. The Panama Canal is an important route for

transporting goods by container from Asia to the east coast of the United States of America.

In terms of global logistics performance, the Logistics Performance Index (LPI) ranking developed under The World Bank is a well-known benchmarking tool that provides measures for more than 160 countries (WorldBank, 2018). The World Bank encourages countries to use the LPI database to compare countries of their choice to identify weak areas for improvement (Su and Ke, 2015).

The LPI ranking brings together six dimensions, namely: efficiency and customs and border management; the quality of infrastructure related to trade and transport; the ease of arranging international shipments at competitive prices; the competence and quality of logistics services; the ability to track and track shipments and the frequency with which shipments reach consignees within the scheduled or expected delivery time (WorldBank, 2018).

According to Su and Ke (2015), national logistics performance benchmarking can fill the gaps in logistics performance and build stronger connectivity between nations to facilitate efficient international trade flows.

Methodological Approach

This research used a qualitative approach to achieve the proposed objective. The work is divided into four main stages.

- *Stage 1*

The work began with a literature review considering two main areas: logistics and regional development. For this stage, reports and scientific publications related to the AM region in Portugal were used as the main data source for this research. Nevertheless, after a comprehensive search for this region (Logistics in AM region) in this region through the current literature, few works were found, revealing the lack of research in this field.

- *Stage 2*

Then, the case of the AM region was used to illustrate the relationship between logistics and RD. In this stage, key aspects related to logistics and RD were analysed.

- *Stage 3*

This stage focuses on developing a framework for analysing regional logistics performance. A set of regional logistic indicators is proposed to assess regional logistical performance, which is the first attempt to develop a methodology that will allow the future to evaluate logistics performance at a regional level. This work aimed to identify the key logistics indicators contributing to socioeconomic development from the scarce literature available. A case study was adopted as a research strategy to study logistics and RD within AM region context.

- *Stage 4*

Finally, the main conclusions of the work and suggestions for future research are presented, aiming to capture the key aspects of logistics to regional and socioeconomic development; the case of AM region in the northern region of Portugal was taken as an example.

This work focused on this region due to its strategic location and contribution to logistics activities in Portugal. The sample consists of ten municipalities that are part of AM region. This region's characterisation will be summarised and discussed in the section where the results are presented. A picture of socioeconomic aspects, logistics indicators, and their contributions as a springboard to RD will be highlighted.

An Overview of the Alto Minho Region

In this work, an analysis of the logistics of socioeconomic development was conducted addressing the Alto Minho region in Portugal. The first attempt to study this relationship showed key indicators to be considered when searching for logistics benefits to RD. Furthermore, the main aspect to ensure logistics activities in this region were pointed out, namely logistics infrastructure and the exportation of goods.

AM region comprises ten municipalities, which run 22 industrial business zones spread across these municipalities. These industrial zones have been operating in different markets through international contracts, producing and delivering export-led products for many countries worldwide. From the research conducted, Table 1 presents the results that highlight the number of business zones for each municipality. According to data from PORDATA 2018, AM represented around 1.45% of the turnover generated in Portugal, which represented 5.14% of the turnover of the entire North region.

These industrial zones connect countries through logistics infrastructures, transporting different goods through railways, ports, airpofrts, and highways. Table 1 illustrates sea and wind activities, electronic machines and devices that stand out in the municipality of Viana do Castelo and common metals in Valença and Monção. The automobile industry cluster is also very important, mainly in Ponte de Lima, Paredes de Coura, and Vila Nova de Cerveira.

Table 1
Technical records from municipalities of the Alto Minho region

Alto Minho	***Turnover***	**Enterprise Category**		
	1.45%	**Number of Companies (sum)**	**Large**	**SMES**
		30089	21	30068
Municipality	***Industrial business zone (n)***	**Cluster (activities)**	**Turnover**	
Arcos de Valdevez	3	Plastic	286115	
Caminha	1	Fish	198902	
Melgaço	1	Rubber and Tires	139548	
Monção	1	Common Metals	238725	
Paredes de Coura	2	Automobile Components	164729	
Ponte da Barca	2	Plastic and Rubbers	100956	
Ponte de Lima	2	Automobile Components / Agrifood and Viticulture	1033091	
Valença	2	Common Metals	363011	
Viana do Castelo	5	Wind Activities / Sea Activities / Electronic Machines and devices	2647080	
Vila Nova de Cerveira	3	Automobile Components / Mechanics and Metallomechanics	585965	
Viana do Castelo	5	Wind Activities / Sea Activities / Electronic Machines and devices	2647080	
Vila Nova de Cerveira	3	Automobile Components / Mechanics and Metallomechanics	585965	

Source: (PORDATA, 2020b)

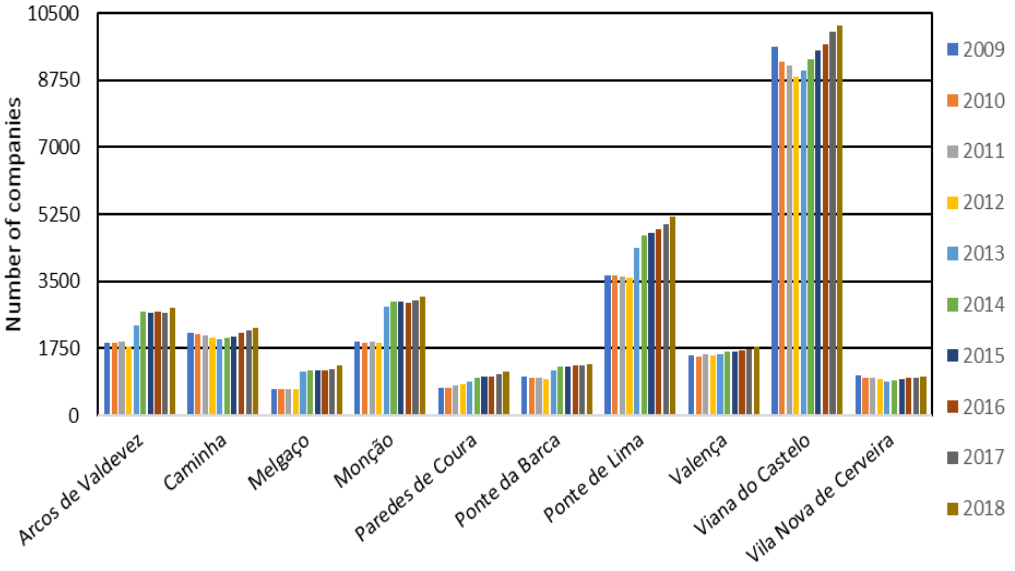
As outlined in Table 1, AM presents a total of 30089 companies, which correspond to 6.98% of the total companies in the North region of Portugal and 2.35% of the total

number of companies operating in Portugal. Regarding the company size, results showed that 21 were considered large companies, with the rest being (30068) considered SMEs (PORDATA, 2020b).

As shown in Figure 1, the municipality of Viana do Castelo has the largest number of companies, with 10185, followed by Ponte de Lima, with 5186. The municipality with the lowest number of companies is Vila Nova de Cerveira, with only 1008 companies, existing four municipalities with less than 1500 companies based.

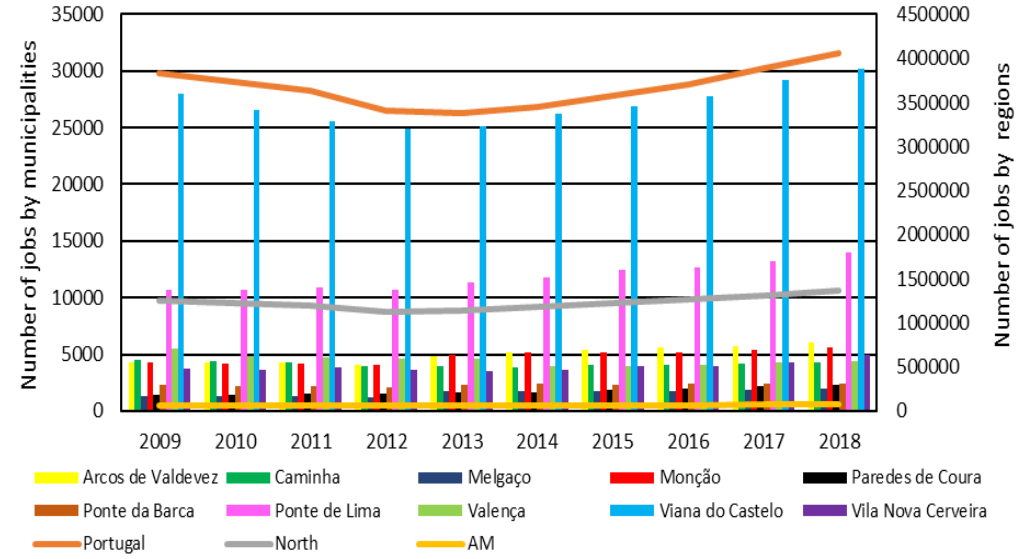
Regarding the contribution of this region to employment, the region is responsible for about 76 thousand jobs in the region. Fig.2 presents the evolution of the created jobs in the region over the last few years.

Figure 1
Evolution of the number of companies in the Alto Minho



Source: (PORDATA, 2020b)

Figure 2
Created jobs by the municipality in the AM region

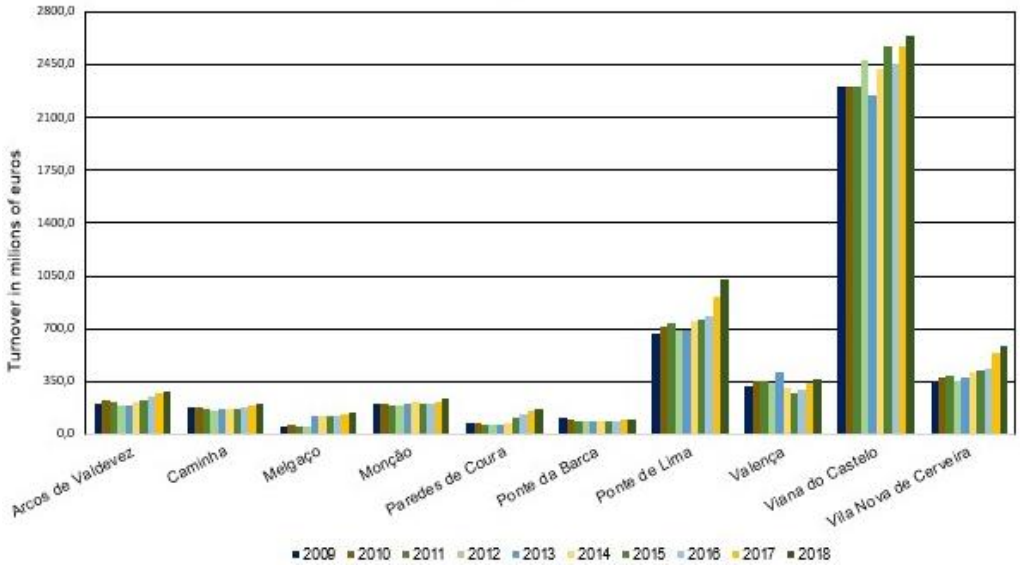


Source: (PORDATA, 2020a)

The results in Figure 2 showed that in 2018, the AM employed 76221 people, corresponding to 1.88% of the total number of people employed in Portugal and 5.56% of the entire North region. The results showed that the industry in Alto Minho alone employs around 59 thousand people (Sociedade de Consultores and Associados, 2013). Of all municipalities analysed, Viana do Castelo was the one with the largest number of people employed, accounting for 30140, followed by Ponte de Lima with 14030, it can be justified since these two municipalities have the largest number of companies based.

Regarding the potential contribution of AM companies to the region's turnover, Figure 3 shows the turnover for the last years for each municipality. Results showed that Alto Minho municipalities performed in a similar way to the North region and Portugal, meaning a decrease in values until 2012 followed by increases (Minho-Lima, 2019), with few exceptions such as the municipalities Paredes de Coura and Viana do Castelo, which registered the lowest value is 2013, and Valença in 2015. Apart from Ponte da Barca and Valença, all municipalities had the highest turnover in 2018.

Figure 3
Turnover of AM municipalities



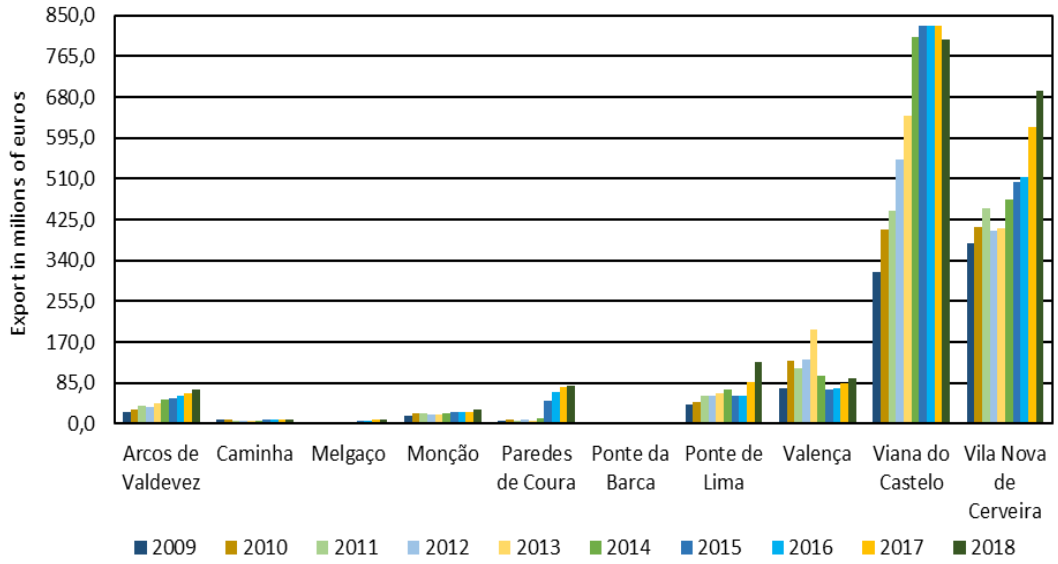
Source: (PORDATA, 2020d)

Despite the positive economic benefits previously mentioned in this research, the role of logistics activities was focused on as a key aspect of bringing RD. As such, AM region in Portugal was used as a case to illustrate this relationship (Logistics-RD); the region was chosen due to its strategic location and economic importance to Portugal.

Data related to the exportation of all municipalities from AM region was used to address the importance of logistics activities to the region. It can be seen as the first picture of logistics contribution to the region since the total values of exportation may reflect the number of transported goods by each municipality.

Figure 4 presents the exportation values from the municipalities from the period between 2009 and 2018. The results showed that the main destination of goods produced in Spain is justified due to the border proximity and the existence of more than 70% of Spanish companies which operate in the industrial parks in the municipalities of Valença and Vila Nova de Cerveira, the results also showed that the United Kingdom, France, and Germany are the biggest export destinations after Spain (Consulting and Consulting, 2018).

Figure 4
The export share of goods by municipalities



Source: (PORDATA, 2020c)

From the reports consulted, emerging markets such as Morocco, Algeria, Ghana, and Iran also play an important role in exporting goods produced in this region. Fig. 4 shows that since 2009 the number of exportations has fluctuated in most municipalities, with the exceptions of Arcos de Valdevez and Paredes de Coura, with continuous growth. The results also revealed that although Portugal has a higher value of imports than exports, the North and AM region are considered one of the main players for all countries, with higher export values than imports.

The results showed that in 2018, the ratio between exports and imports from Portugal was 78.68%, while in the North, it was 130, 45% and in Alto Minho, 150.67%, which indicates that the AM is above the North region average (Minho-Lima, 2019). The results corroborated with data presented in Fig. 4, confirming the municipalities of Ponte de Lima, Valença, Viana do Castelo, and Vila Nova de Cerveira as the main players in the region.

The results presented in Fig. 3, 4, and 5 bring to light two main aspects of the AM region: economic growth and the increasing demand for logistics activities to support companies in delivering goods to different countries. Yet, from the analyses conducted, few works highlighting the contribution of logistic activities to the economic growth of this region were found. To address this concern, the main logistics infrastructures, which have been supported by companies operating in this region on the production and exportation of goods, as well as the main logistics indicators, can be used as tools to identify the contribution of logistics to RD, were analysed. As previously mentioned, AM region is a strategic area for the country since it's a border region with access to key logistics infrastructures. Table 2 summarises a set of potential logistical benefits for each municipality from the research conducted.

Although AM region is well-known as an important economic region for Portugal, the results presented in Table 2 showed that the quality and access to logistics infrastructure persist as a barrier. For the municipalities consulted, the only ones with direct access to railways were Valença, and Viana does Castelo, which means that for the rest of the municipalities, the transport of goods is mostly carried out by highways, contributing to this way to increase economic and environmental concerns.

The results showed that the infrastructure presented in Table 2 connects through export activity Viana does Castelo in the North to Vila Nova de Gaia in the south by the coastal strip and the interior of municipalities such as Braga-Guimarães-Vila Nova de Famalicão. On the other hand, Vila Nova de Cerveira in the North of Viana do Castelo and Bragança in the eastern part of the North stand out in the export activity outside this western exporting block (Consulting, 2018).

Table 2
Logistic infrastructures available in AM region

	Access to infrastructure/distance (km)								Access to foreign infrastructures
Municipality	***Ports***	**Km**	**High way**	**Km**	**Air port**	**Km**	**Rail way**	**Km**	
Arcos de Valdevez	Yes	47.6	Yes	17.3	-	-	-	47.6	
Caminha	Yes	24.1	Yes	6.6	-	-	-	28.6	
Melgaço	Yes	92.7	Yes	40.3	-	-	-	39.6	Port and Airport of Vigo
Monção	Yes	70.7	Yes	18.0	-	-	-	17.3	Port and Airport of Vigo
Paredes de Coura	Yes	50.0	Yes	12.5	-	-	-	23.0	
Ponte da Barca	Yes	47.7	Yes	17.4	-	-	-	48.1	
Ponte de Lima	Yes	30.8	Yes	4.5/3.2	-	-	-	31.6	
Valença	Yes	52.8	Yes	0.75	-	-	Yes	1.0	Port and Airport of Vigo
Viana do Castelo	Yes	0	Yes	5.0/5.0	-	-	Yes	5.1	
Vila Nova de Cerveira	**Yes**	**37.1**	**Yes**	**4.7**	**-**	**-**	**-**	**16.2**	Airport of Vigo

Source: CIM, 2013)

Regarding the ports infrastructure, the results from the administration of Porto do Douro, Leixões, and Viana do Castelo (APDL) showed that the port of Viana do Castelo mainly handles solid bulk and also showed that exports represent 74% of the port's global movement and that Kraft paper remains the main exported commodity (APDL, 2019). At this time, new road access is also under construction for the commercial sector of the port of Viana do Castelo, which can improve accessibility to the port infrastructure, reinforcing its competitiveness and expanding its hinterland. In terms of infrastructure, the port of Viana do Castelo has a new crane with the capacity to transport loads of up to 100 tons and allows the scale of ships with 190 meters in length and 30,936 GT (gross tonnage) (APDL, 2018, 2020).

Regarding the type of goods exported, data from 2018 showed that the most exported items were transport materials (car parts, among others) which account for 752€ million, followed by machines, devices, and electronic materials worth 319€ million, and pulp of wood or other fibrous cellulosic material; accounting to 239€ million, corresponding to more than 68% of all material exported in 2018 by AM (Minho-Lima, 2019).

Over the last few years, logistic activities have played an important role in economies worldwide. Yet, as previously mentioned, few works have discussed its importance to RD, configuring a gap in the current literature. This gap can be justified

due to the lack of indicators to measure RD through logistics activities; the LPI developed an attempt; the methodology proposed a set of indicators, such as infrastructure, imports/exports services, international shipments, and track and trace, to analyse the role of logistics economic performance across countries worldwide. In this research, some of these indicators were analysed in the regional context, aiming to understand the applicability of logistics indicators to evaluate logistics performance in economics and RD.

The results indicate that due to continuous economic growth of AM region and the potential of companies that operates in this region to promote RD leads to a call to increase investments in logistics capabilities in the region, which may also create conditions to support companies to produce and deliver goods as well to increase economic and RD for municipalities and AM region.

Regional Logistics Performance: Analysis Model

As its main objective, this chapter has to present a framework that allows analysing and discussing aspects of regional logistics performance and propose a set of logistics indicators at a regional level. This framework aims to present a model to support logistics performance in different regions.

Framework for Regional Logistics Performance Assessment

The literature analysis made it possible to identify a gap in logistics performance indicators at the regional level. Considering this gap, this research proposes a framework for selecting logistical indicators to be used at the regional level.

The framework proposed is based on a combination of different approaches and methodologies. The development of the framework structure contains three distinct phases divided into several sequential steps that encompass the following topics:

- Literature review.
- Survey of logistics indicators.
- Definition of criteria for the selection of indicators.
- Preliminary list of selected indicators.
- Selection of a set of companies to validate the previously selected indicators.
- Validation of indicators.
- Analysis of regional logistics performance.

As shown in Figure 5, the first phase is based on research of scientific works and publications; it serves as the basis for phase 2, which focuses on LPI indicators. In this second phase, through the information obtained in the previous phase, interviews, questionnaires, and focus groups can be designed to identify the logistics performance indicators that will be part of the framework. After identifying and classifying the indicators, the third and last phase, the logistics performance analysis, begins, focusing on the indicators previously identified in the development phase.

Based on the Framework, the intention is to identify the main gaps found at the level of regional logistics. Then, the evaluation tool can be used to validate the performance of the indicators. The dimensions of the logistical indicators were constructed based on the LPI questionnaire adapted to the regional dimension.

Finally, the third and last phase of the framework presents the analysis of logistics performance. In this last stage, after obtaining the answers to the questionnaires, the value of each logistic indicator for each dimension will be calculated, allowing the analysis of the logistical performance of the region. As previously mentioned, the framework is divided into 3 phases, as summarised in Figure 5:

Phase 1: Literature review

- Analysis of scientific literature focusing on performance indicators and regional development.

Phase 2: Identification of indicators for logistics performance

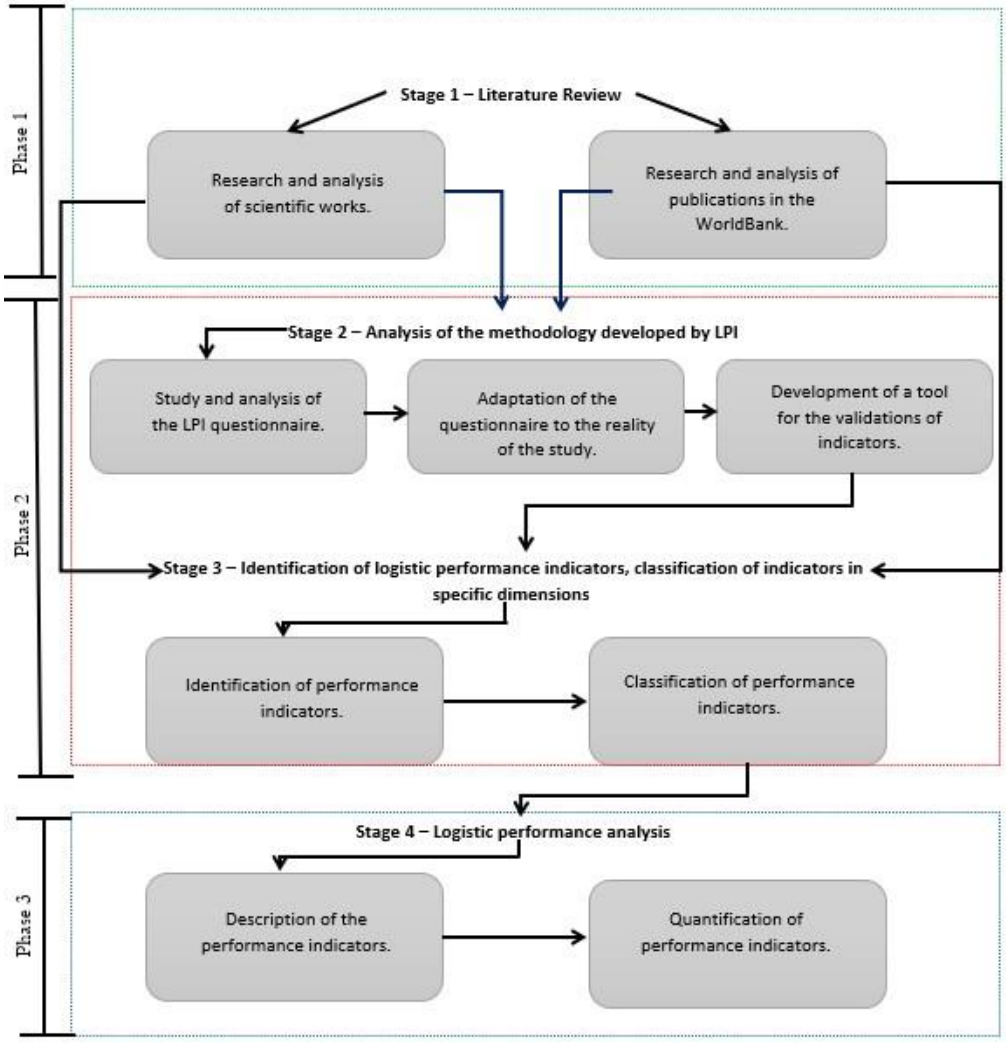
- Analysis of the methodology of the LPI (Logistic Performance Index).
- Selection of a set of performance indicators that can be used and adapted to the reality of the work context (based on the previous phase).
- Classification of performance indicators by dimension.
- Development of the questionnaire adapted to the regional context, considering the indicators selected in the previous phase.

Phase 3: Logistic performance analysis

- Description of performance indicators by dimension and its way to measure.
- Analysis of regional logistics performance, transforming the answers obtained in questionnaires on a Likert scale from 1 to 5 and making their average.
- After the development of the framework, the next topic addresses the assessment tool used in developing performance indicators.

Figure 5

Framework for analysis of logistics performance



Source: Author's illustration

Logistics Performance Indicators

Based on the phases presented in the previous section, a set of indicators was selected and grouped into six dimensions. The indicators presented in this section serve as an initial proposal to assess regional logistics performance. The tables presented below are based on the methodology proposed by the LPI. It was used due to the methodology has already been validated and used in an international context.

The selection of indicators has considered the context in which the companies are inserted; namely, the advantages of applying this type of methodology in the regions and the potential that a set of indicators can do in favour of the development of the companies and the regions where they are located are inserted.

Tables 3, 4, 5, 6, 7, and 8 present the dimensions for each set of indicators: infrastructures, tracking and tracing of goods, customs aspects, punctuality and logistics competence, regional and international shipping, and quality of logistics services.

For the infrastructure dimension, six indicators were selected. Table 3 shows the indicators selected for this dimension. The objective of this dimension is to analyse the conditions of the companies' infrastructures at the regional level and to evaluate whether the companies evaluate parameters such as breaks and obsolescence and the customers' complaints.

Table 3
Infrastructure Indicators

Item	Infrastructure indicators	Measurement
I1	Percentage of companies with implemented logistics performance indicators.	(Number of companies with performance indicators implemented / Total number of companies) * 100
I2	Percentage of companies with industrial management software (Ex .: PR, WMS).	(Number of companies with industrial software implemented / Total number of companies) * 100
I3	Percentage of companies that have established loading and unloading schedules.	(Number of companies with loading and unloading hours / Total number of companies) * 100
I4	Percentage of companies with implemented reverse logistics initiatives.	(Number of companies with implemented reverse logistics initiative / Total number of companies) * 100
I5	Percentage of companies that measure breaks and obsolescence	(Number of companies that measure breaks and obsolescence / Total number of companies) * 100
I6	Percentage of companies that measure customer complaints	(Number of companies that measure customer complaints / Total number of companies) * 100

Source: adapted from (World Bank, 2018)

For the tracking and tracing dimension, four indicators were selected. Table 4 shows the indicators selected for this dimension. This dimension aims to analyse whether companies in the region track their goods shipped as received goods and identify the main modes of transport that companies handle and which are the main markets in which they operate.

Table 4
Goods Tracking and Tracing indicators

Item	Tracking and Tracing Indicators	Measurement
TT1	The average distance of shipments/receipts	Up to 20 km; Up to 100 km; Up to 700 km; More than 700 km
TT2	Export activities	(Number of companies with international shipments / Total number of companies) * 100
TT3	Tracking of shipments by the company	(Number of companies that track / Total number of companies) * 100
TT4	Number of companies using other means of transport than road	(Number of companies using other means of transport than road / Total number of companies) * 100

Source: adapted from (World Bank, 2018)

For regional and international shipping dimensions, six indicators were selected. Table 5 shows the indicators selected for this dimension that aim to assess the competence and quality of the different logistical services provided in the region and the country at the level of regional and international shipments and infrastructure.

Table 5
Regional and International Shipping Indicators

Item	Regional and international shipping indicators	Measurement
RIS1	Quality assessment of regional road, rail, sea, air, storage, and ICT infrastructures.	Very weak; Weak; Satisfactory; Good; Very good
RIS2	Quality assessment of road, rail, sea, air, storage, and international ICT infrastructures.	Very weak; Weak; Satisfactory; Good; Very good
RIS3	Number of documents needed to receive merchandise internationally	0 to 2; 3 to 5; 6 to 10; More than 10
RIS4	Number of documents needed to receive goods domestically	0 to 2; 3 to 5; 6 to 10; More than 10
RIS5	Number of documents needed to send goods domestically	0 to 2; 3 to 5; 6 to 10; More than 10
RIS6	Number of documents needed to send goods internationally	0 to 2; 3 to 5; 6 to 10; More than 10

Source: adapted from (World Bank, 2018)

For the dimension of customs aspects, four indicators were selected. Table 6 shows the indicators selected for this dimension that aim to assess the main difficulties that companies face in releasing goods at customs and borders and how they evaluate the services these logistics agents provide.

Table 6
Customs indicators

Item	Custom Indicators	Measurement
C1	Efficiency in transparency in customs clearance	Never; Rarely; Sometimes; Oftentimes; Ever
C2	Efficiency in transparency in the release of goods at the border	Never; Rarely; Sometimes; Oftentimes; Ever
C3	Classification of the competence of customs brokers	Never; Rarely; Sometimes; Oftentimes; Ever
C4	Classification of the competence of customs agencies	Never; Rarely; Sometimes; Oftentimes; Ever

Source: adapted from (World Bank, 2018)

For the timeliness dimension, five indicators were selected. Table 7 shows the indicators selected for this dimension to assess whether companies experience delays in receiving and sending goods.

Table 7
Timeliness indicators

Item	Timeliness Indicators	Measurement
T1	Import shipments shipped and delivered on schedule	Never; Rarely; Sometimes; Oftentimes; Ever
T2	Export shipments shipped and delivered on schedule	Never; Rarely; Sometimes; Oftentimes; Ever
T3	Delays due to pre-shipment inspection	Never; Rarely; Sometimes; Oftentimes; Ever
T4	Delays due to sea transhipment	Never; Rarely; Sometimes; Oftentimes; Ever
T5	Delays due to mandatory storage/transhipment.	Never; Rarely; Sometimes; Oftentimes; Ever

Source: adapted from (World Bank, 2018)

For the dimension of quality of logistical service, 5 indicators were selected. Table 8 shows the indicators selected for this dimension, which aim to assess whether companies receive timely information about changes in regulations, experience control load theft, how service providers classify and the times they are charged fees for logistical services.

Table 8
Indicators of quality of logistical service

Item	Quality indicators of logistical services	Measurement
QILS1	Receiving timely information on regulations	Never; Rarely; Sometimes; Oftentimes; Ever
QILS2	Experiencing criminal activities (stolen cargo)	Never; Rarely; Sometimes; Oftentimes; Ever
QILS3	Percentage of companies that evaluate the quality of logistics services.	(Number of companies evaluating the quality of logistics services / Total number of companies) * 100
QILS4	Classification of road, rail, sea, air, and storage and transport service providers.	Very low; Low; Satisfactory; Good; Very good
QILS5	A monthly collection of port and airport taxes; highways; railway; service, and agent service.	0 to 5 times; 6 to 12 times; 13 to 20 times; 21 to 30 times; More than 30

Source: adapted from (World Bank, 2018)

After selecting the indicators referred to in tables 3 to 8, an evaluation tool should be carried out, which will be used as an initial attempt at validation using a set of

companies in the Alto Minho region. A questionnaire designed for the regional dimension will be used as an evaluation tool. This questionnaire was based on the LPI methodology. This tool aims to verify whether companies have difficulties answering questions and will make it possible to validate the proposed logistical indicators. In this work, the questionnaire will be a first attempt to assess the logistics performance of the Alto Minho region.

Conclusions

In this research, logistics activities and RD were discussed behind economic and social aspects while considering the AM region in the North of Portugal. The study was conducted addressing this region due to the strategic location in the country as well as the economic importance of the region for the country.

The positive economic benefits of AM region were summarised, and its contribution to RD was analysed. Furthermore, logistic activities were analysed as a key driver for socioeconomic development in the region.

The work was based on a review of the scarce literature concerning logistics and RD. Due to the lack of research matching these topics, the research attempted to analyse data from governmental reports and scientific literature.

Industrial activities in AM region have been growing in different sectors over the last few years. The results indicate that, after the economic crisis in 2008, this region has been increasing its numbers, both level of companies and job creation. Also, in terms of business volume and goods exported, the region has experienced positive gains, making AM one of the regions of Portugal with the highest volume of exports. Results also showed that SMEs mainly characterise this region, the municipalities of Viana do Castelo and Ponte de Lima, with the highest number of companies, goods exported, and jobs created.

Additionally, although Viana does Castelo is the municipality with the highest number of exportations, in second place comes Vila Nova de Cerveira, the municipality with the fewest companies, and on the opposite is the one that most contributes to the value of exports. Yet, the strategic position of the region, namely the border region with Spain, fast access to highways, ports, and railways, bring logistics activities as an instrument to support companies from this region to overcome challenges related to bringing together suppliers and customers in the international market.

In line with previous research published by the LPI, the findings presented in this work describe a set of logistic indicators that can be used to evaluate logistics performance from different countries, namely infrastructure, imports/exports services, turnover, and jobs created, providing the answer to the first research question of the paper (RQ1), about the key logistics indicators which can contribute to socioeconomic development. Different countries largely use these indicators to justify their logistics performance. In this research, they were used as a first attempt to access the logistic performance in a regional context.

The results also indicate that municipalities such as Viana do Castelo, Valença, and Vila Nova de Cerveira were the ones that present the faster access to highways, ports, and railways, it has been reflecting the positive gains in terms of exportation and the number of jobs created in the region. Logistics plays an important role in supporting these regions in production and distribution.

On the other hand, the municipalities of Arcos de Valdevez, Paredes de Coura, Caminha, Ponte da Barca, Ponte de Lima, Monção, and Melgaço fail to access logistics infrastructures. For instance, despite the importance of municipalities such as Paredes de Coura, Arcos de Valdevez, and Ponte de Lima, this region (AM) has no

easy access to railways and ports, which difficult the connection between suppliers and customers, configuring a challenge to be faced by these municipalities.

In summary, regardless of the potential contribution of logistics to regional and socioeconomic development in AM region in Portugal, it becomes evident that actions and strategies for a better discussion about the role of logistics activities need to be disseminated by researchers and stakeholders from AM region. This research showed that faster access to logistics infrastructures such as ports, highways, and railways should be considered key to socioeconomic development for the AM region in Portugal.

As a main result, a framework for assessing regional logistics performance is proposed together with several logistics performance indicators to assess the impact of logistics on regional development. The results presented here are part of ongoing work aiming to demonstrate the benefits of logistic activities to RD. Although initial research, the approach used here is essential for future developments integrating logistics into socioeconomic development. The authors are now proceeding to develop a model resorting to a set of logistic indicators to be used in a real case with a set of companies from AM region, aiming to understand their logistics behaviour in the region. In this work, the questionnaire is a first attempt to assess the Alto Minho region's logistics performance.

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