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Evaluating Competitive Advantages in Portugal Forest Cluster: An Application of Porter's Diamond Model

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BUSINESS
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Department of Marketing, Operations and Management

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Resumo

A questão florestal em Portugal é muito falada. Infelizmente, nem sempre pelas boas razões. Portugal é o cenário crónico de enormes incêndios florestais, e os meios de comunicação social concentram-se neles ano após ano durante o Verão. No entanto, a floresta é muito mais do que incêndios florestais para a economia portuguesa. Ela suporta um cluster muito importante onde as exportações são de 4,094 mil milhões de euros, representando 9,0% de todas as exportações de bens em Portugal. A balança comercial do cluster florestal é muito benéfica para Portugal, com um saldo positivo de 2,339 mil milhões de euros. Utilizámos o modelo do Diamante de Porter como quadro conceptual para avaliar as vantagens competitivas do cluster florestal. Identificámos várias condições específicas necessárias para sustentar as vantagens competitivas através desse quadro. Descrevemos o estado atual de cada condição, dando sugestões para desacorrentar o Diamante da competitividade para aquelas condições que constituem um constrangimento. Os resultados indicam que o Diamante do cluster florestal português está longe de ser o ideal. Encontrámos limitações em todos os determinantes do Diamante: problemas nas condições dos fatores, nas condições da procura, nas indústrias relacionadas e de apoio, e na estratégia das empresas, estrutura e rivalidade. Além disso, o papel do governo está a influenciar negativamente os determinantes do Diamante.

Palavras-chave: competitividade, vantagens competitivas, modelo do diamante, floresta, Portugal

Classificação JEL: (Q23) Recursos Renováveis e Conservação, Silvicultura; (L73) Estudos da Indústria: Produtos primários e Construção, Produtos Florestais

Abstract

The forest issue in Portugal is very spoken. Unfortunately, not always for good reasons. Portugal is a chronic scenario for enormous wildfires, and the media focus on that year after year during the summer. However, the forest is much more than wildfires for the Portuguese economy. It supports a very important cluster where the exports are 4.094 billion euros, representing 9.0% of all goods exportation in Portugal. The trade balance for the forest cluster is very beneficial for Portugal, with a positive balance of 2.339 billion euros. We used the Porter's Diamond model as the conceptual framework to evaluate the competitive advantages of the forest cluster. We identified several specific conditions needed to sustain a competitive advantage through that framework. We describe the status for each condition, giving suggestions to unleash the Diamond of competitiveness for those that are a constraint. The results indicate that the Diamond for the forest cluster is far from optimal. We found constraints in all determinants of the Diamond, problems in the factor conditions, in the demand conditions, in the related and supporting industries, and in the firm strategy, structure, and rivalry. Besides, the role of government is negatively influencing the Diamond determinants.

Keywords: competitiveness, competitive advantage, diamond model, forest, Portugal

JEL classification: (Q23) Renewable Resources and Conservation, Forestry; (L73) Industry Studies: Primary Products and Construction, Forest Products

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1. Introduction

1.1 Contextualisation

The forest issue in Portugal is very spoken. Unfortunately, not always for good reasons. Portugal is the scenario for big wildfires in summer, and the media focus this subject every year on summer in their news. In 2017, Portugal had terrible forest wildfires that killed 116 people and burnt 544 thousand hectares, 6% of Portugal's mainland area (Castel-Branco, 2018). These enormous and terrible wildfires can be related to global climate changes and the lack of management in the forest land. More often, experts say that rural land is left behind, and for that reason, we witness the growth of wildfires statistics decade after decade. In fact, the lack of management leads to excessive growth of shrubs that act as fuel in the forest and promote wildfires (Castel-Branco, 2017).

However, the forest is much more than wildfires for the Portuguese economy. The exports for the forest cluster are 4.094 billion euros, representing 9.0% of all goods exportation of Portugal. The imports are 1.755 billion, representing 3.2% of all goods importation. The trade balance is very beneficial for Portugal, with a positive balance of 2.339 billion euros (AIFF, 2014).

The economic importance of the forest cluster for the Portugal economy is mainly represented by three species: maritime pine, eucalyptus, and cork oak. Indeed, those are the main species of the Portuguese forest cover. ICNF (2019) National Forest Inventory refers that those three species represent 71% of the forest diversity in Portugal. The forest land in continental Portugal is 3,224,200 hectares, of which 713,300 hectares is maritime pine, 845,000 hectares is eucalyptus, and 719,900 hectares is cork oak.

The leading companies for each industry are Corticeira Amorim, for the cork oak industry; Sonae Indústria [today Sonae-Arauco], for maritime pine; and Portucel Soporcel [today The Navigator Company] and Altri for eucalyptus (AIFF, 2014).

The forest cluster is divided into two main subjects: the forestry production industry and the forestry goods manufacturing industry. Both are related. The reason one exists is a consequence of the existence of the other and vice versa; that is why they form the cluster together. The first generates the forest raw materials, and the second uses those raw materials to manufacture finished goods. Therefore, when analysing the forest cluster is essential to use a larger perspective.

1.2 Definition of the research problem

The Monitor Company (1994) launched a report published by the name “Construir as Vantagens Competitivas de Portugal” (i.e., Building the Competitive Advantages of Portugal). The report, also known as Porter’s report, involved the work of almost a hundred Portuguese entrepreneurs,

managers, and engineers, coordinated by the Monitor Company, and directed by Michael Porter, a very renowned Harvard University professor.

The first step in Porter's report was conducting a competitiveness audit of the Portuguese companies, with the new paradigm: developing what was already unique in Portugal rather than imitating strategies from other countries (Monitor Company, 1994). The competitiveness audit contributes to identifying those clusters that could better build long-term competitiveness and recognise the challenges handled by the Portuguese economy (Gonçalves et al., 2015). Applying criteria of relative importance, representativeness of the problems, and potential for action initiatives to add value, eleven action initiatives were selected, of which six were clusters, and five were public policies. The selected clusters on Porter's report were the automotive, footwear, textiles, tourism, wine, and wood manufactured goods. The selected public policies were education, forest management, management capacity, science and technology, and financing (Monitor Company, 1994).

What drew our attention to Porter's report was the fact that it focuses on his study of the Portuguese competitiveness of the entire forestry cluster, as it analyses and proposes initiatives for action in its two components, the forestry goods manufacturing industry, and the forestry production industry. In addition, the report was based on the competitiveness seen from the Diamond model framework. This framework for analysing the clusters competitiveness advantages of nations was elaborated and described in Porter (1990a, 1990b).

The Diamond model is commonly used for cluster competitiveness analysis of nations. For instance, Ribes et al. (2011) have used this model to study the tourism cluster competitive advantage in Spain; Sterns and Spreen (2010) applied the Diamond model to evaluate the competitive advantage in the processed citrus in Sao Paulo (Brazil) and Florida (U.S.); Balc and Giray (2020) in the fruit sector for a region in Turkey; Serra et al. (2005) used this model to evaluate the competitive advantage in the Uruguayan and New Zealand Beef Industries; others examples of the agricultural and food sector studies with the use of Diamond model are described by Sterns and Spreen (2010) as flower industry in Deutschland (van Hermert, 2005, as cited in Sterns & Spreen, 2010), beef supply chain in South Africa (Olivier, 2004, as cited in Sterns & Spreen, 2010), food and fiber complex in South Africa (Esterhuizen et al., 2001, as cited in Sterns & Spreen, 2010), pork industry in Belgique (Gellynck, 2002, as cited in Sterns & Spreen, 2010), and the role of agro-food clusters in developing countries (Neven & Droge, 2001, as cited in Sterns & Spreen, 2010).

However, the forest cluster is not enough explored through this model globally. Even in Porter's report, when describing the attributes, or forces, of the Diamond model, they use a too general approach to the Portuguese economy. Giving some attributes examples taken randomly from several Portuguese clusters, and not so much a systematic Diamond forces description cluster by cluster, among which the one we are interested in exploring: the forest cluster.

In conclusion, no known study focuses exclusively on analysing the competitiveness of the Portuguese forest cluster using the Diamond model. Moreover, it seems scarce the study of the competitiveness of the Portuguese forest conducted comprehensively from the forest to the finish good, which is the gap that this research aims to fill.

1.3 Research question

The research question is: what are the constraints to gain more competitive advantages in the Portuguese forest cluster from the point of view of the Diamond model?

1.4 Research objective

Our main objective is to contribute to the knowledge of the competitive advantage analysis in the forest cluster in Portugal in order to elaborate suggestions to expand the forest cluster competitiveness in Portugal.

1.5 Structure of the dissertation

This dissertation is structured in five chapters. The first chapter is the introduction, and it starts with a contextualisation that gives a first approach to the forest cluster and its relevance, inviting the reader's curiosity. Then it goes to the definition of the research problem, the research question, the research objective, and, finally, the structure of the dissertation. The second chapter is the literature review giving a characterisation of the forest cluster and the principal concepts related to the Diamond model, not only by its author but with a review of how other clusters have been analysed through this model by other authors. The third chapter is the methodology of the research. The fourth chapter is the results and discussion, divided by each attribute of the conceptual model. We present the findings soon followed by a discussion about the recommendations, answering the research question and making suggestions for a competitive advantage enhancement as established in the research objective. The five and last chapter is the conclusion where we explain the main conclusions, implications, the research's limitations, and recommendations for future research.

2. Literature review

2.1 Characterizing the Portuguese forest cluster

There is a very detailed report on the characterization of the forest cluster made by AIFF (2014) concerning data from the year 2012. The information contained in this report is precious, and although it is ten years old, it does not seem negligible to us because changes in this sector occur slowly. That is why it was used in this research. AIFF used to be an organization for the dynamization of forest cluster competitiveness, representing the three main sub-clusters, the oak, maritime pine, and eucalyptus. Unfortunately, in 2019 this organization was extinguished.

Portugal has a gross value-added of 144.509 billion euros which 16.049 billion is regarding all the manufacturing industry. The forestry goods manufacturing industry has a gross value-added of 1.746 billion euros; therefore, it represents 1.2% of the national gross value-added and 10.9% of the manufacturing industry (AIFF, 2014). The forestry production industry is responsible for 0.747 billion euros gross value-added. If we sum all industries, the forest cluster has a gross value-added of 2.493 billion euros, representing 1.7% of the national gross value added. The forest cluster is responsible for 78,000 employees representing 2.2% of the working population in Portugal (AIFF, 2014).

The exports for the forest cluster are 4.094 billion euros, representing 9.0% of all goods exportation of Portugal. The imports are 1.755 billion, representing 3.2% of all goods importation. The trade balance is very beneficial for Portugal, with a positive balance of 2.339 billion euros. If we divide the forest cluster into three main sub-cluster, the balance trade contribution for each is 0.700 billion for the cork cluster, 0.484 billion for wood and furniture (the wood and furniture referred to is predominantly the maritime pine), 1.149 billion for pulp, paper, and paperboard (AIFF, 2014).

The positive trade balance already mentioned is supported only by the export of products from the forestry goods manufacturing industry, which is doing well. Regrettably, Portugal has a chronicle deficit on forest raw materials, besides having the possibility of expanding forestry production. Thus, since the forestry production industry cannot produce enough forest raw materials, they must be imported as described in the up-to-date data from INE (2021): the trade balance for the forest cluster in 2020 was 2.332 billion euros. For round logs importation (which include eucalyptus, maritime pine, and others) of 2.171 million tonnes against 0.225 million tonnes exportation, which is 170.545 million euros imports against 31.408 million euros exports. For the natural cork (raw material) importation of 45,580 tonnes against 5,383 tonnes exportation, which is 104.881 million euros imports against 10.966 million euros exports.

The leading companies for each industry are Corticeira Amorim, for the cork oak industry; Sonae Indústria [today Sonae-Arauco], for maritime pine; and Portucel Soporcel [today The Navigator Company] and Altri for eucalyptus (AIFF, 2014).

The forest cluster is the biggest responsible for renewable energies in Portugal, representing 60%, produced by the nine electrical cogeneration plants and eleven power plants that use forest biomass as input (AIFF, 2014).

Three species mainly represent the economic importance of the forest cluster for the Portugal economy: maritime pine, eucalyptus, and cork oak. Therefore, we intend to focus on these species in our research. Those are also the main species of the Portuguese forest cover. The last and updated ICNF (2019) National Forest Inventory, made with 2015 data, refers that those species represent 71% of the forest diversity in Portugal. The forest land in continental Portugal is 3,224,200 hectares, of which 713,300 hectares is maritime pine, 845,000 hectares is eucalyptus, and 719,900 hectares is cork oak. There is also 2,766,200 hectares of grasslands and bushlands not classified as forest.

Comparing with the previous National Forest Inventory, made with 1995 data, we can observe that the last inventory has a massive decrease of 27.1% on the maritime pine forest, a considerable rise of 17.8% of the eucalyptus forest, and a maintenance or minor decrease of 3.6% of cork oak forest (ICNF 2019).

It is estimated that Portugal's mainland has 10,882 million land properties, but the annual taxation of the land property is just about 8 million euros against 1,065 million euros of the urban properties' taxation. The Portuguese average area of each land property is 0.8 hectares, and it is even below in some regions in North and Central Portugal with 0.5 hectares on average. On the other hand, the average is 8.7 hectares per land property in the Alentejo region in the South (Beires, 2013). As we will describe further on in this study, there is a critical smallholding problem in Portugal. Finally, much of the land property has a tax exemption since the amount is so low that it is unviable to collect tax (Beires, 2013).

There is an estimate of 0.5 to 1 million hectares of land in Portugal with no owner or that the owner is not known. It represents 10% of all the land properties estimation (Beires, 2013).

The Central and North of Portugal roughly coincide with maritime pine and eucalyptus distribution area. Conversely, the Alentejo region in the South roughly coincides with the distribution area of the cork oak. Therefore, the smallholdings mentioned above affect the cork oak forest less than the eucalyptus and maritime pine forests.

Due to particular reasons (namely forests long run and the need for soils and biodiversity protection), public Forests Service make a major contribution to forest management in almost all developed countries. However, Portugal is an exception. Being the country with less public forest in the 28 European Union countries (Eurostat, 2016), as shown in the following figure, Portugal also has the peculiarity of not having a public Forest Service. In 1996 the government demolished the Forest Service structure. Subsequently, it was transformed into a forest authority with no operational function, more focused on national policies and bureaucracy (Castel-Branco, 2018).

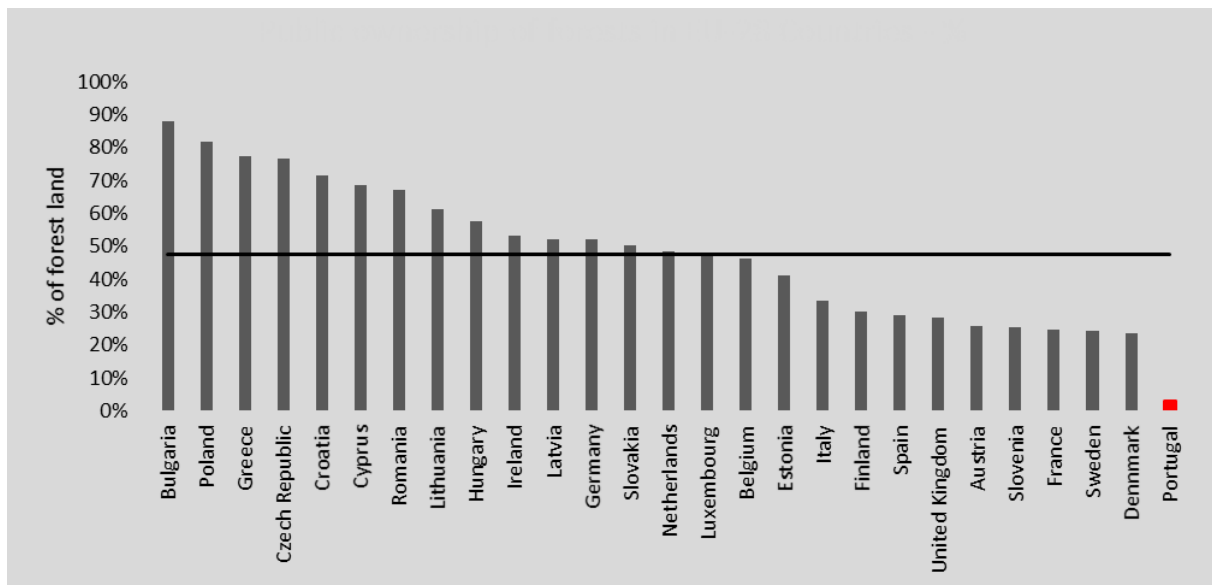


Figure 2.1 Public ownership of forests in EU-28 countries in 2010. Adapted from Eurostat (2016).

2.2 Diamond model

The Diamond model is a theory used to analyse nations' competitive advantage developed by Michael Porter. It is disruptive theory since there is a disparity from the classic economic theories, as Porter (1990a) refers, the predominant thinking defends that labour costs, interest rates, exchange rates, and economies of scale are the most effective elements of competitiveness of a nation, however competitiveness depends on the capability of its industry to innovate and improve. For Porter (1990a), the pressure and challenge make firms achieve an advantage in opposition to the world's greatest competitor. Strong domestic rivals' existence, strong home-based suppliers' existence, and demanding local customers' existence are beneficial for firms to achieve competitive advantage.

Some authors appointed a few wrong criteria judgements from Michael Porter (Grant, 1991; Davies & Ellis, 2000, as cited in Serra et al., 2005). Indeed, in Davis and Ellis (2000) we can find a very detailed critique of Porter's Diamond. For instance, they refute that to achieve sustained prosperity, a nation needs to be innovation-driven; they refute that internationally competitive industries must have strong Diamonds forces. Nevertheless, the Diamond model continues a broadly used concept framework for evaluating the resources and constraints affecting industry competitiveness (Serra et al., 2005).

Bhawsar and Chattopadhyay (2015) made a review article about the reflections and directions of the competitiveness studies. They compile a list of relevant studies on industry-level competitiveness. Among which is a study done using the Diamond model made by Sun et al. (2010, as cited in Bhawsar & Chattopadhyay, 2015) for the regional real estate industry competitiveness in two cities of China. In a long-range analysis from the competitiveness classical theories up to the present, Bhawsar and

Chattopadhyay (2015) give the credit to Michael Porter for encouraging a large-scale discussion on competitiveness.

For Porter (1990a), globalization does not diminish the nation's importance. It is even more important in the era of global competition. It is the very localized process that creates and sustain the competitive advantage. For him, the differences between nations contribute to competitiveness, and no nation could ever be competitive in all industries. Finally, nations that succeed in certain industries because their local environment are the most forward-looking, dynamic, and challenging.

Porter (1990a) emphasises innovation as the engine that leads to the competitive advantage, and he refers that firms around the world have reached the international forefront using very different strategies. Nevertheless, he states that the operation mode is quite similar, that is, they reach the competitive advantage through innovation. For Porter (1990a), once the competitive advantage is obtained, firms cannot relax since almost any innovation can be copied. Therefore, they need to upgrade the innovation indefinitely in order to maintain their competitiveness.

Lastly, Porter (1990a) materialise the four attributes of the nation that make up the Diamond of national advantage: factor conditions; demand conditions; related and supporting industries; firm strategy, structure, and rivalry. Each of these four determinants defines a point on the Diamond. Those forces of the Diamond are also self-reinforcing, and there is an interdependence since they constitute a system. The influence of one force often depends on the condition of others, and the weaknesses in any determinant will constrain the overall Diamond of the nation's advantage.

The following figure shows the Diamond framework as a complete system with the four determinants and the Government and Chance as the external influencers of the four determinants (Porter, 1990b).

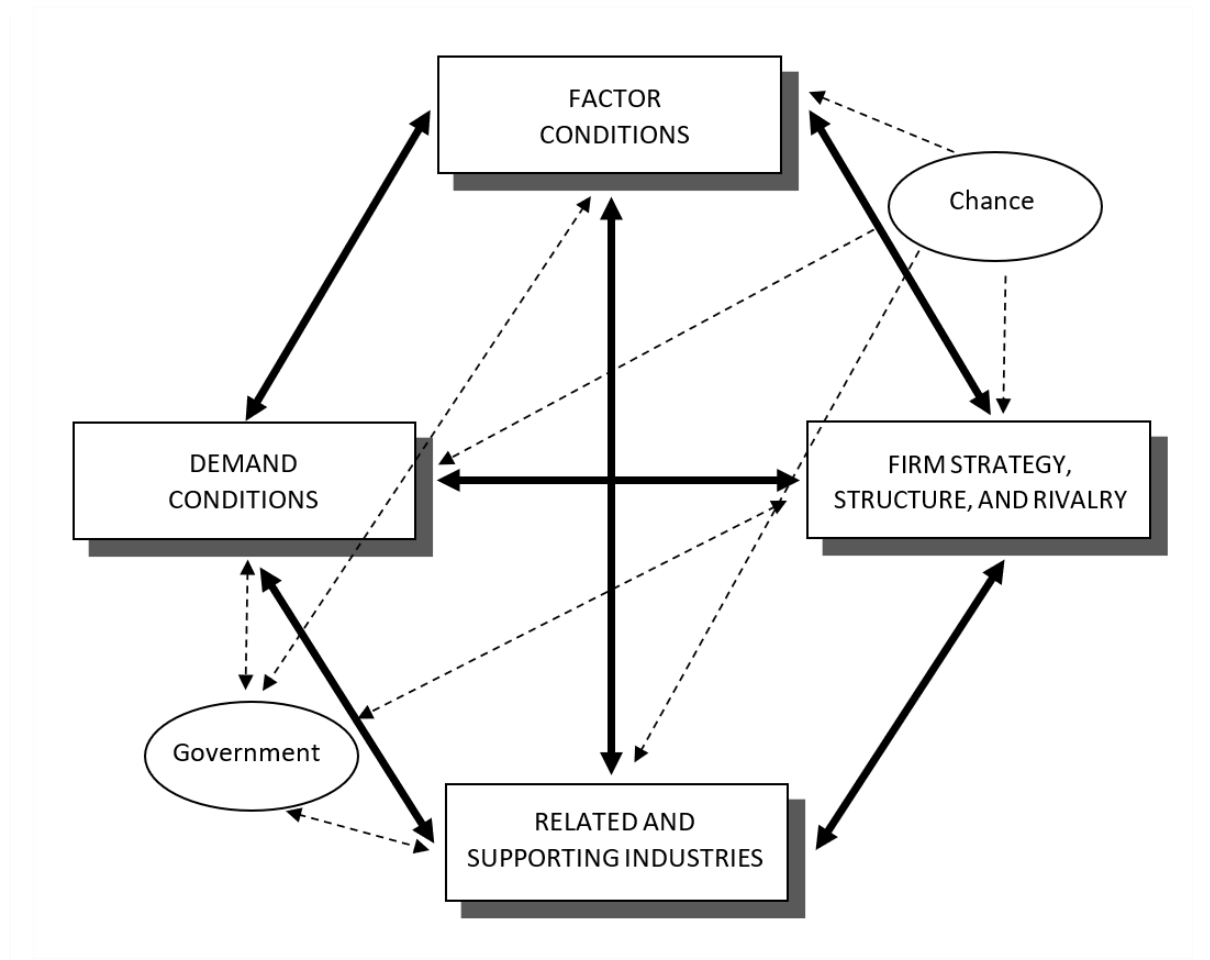


Figure 2.2 The Diamond framework. Adapted from Porter (1990b).

2.2.1 Factor Conditions

The factor conditions attribute is the nation’s status in factors of production, such as skilled labour, infrastructure, among others, which are required to compete in a particular industry (Porter, 1990a).

Porter (1990a) remembers that the standard economic theory affirms that the nation that is well endowed with basic production factors such as labour, natural resources, land, capital, and infrastructure will export the goods that make the most use of these factors, and there is a direct relationship between this endowment and the flow of trade. However, he refers that this is an incomplete version or even a wrong one. For Porter (1990a), when a nation is well endowed with basic factors such as raw materials or abundant labour, firms can lie on these advantages and often use them inefficiently.

For Porter (1990a), the advanced industries of developed countries create the most significant factors of production, such as scientific knowledge of skilled human resources. Factors that are very specialized to an industry's particular needs imply a continuous and substantial investment. To contradict even more the standard economic theory Porter (1990a) refers that some weaknesses in the more basic factors can stimulate a company to innovate and upgrade.

In a competitive analysis of the fruit sector through Diamond Model for a location in Turkey, Balç & Giray (2020) considered and made de analysis of the following factor conditions: technology availability; agricultural inputs availability; qualified labour force availability; non-qualified labour force availability; plants and seedlings varieties availability; road network quality for production and distribution; managers and engineers availability; education that answers the needs for a competitive economy; suitable climatic conditions for fruit production.

In an analysis of the tourism competitiveness of residential destinations on the Spanish coast, applying Diamond model, Ribes et al. (2011) chose the following basic factor conditions: the climate, the area of the tourist destination, the coastline of the destination, the beaches and the landscape. For the advanced factor conditions, they chose the level of residents with a high level of education, the tourism infrastructure and the quality of the transport systems and the accessibility, i.e., airport infrastructures, nautical infrastructure, number of beaches with the 'Q for Quality' certificate, and number of golf courses.

Sterns and Spreen (2010) applied the Diamond model to evaluate the competitive advantage in processed citrus in Sao Paulo (Brazil) and Florida (U.S.). For the basic factor conditions, they describe the abundance of appropriate land and favourable growing conditions. However, they describe threats confronting land availability. The sugarcane expansion in Sao Paulo and the increased demand for land for urban use in Florida diminish their competitive advantage. They refer that both industries created advanced factors conditions to sustain their competitive advantage in the marketplace, such as expertise in consumer-focused marketing of retail, value-added processed orange juice products, and expertise in exporting. Finally, for Florida, they refer that the U.S. land grant university system and its research stations and extension programs correspond to an advanced factor endowment that improves Florida's ability to reply to production calamities such as disease occurrences. Furthermore, the United States Department of Agriculture (USDA) has partnerships with the state-funded University of Florida for research on citrus tree production and pathology.

2.2.2 Demand Conditions

The demand conditions attribute relies upon the kind of domestic demand for the industry's product or service (Porter, 1990a).

Porter (1990a) described that the nations gain competitive advantage in industries where the domestic demand gives their firms a sharper or earlier image of emerging buyer desires. More important is the type of demand pressure, such as sophisticated, than the quantity of the demand.

Porter (1990a) again comments about the globalization demand that could diminish the importance of local demand. However, he is imperative to say that it is not the case. Since the domestic demand usually has a huge impact on the firm's awareness and their reply to buyer's needs.

In a competitive analysis of the fruit sector through Diamond model for a location in Turkey, Balç and Giray (2020) considered and made de analysis of the following demand conditions: level of regional or national demand; level of international demand; level of export opportunities; consumer level of influence to the development of new fruit varieties; level of quality demand by the consumer.

In an analysis of the tourism competitiveness of residential destinations on the Spanish coast, applying Diamond Model, Ribes et al. (2011) chose the following demand conditions: population of the tourist destination, market share in terms of the foreign tourism, market share in terms of the domestic tourism, average daily tourist spending.

Sterns and Spreen (2010) refers that the Florida industry as strong domestic demand. Since the 1950s, a state marketing order was created to support generic advertising that encouraged the consumption of orange juice in the United States. U.S consumers are willing to pay for high quality premium products such as not-from-concentrate orange juice.

2.2.3 Related and Supporting Industries

Related and supporting industries attribute is related to the existence of supplier industries and related internationally competitive industries (Porter, 1990a).

For Porter (1990a), internationally competitive domestic suppliers create advantages in downstream industries because they can provide the most cost-effective inputs efficiently in an early way, they have a communication greatly facilitated by proximity, with a continuous movement of information, and a constant exchange of ideas and innovation. The latter can allow the firms to influence their suppliers' innovations efforts, and since firms can be used as test sites for suppliers' research and development work, it will increase the speed at which it is possible to create an innovation.

In a competitive analysis of the fruit sector through Diamond Model for a location in Turkey, Balç & Giray (2020) considered and made de analysis of the following related and supporting industries: management consultants' availability; technology consultants' availability; marketing availability for region promotion; suppliers' quantity; level of firm's cooperation in promotion, transport, and R&D.

In an analysis of the tourism competitiveness of residential destinations on the Spanish coast, applying Diamond model, Ribes et al. (2011) had some difficulty in determining the related and supporting industries attribute due to the boundaries of what is considered as the tourism sector. They chose the financial services, retail and restaurant activities, the hotel industry, and the number of residences.

Sterns & Spreen (2010) refers that Florida and Sao Paulo industries have well developed clusters. Florida benefits from extensive networks of related firms and activities, such as input suppliers of fertilizer and agricultural chemicals, harvesting and transportation services, specialized containers for fruit and juice, tree nurseries for new trees, and irrigation and engineering firms for new grove development. Networks of growers and processors were linked through an array of institutional arrangements, such as grower organizations to process and market orange juice collectively, intra-firm vertical integration to lower transaction costs, multi-year delivery contracts to assure price and supply stability, and forward pricing measures for current year harvest to manage price risk efficiently. Sao Paulo was an extensive network of large-scale storage and orange juice transport firms. It has a fleet of aseptic transport ships, some with a capacity of over a million gallons of orange juice each. The orange juice industry built a modern, state-of-the-art port facility to serve those ships. However, Sao Paulo industry relies less on external suppliers and downstream industries because much of the supporting industry is within the main industry.

2.2.4 Firm strategy, structure, and rivalry

The last attribute of the Diamond model is the firm strategy, structure, and rivalry that describe how the firms are created, how they are organized and managed in the nation, and mostly the existence and level of local rivalry (Porter, 1990a).

Michael Porter indicates that there is no universally applicable management system. He is much more incisive about the firm rivalry, and he deepens more this issue than those about the firm strategy and structure. The presence of strong local rivals is a final and powerful incitement to the creation and perseverance of competitive advantage (Porter, 1990a). He also refers that domestic rivalry can be the most valuable between all the forces on the Diamond because of the powerfully encouraging effect it has on all the other forces.

Porter (1990a) is imperative about the global rivalry versus local rivalry. He says that it is often said that domestic competition is wasteful because it duplicates efforts unnecessarily, and that it is the enemy of economies of scale. Therefore, conventionally the solution found is to favour one or two domestic leaders to compete with foreign competitors, guaranteeing financial resources, with the full help of the government. However, most of the time, these leaders are not competitive. He says that

this is static efficiency, which has no comparison with the achievement of dynamic efficiency and improvements that domestic rivalry achieves so well. Rivalry generally drives firms to improve. Nevertheless, while rivalry with foreign companies is more analytical and distant, local rivalries become almost personal, in addition, of course, to economic rivalry. The more locally concentrated they are, the more the effect of domestic rivalry is magnified (Porter, 1990a).

In a competitive analysis of the fruit sector through the Diamond model for a location in Turkey, Balç and Giray (2020) considered and made de analysis of the following firm strategy, structure, and rivalry: level of firms investing in R&D and cooperation with local universities; level of innovation of local firms; the firms' capacity to use new technology; level of cooperation between firms.

In an analysis of the tourism competitiveness of residential destinations on the Spanish coast, applying the Diamond model, Ribes et al. (2011) chose the following firm strategy, structure, and rivalry conditions: percentage of superior category hotels (4 or 5-star), number of establishments with quality credentials. For rivalry the shopping facilities (number of residents per shop), and the provision of bars and restaurants (number of residents per bar and restaurant).

Sterns & Spreen (2010) states that Florida's and Sao Paulo's have a big difference in the orange juice industry structure and strategy observed by their vertical integration level. In Florida, citrus processors do not own orange groves. The exceptions are the farmers who collaborate on cooperatives or private joint ventures. A large portion of citrus production came from absentees' ownership. External investors also own and buy groves, but highly specialized custom caretaking companies make the grove care. These companies usually are orange farmers who expand their business to offer grove management services, so economies of scale can be realized even with a diffused ownership structure. In Sao Paulo, there is an industry development on scale economies and vertical integration. Usually, the groves ownership belongs to the industry or large farms from other owners with long-term contracts with the industry at a fixed price.

The mentioned type of partnership between the Sao Paulo industry and the land and grove owners results from the industry fostering program to expand their groves without owning the land.

2.2.5 Role of government and role of chance

The role of the government should not be the supporter of the industry, nor should be the advocacy of the free market to be left to do their job through the invisible hand. Both extreme roles are incorrect. The first will create the demand for more help, and the second is disregarding the role that the government has in creating the atmosphere that stimulates the companies (Porter, 1990a). The government's role in communicating and intensifying the forces of the Diamond is a strong one. By creating an environment in which enterprises can achieve competitive advantage as a replacement for

those that involve government directly (Porter, 1990a). The government can influence positively or negatively each of the four determinants of the national competitive advantage, but it is not a determinant itself. It is an influencer (Porter, 1990b).

The government can improve the education of human resources, increase, and improve supporting information, improve policies for access to capital, improve infrastructure, create a tax policy that creates investment incentives, challenge the industry by imposing demanding standards and regulations in public procurement (Monitor Company, 1994).

The role of chance is to create discontinuities that permit shifts in the competitive position. They can abolish the advantages of previously established companies and create conditions for other companies to succeed. The chance events are external occurrences not controlled by firms neither by the national government, such as wars, surges of the world, major technological discontinuities, revolutionary inventions, foreign governments' political decisions (Porter, 1990b).

3. Methodology

To study the forest cluster competitive advantages with consistency and objectivity, we need to adjust it with some theory. In our thesis, we are going to use the Diamond model framework to study the forest cluster competitiveness in Portugal.

We will use in our thesis the case study research methodology. According to Yin (2014), in a case study, there is the need for triangulation that arises from the ethical need to confirm the validity of the processes. It could be done by using multiple sources of data. In our case, it is particularly true given the scarce scientific work on forest cluster competitiveness.

To ensure the validity of the case study research, we will use statistical data; documental sources, some of them from grey literature such as newspapers; in-depth interviews; and empirical evidence from observation carried out by the author since the author is a forestry engineer with 25 years of national and international experience.

The interviews would be useful to give more credibility to the discussion and may eventually add some new ideas and points of view. We chose to interview experts in the forest cluster who are, or have been, in prominent positions. They were observers, leaders, professors who played a very active role in this environment. It is the only way to gather people capable of answering the questions asked. Still, due to the vastness of the theme, we chose not to ask the same questions to all the interviewees. It is also a way to avoid prolonging the interviews too much. Regardless, there would be no point in asking all the questions because, according to each specialist's profile, there are themes that are unknown to them. So, the questions must be chosen for each specialist profile. Thus, there is no formal questionnaire to be presented. Regardless, there were a set of conditions previously identified for the forest cluster, those that appear in the next chapter, table 4.1, and based on these topics, a semi-structured interview took place.

We will not identify the name of the interviewees due to data protection. However, we will describe each interviewee's profile to describe or give a clue of his expertise. Interviewee A is/was the president of the forest engineers' body in Portugal. He is/was also an entrepreneur in the forestry industry. Interviewee B is a leading expert in land use planning, especially in rural areas, he is/was a consultant to governments, and he is/was also a professor at a university. Interviewee C is/was the general director of the organization representing the eucalyptus pulp mills industry in Portugal.

4. Results and discussion

The identified conditions for the Diamond of forest cluster nation's advantage are related to what we found in the literature review. Those conditions can be observed in the following table.

Table 4.1 – the identified conditions for the Diamond attributes and the author base source

Diamond attributes	Identified condition	Author
Factor condition	Suitable land and climate	Balc & Giray (2020); Sterns & Spreen (2010)
Factor condition	Capital resources	Porter (1990a, 1990b); Monitor Company (1994)
Factor condition	Land availability	Sterns & Spreen (2010)
Factor condition	Infrastructures	Ribes et al. (2011); Balc & Giray (2020); Porter (1990a, 1990b); Monitor Company (1994)
Factor condition	Skilled labour	Balc & Giray (2020); Porter (1990a, 1990b); Monitor Company (1994)
Factor condition	Supporting information	Porter (1990b); Monitor Company (1994)
Factor condition	Knowledge resources	Balc & Giray (2020); Porter (1990a, 1990b); Sterns & Spreen (2010)
Demand conditions	Society's forestry awareness	Adapted from advertising in Sterns & Spreen (2010)
Demand conditions	Local demand for more sophisticated goods	Porter (1990a, 1990b)
Related and supporting industries	Forestry equipment	Porter 1990b); Sterns & Spreen (2010)
Related and supporting industries	Consultants	Balc & Giray (2020)
Related and supporting industries	Service providers	Sterns & Spreen (2010)
Related and supporting industries	Organizations	Similar to consultants and service providers
Related and supporting industries	Suppliers	Balc & Giray (2020); Sterns & Spreen (2010)
Related and supporting industries	Firefighters	Similar to service providers
Firm strategy, structure, and rivalry	Adapting the concept to the forest cluster	Porter (1990a, 1990b)

4.1 Factor conditions

Related to the above Diamond determinant, we describe the status for the identified conditions in the first part of this section.

The status for some of those conditions reveals a constrain in the competitive advantage of the forest cluster. Therefore, in the second part of the section, we suggest some actions that could be done to enhance the competitive advantage.

4.1.1 Identified conditions

Portugal is well endowed with suitable land and climate conditions for producing the three species on focus in this study. Both are basic factor conditions. The maritime pine is native of Portugal, and the species can find in that country, one of the most extensive distributions areas of the world. The cork oak is also native, and the biggest blot that can be found in the world is located in Portugal. Eucalyptus is an Australian species introduced in Portugal. From the three focused species, it is the only one that is not native. However, it found the perfect conditions to grow in Portugal, and today Portugal has the most extensive area in Europe for this species. From the data collected from ICNF (2019) Portugal has 713,300 ha of maritime pine, 845,000 ha of eucalyptus, and 719,900 ha of cork oak. The forest land in continental Portugal is 3,224,200 ha (ICNF 2019), so the three species referred, all together, represent 71% of the forest diversity in Portugal. Other species exist in Portugal. However, the three species referred are responsible for most of Portugal's forestry goods manufacturing industry. Interviewee B says that the eucalyptus species is largely spread in Portugal. However, there are many regions in Portugal where the eucalyptus potential is very low because it was introduced in adverse soil and climate conditions.

Today the climate in Portugal is getting different due to Climate Changes. One of the changes is related to less precipitation availability which can impact future forest growth. The other is the increased frequency and permanence of severe heat waves that dramatically increase the risk of forest fires. Interviewee A agreed with that scenario above, and he added that it is necessary to be more careful when choosing the site for implementing a new forestry project. Even sun exposures: where it used to be possible to afforest with a certain species, may no longer be suitable for afforestation today. Interviewee B agreed with the scenario, and he added that there are studies on eucalyptus in Portugal's central region that state that the growth will decrease 35% in a couple of decades.

The appropriate land and suitable climate conditions are competitive advantages of Portugal. However, the risks inherent to Climate Changes in the future must be taken into account.

Capital is a basic factor condition. The banks can finance the forestry manufacturing goods industry. Capital can also be obtained from non-reimbursable funds from the European Union to modernize their factories. On the other hand, the forestry production industry has more constraints in getting funds. Suppose we exclude some geographic areas like Alentejo. In that case, generally, the landowner is decapitalized, and if he has capital, usually this is due to another economic activity than the forestry. In that case, we will be afraid to invest his savings in afforestation that will take dozens of years to pay back, if it does not burn in the meantime. Interviewee A agreed with the general idea, and he added that since the eucalyptus is a fast-growing species until recently, it was used as an investment, but the new generations of forest producers increasingly consider it too risky in the face of wildfires. Interviewee B agrees with the decapitalization of the smallholding landowner. The landowner will hardly be able to get funds from the bank since banks see the forest investment as a risky investment. Interviewee A agreed with that scenario above, and he added that the banks do not even take the time to analyse the intended forestry investment. Interviewee B says that in Portugal is impossible to get funds from the bank for forestry, even because banks accept mortgages but not risk investments since there is a lack of venture capital funds.

The non-reimbursable funds from the European Union would support the afforestation financially. However, there are several other costs in the long run that may be left without any funding. Interviewee A agreed, and he pointed out that the criteria variation between each European community support framework makes an area previously eligible no longer eligible, which does not allow for the continuity of funding. Remember that the afforestation must be maintained to survive, and trees must be conducted to be able to give an income at the end of their cycle. We conclude that we have a problem in the capital factor condition that it restricts the advantage competitiveness of the forest production industry.

Land availability for purchase at a reasonable price level is a key factor condition. Though, it is challenging to find land to buy or rent in Portugal. Moreover, once some land is for sale, the price is too high for the forestry production's financial viability. The question of land availability is a critical issue in the forest cluster since access to the land is necessary for the expansion of productive forests, especially since forestry products are in short supply in the country. The abandonment of private land is common in Portugal, and it occurs essentially in smallholding areas. The abandonment is a phenomenon with terrible consequences for the availability of land that must be stopped. Bingre do Amaral (2018) refers that the access by lease or purchase of several hundred hectares, which are necessary for a viable forestry unit, is an almost insuperable obstacle in those regions of Portugal where the landscape shows the abandonment of land cultivation, particularly in the central region.

Interviewees A and B agreed with the land availability status. Interviewee A adds that there are no real state agencies focused on forest land, which could facilitate the process. The land market is very reactive in price increase to a major large-scale buying operation. It is possible to buy a smallholding occasionally, but there is a problem because the properties are not interconnected. He gives the lumberman example: they are used to buy smallholding properties at once with the forest at a reasonable price. Some have hundreds of hectares, but they are spread in a region, not a single unit as should be.

The road infrastructures are excellent and well distributed in Portugal, so there are perfect conditions to transport the timber and the cork from the forest to the factories to be transformed. Since the timber price per ton is low compared to other raw materials, road transport from the forest to the factories is limited to short distances, up to about 100 km. The train cargo infrastructure can help the forest industry to amplify those distances. Supposedly Portugal is reasonably endowed with rail infrastructure. Railway transportation is important in this industry since large loads can be transported over long distances at a lower cost than the road transportation. However, interviewee C says that the rail infrastructure is far from being optimized, and the amount of timber transported via railways is very low. The cargo rails stations in Portugal are not capable of loading and unloading much more than ten wagons. However, the locomotives are able to pull twenty and more wagons loaded with timber, so the railway transport is not optimized to the full capacity. The main railway used today for eucalyptus transportation in Portugal is the one that the wagons are loaded in Galicia, Spain, and they are unloaded in Louriçal, where there are two pulp mills nearby, one from The Navigator Company other from Altri. He says that today Portugal is using increasingly less the railway for cargo transportation. He refers that the Spanish eucalyptus pulp industry Ence is using a Portuguese railway to link Huelva in Spain to Pontevedra in Spain transporting in each journey 700 tons of 5 metres length eucalyptus round timber.

Ports infrastructures are essential as a factor condition to enable the importation of timber, and the exportation of finished goods. Portugal is well endowed with several ports in the Atlantic coast. The interviewee C says that the ports used for round timber importation are the Viana do Castelo Port, Leixões, Aveiro, and Setúbal. The ships that transport round timber are limited from 20 thousand to 25 thousand tonnes. The Aveiro port has limitations since it is not deep enough to some ship's vessel draft. To minimize costs in loading and unloading the ship the round timber must be 6 meters in length. However, almost all eucalyptus pulp mills are not adapted to use 6 meters round timber. They are adapted to use 2 meters up to 3 meters. Short length round timber must be conditioned in the ships with strapping, which increases the cost of the operation, then the transport cost as an all. He refers that when the wood is imported, for instance from Brazil, the timber arrives with 6-meter length. Once

unloaded from the ship, it must be cut in half to get the same length as the typical Portuguese harvesting size. He says that the harvesting sizes that are used in Portugal are out-of-date, and that the 6 meters size is better to reduce the costs of loading and unloading the ship, the wagon, and the truck. Finally, he refers that the Leixões port and Setúbal also have the infrastructures needed to unload wood chips. The ships transporting wood chips are limited to 40 thousand to 50 thousand tones.

The availability of skilled labour, as forest engineers and forest technicians, is a must-have factor condition to reach an advantage competition. There are three universities that give the academic degree of forest engineer: the “Universidade de Lisboa (UL)”, “Universidade de Trás-os-Montes e Alto Douro (UTAD)”, and “Escola Superior Agrária de Coimbra (ESAC)”.

The principal professional school for foresters' practical training is the “Centro de Operações e Técnicas Florestais (COTF)”, as agreed by interviewee A. This public school was founded in the 1980s with the support of the Norwegian government. This school is the only place in Portugal training foresters for the challenging job of forest harvesting. Nevertheless, other courses include forest inventory and prescribed burning and other fire techniques. It belongs to the “Instituto da Conservação da Natureza e Florestas (ICNF)”.

Until the nineties of the last century, there was also training and education of the “guardas florestais” (i.e., forest rangers) by the Forest Service under the Agriculture Department as referred by the interviewee A. They were trained in forestry and law enforcement. Especially the first-grade forest rangers were very technically skilled. Under the forest engineer administration, they were directly responsible for the afforestation, forest conduction, and tree selection for harvesting in Portugal's national forests and communal forests. After the Forest Service destruction in 1996, and later in 2006, with the extinction of the forest ranger's corps and the allocation from the agriculture to the ministry of interior, the forest rangers gave the place to a new type of police responsible exclusively for the law enforcement. Therefore, Portugal can no longer rely on their expertise in forestry.

The main professional occupation of forest engineers in Portugal is related to meeting the state bureaucracy's requirements. There are so many obligations and procedures that must be followed that Portugal is training and getting engineers more and more detached from operational forest management. Of course, there are exceptions. One of them is related to the prescribed fire operational techniques. Recently there was an increase in the operational and scientific knowledge in the fire ecosystem field. Interviewees A and B agrees. Interviewee A added that, unfortunately, the role of today's forest engineer is more and more to make and assemble paper, and that the profession is losing its glamour and interest. Indeed, he affirms that the forest engineer's operational functions are increasingly put on the back burner, on the other hand, the fire science and its operational side are

increasing. Interviewee B added that fire science absorbs too much of the forest engineers' work. As a result, the other engineers' functions have been neglected. Interviewee C has another approach to this issue. He feels that the level of computing has improved significantly and that this was also helped to remove forest engineers from the field to the office. However, this has taken away the profession's direct contact with the field, causing a loss of sensitivity which was significantly increased screw-ups. He believes that in the forestry profession and other open-air activities, there is an inevitable level of unpredictability. Therefore, when someone starts to rely excessively on office work, on computer resources, going less and less into the field, the risk of exogenous factors betraying him is very high.

We have the perception that the quality of the forest engineer courses has been declining through the years, which could be related to the lack of private and public forestry players dynamics, which are not promoting and stimulating the universities as they should. Interviewee A agreed with this sentence. Moreover, he says that there was a strong relationship between the former Forest Service and the university forestry education, and their disappearance has not been substituted by other strong forestry actors. Interviewee B have a different opinion. He believes that the universities have been making an effort mainly on investigation despite all the difficulties. However, he agrees that increasing the private and public players dynamic would benefit the universities.

It seems to us that even though there may be some problems at universities and schools, the biggest problem is downstream of the education system. We state that nations need to have active players in their forestry production industry to achieve and maintain an excellent level of skilled labour. It could be reached by a public Forest Service and/or by private large companies, with capital, which have an extensive area of biological assets through land ownership or leasing and their own teams. Through this public and/or private, professional environment, forestry engineers and technicians can put their knowledge into practice, receive lessons from their colleagues, learn from their mistakes, and constantly increase their level of professional development. Interviewee A agrees with the described interrelationship.

The absence of an operational Forest Service in Portugal, which has already been mentioned, means that the existent bureaucratic forest authority hardly could provide the private sector with skilled professionals as it should, as agreed by interviewee A. The same problem happens with private companies. Since, Portugal has few private companies that fit the above description. Excluding the eucalyptus industry, roughly all forest goods manufacturing industries do not own a forest.

In conclusion, it seems that Portugal does not have the right conditions to create excellent skilled labour in the forestry area despite so many graduated forest engineers.

Supporting information is all the information needed to technically and economical support the forestry production industry: the national network of weather stations, orthophotomaps, satellite

images, detailed maps with topographic contour lines, soil maps, climate maps, national forest inventory, statistics from the government statistical agencies, namely statistics on the evolution of forest raw material prices and statistics on the evolution of forest land prices, finally the land registry. Supporting information is part of the knowledge resources of a nation. We can argue that Portugal is reasonably provided with such type of supporting information except for the last three items. There are no reliable statistics for timber and land prices, which are imperative to make viability analyses of new forest investments and essential to a more transparent and informed transaction. The statistics for timber prices would also be valuable data to be used in long-term contracts for the forestry partnership contracts. Finally, the missing Portuguese land registry, which is a severe problem for the forest cluster. Beires (2013) states that it is impossible to find how many rural properties are or where each one is localised. He defends that the land registry is crucial to have free access to the limits of the rural property, speeding up and making all the public administration processes more economical, and giving equality to taxation.

Knowledge resources exist or are created in universities, government research institutes, and private research facilities. Applied research is crucial on forestry, namely tree breeding. Research and tree breeding on eucalyptus has a long tradition in Portugal. Today this species can count with high performance tested seedlings coming from clones and improved seeds, which grow much faster, and have improved trunk characteristics facilitating the harvesting, transport, and pulp mill efficiency. Both major pulp companies work on tree breeding. However, The Navigator Company took this issue even more seriously since they created a significant R&D institute called Raiz, where three universities are involved as partners (Instituto de investigação da Floresta e do Papel, n.d.).

The improvement research situation is worst for the maritime pine. Even growing less than eucalyptus, the growth of the maritime pine is compatible with a tree breeding project. In the sixties of the last century, an Australian tree breeding expert named D. H. Perry selected almost a hundred maritime pine in Leiria National Forest, western Portugal. Those trees were considered plus trees for growth rate, trunk shape, etc. It is the moment that starts the maritime pine tree breeding project in Australia, where the maritime pine was introduced, and simultaneously in Portugal. Today Portugal still has the same clonal orchard from the trees selected in the sixties by the Australian researcher. Portugal has excellent tested seeds from that first improvement generation orchard, but it could be better. In Australia, they went further than in Portugal, working on the subsequent generation, the second. In France, for instance, where the maritime pine is a valuable forest production species in the “Landes de Gascogne”, they are working on the fourth improvement generation. The refinement improves with each passing generation, achieving more significant growth than the previous

generation. Public organizations conducted the maritime pines tree breeding projects from Portugal, Australia, and France.

We do not know such work on tree breeding for the cork oak. Since it is a long-run generation species that enlarge the cycles for genetic improvement, it is not easy to design and materialize a tree breeding project unless they choose a different approach, for instance, the clonal methodology. Since there are no tested or qualified certified seeds for cork oak, Portugal must use selected certified seeds.

Interviewee A says that tree breeding is crucial for forestry and that there is research in genetic improvement only made by the eucalyptus industry. He remembers that Portugal never continued the great work on cork oak research that, the world's most prominent specialist in cork oak species, Vieira Natividade did, and it should. Interviewee C also says that genetic improvement is essential, and he added that it is sad to see that public forestry research institutions have done almost nothing regarding the improvement of maritime pine and cork oak. In the latter, he states that nothing, really nothing, has been done in 30 years.

4.1.2 Suggestions for competitive advantage enhancement

As we said above, the land availability for purchase and reasonable price level is a critical factor. It is a complex problem, and several reasons are contributing to it.

Except for the southern region where most of the cork oak forest is located, the Portuguese forest property is characterized by small, fragmented landholdings of 1 hectare and less. This situation is not exclusive to Portugal. This fragmentation of land often occurs in Europe, the old world, due to the division by successive inheritance. For example, in Brazil, in the new world, this phenomenon almost does not exist.

We believe that a landowner is an economic agent, and as such, he makes decisions based on economic rationality. It is therefore expected that a landowner will try to exploit his property for profit, and if he cannot or does not want to do so, it is expected that he will sell the property to whoever is interested in doing so. However, when the property is so small, so insignificant, a deviation from this economic rationality seems to occur. The owner of a 0.5 hectares smallholding knows that he will not produce forest because the activity would be economically unsustainable at that size, he will not try to sell because he knows that it is not easy to find a buyer, and he knows that there is a complex bureaucracy associated with the sale, especially since the registry is probably not up to date and there will be associated costs. He is left with the most comfortable option: doing nothing, that is, abandoning the property.

Several factors corroborate the fragmentation and abandonment of forest property. Bingre do Amaral (2018) mentions that the Portuguese law gives the legal right to the owner to give the property

the purpose he wants, namely abandonment. There have been attempts to stop the fragmentation of the property since 1929 with the definition of a minimum cultivation unit from which heirs could no longer fraction the property. However, the succession law allows the indivisible property to be fractioned indefinitely in the co-ownership regime, even allowing the sharing of an inheritance to remain indefinitely unresolved. That is, there is no time limit in the Portuguese law for which a vacant inheritance must be settled and registered in the name of the heirs. Bingre do Amaral (2018) then refers the tax law, which stipulates that a property in a state of abandonment may be tax exempt while a forest property in active production may be taxed more heavily.

Thus, with a succession law that allows the co-ownership regime, which allows the property to remain in the name of the deceased indefinitely without taking away the property rights of all his successors, with a tax regime that favours abandonment, with the legal right to leave the property abandoned, and adding the fact that the sale of a property with several owners legally requires a unanimous decision, it is understandable that abandonment is so common. It is understandable why land is paralyzed. According to Bingre do Amaral (2018), the current panorama is the extreme fragmentation of property, and future prospects are for this phenomenon to worsen.

The price of rural properties in Portugal is often too high for the extensive and relatively unprofitable exercise of forestry. One of the phenomena that benefit the increase of land prices is the real estate pressure in forest areas. Pardal (2002) refers that the current authorization of construction in rural spaces, instead of being confined to urban spaces, ends up marginalizing the agroforestry activity. In rural areas, there must be great limitations on construction, allowing only those constructions necessary for agroforestry activities, thus stimulating primary activity, and limiting the increase in land prices.

As long as municipal councils continue to authorize constructions in forest land, any landowner will have a potential expectation of selling his property at a higher price than the forest producer can afford. As the owner is not encouraged by taxation to produce or sell the property, it may be decades in standby for speculation with the consequences of promoting abandonment and land unavailability for those who want to invest and produce forest. Interviewee B absolutely agrees. However, he says that the situation was worse before because after the new land law of 2014 the trend for approving buildings on forest land decreased.

The forest management to be possible and economically viable must be done on a large scale. For instance, Bingre do Amaral (2018) refers that forest management should be done in individual units of several hundred or thousands of hectares.

The ideal is that each forest business should have at least 500 hectares; the more is better. Taking into account the Portuguese smallholdings, the forest management to be successful has to go through a grouping dynamic that is characterized by: a single managing entity with its own capital and financial

autonomy managed as a unique farm, with its own team, that can negotiate the forest products sales in conjunction, and hiring contractors in scale; managed without borders between small properties, with an integrated vision of forest roads, and a joint vision of the defence of the forest against wildfires and other factors such as pests and diseases. The management could be done through the creation of a society, for which each smallholding landowner would exchange his land and biological assets proportionally for shares in the society. It is not a new idea. In Monitor Company (1994) this type of approach is already advocated by the name of coordinated forestry management as one of the main proposals to improve forestry competitiveness. Interviewee A does not disagree with the idea as being ideal. However, he thinks it is a bit utopian. He says it is challenging to unite such a large area and that the goal has to be more modest, around a few dozen hectares. He thinks that the forest owner has little confidence in the stability of a process on this scale. He recalls that there have been similar situations 30 years ago during the first community support framework where, through the “Programa de Ação Florestal (PAF)” programme, he managed to bring together about 900 hectares in a grouped afforestation project, which he calls the Avigos APF, or Avigo forestry producers’ group. However, this group ceased to be eligible in the second community support framework, so it was no longer maintained, it was abandoned, and after six years, it burned down. An aggregation project needs stability and predictability, which has to be given by legal force and financial commitment. Interviewee B agrees that the forest management in the smallholdings landscape must be done thru landowners’ grouping.

In France, there is the “Groupements Forestiers (i.e., Forestry Groupings). It is a society of people where the society object is strictly limited to forestry activities. They are formed by owners of contiguous forests who want to stop the fragmentation of land ownership by the creation of a society of people who wish to own and manage a forest in common (Société forestière de Franche-Comté, 2006). The establishment of a Forestry Grouping is an initiative of the landowners, at least two, and it involves the loss of property rights by them. The members are only holders of shares in proportion to their respective contributions, and it is the Forestry Grouping that owns the land. The decision-making body is the general meeting. There are several types of Forestry Groupings. The Familiar type is the most widespread since it makes it possible to avoid the undivided ownership regime or the dismemberment of a property by the heirs. And others like the Forestry Groupings for Investment, the Forestry Groupings for Reforestation (Groupements Forestiers, 2016). We believe that the grouping dynamic that Portugal needs can be found in the Forestry Grouping of France.

“Zona de Intervenção Florestal (ZIF)” is the more similar to the Forestry Grouping described above that Portugal has. Nevertheless, the achievement is different. The ZIF is a continuous and delimited territorial area, consisting mostly of forest, subject to a single forest management plan and managed by an organization (ICNF, n.d.). There has been a significant adherence. Therefore, the numbers are

impressive. In 2021 there was 263 ZIF (ICNF, 2021), representing a continuous area of 1,856,382 hectares and a forest area of 992,536 hectares (ICNF, 2022). The main reason for such landowner adherence is that being a member of the ZIF makes it easier to get non-refundable grants from the state for forestry. On the other hand, landowners lose nothing by being part of the ZIF: they do not need to pay a membership, and the property continues to be theirs without no obligation of management delegation. This model has several problems. Since each of the small properties that constitute the ZIF is still owned by the same landowner. Each of them will want to maximize the revenue and, therefore, the forest production on it. It is normal. The problem is that it is incompatible with the high risk of wildfires in Portugal. In Portugal, forest production areas must be interspersed in mosaic with other functions such as grazing and agriculture. There also must be a gap in vegetation made on strips between each stand, such as firebreaks, which have no productive potential but are essential for common protection. Interviewee A defended that a smallholding landowner will hardly accept that half of his land could be sacrificed for firebreaks or grazing for free and there are no funds to pay for it. Thus, this individualist model cannot deal well with the wildfire problem. There are more issues like the fact that the organization supposed to manage the ZIF does not have financial and decision-making autonomy. Therefore, this model should be studied further in order to try to improve it.

Recently, new legislation has been introduced since 2020 to create a new type of coordinated forest management called "Áreas Integradas de Gestão da Paisagem (AIGP)". According to AIGP (n.d.) this type of large grouping aims to commonly manage and exploit agroforestry spaces in areas with smallholdings and high fire risk. Municipal councils or associations of forest producers, among others, can propose an AIGP. There will be a single forest management plan for the entire area. The landowners are obliged to do what is in the plan on their property, or they must delegate the operation to the management entity to do it for them. If they refuse, there will be a forced lease of the property. The cadastre will be one of the first steps to be taken in the AIGP. Once done, all the land within the boundaries of an AIGP that has no owner or the owner is unknown will pass into the possession of the state that may cede or lease it (AIGP, n.d.). According to Jorge (2021) there are currently 47 AIGP formed representing almost 100,000 hectares and an estimated 170,000 smallholding properties that will be involved. The goal is to reach 60 AIGP. To accomplish this, the state will make available non-reimbursable funds from the European Union in the amount of 270 million euros.

Those AIGP are not yet operational; the first studies are still being carried out. It seems to us that the legislation on the subject has been too fruitful. It is not simple and uses too many concepts and jargon that could be avoided. It is still too early to analyse the results of this new government policy. Interviewee A is confident in the positive results of this new type of landowners grouping. Interviewee B says they are a new solution to the problem; however, it will create an additional complexity for land

use planning and forestry policy, not least since it is not articulated with other previous planning and policies concepts. He thinks that the solution found is a big mess and believes it will become inoperative when it comes time to act. Besides, the financing model through European Union funds is not enough, there will be a lack of money, and in the end, it will burden the state with expenses in private areas.

The only industry that gave a solution for the lack of capital of the landowners was the eucalyptus industry. The eucalyptus industry has a strategic forestry partnership that allows the landowners to transfer to the eucalyptus industry part of the capital required for an investment. Although the other two industries (maritime pine and cork oak) should pursue similar partnership strategies, other ways must be found to attract other investors, the capital, to forestry investment and teaming up with landowners. For us, the most inspiring example of bringing capital to the forest was achieved in Brazil. Through the policy “incentivos fiscais ao reflorestamento e florestamento” (i.e., tax incentives for reforestation and afforestation), Brazil has gone from an extractive forestry activity to one of the world's leading countries of forestry production industry through planted forests. ABRAF (2013) report refers 6.6 million hectares of planted eucalyptus and pine forests in Brazil for 2012.

Antonangelo and Bacha (1998) refer to the Brazilian forestry first phase begins in the discovery of Brazil in 1500 until 1965: It consisted of an extractive activity in which plantations were practically non-existent. In that phase, pioneer efforts in introducing homogeneous plantations of eucalyptus and pine trees were essentially for scientific or ornamental purposes, like species and varietal research on eucalyptus and some afforestation by the Paulista Railway Company. The Forestry Service of Sao Paulo, and the Forestry Research Institute of the University of Sao Paulo, researched pine species, varieties, and different provenances of seeds. In the sixties were founded the first forestry schools.

The second phase begins in 1965 with the creation of the federal tax incentives for reforestation and afforestation, which have lasted until 1988. During the tax incentives programme there was a great expansion of the forested area in Brazil, from almost 0.5 million hectares in 1964 to 5.9 million hectares in 1984 (Antonangelo & Bacha, 1998). However, it is important to note that such expansion was not only due to the tax incentives programme. Other elements encouraged forestation as the demand created by the national paper and pulp programme, the charcoal steel programme, and the energy substitution programme, among others (Antonangelo & Bacha, 1998).

We want to underline that there was almost no forestry goods manufacturing industry before the tax incentives programme. It was these massive plantations that increased the supply of wood and attracted investors to create a complex industry. For example, the author worked in Brazil for a multinational company that entered the Brazilian market precisely because of the enormous supply of

pine trees, which allowed the company to make resin tapping on a large scale and create a chemical industry to transform the natural resin into other finished goods.

The tax incentives for reforestation and afforestation consisted of the possibility that an individual or a company could deduct from their taxable income [in Portugal it would be the IRS and IRC respectively], the amounts that would be destined to afforestation projects. These projects could be done on the individual's or the company's property, or they could be shared projects done on third-party property from which the individual or the company received the respective title of participation, called certificate of participation in afforestation (Antonangelo & Bacha 1998).

The author had the experience to work several years in a 5,000 hectares pine forest “fazenda” in Brazil that was a third-party company property as mentioned above. The third-party company mentioned bought the land. Endowed with some know-how, it conducts the pine afforestation and finally makes business selling certificates of participation in afforestation to other companies seeking to invest in afforestation to deduct their taxes. Those companies who wanted to deduct their taxes belonged to industries unrelated to the forestry industry, such as tire companies, ink companies, and others. Later these multiple forest stands, of 30 and 40 hectares each, were bought by a forestry goods manufacturing industry, which successfully formed a unit of 5,000 hectares. Today some of these plots are still known by the name of the former title company.

We believe Portugal must bring the capital to forestry. We believe that the successful Brazilian case must be explored and adapted to Portugal’s reality. For instance, due to the wildfire risk in Portugal the forest must be well protected and conducted much further than the early years on afforestation and consolidation as it has in Brazil, most likely to an entire forestry cycle. In Brazil, it was elementary to buy properties with several thousand hectares for afforestation. In Portugal, there are not so much large properties. Therefore, the objective must be more ambitious in Portugal than in Brazil. We must take advantage of a tax incentive opportunity to promote the land reparcelling. Thus, the necessary condition to be granted the tax incentives had to be related to the success of the land consolidation. Only the “Agrupamento Florestal” (i.e., Forestry Grouping) with a continuous land area above fifty hectares and above ten smallholding properties would be accepted. The larger the grouped area, and the greater the number of smallholdings properties grouped, the greater the tax incentive would be.

We believe that successful companies in the energy industry, like Galp, REN, EDP, communication companies like NOS, MEO, Vodafone, among others, could be attracted by forest investment certificates to lower their income taxes while at the same time are promoting their CSR sustainability policy by participating in the environmental restoration and by compensating their carbon emissions. It could be an opportunity for the forestry producer’s organizations that are spread all over the country to act as the third-party companies referred above. It could also be an opportunity to promote the

forest in possession of the forestry goods manufacturing industry, especially the maritime pine and cork oak industries, since the eucalyptus industry has already followed the verticalization strategy. Finally, to be a success, there are some must have conditions like the possibility to create a Forestry Grouping, since it is not yet legislated in Portugal, and change all other measures described in this study that unleash the constraints of land availability.

To improve the skilled labour in forestry we believe that Portugal needs to create the conditions that will attract the most skilled workers that still exist today. It could be done by creating new forestry businesses that will make an active forest management with appropriate scale through attracting capital to the forest, whether for business reasons, the voluntary carbon market, or the sustainability marketing that the companies' CSR wants to advertise.

A different approach for achieving and maintaining an excellent level of skilled labour is through the public sector, namely through a good forest service and a relevant area of public forest that they operationally control. This labour force could then migrate to the private sector and universities, feeding excellent professionals and experienced teachers.

The lack of a land registry supporting information is crucial to the forestry production industry for the following reasons: 1) to promote land re-parcelling policies, for instance instituting the preferential right of purchase, i.e., prior to the sale of a property, all neighbouring should be informed to exercise their preferential right of purchase; 2) to facilitate contacts for business relationships, to be made by the timber buyer, land buyer, manufactories looking for forestry partnerships, organizations aiming the agglomeration of landowners; 3) to identify landowners who have the land abandoned. Given the high risk of wildfires propagation that this entails, these identified landowners may thus be subject to fines, or simply to a significant increase in taxes; 4) to promote a tax policy that is in line with the activity performed on the property; 5) to identify the lands without owner, or of unknown owner, that will then be integrated into the state's public lands and made available for the public or private forestry production industry, instead of promoting the risk of spreading wildfires.

To promote land re-parcelling, France already has the “Sociétés d'aménagement foncier et d'établissement rural (Safer)” that could decide if a property could be sold to another when there is already a farmer nearby that wants to expand his farm business. Today France, go further. The seller must inform that he wants to sell his property to all neighbouring landowners and give them the preferential purchase right.

The cost of making the land registry in Portugal was estimated to be 690 million euros (Beires, 2013). This investment has always been postponed. However, in 2019 the simplified land registry began. This is a new approach in which it is the owner himself who declares the boundaries of his

property, online or at the service offices made for this purpose. The process will be more economical less precise but will have the advantage of speeding up the knowledge of property boundaries in Portugal. There are no concrete results from this policy yet, but we expect it to be operational soon and available to stakeholders while surveys continue and that the crucial policies examples given above could be put into practice.

We emphasise tree breeding within the knowledge resources. Improved seeds and clones obtained by a tree breeding programme are essential to make the forest business attractive to investors, so it is a must-have condition for a competitive advantage in the forest cluster. The trees growth rate could be 40% and more compared to the wild varieties. The same happens in agriculture. Imagine if we still were using the wild corn seeds or the wild wheat seeds? For sure, we will be starving!

Portuguese forest producers and forest engineers do not take much importance on the region of provenance for the selected cork oak, neither seek nor ask the nurseries for the tested maritime pine tree origin described before. In Brazil, for instance, when a producer wants to make afforestation with pine trees, he will seek the best improved seedlings, and he is willing to pay more for each seedling if he knows that the growing rate will be higher.

We believe that the forest engineers' awareness about the genetic quality of the seedling must be improved in the universities, and this course must be compulsory. Finally, we advocate that the research state institutions must continue the maritime pine tree breeding programme and that the supply of seeds with superior genetic quality must be advertised.

4.2 Demand conditions

Related to the above Diamond determinant, we describe the status for the identified conditions in the first part of this section.

The status for some of those conditions reveals a constrain in the competitive advantage of the forest cluster. Therefore, in the second part of the section, we suggest some actions that could be done to enhance the competitive advantage.

4.2.1 Identified conditions

This attribute is one of the most difficult for finding accurate conditions. There are enough local pulp mills that produce pulp, office paper, and tissue paper from the eucalyptus timber. Many local factories use natural cork to produce cork stoppers and other cork applications, for instance, in the construction sector. There are numerous local saw-mills, local wood pallets factories, local furniture factories and local energy pellets factories that use maritime pine timber, and several local factories that use pine

resin. Indeed, there is always a demand for forest raw materials products. The demand for raw materials by the forestry goods manufacturing industry is always higher than the available local supply for all three species. As we disclosed in the literature review, Portugal has a chronic deficit and needs to import them. However, if we change the perspective to focus on the forestry finished goods, we do not see the Portuguese consumer as a particular and exigent buyer for almost all goods.

Since there is an unsophisticated local demand for most forestry finish goods produced in Portugal, following Michel Porter's Diamond theory, the demand would not interact with the forest cluster and would not give the right signs for innovation. Furthermore, most of the finished goods referred are mainly exported. Here, the criticisms of the Diamond model made by Davis and Ellis (2000) occur in the described situation. For example, the printing paper produced by The Navigator Company is internationally competitive, although they do not have sophisticated local demand.

We believe that the only domestic exception to more sophisticated and demanding buyers for finished goods can be found in the cork sector. Cork stoppers always had local demand since Portugal has a strong wine tradition. Portuguese are familiar with cork, so innovations for architecture and construction, for instance, could have been used locally then, tested, and optimized before starting the exportation, as argued by Michael Porter's Diamond theory.

We believe that society's forest awareness can fit into the demand conditions, even because an advertising component could change that awareness, and the advertising is related to demand improvement. The society's forest awareness is how the Portuguese public absorbs information from the forest cluster and the signals it gives to the public agents. In this aspect, it seems to us that the issue of forests for the average citizen boils down to the eucalyptus, the villains, and the native forests like the oaks, the good guys. Although the eucalyptus industry is not exempt from criticism, for society, the eucalyptus is solely responsible for the wildfires and the loss of biodiversity in the country; the lack of native forest and its culprit: the mean and even unintelligent landowner who does not want to plant them. Finally, these issues are discussed in the summers, with much conviction by those who don't understand it, to be soon forgotten with the entry of autumn.

We believe that the forestry sector does not receive from society the correct stimuli to progress, both from the point of view of forestry production and the development of biodiversity. Something must be done to reverse this too simplistic and somewhat black-and-white vision. In Monitor Company (1994), one of the main proposal actions to improve forestry competitiveness was to advocate the importance of raising society's awareness of forestry problems to create a more balanced public opinion and give more political importance to the problems of forest management. Interviewee A agreed, and he added that forestry is based on the binomial: production with conservation and conservation with production. He claims that Portugal society has discarded the forest production

importance, breaking the binomial balance. Interviewee C also agrees that the forest cluster does not receive the correct stimuli to progress from society. He adds that eucalyptus is related to a successful system in which the pulp mills and the owners make a profit. Portuguese society does not seem to like businesses that make a profit. Besides, if in 1975 there were only 250 thousand hectares of eucalyptus, today there are almost 900 thousand hectares. There has been a vast expansion, a radical change in the landscape, and people are understandably frightened.

4.2.2 Suggestions for competitive advantage enhancement

Our suggestions fall mainly on the maritime pine industry since the downstream market for eucalyptus is well consolidated as an export market, and the local demand for cork manufactured goods is already assured. Maritime pine wood timber is currently poorly valued since most of its use is for chipping particles or for pallets, which, although a sawmill product, has a low added value. We need to reverse this trend increasing the sophisticated demand towards maritime pine products with higher added value, which require larger diameter logs, such as sawmilling and veneering, to be reflected on the sustainability of the supply chain, namely upstream: the forestry producer. Interviewee A defends this strategy. However, interviewee C has a different opinion. He argues that we have seen factories closing because of raw material lack. For example, a Sonae sawmill in Nelas was closed due to lack of supply. Some recently opened pellet factories have already closed due to a lack of raw material. Unfortunately, the current situation is awful since the old forest cycle was broken. Therefore, he believes that first and foremost, we must create the forest, for example, as the Brazilians did with the tax incentives programme, which will create a substantial supply of raw material. Portugal should invest in factories and new processes for value-added goods only after this forest is already growing.

As Cheng et al. (2018) refer, a significant driver towards environmentally friendly procurement is public procurement through the substantial value of public purchases. It is an increasingly used instrument that could change unsustainable consumption. Porter (1990a) cites measures to increase Diamond forces made by the Japanese government, such as promoting early demand for advanced products and creating prizes for quality. Monitor Company (1994) states that public procurement can be used to strengthen the competitive advantage, and this is the more direct way a government can affect the demand conditions. Porter (1990b) refers that governments are major buyers, so they can play a role to help the nation's industry.

Public procurement has a role to play that has not yet been implemented. Especially in the building sector, new public architectural designs must contain solid maritime pine wood in the floors, wall cladding, ceilings, stairs, and furniture. Even the wooden structure of buildings should be favoured, not least because it is now possible to replace the concrete structure with the wooden structure in

very tall buildings, such as the 85.4 meters, 18 floors in Mjøsa Tower in Norway or 84 meters, 24 floors in HoHo, Austria (McLaren, 2019). Demanding standards for the various pine woods should be revised or launched by the public authorities, and the organizations of the sector should promote marketing to architects and create architectural competitions for wood construction. Portuguese can base their approach on the good French institutions, such as FCBA, designed to promote wood construction. A detail, when we refer to solid maritime pine wood, we include wooden board, cross-laminated timber (CLT), laminated veneer lumber (LVL), glue-laminated timber (glulam), among others. Against the wooden product manufactured from wood chips like particleboard (PB), medium-density fibreboard (MDF), or oriented strand board (OSB).

This policy would promote sawmills. Therefore, it will indirectly promote wooden boards like PB and MDF, since the sawmill produces sawdust, a raw material for those wooden boards.

For private consumers, some punctual measures could also be taken to promote the demand for maritime pine more advanced products, such as discriminating the taxes positively for solid wood or giving small allowances to those consumers through the Portuguese environmental fund. This could be done punctually articulated with advertising.

Since there is a structural deficit of maritime pine wood in Portugal, which in 2018 was estimated to be 57% of industrial consumption (Centro Pinus, 2020). As such, applying these measures will not only influence domestic maritime pine forest producers. As alleged by interviewee A, maritime pine producers from Spain and France will also benefit. However, as interviewee A alleged, these measures could be necessary to increase the national demand for advanced products and provide signals to investors to promote the afforestation and the management of maritime pine in Portugal. So that in the future, the local supply of maritime pine may increase.

About the society's forest awareness, we believe that pressure from society is focused on the wrong actors, the private ones, when it is primarily the state, and not the privates, which has the responsibility and onus of driving public goods, such as conservation forests composed only by native species, for the good of all. Interviewee A claims the same idea, and he says that society is completely confused; it does not understand the roles of the state and the private sector in forestry. Interviewee B agrees that it is the state's responsibility to manage public goods. However, since the public forest land in Portugal is scarce, it is not easy to execute it in the short term. Even if the state assumes more responsibilities from now on, the government must ask the privates to give their contribution. Nevertheless, in this case, the government have some obligation to support them financially. So, this topic is controversial.

We defend that private forestry must always be driven by profit, although there must be some minimum rules for conservation and more biodiverse forests creation. On the other hand, we

advocated for vigorous public forestry by creating a modern, capable, and operational Forestry Service that would manage public lands with native species, where conservation and recreation would be the primary management objectives. The expansion of public lands would be done by purchasing, applying the “Regime Florestal” (i.e., Forestry Regime), and possessing abandoned lands with no known owner.

There is a lack of forest cluster public relations activities. It seems advisable that private forestry join efforts to affirm itself as necessary to the country's economy, such as producing exportable goods, creating jobs, and respecting biodiversity. Especially the eucalyptus industry. While in Brazil, the eucalyptus industry is very proud of its results, showing in its advertisements beautiful eucalyptus forests, the Portuguese eucalyptus industry is more embarrassed than the Brazilian. In Portugal, the eucalyptus industry shows in their advertisements almost no pictures of their forests, but pictures of the bucolic forest, like cork oak forests and riparian gallery forests. Interviewee A agrees with the Portuguese panorama and says that the pulp industry should be proud of its achievements and must pass this image on to society. For interviewee C, this is evident. He says that it is ridiculous for an industry that depends exclusively on eucalyptus to have an external communication in which they show images of spruce trees and cork oaks.

4.3 Related and supporting industries

Related to the above Diamond determinant, we describe the status for the identified conditions in the first part of this section.

The status for some of those conditions reveals a constrain in the competitive advantage of the forest cluster. Therefore, in the second part of the section, we suggest some actions that could be done to enhance the competitive advantage.

4.3.1 Identified conditions

Forestry needs specialized equipment. Timber harvesting needs manual chainsaws and harvesters to cut trees. Like skidders and forwarders, vehicles used to carry logs from the forest to a roadside, like articulated trucks and trailers used to transport logs to the factory. Forestry also needs unique equipment such as trimmers for weed competition control, tractors, and implements for soil preparation. Forest inventory needs callipers, rangefinders, hypsometers, clinometers, dendrometers, GPSs, and topographic instruments. Items described are imported since Portugal do not produce them. The only exception is the implements for soil preparation, not much.

Some other countries with a great forestry tradition seem to have better supporting industries than Portugal. For instance, the Sweden company Haglof developed callipers, rangefinders, and hypsometers. The Husqvarna Swedish company and the German company Stihl developed chainsaws

and trimmers. In Finland Ponsse company and in the USA the Timberjack (John Deere) developed big machineries like harvesters, skidders, and forwarders. In Monitor Company (1994), there is a comparison between the forest cluster in Sweden versus Portugal that reveals the great contrast in the variety of related and supported industries. They affirm that the forest cluster is much deeper in Sweden than in Portugal, with more related industries that are internationally competitive.

The interactions between the support industries can solve common problems and bring innovation that is spread to the entire cluster. On the other hand, Portugal has a fragile and less deep cluster, with companies needing extra effort because they do not have the proper local support (Monitor Company 1994).

Forestry consultants' firms that support the forest producers are common in Portugal. We stress that Portugal's public administration are very demanding in reports, plans, and documents, before giving a favourable acceptance of a project or forest operation. The bureaucracy is even worst in the case of eucalyptus afforestation. Since it is not a native species, public administration has a negative approach. In general, those firms produce excellent reports, with a good cartography quality made with GIS software (Geographic Information System) that also reports the never-ending complexity of the legal framework from the different public administrations. The regulations from the municipality, environment ministry, forest authority, and interior ministry (for wildfire prevention) are fully described and mapped. Frequently, those reports leave not much room for the development or description of new techniques or room for adding a new scientific method. The public administration could reject this type of report because of its originality and audacity.

On the other hand, only a few forestry consultant firms specialising in forestry economy, working with the value of the biologic assets, or making the financial viability analysis of a new forest investment. It reveals that the forestry production industry in Portugal is not seen as an agribusiness, so there is no need for such consultancy. Besides some exceptions in the eucalyptus industry, the forest investor in Portugal is an individual with little capital and the business approach is not fulfilled on many occasions. In Brazil, for instance, there are more forestry consultant firms specialized in forestry economy. In contrast, Brazil's private forest management reason is agribusiness, made by national and multinational forestry industry companies, who often have land ownership.

Service providers, as forest contractors, are common in Portugal. For afforestation, forestry or harvesting. These providers typically are small enterprises not very specialised. In Brazil, for instance, the service providers are generally medium enterprises, more stable, organized, and highly efficient. The main reason is that they are partners, i.e., there is a third-party relationship where the main

company monitor and support the performance growth, based on a medium-term contract with the third-party.

We believe there is a lack in Portugal about very specialised service providers since there is no demand for such services. For instance, it is easy to find specialized services providers to collect fruits from selected trees in the forest or orchards in Brazil. Then they prepare the fruits, remove the seeds, and supply the seeds in perfect conditions to be sown in the nursery. We can also get sophisticated services in Brazil from providers specialized in genetic improvement (tree breeding) like cross-pollination, micro-propagation, and DNA verification.

Organization of forestry producers, also named forest non-profit organizations, are very common and well distributed in the country. One of the main objectives of one organization of forestry producers is to defend and promote the interests of the forest owners in their region. It also aims to provide forestry services to its members, including consulting, public funding, and support in the sale of forest products. This type of organisation is relevant because they somehow represent the private forest in their region and are well placed to be a discussion partner for government policies. There are more than a hundred organizations of forestry producers. The Forestis organization represents the organizations of forestry producers in Portugal. Thirty-three organizations of forestry producers are members of Forestis (Forestis, n.d.).

The forest production needs suppliers such as nurseries to provide forest seedlings to the afforestation, fertilizers to be used mainly in the eucalyptus forestry, herbicides to control the weeds, traps, biopesticides and pesticides to control pests, among many others. There is no lack of these basic supplies in Portugal that could be imported or produced locally. The most vital to be supplied locally is the forest seedlings since they must be adapted to the local conditions of soil and climate. Portugal has several private nurseries that produce several million plants per year. The principal nurseries belong to the pulp industry, like Viveiro do Furadouro from Altri (Altri Florestal, n.d.); Viveiros de Espirra, Viveiro de Caniceira, and Viveiro de Ferreiras from The Navigator Company (Viveiros, n.d.). These nurseries are focused mainly on eucalyptus plants production, but they also supply other forest plants, namely the maritime pine and the cork oak. Some other big private nurseries are not related to the pulp industry, such as the Viveiros de Santo Isidro. A crucial issue in producing quality seedlings in the nursery is achieved by using improved seeds or clones obtained by genetic improvement research or tree breeding.

Firefighters are essential to diminish and contain the wildfires, mainly in Portugal, where the wildfire risk is very high. However, the Portuguese firefighter's national agency is not professional and

not well trained for the task. Very recently, there was some progress, but it is still too soon to measure the results.

Some private pulp companies like Altri and Navigator made a joint venture called Afocelca, where well trained firefighters effectively restrict the wildfire risk in their eucalyptus forests. However, the wildfires often begin from outside and are spread freely and with no control, so when it reaches their eucalyptus forests, the fire intensity is so strong and large that it becomes impossible to extinguish. In those situations, nothing more than mitigating the damage could be done.

We believe that the quality of firefighter's agency is essential. However, we understand that the combat approach is limited. The wildfire risk is related to the Portuguese Mediterranean climate that leads to great vegetive growth in the Spring followed by a very hot and dry Summer, plus the continuous forest landscape giving the perfect conditions for large wildfires spread. The continuous forest landscape is due to forest naturalization because of agricultural abandonment and the lack of active forest management. As expressed by interviewee B, we believe that we must create all conditions for a more managed territory by forestry and agriculture. Once we arrive at this path, with the contribution of a good firefighter agency, the wildfire risk will slow down.

4.3.2 Suggestions for competitive advantage enhancement

We referred to the organization of forestry producers that are very common in Portugal. However, another kind of organization is missing in Portugal, the forestry cooperatives. Interviewee A advocates that the forestry cooperative is a missing player in Portugal. Those cooperatives begin when their future members seek to create benefits and answers to their needs that they would not be able to create independently. Although they are common in the Portuguese agricultural sector, in the forestry sector, they are rare. In France, for example, there are quite a few forestry cooperatives, such as "Alliance Forêts Bois" or "CFBL Coopérative Forestière". In the latter, where the author had the opportunity to visit, the cooperative has a large sawmill and a couple of forestry harvesting machinery. Therefore, it buys timber from its members and sells wood boards to the market. It has machines for soil preparation and forest management. It has field teams and forest engineers that provide operational forestry services and consulting services, from forestry to taxation. We think that it would be an added value for the forestry industry if Portugal had more organizations of this type.

4.4 Firm strategy, structure, and rivalry

Related to the above Diamond determinant, we describe the status for the identified conditions in the first part of this section.

The status for some of those conditions reveals a constrain in the competitive advantage of the forest cluster. Therefore, in the second part of the section, we suggest some actions that could be done to enhance the competitive advantage.

4.4.1 Identified conditions

In the eucalyptus industry, the structure of the two big pulp companies is verticalized. Those companies own pulp mills and forest land, sometimes by long term lease agreement, which guarantees the supply of an essential amount of eucalyptus timber and a scale to support research and development. Celpa (2018), refers that the eucalyptus industry directly manages 193,800 hectares. They have a forestry partnership program with private landowners with whom they make long term contracts where the risk is divided by the parts involved. There are several types of possible contracts. For instance, the private owner gives the land and a part of the eucalyptus production for free. The other part must be sold to the pulp mill at a fixed price. The pulp-mill industry will give the eucalyptus improved seedlings, the afforestation, and the conduction of the forest. This type of partnership is beneficial to guarantee a regular supply to the pulp mill without the investment cost of buying land.

Celpa is the organization that represents the pulp industry, namely the eucalyptus pulp. They have recently launched a project to help private landowners take the best from their eucalyptus afforestation, such as through online guides. This project is known as “Melhor Eucalipto” (i.e., Best Eucalyptus). In 2018 they launched a new programme called “Limpa e Aduba” (i.e., Clean and Fertilize). The latter's idea is to stimulate the private landowner in brunching the bush and weeds competing with eucalyptus grow and promoting the wildfires. Celpa will pay for the fertilizer and the fertilizer application cost in return. This program has been a success. In the first year, they started with 6,000 hectares, the second year 18,000 hectares, and they estimate to do a sum amount of 100,000 hectares until 2024 (Celpa, n.d.). Since private landowners provide the main eucalyptus supply and since there is a chronicle lack of good management on those eucalyptus forests, this strategy seems to be very interesting to reduce the wildfire risk, increase the national eucalyptus supply, and strengthen the links between the pulp mills industry with the forest producers' organizations and with the eucalyptus producers. Interviewee C believes that until approximately the year 2000 there was an interesting relationship between the forestry industry, society in general, and the pulp mills industries. Since then, there has been a remarkable evolution and investment in the pull mills. The paper pulp industry's management executives have become more overbearing. They have turned towards the factories and away from the forestry production industry, waiting for the raw material to come into the pulp mill. The Better Eucalyptus project and the Clean and Fertilize programme intend to reverse this trend, reconnecting the pulp mills with the Portuguese forestry world.

Several small timber operators buy eucalyptus forests from private landowners' producers. Then, they resell this timber to the pulp industry.

Finally, the pulp-mill industry imports a considerable amount of eucalyptus wood every year. The main regions of origin are Spain and South America. In 2018, Portugal's importation of eucalyptus timber was 1.862 million m³ for a total supply of 7.955 million m³. Importation represented 23%. (Celpa, 2018). The Navigator Company (2021), for a total wood consumption of 3.799 million m³ in 2020, 2.915 million m³ are domestic supplied and 0.884 million m³ for the imports (23% of consumption).

We could say that the level of rivalry is not very strong since there are just two big players, the Navigator Company and Altri.

The supply for the cork oak industry in Portugal depends exclusively on private landowners. The cork oak industry owns almost no forest land, neither they have a forestry partnership program. In Centro de Estudos de Gestão e Economia Aplicada (2020), one of the sector's weaknesses mentioned is the limited involvement of the manufacturing industry in forestry issues.

Recently, Amorim, one of the principal firms in the cork oak industry, started making for the first time a link between the industry and forest production. In Neves (2018), it is related that Amorim bought a farm named "Herdade da Baliza" in Portugal for the first time. It has 2,866 hectares.

The importation of natural oak for 2019 reach 43,843 ton for a value of 111,569,000 € (INE, 2021).

In 2018 there were 640 firms of cork transformation operating in Portugal, which are employing 8,343 workers. 487 firms are in the municipality of Santa Maria da Feira where there are 6,576 workers (APCOR, 2020). As we can observe, a high local industry concentration in a municipality is a good indicator of permanent rivalry between the firms.

The 640 cork firms are distributed in the following activities: 116 firms for cork preparation; 377 firms for cork stoppers manufacture; 52 other cork products manufacture; 95 firms of wholesale trade in raw corkwood (APCOR, 2020).

The supply of maritime pine in Portugal is sourced from private landowners and public forests. The maritime pine industry owns almost no forest land, neither they have a forestry partnership program, and we do not see any progress yet to expand the afforestation.

Centro Pinus is the organization that represents the maritime pine industry. This organization had a low profile until 2017, the year of the biggest wildfires ever in Portugal. Today, they are very interventive in creating pressure to push the government and other stakeholders for new policies and to influence and stimulate the maritime pine expansion in Portugal.

According to the estimate Centro Pinus (2020), pine timber consumption in 2018 in Portugal was 4.2 million m³ for a national availability of 1.82 million m³. From this, we can conclude that imports compensate the deficit of 2.28 million m³.

There are 305 companies sourcing pine timber in the Portuguese maritime pine industry distributed by the following types of factories: 248 saw-mills for an estimated consumption of 44%, 26 pellets factories for a consumption of 19%, 6 wood panels factories for a consumption of 15%, 1 pulp-mill for a consumption of 14%, and finally all the other type of factories are responsible for an estimate consumption of 9% (Centro Pinus 2020). We can argue that there are potential conditions for rivalry since there are many competitors in this industry. However, due to particular conditions of the high transportation costs against the timber value per m³, the competition could be smaller than it seems. There is a short-range distance from each forest from where the forest producer needs to find the best offer to sell his timber.

As explained above, Portugal does not have a sufficient supply of forest raw materials to meet the demand from the manufacturing sector, whether eucalyptus logs, maritime pine logs or cork, but importing these types of raw materials may be unviable due to an increase in transport costs. It should be noted that imports of raw materials with a low value per unit of transport volume are less resilient to occasional external factors such as increases in transport costs caused by a simple increase in fuel prices or, for example, by an increase in maritime transport prices due to excess demand, as occurred in the recovery from the pandemic. Eucalyptus and maritime pine logs have an approximate intrinsic value of only 26 euros per m³ of load space¹, and cork, better placed, has an approximate intrinsic value of 230 euros per m³ of load space². As a result, while the cork industry is better positioned to maintain its competitive advantages by resorting to imports, the eucalyptus and maritime pine industry may not be able to maintain its import strategy in the long term, especially the pulp industry that has to compete in a very aggressive global market.

4.4.2 Suggestions for competitive advantage enhancement

What keeps our attention in terms of the strategy of the maritime pine and cork oak industries is that they have not been able to create a verticalized structure in which the forestry goods manufacturing industry holds vast forests under its management. We believe it is crucial to modify this strategy

¹ 1m³ of load space is like 1 st. of wood unit, then if we consider approximately a value of 40.00 euros/ton at the factory on both eucalyptus and maritime pine logs. Considering a stacking factor of 0.65 ton/st., the result will be 26.00 00 euros/st.

² 1m³ of load space is like 1 st. of wood unit, then if we consider approximately a value of 35.00/@ of cork, since the @ is equal to 15 kg, then we get 2,333.00 euros/ton at the factory on natural cork. Considering a stacking factor of 6.5 @/st. or 97.5 kg/st., the result will be 227.47 euros/st.

because we believe that only through an extensive forest area in the respective manufacturing industry is it possible to engage research and development that will lead to innovations and the achievement of competitive advances. These forest areas are also crucial to be demonstration areas for best practices that should be used to teach and train the stakeholders, such as private forestry producers, forestry students, teachers, and schools.

We mentioned in this study the success of the eucalyptus industry in Portugal on being linked to research and development. Outside Portugal, for example, in Brazil's forest cluster, the verticalized structure of the companies has also allowed a strong development of competitive advantages through innovation and operational efficiency.

The state used to be one of the biggest maritime pine producers through the work of the former Forestry Service. The first quality maritime pine timber in the market, the most suitable to produce the goods with higher added value, was a tradition of the former Forest Service. The National Forests, although with only 55 thousand hectares (Castel-Branco, 2018), were an important source of maritime pine supply in the market. There were also 525,400 hectares of communal forests (Castel-Branco, 2018), under the "Regime Florestal" (i.e., Forestry Regime) also managed by the Forestry Service, which was mainly used for maritime pine forestry, sometimes exaggeratedly. It would be crucial for the maritime pine industry if it were re-established.

The organization that represents the maritime pine industry, "Centro Pinus", is promoting the afforestation and forest management of maritime pine in smallholdings to the government and other stakeholders. We believe that it is a wrong strategy. This study explains that forest management in smallholding areas is not economically viable. It would be better as a strategic vision for the future if they would advocate the land grouping.

4.5 Role of government

As explained before, the role of government is to influence the four determinants of the Diamond (Porter, 1990b) and create an environment in which enterprises can achieve competitive advantage as a replacement for those that involve government directly (Porter, 1990a). In the results and previous discussion for each determinant, we identified already several subjects and actions in the government's sphere of influence and for the government's political reform actions.

Government can influence the improvement of factor conditions, namely capital resources, and land availability, through legislation and tax regulation. It can directly improve the knowledge resources, namely the tree breeding programme and the supporting information such as the land registry.

Government can influence the improvement of demand conditions, namely society's forest awareness and can directly increase the demand for more sophisticated goods by public procurement.

Government can directly improve the related and supporting industries attribute throughout the firefighter agency.

As above described, several situations were previously discussed when identifying the themes for each determinant. However, some other points that could unleash the Diamond forces to a more competitive advantage in the forest cluster were not focused on. First and foremost, an example of negative influence on the Diamond forces by the government is the approved cluster forest tax on 4th February 2020 by the parliament with the favourable votes of the governing party. Gomes da Silva (2020) explain that this tax applies to people and companies that carry out economic activities that use, incorporate, or transform forest resources intensively. This tax has not yet been legislated. So, it has not been put into practice yet, but it may be in the future. However, it is already a sign that the government and parliament want to take any opportunity to stifle economic activity around the forest cluster further, thus discouraging the investment (Gomes da Silva, 2020). This tax negatively influences the government in the Diamond forces, namely the factor conditions, e.g., the capital factor, and the demand conditions, e.g., society's forest awareness.

There are more examples of government issues constraining the Diamond forces, which have not yet been framed in our study, such as: excessive bureaucracy; the request for unnecessary studies that have no empirical utility but burden the forestry producer; excessive, and non-condensed legislation, lacking a forestry code that articulates and simplifies it; excessive or unnecessary legal regulations and limitations on eucalyptus plantations, on pruning and harvesting cork oaks, on how to conduct resin tapping in maritime pines, among others; too many public or local entities involved in the forestry industry; the absence of a clear strategy that defines the roles of the various actors in the forest cluster namely: private owners, state-owned forests and communal forests, government institutions, municipalities, organizations of forest producers and the forest engineers.

5. Conclusion

This dissertation brings a new study that does not seem to have been carried out, the study of the competitiveness of the forestry sector through the Diamond model. Through this research, we can reach some conclusions. Although Portugal is considered the country of forests, the result indicates that the forest cluster seen through Porter's Diamond is far from optimal. We found constraints in all determinants of the Diamond, problems in the factor conditions, in the demand conditions, in the related and supporting industries, and in the firm strategy, structure, and rivalry. Besides, the role of government most of the time is negatively influencing the Diamond determinants.

The following figure shows a version of the Diamond framework with a list of the identified negative conditions for the four determinants and a list of the government main negative influences that are constraining the competitive advantages of the Portuguese forest cluster.

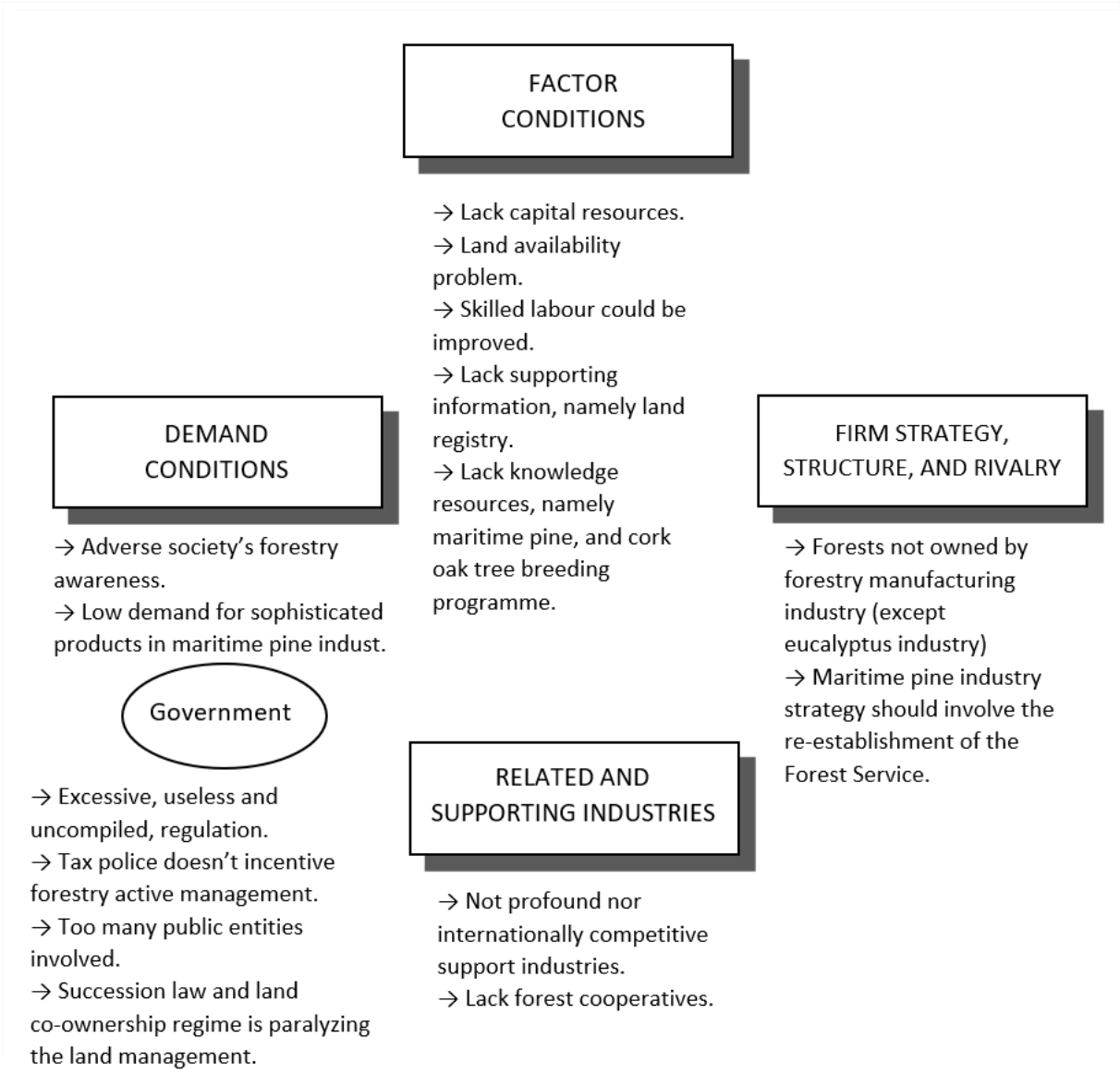


Figure 5.1 Negative conditions and influences in the Diamond of Portuguese forest cluster.

As for the condition factors determinant, we found a lack of *capital resources* in the forestry production industry. Currently, no system allows the landowner or forestry producer to have the capital to meet the financial needs of the forest in its long-term cycle, especially in the maritime pine industry. Portugal has a huge problem in what concerns *land availability* to expand the forestry production industry, although more and more land is left uncultivated and abandoned. The problem is so restraining that we believe that overcoming this problem will unleash the Diamond forces to a higher level of competitiveness. Portugal also has a problem with the lack of *skilled labour*, although this does not seem to be the most limiting factor compared to the constraints caused by the other two conditions. Portugal has the enormous constraint of not having a land registry within the *supporting information* related to forestry. And finally, the lack of *knowledge resources* in the theme of tree breeding for the maritime pine and cork oak. These programmes are crucial for improving forestry performance, i.e., creating a competitive advantage in these industries through innovation.

Regarding demand factors determinant, we found a problem on the *society's forest awareness* that leads to severe constraints. It creates a not very encouraging society environment to invest and develop the forest cluster even because this status negatively favours public decision-makers to act against the forest cluster. In a democracy where the politician seeks the population vote, this condition looks pretty constraining. Portugal also has a low *demand for sophisticated products* in the maritime pine industry. However, according to the interviews, probably the right moment to increase this demand has not yet arrived.

In the related and supporting industries determinant, Portugal lacks *forest cooperatives* as an alternative form of organization that would allow the sharing of forestry equipment and improve the timber flow by creating a fair market.

Regarding firm strategy, structure, and rivalry determinant, essentially, we mention some possible constraints in the strategies followed by the maritime pine and cork oak industry. We defend that the forestry goods manufacturing industry should have a more vertical structure by *having their own forest*, following the same strategy as the eucalyptus industry in Portugal.

Regarding the government's role, we believe that the government is not creating the conditions and environment necessary to enable forestry activity to develop. On the one hand, it is very active in creating legislation without understanding or listening to stakeholders. On the other hand, it lacks the reformist will to change obsolete legislation, as is the case of the succession law, land co-ownership regime, examples of a bottleneck that is paralyzing land management, strangling land availability and forest expansion. We look at the case of the forest tax, where the government reveals that it is willing to discriminate against the forest cluster negatively. Here the government's objective of negatively influencing the Diamond forces is direct and shocking.

Because this study on the competitiveness of the forestry cluster has used the Diamond framework, it was inevitable to look at the forest cluster as comprehensively as possible, especially as the Diamond framework forces us to structure our thinking in search of conditions for each of the four determinants. Therefore, thinking flows outside the box resulting in this study discussing less usual topics. A prime example of this is the topic of land availability, which typically had to come in as a determinant of Diamond factor conditions, and this turned out to be one of the most interesting topics in this study. Another good example is the theme of society's forestry awareness, which emerged when trying to find conditions that would satisfy the Demand determinant.

This work reveals many constraints to competitiveness and suggests actions to improve them. The actions to be taken are sometimes the responsibility of various stakeholders, as in the previous example of the society's forestry awareness, but the most frequent actions must be taken by the government. On the one hand, because the forestry industry traditionally has a strong public component. Moreover, far beyond that, because for Porter's (1990a), the role of government is to create an environment in which enterprises can achieve competitive advantages. This study shows why the government is not creating an environment in which enterprises can achieve competitive advantages. It has elements that can help public decision-makers identify the upstream causes of some problems and give some clues to solve them. Moreover, if the trend of the chronic shortage of forest raw materials exposed in the literature review is not reversed, the competitive advantages of Portuguese forest cluster may disappear.

It is possible to mention some limitations of this research. The number of the in-deep interviews could be more considerable and better distributed among the three main forest species industries. We have a specific interviewee that represents the eucalyptus industry, we have two general interviewees covering different forest themes, but we have none representing the maritime pine industry or the cork oak industry. In addition, we could have done a quantitative study about the demand, namely, to get a better picture of the society's forest awareness. This study is also limited since it does not comprehensively study all the forest cluster. It focuses much more on the forestry production industry and much less on the forestry goods manufacturing industry since the author is a forestry engineer who is very involved with the former but not so familiar with the latter. Therefore, it would be a good opportunity for researchers to use this study as a baseline to investigate the forestry goods manufacturing industry. Indeed, to produce Porter's report on Portugal, the authors created two working teams, one for forestry goods manufacturing other for the forestry production industry. Finally, expanding this study to other countries, namely those with similar climate and culture to Portugal, such as Spain, France, or Italy, would be interesting.

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