Does competition from China encourage green practises?

Evidence from Portugal

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Abstract

China's expanding range and quality of exports is a major ongoing trend in the global economy with potentially far-reaching implications. In this research I investigate whether firms' sectors subject to greater competition from Chinese imports are more likely to go green. Using a questionnaire database from the Instituto Nacional de Estatística (INE), the analysis focuses on Portuguese small and medium enterprises (SMEs) between 2010 and 2017. Evidence suggests that companies actually seem to go "brown" when facing increased competition.

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Keywords: Sustainability; Green Practices; Import Penetration Ratio; China; Multiple Linear Regression Models.

Resumo

Atualmente, a expansão e qualidade das exportações da China é uma tendência relevante na economia global com grandes implicações para o futuro. Neste estudo investigo se os setores de empresas sujeitas a maior concorrência por parte da China são mais suscetíveis a se tornarem empresas ambientalmente sustentáveis. Utilizando uma base de dados proveniente de questionários realizados pelo Instituto Nacional de Estatística (INE), a análise centra-se em pequenas e médias empresas (PMEs) portuguesas no período de 2010 a 2017. As evidências sugerem que, na verdade, as empresas tendem a não adotar práticas ambientais quando enfrentam uma maior competitividade.

Título: A concorrência da China incentiva a realização de práticas verdes? Provas de Portugal.

Nome: Maria Dias Pereira da Costa

Palavras-chave: Sustentabilidade; Práticas Verdes; Taxa de penetração das importações; China; Modelos de Regressão Linear Múltipla.

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1 Introduction

Climate change's impact on everyday society is quickly becoming one of the century's most pressing issues. Adopting more sustainable practices is not just a personal obligation, but also a corporate responsibility. In this sense, scholars have been prompted to explore the topic from a corporate viewpoint due to the social and environmental repercussions of firms, notably the emissions resulting from industrial activities, which contribute to climate change acceleration (Nordhaus, 2019). Moreover, according to studies, green technology not only improves environmental quality but also assists firms in competing and thriving (Lopéz-Gamero, 2010 and others). Businesses are becoming more aware of the environmental and societal implications of their operations as consumer preferences for environmentally friendly alternatives shift, particularly among young consumers, and they recognize that adopting more sustainable practices can help them improve overall performance and establish new commercial opportunities.

Recognizing what factors impact businesses' decisions to engage in environmental protection is crucial for the creation of policy initiatives aimed at making green investments more accessible to businesses. Firms differ not just in terms of their ability to acquire external capital, but also in terms of the quality of their management (Bloom N. a., 2007) and to what extent green management strategies are implemented (Martin, 2012). Firms that have an easier time obtaining financing and a management focus on sustainability can become more energy efficient and, consequently, greener.

This article aims to provide favorable insights on whether Portuguese firms in industries that suffer greater competition from China and are more economically dependent on China face an incentive to adopt sustainable practices. There are no studies on this link because of the uniqueness of this market, and topics relating to Chinese competition are more focused on labor market implications than on green practices implementation. (Cabral, Martins, Santos, & Tavares, 2018).

Focusing on China, it has emerged as one of the world's major manufacturing superpowers in recent decades, with a tremendous surge in overseas manufacturing exports (Autor et al, 2016). Doing business with China brings increased rivalry, which is especially noticeable in small nations like Portugal, but it also provides a chance for corporate innovation and differentiation (Child & Rodrigues, 2005). (1) On the one hand, greater competition from China can push

Portuguese firms to go green in order to differentiate themselves and cater to a different market. (2) On the other hand, greater competition is going to create financial pressure on Portuguese firms, implying that they have less money to go green. So, mechanism (1) would be empirically supported by finding a positive effect of IPR on green practices, while mechanism (2) would predict the opposite.

This study's database was constructed by combining two statistical processes developed by the Instituto Nacional de Estatistica (INE), between 2010 and 2017: i) the first is based on the Inquérito às Empresas Gestão e Protecção do Ambiente (IEGPA) – Management and Environmental Protection Companies' Suitability Survey, and ii) the second is termed Sistema de Contas Integradas das Empresas (SCIE) – Company's Integrated Accounting System. Furthermore, the empirical research used a multiple linear regression model (MLRM) to evaluate the link between Portuguese reliance on Chinese imports and corporate environmental practices.

I use the import penetration ratio (IPR) to generate a standard measure of direct import competition from China in specific Portuguese industry j across the period, following Cabral et al. (2018). Due to computation problems, I only utilize three-time samples as a gauge of China's impact on the Portuguese economy. In this regard, the IPR will be examined across time in order to evaluate a number of key events that occurred during that time period, including: i) the Great Recession of 2010; ii) the Portuguese financial crisis from 2010 to 2014; and iii) the strong export growth in 2017.

Moreover, ten green practices variables were built, which represent the implementation of environmental practices, including green investments, as well as the revenues and respective expenses of those investments. In order to examine the underlying implications of sustainability in a firm's financial performance using accounting data from financial statements, control variables such as firm size, productivity, technological efficiency, and leverage were used. Finally, the models were regressed in two scenarios to control the influence of specific components on the outcome: no fixed effects and region fixed effects.

The data reveal that as time passes, the import penetration ratio coefficient becomes statistically significant and negative, demonstrating a link to the mechanism (2) described above. Therefore, industries that rely heavily on China are less inclined to invest in sustainability or have less money to go green. Despite the fact that the results were not what I had hoped for, I

must recognize that this study has demonstrated that China's competitiveness is not a driving force behind green practices adoption.

The remainder of the paper is organized in the following manner. Section 2 delves into some of the relevant studies that supports our investigation. The data, descriptive statistics, and main variables used throughout the study are described in Section 3, and Section 4 examines the methodology and explains how we build the variables and compute the regressions. The findings of our estimation are presented in Section 5. Finally, Section 6 concludes, highlighting the empirical approach's potential limits and shortcomings.

2 Literature Review

2.1 Sustainability and Business Sustainability

The concept of sustainability has never been more important, both in academic research and from a societal standpoint. Climate change's potential influence on future generations is becoming increasingly obvious, leading to the adoption of new sustainable practices not only by individuals but also by businesses and governments.

Despite the fact that it is a topic that is intimately linked to sustainability problems in the twenty-first century, resource management has always been a problem throughout human history. Nowadays, *sustainability* is defined as the long-term goal of creating a more sustainable world, and it is generally divided into three "pillars": environmental, economic, and social.

In 2010, the Academic Advisory Committee for Sustainability at the University of Alberta describes *sustainability* as "the process of living within the limits of available physical, natural and social resources in ways that allow the living systems in which humans are embedded to thrive in perpetuity".

Focusing on business, sustainability comes from sustainable development. This concept was defined in the United Nations Commission (1987), as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Although it is the most accepted definition, sustainable development is still an ambiguous topic and open to several interpretations. In this regard, a series of conventions were carried out with the purpose of discussing actions in this field.

World leaders meet for the World Summit in 2005 with the goal of reviewing the Millennium Declaration. Three pledges on environmental conservation and economic and social development were made as a result of this event. More recently, the United Nations Climate Change Conference (COP2026) brought together country representatives to work together to achieve the goals of the Paris Agreement[1] and the UN Framework Convention on Climate

[1] The Paris Climate Agreement sets out a global framework aiming to produce zero net grenhouse gas emissions by 2050.

Change, where participants agreed to focus on fossil fuels as the primary source of global warming today.

2.2 Sustainability and Corporate Social Responsibility

As biodiversity loss, pollution, and human climate change have become more prevalent around the world, sustainable policies, such as investments in green technology and the implementation of sustainable corporate practices, have become increasingly important. In September 2015, a plan titled "Transforming Our World: The 2030 Agenda for Sustainable Development" was developed, with the Five P's (people, prosperity, planet, partnership and peace) taken into consideration (Khaled, 2021). In this regard, the government, community members, other stakeholders and corporations were expected to take action on a global scale in the face of growing sustainability challenges, but PwC (2019) findings do not support this. In their reporting papers, about 72% of corporations have used the title of the Sustainable Development Goals (SDGs), but only 20% have established some quantifiable goals to achieve these objectives.

Throughout times the interest about sustainability in literature has been growing, however the opinions of authors do not always converge. In 1970, Milton Friedman refers that the only social responsibility of businesses was to "increase profits", maximizing gains for shareholders. Contrarily, some academics advocate a more social approach, believing that companies should carry commitments towards society, increasing responsibility over their actions. On this matter, McDonald and Puxty (1979) affirm that corporations should be available for shareholders and operate within society. Porter and Kramer (2006) define corporate sustainability as meeting the needs of a firm's stakeholders while not compromising the company's future obligations.

Following repeated public outcries over short-term profit-driven policies, corporate sustainability has been incorporated into the concept of business ethics. In this regard, senior executives from various investment firms are convinced that business can play a significant role in addressing critical challenges such as climate change, according to a Harvard Business Review article. Furthermore, Barbieri et al. (2020) state that external pressure, in particular judgements, opposition of authorities and anti-company protests blaming them for environmental degradation of the planet, made sustainable development increase in the business world.

Occasionally, sustainability is often associated with corporate social responsibility (CSR), as Marrewijk defended in 2003. Carroll (2000) suggests that corporations have four responsibilities towards citizens: economic, ethical, legal and philanthropic. According to Belu (2009) corporate sustainability is an undergoing transformation: modifying the inputs, transforming them into environmentally sustainable results. Hence, I will assume business sustainability as the implementation of procedures that mitigate negative effects of their activities on society and in the environment along with focuses on encouraging positive initiatives.

Several research has shown a variety of frameworks that measure sustainability. Nikolaou et al. (2019) advance the variety applications for corporate sustainability that simultaneously combine the environmental, social and economic components. Veleva et al. (2003) use a five-level index of sustainability according to environmental considerations to assess the progresses made towards sustainable production. Different metrics were used to evaluate corporate environmental performance as well as evaluating trade-offs connected with the choice of methodology for ethical investment (Delmas & Blass, 2010). Focusing more on social frameworks, Chen and Delmas (2011) suggest a new approach to calculate corporate social based upon efficiencies of companies. Regarding economic matters, Schaltegger et al. (2012) propose an innovative framework that encourages environmental as well as social practices to add value to firms. Following various critics of these one-dimensional models, some academics merge the three dimensions. In 2001, Veleva and Ellenbecker presented a complete framework with guidance orientation towards the adoption of production-specific indicators.

2.3 Competitive Advantage and Sustainability Practices, particularly in SMEs

The switch to sustainability can be a challenge for companies. Santa Fe Institute (2020) outlines the main obstacles to improve environmental impacts on firms: i) it is hard to understand the environmental impact of any individual firm, ii) it can be difficult to compare the environmental impact of some activities and iii) it is difficult to predict how economic agents react to new stimulus. However, a sustainable approach can translate into a better management towards risk, an enhanced external affair or even the reduction of costs, therefore reinforcing a better position in the market.

Cruz et al. (2006) argue that companies should adopt sustainability activities as a core corporate strategy to achieve long-term benefits. Several studies have been performed with the purpose

of a better understating of what motivates companies to engage in present sustainable practices. In this sense, Artiach et al. (2010) analysed US firms adopting the Dow Jones Sustainability World Index (DJSI) as a proxy. They demonstrate a higher level of corporate sustainability performance (CSP) leads to higher levels of growth and a higher return on equity than orthodox companies, but contrary to their hypothesis, having lower leverage and generating higher free cash flows was not correlated with having higher sustainability performance.

For Holton et al. (2010) "the managing for sustainability is considered to be critical to the development of corporate sustainability and is fundamentally about strategic organizational development and change". In addition, Porter and Linde (1995) believe that "success must involve innovation-based solutions that promote both environmentalism and industrial competitiveness."

Moreover, it can be a source of differentiation among competitors. Quoting Savitz and Weber (2007, p. 2), "sustainable business is one that creates profit for its shareholders, while protecting the environment and improving the lives of people with whom it interacts." Finally, Chen et al. (2006) found a positive correlation between the investment in green product innovation and a firm's competitive advantage.

There are two contrasting theoretical viewpoints when it comes to the relationship between firm size and sustainability. Larger firms, according to some experts, can be more innovative since they have greater resources and capabilities in research and development, marketing, and financing (Dixon-Fowler H.R., 2013). Smaller firms, on the other hand, are more inventive, according to some experts, because of their flexible and less formal organizational structure, as well as their ability to make swift decisions in reaction to environmental change (Darnall, 2010), (Guo, 2017).

The definition of Small and Medium Enterprises includes a wide scope of parameters according to economic zones. In this study I will consider the European Union definition of Small and Medium Enterprises (SMEs), established in the EU recommendation 2003/361 (European Commission, 2021).

Table 1: **SMEs definition according to the European Commission**

Company category	Staff headcount	Turnover	or	Balance sheet total
Large	> 250	> €50M		> €43M
Medium	< 250	≤ €50M		≤ €43M
Small	< 50	≤ €10M		≤ €10M
Micro	< 10	≤ €2M		≤ €2M

Some academics recognized obstacles when taking into account sustainability practices in SMEs, such as: i) understanding of individual importance, (ii) insufficient experiences to address the environmental problematics and (iii) low financial benefits from environmental investments (Ammenberg & Hjelm, 2003). Cantele and Zardini study (2019) concludes a negative influence of the perceived barriers and the positive effect of the recognisable benefits of sustainability. In that sense, it is fundamental to promote "greener economies" investments among SMEs to overcome those barriers.

Recently, Crossley et al. (2021) have shown that social engagement, reputation, differentiation, and environmental practices deeply influence SMEs performance. Additionally, a study from Musa and Chinniah (2016) concludes that green practices are crucial for the long-term competitiveness, profitability and productivity of SMEs.

2.4 Consequences of China's Globalization

Markets become increasingly global and competitive as a result of globalization. Over the years, the importance of China in commercial trades created both opportunities, such as access to customers and suppliers, but also challenges, namely strong competition within SMEs (Dana, 1999).

In this section, I will give a review of several relevant studies of Chinese import competitiveness. I will focus on general topics connected to China's growth because there isn't a comprehensive study on the implementation of sustainable policies. In 2013, the Autor et al. conclude that growing imports from China generated higher unemployment and reduced compensation in US labour markets that anchor import competing manufacturing industries. Pereira (2016) followed the same methodology for Portugal. Also, Bloom et al. (2016) assume

that increased competition from Chinese imports has led to falls in employment and the number of unqualified workers. Finally, in an econometric approach, Ashournia et al. (2014) exploit data from Danish workers and find that Chinese import penetration decreases wages for low-skilled employees.

As we all know, China has one of the world's largest human resource economies, which is one of the key reasons for its global economic success. However, a majority of Chinese sectors are plagued by serious issues, including: i) high energy consumption ii) high pollution and iii) low added value. (Feng, Zhang, & Zhou, 2018). Furthermore Liu et al. (2020) proved that Chinese agriculture has and will have negative effects on climate change. Also, the study reminds us that because agricultural output is such an important aspect of China's domestic economy, this is a problem that should not be disregarded.

Lastly, I focused on the concept of import penetration – it is a form of trade measurement that describes how much of domestic consumption is fulfilled by foreign imports rather than domestic supply, whether by industry or overall. (OECD , 2005). As a result, a country with a high import penetration ratio will have domestic consumption supplied by a large number of foreign imports, whereas a country with a low import penetration ratio will have their needs satisfied by domestic goods. When we talk about increased import penetration from China into any OECD country (Organisation for Economic Co-operation and Development), it means that Chinese products are meeting a greater proportion of domestic consumer demand. In this situation, increased imports of goods may benefit consumers since they will have access to a wider range of items at lower prices than they would get from their home producers. On the other hand, they might have negative consequences in domestic output and employment rates. (OECD , 2005).

3 Data and Methodology

The target population, as well as the database sources, the specifics of the variables used in the analysis, the database's treatment, descriptive statistics, and the development of the regression models used in the analyses, are explained in the following section.

3.1 Target Population

The target population used in this study is composed by all the companies involved in a goods and/or services production activity between 2010 and 2017 in Portugal. Financial and insurance firms, as well as non-market-oriented enterprises, such as Non-Profit Institutions, Financial Corporations, and Public Administrations, are excluded from the scope of this research. Therefore, the dataset includes the following industries and for each industry the following number of observations, listed according to "Classificação Portuguesa das Atividades Económicas Rev.3" (Instituto Nacional de Estatística , 2007).

Table 2: Observations for each industry

Industry	N	Industry	N
Agriculture, Livestock, Hunting, Forestry and Fishing	161	Hospitality, Restaurants and Similar Services	170
Mining and Quarrying	3331	Information and Communication	55
Manufacturing Industry	92797	Real Estate	154
Electricity, Gas, Steam, Hot and Cold Water and Cold Air	2722	Consulting, Scientific, Technical and Similar activities	235
Water collection, treatment, and distribution; Sanitation Waste Management and Remediation	1084	Administrative and Support Services	111
Construction	557	Human Health and Social Assistance	57
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorbikes	1862	Artistic, Entertainment, Sports, and Recreational Activities	32
Transportation and Storage	38	Other Services Activities	50

The database I used was divided into two sections: management and environmental protection company surveys – "Inquérito às Empresas Gestão e Proteção do Ambiente" (IEGPA), and financial data from firms, both carried out by the The Portuguese Statistics Institute – Instituto Nacional de Estatística (INE). The data collected in the survey refers to financial and qualitative data on environmental management and protection efforts, as well as current environmental practices adopted by firms. Financial data was taken from the companies' financial statements for the same time period as the Integrated Business Accounting System – Sistema de Contas Integradas das Empresas (SCIE) – defined by INE and it is broken down into economic activity sectors, employee size, and NUTS II[2], version 2013, as follows:

Table 3: NUTS codes

Code	Description
11	Norte
15	Algarve
16	Centro
17	Lisboa
18	Alentejo
20	Região Autónoma dos Açores
30	Região Autónoma da Madeira

3.2 Chinese Import Penetration Ratio

This section explains how I calculate the economic impact of China on Portugal. Following Cabral et al. (2018), I use the import penetration ratio (IPR) to calculate a standard measure of direct import competition from China in specific Portuguese industry j over the τ period 2010-2017:

$$\Delta IPRj,t = \frac{\Delta M_{j,t}^{chn \rightarrow prt}}{\mathrm{W}B_{j,2010}}$$

[2] NUTS II correspond to the 3rd level of nomenclature of territorial units for statistics.

where $M_j^{chn \to prt}$ represents Portuguese imports from China for a specific industry j and $\Delta M_{j,\tau}^{chn \to prt}$ is the change of the latter over the period t, 2010-2017. I used the Gross Value Added by industry j in 2010 as proxy of the initial industry size. Due to issues regarding computation, I assume only three time samples: the variation that corresponds to the first two years ($\Delta M_{2010-2011,t}^{chn \to prt}$), the variant that coincides to the sample's midpoint ($\Delta M_{2013-2014,t}^{chn \to prt}$) and finally the fluctuation that corresponds to the sample's final year ($\Delta M_{2016-2017,t}^{chn \to prt}$) to gauge China's impact on the Portuguese economy. In this way, the IPR will be examined across time in order to examine a variety of significant events that occurred over that period: i) Great Recession of 2010; ii) Portuguese financial crisis during 2010-2014 and respectively the exit of the "Troika"[3] from the country and iii) strong export growth in 2017.

3.3 Green Practices

Sustainability is a broad notion that can contain various elements, as explained in section 2. The survey focused on an environmental perspective, especially evaluating how businesses change their operations to become more environmentally friendly. As a result, the environment will serve as the primary dependent variable through my study. In this regard, there are no globally approved sustainability criteria or methodologies for measuring a company's success in implementing sustainable policies. Knirsch & Székely (2005) affirmed that demonstrating the link between sustainability and economic success, as well as how sustainability characteristics may be transformed into measurable indicators that business managers and financial analysts can use are two areas that need to be researched further.

Throughout the survey database, (i) the examination of a practice's implementation/adoption; and (ii) the financial data on environmental management and protection efforts are among the data collected. For (i) six distinct dummies were evaluated and are listed in table 4, with a value of zero or one, depending on whether the response to the question is "no" or "yes." The acronyms listed in the table's last column were used to refer to these dummies.

[3] "Troika" is the team consisting of the International Monetary Fund (IMF), the European Central Bank (ECB) and the European Commission. During the European debt crisis, the term was first used in relation to the "bailouts" of Cyprus, Greece, Ireland and Portugal, which were prompted by their potential insolvency, as a result of the global financial crisis of 2007-2008.

Finally (ii) the financial data gathered is primarily focused on the portion of company investment in technologies that promote environmental protection actions, as well as the revenues and respective expenses of those investments. In this field, a variable that matches the number of employees which has environmental functions during their day-to-day job was also included.

Table 4: Green Practices Variables (Qualitative): Definitions and Acronyms

Dummy 1	Investment in technology/equipment to reduce environmental impact?	ITR
Dummy 2	Support activities to control, prevent, and reduce pollution?	CPR
Dummy 3	The existence of some financial guarantee that allows it to assume environmental responsibility?	FGR
Dummy 4	Implemented measures to reduce carbon emissions?	RCE
Dummy 5	Promotion of employees training regarding sustainable practices to adopt within the organisation?	TES
Dummy 6	Adoption of environmental practises in daily activities?	EPA

Table 5: Green Practices Variables (Quantitative): Definitions and Acronyms

Revenues	Total Green Revenue (€)
Investments	Total Green Investment (€)
Expenses	Total Green Expenses (€)
SEF	Nº of staff in environmental functions

3.4 Firm Characteristics

Based on accounting data gathered from financial statements, I created business characteristics factors to assess the actual implications of sustainability in a firm's financial performance (control variables). I take into account these aspects that affect a company's success in order to eliminate potential result biases and endogeneity concerns. In this regard, four categories were considered: Firm Size, Productivity, Technology Efficiency and Leverage. Table 6 present the data of the respective computations.

Table 6: Definitions of the Firm's Variables Characteristics

Firm Size	Based on European Union definition of SMEs
Prod Control	Productivity = Gross Added Value / Total employees
Tech Control	Technology Efficiency = Gross Added Value / Energy and Electricity Expenses
Leverage Control	Debt Ratio = Total Debt / Total Assets

3.5 Data Treatment

When employing parametric or nonparametric tests, using outliers in research might cause significant distortions in statistic estimations (Zimmerman, 1998). Even though there are numerous definitions for outliers, in this research I decided to use Jarrell's (1994) definition of a data point that is far beyond the norm for a variable or population. According to Osborne & Overbay (2004) outliers can skew the results of statistical analyses: i) outliers tend to increase error variance and lower statistical test power; ii) if they are not dispersed randomly, they can reduce normality and iii) they can bias or influence the estimates of interest. As a result, I applied the Winsorising approach – the numbers below the first percentile were replaced by the first percentile value, and those above the ninety-ninth percentile by the ninety-ninth percentile value – for the following numerical variables: Productivity, Technology, Efficiency and Leverage.

3.6 Descriptive Statistics

Table 7 shows the Descriptive Statistics results for each variable, which are split into three panels: Panel A, Panel B, and Panel C. The summarized data used in the model for the import penetration ratios of the three periods under consideration, as well as the Firm Characteristics variables mentioned in section 2, are included in Panel A. Panel B outlines the six dummy variables included in the model, followed by Panel C, which is a description of the quantitative green practices.

For a more complete analysis of the variables, see Appendix B for a more detailed table with descriptive data by industry, using the same classification as Table 7.

3.6.1 Import Penetration Ratio (IPR)

Our sample's average IPR11 is 0.018, with a standard deviation of 0.647. The values vary from -2.796 to 26.631, with the "Manufacturing Industry" having the highest mean. Regarding the variable IPR14, the mean corresponds to the highest of the three periods in analysis reaching 0.039 and a standard deviation of 0.623. The numbers range from -0.0214 to 24.624, and Manufacturing was once again the industry with the highest mean. Finally, our sample's mean IPR17 is 0.03 with a standard deviation of 0.337. Manufacturing has the greatest mean value, with the "Agriculture, Livestock, Hunting, Forestry, and Fishing Industry" having a negative average of -0.004.

Because a large majority of other industries make no observations, the behavior of all three variables is often comparable. The import penetration ratio was found to be significantly dispersed across three industries in the study's database: Agriculture, Livestock, Hunting, Forestry, and Fishing, Manufacturing Industry, and Mining and Quarrying. Also, the number of observations is more than half when compared to the Firm's Variables Characteristics.

3.6.2 Firm's Characteristics

The average of both Productivity and Technology Efficiency is 0 and the standard deviation is 1 due to the Winsoring Approach used in the data treatment. The median values are -0.178 and -0.224, respectively, with values ranging from -0.7 to 8 (approximately). Also, the industry with higher mean is "Electricity, Gas, Steam, Hot, Cold Water and Cold Air" in both variables.

The debt ratio is used to determine the company's leverage. The ratio has a mean of 0.76 and a standard deviation of 0.669. The median is 0.676, which indicates a favorably skewed sample because it is lower than the mean. "Hospitality, Restaurants and Similar Services" has the highest mean, and " Transportation and Storage " has the lowest mean for debt ratio.

The average Firm Size is 2.53 what helps to conclude that our sample is mainly focused on small and median firms, according to the European Union definition of Small and Medium Enterprises (SMEs).

3.6.3 Green Practices

In my sample, the Green Practices Dummies have an approximate number of observations that ranges from 34136 to 34192. Only 10.1% of the companies in the sample have invested in environmentally friendly technologies, and 8.3% support pollution control, prevention, and reduction measures. Furthermore, only 22.6 % have any financial guarantee that permits them to assume environmental responsibility, and only 28.9% have adopted greenhouse gas emission reduction measures. Moreover, 31% of the firms in the sample provide green training to their staff, and 73% incorporate environmental practices into their daily activities.

Regarding the quantitative variables, the mean of the Total Green Revenue is 30323€, the mean of the Total Green Investments is 19020€ and The Total Green Expenses is 50342€, which means that the expenses in sustainable practices indicate that sustainable practices' expenses are on average larger than their income. Lastly, the number of staff in environmental functions in our sample correspond to 10.168 on average, but the number of observations is down by more than a third when compared to the other quantitative variables.

Relatively to the industries, “Water collection, treatment and distribution; Sanitation Waste Management and Remediation” has the highest average value for various dummy variables, such as FGR, RCE, and EPA. This indicates that this industry has the highest rate of green initiative compliance. The "Other Services Activities" sector has the greatest average TES values, the "Real Estate" sector has the highest CPR mean, and the "Human Health and Social Support" sector has the highest average ITR values. Finally, the highest average for all quantitative variables, including Revenues, Investments, Expenses, and SEF, is "Electricity, Gas, Steam, Hot and Cold Water, and Cold Air." On the other hand, "Transportation and Storage" has the lowest average value for most dummy and quantitative variables. This either means that this industry has the lowest rate of green initiative compliance, or that the companies in the survey did not report their green adoption.

Finally, because the quantity of observations varies greatly among industries, the examination of green practices among enterprises may be biased. Manufacturing and Mining and Quarrying, the first with the highest weight, have a bigger number of firms reporting green practices than other industries with a smaller number of companies on the study, such as Artistic, Entertainment, Sports and Recreational Activities and Transportation Storage.

Table 7: Descriptive Statistics

The table below shows my sample's descriptive statistics, from 2010 to 2017. I present descriptive statistics for the entire database timeframe, which means I include the complete observation period in the table even if a company was only active for a short time within the era studied.

A – Import Penetration Ratio and Firm Characteristics Variables

IPR 11, IPR 14, IPR 17 are the Portuguese's import penetration ratio from China in the following time sample, respectively 2010-2011, 2013-2014 and 2016-2017. Control Variables: Productivity correspond to the output per staff (€) normalized; Technology Efficiency match the ratio of energy, including electricity, spending per output (€) normalized; Leverage is the leverage normalized, using the debt ratio; Firm Size definition is based in "Decreto-Lei n.º 372/2007".

	N	Mean	Median	Std. Dev.	Min	Max
IPR 11	33887	0.018	0	0.647	-2.796	26.631
IPR 14	33887	0.039	0.002	0.623	-.0214	24.624
IPR17	33387	0.03	0.001	0.337	-0.418	11.827
Productivity	97835	0	-0.178	1	-0.731	8.496
Technology Efficiency	80356	0	-0.224	1	-0.727	7.595
Leverage	97711	0.76	0.676	0.669	0.038	5.294
Firm Size	73776	2.53	2	0.8	1	4

B – Qualitative Variables [Green Practices Dummies]

The table below shows the descriptive statistics for the green practices dummies as a measure of sustainability, in our sample. Because these are dummies, the values are either 0 for the lowest observed value or 1 for the highest. The values are in units.

	N	Mean	Std. Dev.
ITR	34192	0.101	0.301
CPR	34192	0.383	0.486
FGR	34153	0.226	0.418
RCE	34136	0.289	0.453
TES	34138	0.314	0.464
EPA	34152	0.735	0.441

C – Quantitative Variables [Green Practices Variables]

The table below shows the descriptive statistics for the green practices' quantitative variables as a measure of sustainability in our sample. The variables Revenues, Investments and Expenses are expressed in euros.

	N	Mean	Std. Dev.
Revenues	34189	30323.978	223996.72
Investments	34170	19020.096	369716.44
Expenses	34189	50342.353	340541.1
SEF	7839	10.168	52.045

3.6.4 Multiple Regression Models

For the time period of our sample (2010 – 2017), the empirical analysis will be undertaken using multiple linear regression models (MLRM) and the Ordinary Least Squares (OLS) approach. The goal is to model the linear relationship between the independent (or explanatory) variable, Import Penetration Ratio, and the dependent variables, Sustainability (green practices).

The equation of the effects of China's import competition is specified as follows:

$$Green\ Practises_{j,t} = \beta_0 + \beta_1 * IPR_{j,t} + \beta_2 * Prod_{j,t} + \beta_3 * Tech_{j,t} + \beta_4 * Leverage_{j,t} + \beta_5 * Firm\ Sized_{j,t} + \varepsilon,$$

where $t = 2011, 2014, 2017$ and j indicates that the variable varies across firms. Green Practices were used to represent the dependent variables, which included both quantitative and qualitative characteristics:

TR, CPR, FGR, RCE, TES, EPA, Revenues, Investments, Expenses and lastly SEF.

China's import penetration ratio is the independent variable. The coefficient of interest is β1, which measures the effect of the change in direct import exposure to China during our sample. In addition, as noted in the subsection Firm Characteristics, Productivity (Prod), Technology Efficiency (Tech), Leverage, and Firm Size are included as control variables. Finally, the ε represents the omitted variables or unpredictable components on the equation.

A fixed effect analysis was also performed using the panel data to compensate for changes within individual-specific categories. By taking into account differences within distinct groups, fixed effect models reduce endogeneity issues related to omitted variables. In this regard, my study only used a region fixed effects because the independent variable does not differ between firms, but rather between industries.

4 Empirical Results

This section provides empirical evidence on implementing sustainable practices in firms with high competition from China. This chapter is split into three parts according to the period of the independent variable IPR. Furthermore, for each green practice variable, multiple regressions with no fixed effects were first run, and then a region fixed-effects model was applied. The regressions regarding the region fixed effects model can be found in the Appendix D.

As a result, each section provides a summary of the findings for each of the green practices studied, as well as a table of the findings that includes the coefficients and standard errors for all the model's variables.

4.1 IPR11

The import penetration ratio is statistically significant at the 10% level exclusively for the variable SEF in the model with no fixed effects, as well as in the model with region fixed effects. The coefficient is positive, demonstrating a strong relationship with the dependent variable, implying that industries with larger import penetration ratios employ more people in environmental functions, corroborating our main hypothesis. In this regard, the lack of a significant positive correlation for a large percentage of dummy variables shows that the level of Chinese IPR had no impact on enterprises' environmental efforts in 2010-2011, which could be a result of Portugal's Great Recession.

Except for the SEF, which is only statistically significant at the 5% level, Prod has a positive correlation with each green practice in all models, statistically significant at the 1% level. As a result, businesses that practice more environmentally friendly practices are more productive. Furthermore, as the p-value is less than 0,01, the t-stats of Tech show that they are statistically significant to explain changes in the CPR, FGR, EPA, and Expenses at the 1% level, and statistically significant in TES and Investments at the 5% level. Nonetheless, the coefficients are negative, implying that an increase in technological productivity reduces the number of green measures applied in businesses. Finally, in the model with region fixed effects, the t-stats of the variable Tech reveal statistically negative significance only for CPR, FGR, EPA, Expenses, and Investments at the 1% level, the first four, and at the 5% level, the final one.

Leverage is statistically significant at the 1% level with EPA and SEF, at the 5% level with CPR, TES, and Expenses, and finally at the 10% level with RCE, Revenues, and Investments for the model, with no fixed effects. All the dummy factors have negative coefficients, indicating that a company with more debt is more likely to implement fewer green measures. When looking at the quantitative factors, the coefficients are positive, implying that more leverage can lead to higher green income, investments and expenses, as well as a rise in the number of people working in environmental functions. Because the p-value is less than 0,05, Leverage is only statistically significant at the 5% level, when using region fixed effects to explain changes in the SEF. Such findings contradict Artiach et al. (2010), who found that having lower leverage was not associated with improved sustainability performance.

Finally, all green variables have a negative relationship with Firm Sized at the 1% level, implying explanatory power. As a result, contrary to the conclusions of the literature review, I do not believe that the size of a company (Micro, Small, Medium, or Large) has an impact on the level of green practice adoption.

Table 8: Regression Analysis – IPR11

A multiple linear regression with qualitative and quantitative factors, described in ten measures, was used to investigate the relationship between China's dependence and the application of green practices in businesses. As noted previously, variables are defined. Below the coefficients, T-statistics are shown in parenthesis. The symbols *, **, and *** denote the statistical significance of coefficients at the 10%, 5%, and 1% levels, respectively, with standard errors in parenthesis.

VARIABLES	ITR	CPR	FGR	RCE	TES	EPA
IPR11	0.001	0.004	-0.003	0.005	0.003	-0.005
	(0.451)	(0.448)	(-0.914)	(0.316)	(0.288)	(-0.413)
Prod	0.138***	0.174***	0.255***	0.129***	0.205***	0.080***
	(8.732)	(8.770)	(11.095)	(5.401)	(9.253)	(4.487)
Tech	-0.013	-0.031***	-0.036***	-0.008	-0.018**	-0.026***
	(-1.619)	(-3.768)	(-3.692)	(-0.901)	(-2.007)	(-2.734)
Leverage	-0.000	-0.002**	-0.001	-0.001*	-0.001**	-0.004***
	(-0.123)	(-2.078)	(-1.497)	(-1.665)	(-2.384)	(-4.044)
Small	-0.453***	-0.824***	-0.769***	-0.424***	-0.626***	-0.371***
	(-19.151)	(-72.266)	(-45.577)	(-17.102)	(-30.021)	(-28.512)
Medium	-0.329***	-0.284***	-0.466***	-0.190***	-0.349***	-0.075***
	(-13.584)	(-25.340)	(-26.765)	(-7.740)	(-16.920)	(-9.540)
Large	-0.420***	-0.576***	-0.681***	-0.289***	-0.492***	-0.159***
	(-17.316)	(-35.425)	(-36.567)	(-10.823)	(-21.558)	(-12.269)
Constant	0.490***	0.952***	0.857***	0.617***	0.794***	0.975***
	(21.369)	(131.814)	(59.541)	(27.250)	(43.991)	(168.943)
Observations	6,755	6,755	6,748	6,747	6,746	6,749
R-squared	0.151	0.315	0.264	0.081	0.158	0.126
Region FE	NO	NO	NO	NO	NO	NO

VARIABLES	Revenues	Investments	Expenses	SEF
IPR11	-317.948	224.084	3,357.018	28.811*
	(-0.443)	(0.447)	(1.591)	(1.765)
Prod	53,839.957***	93,739.320***	250,201.859***	17.448**
	(3.488)	(4.337)	(5.440)	(2.106)
Tech	1,165.383	-7,223.673**	-32,670.291***	0.555
	(0.260)	(-2.073)	(-4.965)	(0.318)
Leverage	446.516*	668.564*	1,586.667**	11.391***
	(1.701)	(1.912)	(2.029)	(3.679)
Small	-287,038.063***	-147,236.047***	-551,513.063***	-28.983***
	(-9.465)	(-7.151)	(-12.659)	(-5.693)
Medium	-263,245.094***	-141,012.188***	-524,248.406***	-23.187***
	(-8.605)	(-6.687)	(-11.824)	(-4.865)
Large	-290,028.938***	-153,797.438***	-572,720.938***	-27.608***
	(-9.451)	(-7.074)	(-12.549)	(-5.547)
Constant	294,267.625***	158,685.359***	580,396.938***	23.257***
	(9.550)	(7.236)	(12.665)	(5.836)
Observation	6,755	6,751	6,755	1,896
R-squared	0.115	0.102	0.237	0.063
Region FE	NO	NO	NO	NO

4.2 IPR14

In the model with no fixed effects, the Import Penetration Ratio is statistically significant at the 5% level exclusively for the variable FGR, and statistically significant at the 10% level for SEF. Hence, the coefficient is negative, indicating an inverse relationship with the dependent variable, implying that industries with higher dependence on China are the ones with less financial guarantee that allows them to assume environmental responsibility. A factor could be that increased competition create financial pressure on Portuguese business, meaning that they will have less money to go green. This result contradicts the concept that industries with a higher import penetration ratio are more environmentally conscientious. On the other hand, the positive coefficient in the second variable confirms our theory. The independent variable is not statistically significant for any green variable in the model with fixed effects by region.

When comparing the time periods in the previous chapter, it is possible to discern a deterioration in the relationship between Chinese competitiveness and green practice adoption, as some of the dependent variables' coefficients turn negative. Furthermore, the impact of increased Chinese import penetration on the adoption of green practices in Portuguese enterprises is statistically small, which could be related to Portugal's economic crisis in 2013 and 2014. Following the existing literature, Gough and Meadowcroft (2011) argue that fiscal and economic issues have resurfaced as important political issues, posing a risk that sustainability transitions may be hampered or delayed.

As stated in section one, besides the SEF, which is only statistically significant at the 5% level in the region fixed effects model, productivity has a positive correlation for each green variable, statistically significant at the 1% level in both models.

Technology exhibits the same behavior as the previous page, emphasizing that when technical productivity rises, CPR, FGR, EPA, Expenses, TES, and Investments decrease in value. Additionally, in the model with region fixed effects only CPR, FGR, EPA, Expenses, and Investments have statistically negative significance at the 1% level, the first four, and at the 5% level, the last one.

Moreover, the variable Leverage is statistically significant at the same level in the no fixed effects and region fixed effects models as it was in the first section, implying that this variable

is unaffected by the time period change in the independent variable (IPR) and that the implementation of green practices is mainly reliant on the company's capital structure.

Last but not least, all green variables have a negative connection with Firm Sized, which is statistically significant at the 1% level. As a result, the same conclusion may be drawn: a company's commitment to sustainability is unaltered by its size.

Table 9: Regression Analysis – IPR14

A multiple linear regression with qualitative and quantitative factors, described in ten measures, was used to investigate the relationship between China's dependence and the application of green practices in businesses. As noted previously, variables are defined. Below the coefficients, T-statistics are shown in parenthesis. The symbols *, **, and *** denote the statistical significance of coefficients at the 10%, 5%, and 1% levels, respectively, with standard errors in parenthesis.

VARIABLES	ITR	CPR	FGR	RCE	TES	EPA
IPR14	-0.003	-0.002	-0.011**	0.002	0.001	-0.002
	(-1.628)	(-0.170)	(-1.986)	(0.100)	(0.118)	(-0.169)
Prod	0.137***	0.174***	0.255***	0.129***	0.205***	0.080***
	(8.730)	(8.771)	(11.093)	(5.403)	(9.253)	(4.484)
Tech	-0.013	-0.031***	-0.036***	-0.008	-0.018**	-0.026***
	(-1.604)	(-3.749)	(-3.669)	(-0.894)	(-2.002)	(-2.738)
Leverage	-0.000	-0.002**	-0.001	-0.001*	-0.001**	-0.004***
	(-0.135)	(-2.079)	(-1.501)	(-1.665)	(-2.384)	(-4.043)
Small	-0.453***	-0.824***	-0.769***	-0.424***	-0.626***	-0.371***
	(-19.143)	(-72.185)	(-45.551)	(-17.098)	(-30.010)	(-28.504)
Medium	-0.329***	-0.285***	-0.466***	-0.190***	-0.349***	-0.075***
	(-13.584)	(-25.351)	(-26.763)	(-7.743)	(-16.923)	(-9.531)
Large	-0.420***	-0.576***	-0.681***	-0.289***	-0.492***	-0.159***
	(-17.309)	(-35.419)	(-36.545)	(-10.818)	(-21.557)	(-12.270)
Constant	0.490***	0.952***	0.858***	0.617***	0.794***	0.975***
	(21.371)	(131.786)	(59.545)	(27.250)	(43.988)	(168.865)
Observations	6,755	6,755	6,748	6,747	6,746	6,749
R-squared	0.151	0.315	0.264	0.081	0.158	0.126
Region FE	NO	NO	NO	NO	NO	NO

VARIABLES	Revenues	Investments	Expenses	SEF
IPR14	-90.325	-142.951	1,022.639	18.679*
	(-0.183)	(-0.279)	(0.865)	(1.720)
Prod	53,837.129***	93,739.734***	250,232.219***	18.239**
	(3.488)	(4.338)	(5.440)	(2.224)
Tech	1,161.254	-7,214.396**	-32,628.830***	0.428
	(0.259)	(-2.068)	(-4.955)	(0.242)
Leverage	446.565*	668.390*	1,586.198**	11.678***
	(1.701)	(1.912)	(2.029)	(3.801)
Small	-287,040.656***	-147,227.063***	-551,488.063***	-28.999***
	(-9.464)	(-7.150)	(-12.657)	(-5.669)
Medium	-263,240.438***	-141,015.813***	-524,297.563***	-23.535***
	(-8.605)	(-6.688)	(-11.824)	(-4.965)
Large	-290,033.281***	-153,787.328***	-572,677.563***	-28.335***
	(-9.450)	(-7.073)	(-12.547)	(-5.775)
Constant	294,263.906***	158,692.516***	580,434.750***	23.126***
	(9.550)	(7.237)	(12.666)	(5.767)
Observations	6,755	6,751	6,755	1,896
R-squared	0.115	0.102	0.237	0.061
Region FE	NO	NO	NO	NO

4.3 IPR17

The variables CPR, FGR, TES, and Revenues are statistically significant at the 5% level, the quantitative variable SEF is statistically significant at the 1% level, and the dummy variables ITR and RCE are statistically significant at the 10% level. The coefficient is negative across dummy variables, indicating an inverse relationship with the dependent variable. This indicates that industries with a higher dependence on China are less likely to invest in technology, encourage pollution prevention and reduction effort, provide financial assurances, adopt carbon emission reduction measures, provide employee sustainability training and lower green revenues, which contradicts our theory. A possible explanation for these findings is that increased competition from China will put financial strain on Portuguese businesses, meaning that they will have less money to go green, and that becoming green is always associated with higher costs. Musa and Chinniah (2016), on the other hand, believe that green practices are critical for SMEs' long-term competitiveness, profitability, and productivity.

Contrarily, my argument is supported by the positive SEF coefficient, which implies that sectors with a higher import penetration ratio hire more staff active in environmental practices. When considering the region fixed effect model, only TES and EPA are statistically significant at the 10% level, while the variable SEF is statistically significant at the 5% level. Nonetheless, in both models, the Chinese import penetration ratio has a statistically negative significance across practically all green variables, suggesting that a higher import penetration ratio, i.e., greater reliance on China, may actually reduce the number of green practices undertaken in enterprises.

As mentioned in the previous two sections, Productivity has a positive correlation for each green variable, statistically significant at the 1% level in both models, with the exception of SEF, which is statistically significant at the 5% level in the no fixed effect model and 1% in the region fixed effect model. Aside from EPA, which is statistically significant at a 5% level in the region fixed effect model, the t-stats of Technology show that the same analysis was done previously.

The t-stats for the variable Leverage show the same level of statistical significance in both models as before, reiterating that the capital structure of companies is unaltered by the independent variable's time period change.

At least, the t-stat for the variable Firm Size constantly show the size of a company has little bearing on whether or not it adopts green practices.

Table 10: Regression Analysis – IPR17

A multiple linear regression with qualitative and quantitative factors, described in ten measures, was used to investigate the relationship between China's dependence and the application of green practices in businesses. As noted previously, variables are defined. Below the coefficients, T-statistics are shown in parenthesis. The symbols *, **, and *** denote the statistical significance of coefficients at the 10%, 5%, and 1% levels, respectively, with standard errors in parenthesis.

VARIABLES	ITR	CPR	FGR	RCE	TES	EPA
IPR17	-0.014*	-0.033**	-0.028**	-0.033*	-0.040**	-0.041
	(-1.699)	(-2.071)	(-2.003)	(-1.879)	(-2.215)	(-1.049)
Prod	0.138***	0.174***	0.255***	0.129***	0.206***	0.080***
	(8.731)	(8.775)	(11.092)	(5.404)	(9.257)	(4.491)
Tech	-0.013	-0.030***	-0.036***	-0.007	-0.017*	-0.025***
	(-1.584)	(-3.691)	(-3.653)	(-0.819)	(-1.925)	(-2.672)
Leverage	-0.000	-0.002**	-0.001	-0.001*	-0.001**	-0.004***
	(-0.165)	(-2.082)	(-1.505)	(-1.695)	(-2.393)	(-4.079)
Small	-0.453***	-0.823***	-0.769***	-0.424***	-0.625***	-0.371***
	(-19.132)	(-72.143)	(-45.531)	(-17.065)	(-29.970)	(-28.475)
Medium	-0.329***	-0.285***	-0.467***	-0.191***	-0.349***	-0.076***
	(-13.587)	(-25.361)	(-26.785)	(-7.751)	(-16.940)	(-9.551)
Large	-0.420***	-0.575***	-0.681***	-0.289***	-0.492***	-0.158***
	(-17.303)	(-35.419)	(-36.557)	(-10.804)	(-21.537)	(-12.261)
Constant	0.491***	0.953***	0.858***	0.618***	0.796***	0.976***
	(21.382)	(131.321)	(59.610)	(27.271)	(44.048)	(164.701)
Observations	6,755	6,755	6,748	6,747	6,746	6,749
R-squared	0.151	0.315	0.264	0.082	0.158	0.126
Region FE	NO	NO	NO	NO	NO	NO

VARIABLES	Revenues	Investments	Expenses	SEF
IPR17	-18,329.531**	-1,305.338	-13,396.757	39.578***
	(-2.075)	(-0.585)	(-1.404)	(2.731)
Prod	53,883.250***	93,743.953***	250,257.734***	19.316**
	(3.489)	(4.337)	(5.440)	(2.346)
Tech	1,510.445	-7,193.751**	-32,340.043***	0.533
	(0.337)	(-2.066)	(-4.948)	(0.303)
Leverage	434.584*	667.630*	1,576.705**	12.075***
	(1.683)	(1.912)	(2.027)	(3.922)
Small	-286,757.875***	-147,211.641***	-551,243.625***	-28.024***
	(-9.463)	(-7.153)	(-12.662)	(-5.396)
Medium	-263,411.875***	-141,027.828***	-524,424.625***	-22.959***
	(-8.611)	(-6.687)	(-11.822)	(-4.814)
Large	-289,828.438***	-153,777.359***	-572,490.688***	-27.450***
	(-9.450)	(-7.074)	(-12.551)	(-5.534)
Constant	294,824.875***	158,729.484***	580,868.688***	21.938***
	(9.561)	(7.232)	(12.656)	(5.329)
Observations	6,755	6,751	6,755	1,896
R-squared	0.115	0.102	0.237	0.064
Region FE	NO	NO	NO	NO

5 Conclusion

5.1 Conclusion Remarks

As environmental catastrophes become increasingly common, the transition to greener economy is both challenging and crucial. Companies face, not only government and social pressure to embrace more environmentally friendly practices, but they also reap a slew of benefits, including increased long-term profitability and productivity, a competitive advantage over competitors, and cost savings.

Studies on firms' adoption of environmental methods to become more sustainable are recent and limited due to the shortage of data. Furthermore, there hasn't been detailed research of the relationship between competitiveness with China and environmentally sustainable business practices. The INE database, which is mostly made up of unlisted Portuguese companies, allows us to see past this issue and analyze whether industries that are more reliant on China are more environmentally friendly. In this regard, I adopt Cabral et al. (2018)'s import penetration ratio (IPR) to quantify China's economic impact in Portugal.

To measure the temporal value, I looked at three separate periods of the IPR, each of which corresponded to three key events in Portugal's history: The Great Recession of 2010, the Portuguese financial crisis from 2010 to 2014, as well as robust export growth in 2017.

My results reveal that overtime, the import penetration ratio coefficient become statistically significant and negative, contradicting our hypothesis. In the first time period in analysis, I conclude that industries with larger import penetration ratios employ more people in environmental functions. In 2014, the negative coefficients suggest that industries that are more reliant on China have less financial security, making it more difficult for them to take environmental responsibility. Additionally, the Portuguese economic crisis could be a factor in the degradation of China's competitiveness and adoption of green practices.

Finally, it was expected that in the most recent era investigated (2017), which coincided with the rise of the Portuguese economy, industries with more competition from China would have more green practices, for reasons of reputation and competitiveness with other markets. However, my findings indicate that industries that are more reliant on China are less likely to invest in technology, encourage pollution prevention and reduction efforts, provide financial

assurances, adopt carbon emission reduction methods, provide employee sustainability training and generate small revenues, which could indicate that increased competition from China create financial pressure on Portuguese firms, resulting in them having less money to go green. Aside from that, the IPR only behaves statically significant and positively for quantitative green practices for all three eras studied, implying that sectors with a greater import penetration ratio hire more individuals who are involved in environmental practices.

To conclude, I must recognize that, despite the fact that the results were not as expected, this research helped me to comprehend that China's competitiveness is not a driving force behind the adoption of green practices. Furthermore, the survey utilized used for this analysis does not include all green practices used by Portuguese firms, which could lead to inaccurate and unreliable conclusions.

5.2 Recommendation for future research

Overall, my findings add to a better understanding of Portuguese enterprises' sustainability concerns, even though we were unable to find a link between increasing reliance on Chinese goods, namely, to determine if there was any pattern associated to temporal evolution. In this regard, it would be interesting to examine not just the three periods studied in this work, but also the entire survey period. Furthermore, constant government political social pressure, rather than competitive market considerations, can be a driving force for the introduction of green practices in corporations. These topics could be the subject of further investigation.

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7 Appendices

7.1 Appendix A – Import Penetration Ratio Data

The Import Penetration Ratio is calculated using two types of data: trade flows and wage bill, where was used different methods to retrieve and compute this data. The trade flow values had to be multiplied by $0.87^{4} * 1000$ because the data was in different units, the first were in thousands of current USD. The trade flows were retrieved from the CEPII – BACI Database, which contains disaggregated data on bilateral trade flows for over 5000 products and 200 countries and is based on data submitted directly to the United Nations Statistical Division by each country. Finally, as previously stated, the wage bill was used to calculate the Gross Value Added by industry, with data obtained from Statistics Portugal – Instituto Nacional de Estatistica (INE).

The products of the CEPII – BACI Database are recognized using the Harmonized System (HS) revised in 2007, which is the standard nomenclature for international trade, whereas the Gross Added Value uses the Portuguese industrial classification – Classificação Portuguesa das Atividades Económicas (CAE) – in the version in use at the time the data was collected.

Some changes were made to the CEPII – BACI database in this regard, such that the databases described above, as well as the green practices database, have the same classification in terms of industry. Since CAE, at the 4-digit level, matches the second revision of the Statistical Classification of Economic Activities in the European Community (NACE2), several linkages were established to convert the HS2007 code to NACE2 (HS07 – CPC2 – ISICrev.4 – NACE2). The United Nations Statistics Division offers a correspondence table all this codes.

Regarding the Gross Added Value Database, the information about the economy activity of firms was designated in terms strings and rather than codes. As a result, it was necessary to manually match the industry description to the appropriate class – CAE at the 4-digit level.

[4] US Dollars to Euros Exchange Rate on 13 November 2021.

7.2 Appendix B – Descriptive Statistics by industry

	N	Mean	Std
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	154	-.285	.087
Tech Control	131	-.26	.334
Leverage Control	154	1.054	1.042
Firm Size	81	2.222	.5
Administrative and Support Service			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	108	-.035	.483
Tech Control	74	.252	1.28
Leverage Control	108	.816	.652
Firm Size	81	2.333	.689
Agriculture, Livestock, Hunting, Forestry and Fishing			
IPR 11	34	.001	.003
IPR 14	34	-.006	.013
IPR 17	34	-.004	.007
Prod Control	126	.299	1.874
Tech Control	106	-.188	.708
Leverage Control	126	.726	.63
Firm Size	146	2.315	.731
Artistic, Entertainment, Sports and Recreational Activities			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	32	-.182	.328
Tech Control	28	-.248	.279
Leverage Control	32	.971	.592
Firm Size	32	2.438	.801
Construction			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	469	-.006	.868
Tech Control	395	.049	1.094
Leverage Control	469	.726	.607
Firm Size	400	2.465	.81
Consulting, Scientific, Technical and Similar activities			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	233	.274	1.052
Tech Control	164	.406	1.704
Leverage Control	233	.645	.523
Firm Size	178	2.404	.701

	N	Mean	Std
Electricity, Gas, Steam, Hot and Cold Water & Air			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	2707	3.381	3.881
Tech Control	1807	2.284	2.889
Leverage Control	2701	.769	.736
Firm Size	1769	2.154	.573
Human Health and Social Assistance			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	34	.069	.534
Tech Control	31	.02	.35
Leverage Control	34	.516	.433
Firm Size	47	2.043	.359
Information and Communication			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	55	-.079	.145
Tech Control	48	.335	.668
Leverage Control	55	.835	.349
Firm Size	30	2.8	.761
Manufacturing Industry			
IPR 11	32565	.019	.66
IPR 14	32565	.041	.636
IPR 17	32565	.031	.344
Prod Control	87688	-.109	.479
Tech Control	72579	-.051	.826
Leverage Control	87580	.761	.668
Firm Size	65673	2.54	.797
Mining and Quarrying			
IPR 11	1288	0	0
IPR 14	1288	.002	0
IPR 17	1288	.004	0
Prod Control	3199	-.034	.656
Tech Control	2548	-.26	.74
Leverage Control	3195	.743	.728
Firm Size	2634	2.583	.888
Other Services Activities			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	47	-.105	.199
Tech Control	39	.385	1.825
Leverage Control	47	.631	.394
Firm Size	33	2.848	.795

Real Estate			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	143	.357	1.693
Tech Control	89	.705	2.485
Leverage Control	143	.81	.78
Firm Size	141	2.27	.584
Transportation and Storage			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	36	-.028	.587
Tech Control	31	-.351	.062
Leverage Control	36	.462	.275
Firm Size	21	2.333	.73

Water collection, treatment, and distribution; Sanitation Waste Management and Remediation			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	1084	.184	.673
Tech Control	889	-.103	.647
Leverage Control	1083	.732	.537
Firm Size	1028	2.651	.892
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorbikes			
IPR 11	0	.	.
IPR 14	0	.	.
IPR 17	0	.	.
Prod Control	1720	.105	.919
Tech Control	1397	.133	1.265
Leverage Control	1715	.767	.619
Firm Size	1482	2.468	.829

7.3 Appendix C – Descriptive Statistics of Green Practises by industry

	N	Mean	Sd
Hospitality, Restaurants and Similar Services			
ITR	23	.087	.288
CPR	23	.261	.449
FGR	23	.087	.288
RCE	23	.174	.388
TES	23	.174	.388
EPA	23	.609	.499
Revenues	23	1.739	8.341
Investments	22	98.955	464.138
Expenses	23	925.37	2898.466
SEF	3	0	0
Administrative and Support Service			
ITR	17	.059	.243
CPR	17	.176	.393
FGR	17	.118	.332
RCE	17	.059	.243
TES	17	.294	.47
EPA	17	.412	.507
Revenues	17	0	0
Investments	17	1852.941	7639.872
Expenses	17	1669.561	5327.878
SEF	1	8	.
Agriculture, Livestock, Hunting, Forestry and Fishing			
ITR	16	.063	.25
CPR	16	.188	.403
FGR	16	.063	.25
RCE	16	.25	.447
TES	16	.313	.479
EPA	16	.75	.447
Revenues	16	218.75	875
Investments	16	656.25	2625
Expenses	16	1580.354	5242.04
SEF	2	0	0

	N	Mean	Sd
Artistic, Entertainment, Sports and Recreational Activities			
ITR	6	0	0
CPR	6	.167	.408
FGR	6	0	0
RCE	6	0	0
TES	6	0	0
EPA	6	.167	.408
Revenues	6	0	0
Investments	6	0	0
Expenses	6	139	340.479
SEF	1	0	.
Construction			
ITR	87	.011	.107
CPR	87	.103	.306
FGR	87	.046	.211
RCE	86	.209	.409
TES	87	.207	.407
EPA	87	.552	.5
Revenues	87	941.354	5441.204
Investments	87	1367.816	12758.139
Expenses	87	2352.044	15198.72
SEF	7	5.429	9.502
Consulting, Scientific, Technical and Similar activities			
ITR	27	.111	.32
CPR	27	.333	.48
FGR	27	.074	.267
RCE	27	.185	.396
TES	27	.222	.424
EPA	27	.556	.506
Revenues	27	759.025	3222.413
Investments	26	246.577	1039.494
Expenses	27	8405.694	31830.302
SEF	4	3.25	3.594

Electricity, Gas, Steam, Hot and Cold Water and Cold Air			
ITR	884	.092	.289
CPR	884	.32	.467
FGR	882	.306	.461
RCE	882	.264	.441
TES	881	.254	.436
EPA	881	.585	.493
Revenues	884	46577.531	250934.81
Investments	884	206810.88	1994456.6
Expenses	884	252985.21	1297088.5
SEF	177	45.689	148.196
Human Health and Social Assistance			
ITR	10	.2	.422
CPR	10	.4	.516
FGR	10	.3	.483
RCE	10	.3	.483
TES	10	.3	.483
EPA	10	.5	.527
Revenues	10	2235.85	4723.059
Investments	10	20880	45770.073
Expenses	10	57192.2	125660.88
SEF	3	12.667	8.386
Information and Communication			
ITR	10	0	0
CPR	10	0	0
FGR	10	0	0
RCE	10	.2	.422
TES	10	.2	.422
EPA	10	.6	.516
Revenues	10	0	0
Investments	10	0	0
Expenses	10	0	0
SEF	0	.	.
Manufacturing Industry			
ITR	30724	.103	.304
CPR	30724	.396	.489
FGR	30691	.215	.411
RCE	30673	.29	.454
TES	30674	.316	.465
EPA	30689	.746	.435
Revenues	30721	32103.426	232129.29
Investments	30706	12839.466	139365.02
Expenses	30721	45542.092	266175.5
SEF	7321	9.416	48.279
Mining and Quarrying			
ITR	1368	.083	.276
CPR	1368	.27	.444
FGR	1367	.285	.452
RCE	1367	.214	.41
TES	1367	.275	.447
EPA	1366	.607	.489
Revenues	1368	4660.031	37328.016
Investments	1366	47463.993	619952.94
Expenses	1368	43999.178	415175.9
SEF	198	7.364	12.957
Other Services Activities			
ITR	13	0	0
CPR	13	0	0
FGR	13	0	0
RCE	12	0	0
TES	13	.538	.519
EPA	13	.769	.439
Revenues	13	0	0
Investments	13	0	0
Expenses	13	0	0
SEF	0	.	.
Real estate			
ITR	27	.185	.396
CPR	27	.444	.506
FGR	27	.296	.465
RCE	27	.222	.424
TES	27	.259	.447
EPA	27	.667	.48
Revenues	27	7548.762	19201.781
Investments	27	7172.037	26020.384
Expenses	27	18091.214	34566.598
SEF	6	8.333	3.882
Transportation and Storage			
ITR	6	0	0
CPR	6	0	0
FGR	6	0	0
RCE	6	0	0
TES	6	0	0
EPA	6	0	0
Revenues	6	0	0
Investments	6	0	0
Expenses	6	0	0
SEF	2	0	0
Water collection, treatment and distribution; Sanitation Waste Management and Remediation			
ITR	758	.084	.278
CPR	758	.252	.434
FGR	758	.508	.5
RCE	758	.476	.5
TES	758	.446	.497
EPA	758	.801	.4
Revenues	758	2456.92	13010.42
Investments	758	8956.678	66137.382
Expenses	758	38138.088	173217.24
SEF	89	11.539	20.729
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorbikes			
ITR	216	.056	.23
CPR	216	.25	.434
FGR	213	.117	.323
RCE	216	.148	.356
TES	216	.162	.369
EPA	216	.542	.499
Revenues	216	3487.069	32250.936
Investments	216	3010.301	22104.501
Expenses	216	35879.021	171847.14
SEF	25	2.12	1.833

7.4 Appendix D – Tables for regressions with region fixed effects model

Table 11: Regression Analysis – IPR11

A multiple linear regression with qualitative and quantitative factors, described in ten measures, was used to investigate the relationship between China's dependence and the application of green practices in businesses. As noted previously, variables are defined. Below the coefficients, T-statistics are shown in parenthesis. The symbols *, **, and *** denote the statistical significance of coefficients at the 10%, 5%, and 1% levels, respectively, with standard errors in parenthesis.

VARIABLES	ITR	CPR	FGR	RCE	TES	EPA
IPR11	0.001	0.005	-0.002	0.005	0.003	-0.005
	(0.188)	(0.448)	(-0.157)	(0.394)	(0.308)	(-0.510)
Prod	0.135***	0.158***	0.241***	0.126***	0.200***	0.071***
	(9.802)	(8.428)	(13.808)	(6.092)	(10.076)	(4.145)
Tech	-0.010	-0.023***	-0.029***	-0.003	-0.012	-0.021***
	(-1.605)	(-2.692)	(-3.680)	(-0.323)	(-1.277)	(-2.621)
Leverage	0.000	-0.001	-0.000	-0.000	-0.000	-0.003
	(0.225)	(-0.350)	(-0.187)	(-0.096)	(-0.122)	(-1.618)
Small	-0.453***	-0.821***	-0.774***	-0.404***	-0.617***	-0.366***
	(-27.766)	(-36.859)	(-37.263)	(-16.399)	(-26.116)	(-17.966)
Medium	-0.325***	-0.283***	-0.469***	-0.189***	-0.345***	-0.070***
	(-21.092)	(-13.444)	(-23.870)	(-8.123)	(-15.456)	(-3.614)
Large	-0.424***	-0.577***	-0.692***	-0.277***	-0.487***	-0.155***
	(-24.909)	(-24.871)	(-31.991)	(-10.803)	(-19.797)	(-7.327)
Constant	0.489***	0.949***	0.861***	0.608***	0.788***	0.970***
	(34.178)	(48.616)	(47.260)	(28.168)	(38.091)	(54.295)
Observations	6,755	6,755	6,748	6,747	6,746	6,749
R-squared	0.159	0.324	0.274	0.088	0.166	0.135
Region FE	YES	YES	YES	YES	YES	YES

VARIABLES	Revenues	Investments	Expenses	SEF
IPR11	-819.938	-99.035	2,435.093	26.742*
	(-0.154)	(-0.026)	(0.316)	(1.880)
Prod	49,562.434***	91,204.484***	244,118.016***	15.543***
	(5.170)	(13.373)	(17.621)	(3.717)
Tech	869.904	-7,301.345**	-33,958.707***	0.303
	(0.199)	(-2.345)	(-5.365)	(0.151)
Leverage	359.006	591.656	1,318.623	9.482**
	(0.341)	(0.791)	(0.867)	(2.147)
Small	-287,198.563***	-147,915.031***	-554,426.938***	-29.600***
	(-25.194)	(-18.246)	(-33.653)	(-3.589)
Medium	-255,083.438***	-136,699.156***	-513,682.000***	-23.306***
	(-23.678)	(-17.845)	(-32.993)	(-7.644)
Large	-289,458.063***	-153,177.500***	-571,207.000***	-29.185***
	(-24.375)	(-18.139)	(-33.282)	(-5.768)
Constant	290,154.438***	156,650.609***	575,721.313***	24.570***
	(29.028)	(22.040)	(39.854)	(6.667)
Observation	6,755	6,751	6,755	1,896
R-squared	0.129	0.110	0.249	0.067
Region FE	YES	YES	YES	YES

Table 12:Regression Analysis – IPR14

A multiple linear regression with qualitative and quantitative factors, described in ten measures, was used to investigate the relationship between China's dependence and the application of green practices in businesses. As noted previously, variables are defined. Below the coefficients, T-statistics are shown in parenthesis. The symbols *, **, and *** denote the statistical significance of coefficients at the 10%, 5%, and 1% levels, respectively, with standard errors in parenthesis.

VARIABLES	ITR	CPR	FGR	RCE	TES	EPA
IPR14	-0.002	-0.001	-0.009	0.001	0.002	-0.001
	(-0.262)	(-0.103)	(-0.858)	(0.098)	(0.138)	(-0.144)
Prod	0.135***	0.158***	0.241***	0.126***	0.200***	0.071***
	(9.801)	(8.428)	(13.805)	(6.093)	(10.077)	(4.143)
Tech	-0.010	-0.023***	-0.029***	-0.003	-0.012	-0.021***
	(-1.589)	(-2.675)	(-3.650)	(-0.316)	(-1.274)	(-2.628)
Leverage	0.000	-0.001	-0.000	-0.000	-0.000	-0.003
	(0.224)	(-0.351)	(-0.189)	(-0.097)	(-0.122)	(-1.617)
Small	-0.453***	-0.821***	-0.774***	-0.404***	-0.617***	-0.366***
	(-27.755)	(-36.846)	(-37.243)	(-16.394)	(-26.111)	(-17.966)
Medium	-0.325***	-0.283***	-0.469***	-0.189***	-0.345***	-0.069***
	(-21.094)	(-13.447)	(-23.871)	(-8.126)	(-15.458)	(-3.611)
Large	-0.423***	-0.577***	-0.692***	-0.277***	-0.487***	-0.156***
	(-24.898)	(-24.860)	(-31.974)	(-10.798)	(-19.793)	(-7.329)
Constant	0.489***	0.949***	0.861***	0.608***	0.789***	0.969***
	(34.181)	(48.619)	(47.269)	(28.169)	(38.091)	(54.290)
Observations	6,755	6,755	6,748	6,747	6,746	6,749
R-squared	0.159	0.324	0.274	0.088	0.166	0.135
Region FE	YES	YES	YES	YES	YES	YES

VARIABLES	Revenues	Investments	Expenses	SEF
IPR14	157.828	-161.706	762.149	19.342
	(0.028)	(-0.041)	(0.094)	(1.292)
Prod	49,559.012***	91,202.953***	244,135.688***	16.091***
	(5.170)	(13.373)	(17.622)	(3.851)
Tech	847.551	-7,298.582**	-33,929.531***	0.150
	(0.193)	(-2.343)	(-5.359)	(0.075)
Leverage	359.415	591.602	1,318.119	9.639**
	(0.341)	(0.790)	(0.867)	(2.182)
Small	-287,224.688***	-147,910.656***	-554,400.563***	-29.046***
	(-25.192)	(-18.243)	(-33.646)	(-3.513)
Medium	-255,073.063***	-136,697.938***	-513,712.688***	-23.611***
	(-23.677)	(-17.845)	(-32.995)	(-7.755)
Large	-289,489.125***	-153,173.375***	-571,168.438***	-29.764***
	(-24.374)	(-18.136)	(-33.276)	(-5.891)
Constant	290,140.281***	156,652.078***	575,741.750***	24.440***
	(29.026)	(22.040)	(39.854)	(6.616)
Observations	6,755	6,751	6,755	1,896
R-squared	0.129	0.110	0.249	0.066
Region FE	YES	YES	YES	YES

Table 13: Regression Analysis – IPR17

A multiple linear regression with qualitative and quantitative factors, described in ten measures, was used to investigate the relationship between China's dependence and the application of green practices in businesses. As noted previously, variables are defined. Below the coefficients, T-statistics are shown in parenthesis. The symbols *, **, and *** denote the statistical significance of coefficients at the 10%, 5%, and 1% levels, respectively, with standard errors in parenthesis.

VARIABLES	ITR	CPR	FGR	RCE	TES	EPA
IPR17	-0.012	-0.031	-0.022	-0.035	-0.042*	-0.041*
	(-0.727)	(-1.345)	(-1.018)	(-1.357)	(-1.714)	(-1.940)
Prod	0.135***	0.158***	0.241***	0.126***	0.200***	0.071***
	(9.807)	(8.439)	(13.815)	(6.103)	(10.091)	(4.157)
Tech	-0.010	-0.022***	-0.029***	-0.002	-0.011	-0.020**
	(-1.561)	(-2.609)	(-3.629)	(-0.243)	(-1.180)	(-2.533)
Leverage	0.000	-0.001	-0.000	-0.000	-0.000	-0.003
	(0.219)	(-0.361)	(-0.194)	(-0.108)	(-0.136)	(-1.632)
Small	-0.453***	-0.820***	-0.774***	-0.403***	-0.616***	-0.365***
	(-27.749)	(-36.831)	(-37.245)	(-16.371)	(-26.085)	(-17.940)
Medium	-0.326***	-0.283***	-0.469***	-0.189***	-0.345***	-0.070***
	(-21.100)	(-13.461)	(-23.880)	(-8.139)	(-15.477)	(-3.630)
Large	-0.423***	-0.576***	-0.692***	-0.276***	-0.486***	-0.155***
	(-24.896)	(-24.847)	(-31.979)	(-10.778)	(-19.770)	(-7.305)
Constant	0.490***	0.950***	0.861***	0.609***	0.790***	0.971***
	(34.186)	(48.644)	(47.270)	(28.205)	(38.139)	(54.341)
Observations	6,755	6,755	6,748	6,747	6,746	6,749
R-squared	0.159	0.324	0.274	0.088	0.167	0.136
Region FE	YES	YES	YES	YES	YES	YES

VARIABLES	Revenues	Investments	Expenses	SEF
IPR17	-17,139.119	-1,137.115	-12,696.820	37.915**
	(-1.442)	(-0.135)	(-0.739)	(2.542)
Prod	49,651.945***	91,210.117***	244,200.594***	17.265***
	(5.180)	(13.374)	(17.627)	(4.108)
Tech	1,176.270	-7,281.987**	-33,666.508***	0.275
	(0.268)	(-2.336)	(-5.314)	(0.137)
Leverage	347.704	590.923	1,309.071	10.098**
	(0.330)	(0.790)	(0.861)	(2.289)
Small	-286,926.063***	-147,898.000***	-554,152.500***	-28.218***
	(-25.171)	(-18.242)	(-33.634)	(-3.415)
Medium	-255,217.688***	-136,707.516***	-513,819.875***	-23.095***
	(-23.693)	(-17.846)	(-33.002)	(-7.575)
Large	-289,216.813***	-153,162.781***	-570,938.563***	-28.946***
	(-24.357)	(-18.136)	(-33.267)	(-5.724)
Constant	290,646.438***	156,682.656***	576,128.063***	23.312***
	(29.065)	(22.032)	(39.860)	(6.258)
Observations	6,755	6,751	6,755	1,896
R-squared	0.129	0.110	0.249	0.068
Region FE	YES	YES	YES	YES