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Systematic Review

What's Happening with the Patent Box Regimes? A Systematic Review

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Abstract: Patent Box regimes are a tax relief incentive promoted by governments to encourage the R&D activities of enterprises. The literature developed on Patent Box is still examining the effects on certain economic variables. Thus, this research conducted a systematic review of the Patent Box literature since 2010 and applied regimes worldwide. For this aim, the authors developed a comprehensive systematic review using the PRISMA scheme, analyzed the main scientific characteristics with bibliometrix R-package, and prepared a summary table with the attributes collected from the Patent Box scheme applied worldwide. The findings showed that the Patent Box literature is focused on describing applications on countries and implications, analyzing its effects on company and country performance, or examining its influence on location choices. However, there is no definitive consensus on its effect on innovation or economic outcomes, which finally depends on the design of this scheme. As an applied tool, Patent Box is mainly used in European countries. This review and future updates could help as a reference monitor of the Patent Box mechanism.

Keywords: patent box; literature review; PRISMA; innovation; taxes; bibliometrix R-package; systematic review

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1. Introduction

Innovation activities are a crucial factor in countries' economic growth and productivity, so it is necessary to motivate companies toward it [1,2]. Governments have introduced fiscal incentives to encourage the firm's R&D activities with tax-related tools or money support [3]. With this aim, many governments have designed strategies for the promotion of R&D activities such as grants, loans, investments in R&D, "super-deductions" of R&D expenses, tax credits for R&D, accelerated depreciation programs, and payroll tax credits, as well as the creation of the Patent Box (PB), Intellectual Property Box, or Innovation Box regime [1,4].

Patent Box is a term for low preferential rates applied to income generated by patents, intellectual assets, or intellectual property rights [5–7]. A report from PricewaterhouseCoopers (PWC) described that a company who wants to apply to the Patent Box relief should (1) estimate their relevant IP income, (2) deduct related costs as routine or marketing return, and (3) calculate the Nexus fraction (proportion of IP profits subject to Patent Box) [8].

Many countries have used this policy to promote benefits and encourage enterprises' R&D activities. A report of Her Majesty's Revenue and Customs (HMRC) about the Patent Box regimen in the United Kingdom showed that 1160 companies claimed the patent box tax relief with a total value of 1031 million euros in the 2019–2020 fiscal year [9]. Thus, its effects have attracted the attention of worldwide researchers, developing studies analyzing their impact around the world.

There are reviews, in the academic literature, about the effects of fiscal incentives on innovation activities that gather empirical evidence and discuss methodological issues,

economic effects, and different levels of scope (firm, industry, or country) [10,11]. Similarly, recent meta-analyses have contributed to the research with specific studies of certain characteristics of tax incentives, such as direct or indirect government support and tax schemes to explain the heterogeneity in the empirical evidence developed thus far [3,12,13]. However, this kind of work related to the Patent Box does not exist. During recent years, with more countries adopting this tax incentive and increasing the data available at the country or enterprises level, various studies on PB have been developed with different empirical models such as the Blundell–Bond Model [1], Difference in Differences estimation at a city or country level [5,14,15], Fixed-Country-Effects Poisson Model at the country level [4], and events study methods [16]. However, no review has developed a general framework for this tax tool. On the other hand, as an applied tool, Patent Box has been described and analyzed in nonscientific research documents such as the Corporate Tax Heaven report about the Tax Heaven Index [17], the Corporate Taxes report about the country's profile in taxes [18], and the R&D Incentives Guide [19].

Therefore, this document aims to fill in the gap in the literature about R&D incentives gathering the previous works about Patent Box by executing a systematic review of this topic. Patent Box is a novel tool to encourage R&D activities with incipient academic literature and still growing empirical evidence about its effectiveness. In this sense, the authors aim to respond to the following questions: What are the observed effects of the application of Patent Box in countries? How widespread is this tax incentive?

For this purpose, this document conducts a comprehensive systematic review of the Patent Box based on the PRISMA scheme [20] in the literature developed worldwide. First, it describes the main characteristics of the scientific production developed in the last ten years using the R tool for bibliometric analysis called "Bibliometrix." It is followed by a detailed analysis of the Patent Box's research development, ending with the data collection and analysis of the characteristics of the Patent Box scheme applied among countries.

This document is structured as follows: Section 2 contains the conceptual framework of Patent Box. Section 3 describes the methodology applied to select and analyze the academic literature. Section 4 shows the descriptive results of the literature review and the Patent Box as a tool used worldwide. Finally, the last part details the discussions and conclusions.

2. Conceptual Framework

Patent Box regimes aim to improve R&D and encourage the country's position on intellectual property benefits [21]. Unlike standard policies such as grants, subsidies, and other fiscal incentives, which are considered front-end (when companies incur expenses), Patent Box regimes are back-end incentives (when revenues are generated) [4,22,23]. All these policies are applied in a combined way [24]. Governments have three reasons to introduce the Patent Box: (i) to encourage companies to develop innovation activities, (ii) to attract or retain investments with highly skilled labor and knowledge creation, and (iii) to improve revenue streams with differentiated tax rates [7,25]. This kind of tool can vary across countries depending on its design. There are cases in which the incentive is called "Patent Box", referring purely to the treatment of patents. In other cases, it is named "Innovation Box" due to the reduction in the formal requirement of patents focusing on immaterial assets [5]. In this sense, there are some relevant distinctions between Patent Box schemes. These are coverage, gross or net income, existing IP, and acquired IP [26].

The Patent Box system appeared in France and Ireland initially in the 1970s. It then spread to other countries such as Belgium, China, Luxembourg, the Netherlands, and Spain between 2007 and 2008, the United Kingdom in 2013, Portugal in 2014, and Italy in 2015 [15]. Later, it rose in other non-European countries such as China, Israel, and Turkey [27]. This development received particular attention in 2013 from the OECD, which designed a normative scheme on preferential harmful tax regimes in Action No. 5 of the Base Erosion and Profit Shifting (BEPS) [28]. It established a link between the Patent Box regime and the place of origin of the R&D process, the maximum amount of intellectual

property income subject to a preferential rate, and the ratio to qualified expenses in the tax jurisdiction. Thus, the "nexus" approach seeks to establish a connection between back-end incentives for intellectual property revenues with the research and development expenditures [23] excluding intangible assets such as trademarks, logos, or names [24].

In general terms, there is evidence of the mixed relationship between fiscal incentives and innovation outcomes or R&D. In the case of direct government incentives, grants, subsidies, and other fiscal incentives for R&D may not always encourage innovation expenditures [29]. There is evidence of positive effects on innovation outputs [30–32], adverse effects [33], and mixed effects in the same analysis [34]. Moreover, the Patent Box does not differ, due to its novelty and complexity [16]. Empirical findings of the relationship between Patent Box and economic variables such as patent output or company performance are described in the following sections.

3. Methodology

This research sought a complete overview of the Patent Box (PB). With this aim, it processed two kinds of data, the scientific production and the current regimes applied by all Patent Box countries.

3.1. Scientific Research Selection

3.1.1. Search Strategy and Information Sources

This research adopted the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement [20]. It allowed us to describe the review process in an objective and ordered way. PRISMA (See Supplementary File) methodology principles were used to select the articles that accomplish the relevance of the topic in titles and abstracts during screening. The systematic search was conducted on the Scopus Database to find studies about Patent Box Regimes. The last literature search was on 31 July 2022, with the keywords PATENT BOX (PB).

The Scopus database retrieved 552 results on the website with the "Patent" and "Box" keywords. These keywords were separated to include effects of others patent regimes such as Innovation Box and Intellectual Property Box. Papers have been published since 1838 on the subject, but Patent Box is a recently implemented policy for most countries (since the 2000s). In this sense, the analysis period was defined from 2010 to 2022 to cover the most appropriate range of periods with documents developed about the topic.

In addition, manuscripts were found in different research areas such as Economics, Medicine, or Engineering due to the general use of the word "patent" associated with inventions and technology development. With this consideration, results were delimited by subject, considering results in the Economics, Business, and Social Science fields.

According to the PRISMA scheme in Figure 1, 552 potential documents were identified with PATENT BOX keywords from the SCOPUS database. Two hundred thirty-two records were removed after filtering by the period of analysis selected. Two hundred forty-five records were eliminated due to their subject, and only Economics, Accounting, and Social Science were included. In the remaining sample, 44 articles were dropped for not being related to Patent Box, and a small group of 5 documents was removed by accessibility; the files were not found on the web. At the end of the process, 26 studies were selected for review and analysis.

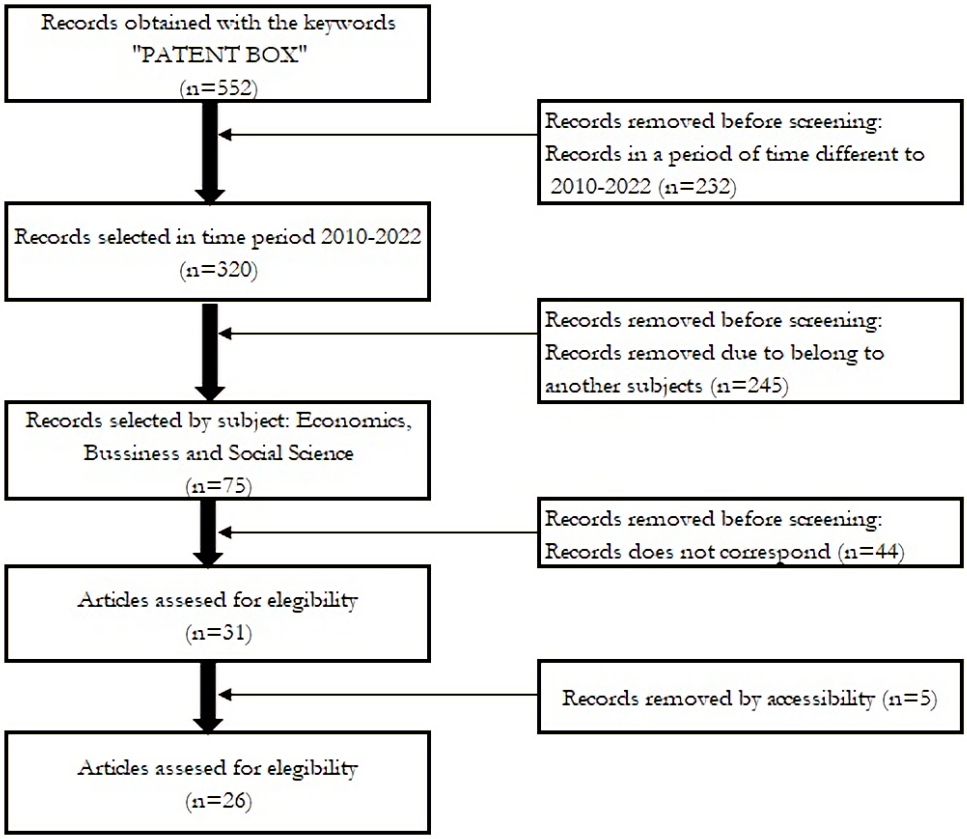

Figure 1. PRISMA flow diagram about Patent Box systematic review.

The findings were confirmed by applying the alternative terms "Innovation Box" and "intellectual property box" without obtaining different results.

3.1.2. Inclusion and Exclusion Criteria

Inclusion Criteria: This review had no limitations on geographical variables. All published studies discussing Patent Box were included. Studies in a different language were translated to English to be analyzed.

Exclusion Criteria: Documents were selected by filtering by year of publication and the subject of the document.

Titles, abstracts, and content were thoroughly and carefully reviewed to determine if they were eligible. Articles that did not report Patent Box were excluded.

3.2. Scientific Production Analysis

After the PRISMA scheme, the documents selected were analyzed in detail to extract the related contribution to the Patent Box from each one. Information about the author, year of publication, title, type of analysis (quantitative or qualitative), main outcomes, research objective, methodologies used, and countries analyzed were listed to show the main similarities and differences between the evidence developed.

3.3. Bibliometric Analysis

A bibliometric analysis was conducted using the R-package called "Bibliometrix" [35], designed to perform a comprehensive science mapping analysis. This tool allows a quantitative analysis of the variables related to scientific production such as author, year, country of publication, and sources. Furthermore, analysis of the bibliographic characteristics, document types, and authors were performed using this tool for the scientific production per year and country.

3.4. Current Regimes in Patent Box Countries

In the case of the current Patent Box regimes around the world, information was obtained from leading international tax and policy organizations such as the Organization for Economic Co-operation and Development (OECD), PricewaterhouseCoopers (PWC), Ernest and Young (EY), and Tax Foundation. The main table obtained from the Tax Foundation report about Patent Box [36] was complemented and updated with data per country of Intellectual Property regimes displayed on the OECD website [37], summary per country of corporate taxes report [18], and the R&D incentives references guide [19]. These details were summed up to obtain the most current and precise information on the countries with PB, year of implementation, type of qualified PI assets, PB rate, and the Corporate Income Tax.

4. Results

4.1. Sample Characteristics

The study's first objective refers to the descriptive results of the selected sample. According to Figure 1, 26 studies were determined using the PRISMA process [20]. Table 1 details the descriptive information of the sample, which was selected starting on 2010. It also shows the findings from twenty-one diverse sources such as books or journals from 2013 to 2022. On average, the documents are approximately five years old, cited by nearly 11 research documents. The records selected were divided into twenty-one articles, one book, one book chapter, and three reviews. There are forty-nine authors in the total of the chosen studies; eight of them worked on single-authored documents, and an average of two authors per document worked in collaboration cases.

Table 1. Descriptive summary of the studies.

Description	Results
Timespan	2013–2021
Sources (Journals, Books, etc.)	21
Documents	26
Average years from publication	4.73
Average citations per document	11.08
References	1239
Document Types	
Article	21
Book	1
Book chapter	1
Review	3
Authors	
Authors	49
Authors of single-authored documents	8
Co-Authors per Doc	2.08

The USA is the leading country with thirteen developed research studies about Patent Boxes. Germany follows it with seven research documents, the United Kingdom with six contributions, and Belgium, China, and the Netherlands with three studies. According to the registers, Austria and Norway have two studies until the analyzed date.

According to Figure 2, the PB scientific research is concentrated in North America, a few countries in Europe, and China. Moreover, the evidence shows the absence of PB scientific contributions from LAC, Africa, and Oceania.

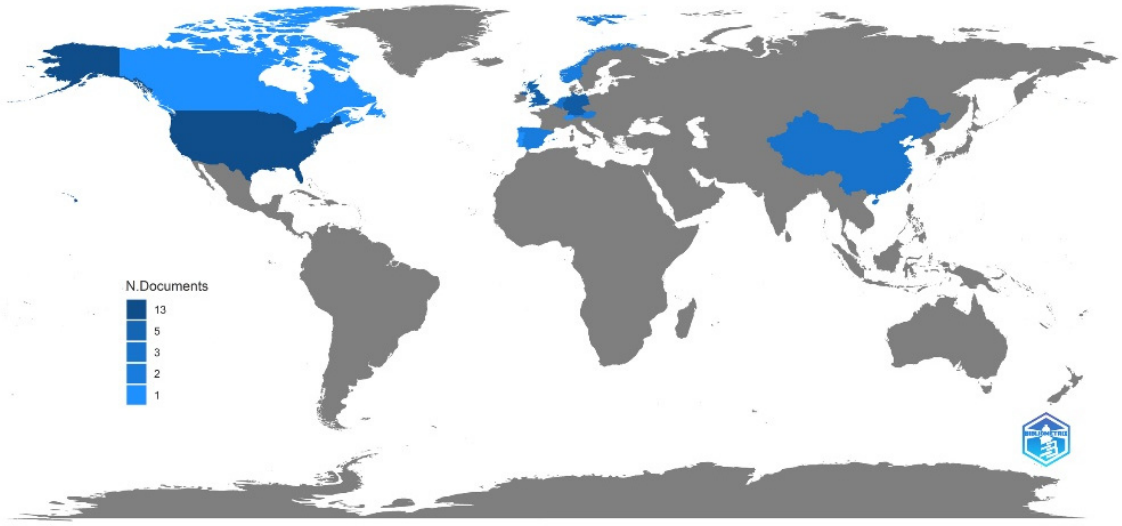

Figure 2. Scientific production of Patent Box by Country.

The annual scientific production graph shows that research on the Patent Box topic increased between 2014 and 2018 but has decreased in recent years. However, in 2021, the scientific production on this topic received renewed attention, reaching four new works (see Figure 3).

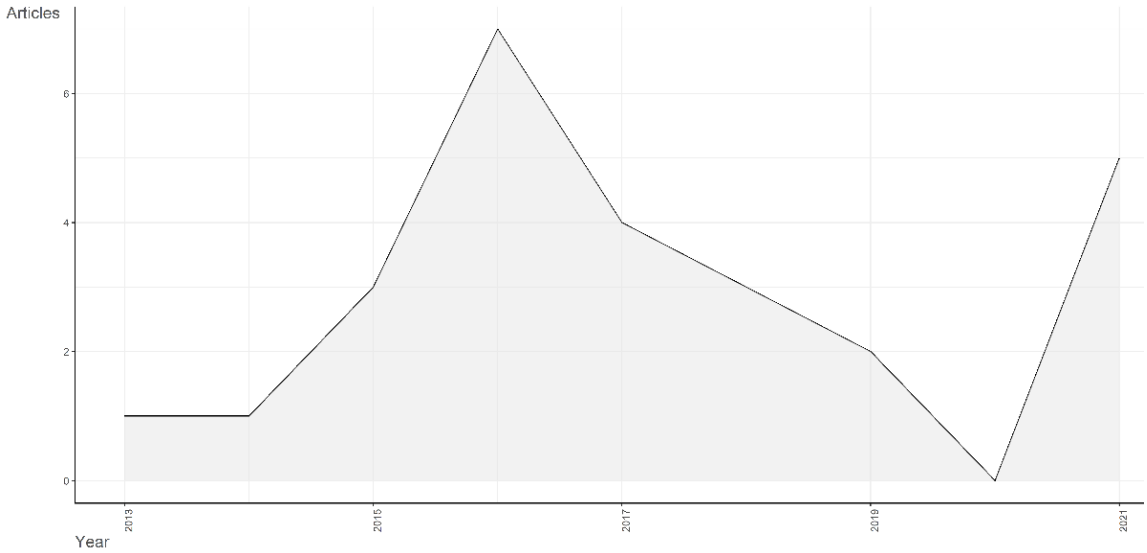

Figure 3. Annual Scientific Production of Patent Box.

4.2. Patent Box: A Complete Review

This subsection explores the documents gathered in the systematic reviews, its methodologies, and findings. Twenty-six documents were selected and reviewed through the PRISMA method [20], as seen in Figure 1; sixteen studies offer an empirical contribution with a quantitative approach, while the ten documents remain purely qualitative. Patent Box documents were developed around four themes or research interests: effects on company performance, impacts on patent activity, effects on patent location, and descriptions of the Patent Box regime (including the Nexus approach). See Appendix A with the relevant information summarized from the selected research articles list

Qualitative papers were focused on the implementation and evolution of Patent Box [38,39], trust in government and trade issues [24], the Nexus Approach [23,27], its effectiveness [40], and experience in countries with earlier implementation [41]. In addition,

qualitative studies generally analyzed a single country such as Portugal [38], Germany [40], Luxembourg [27], the United States [23,42], and United Kingdom [39]

Qualitative papers discuss the Patent Box's effect on states due to harmful tax competition and migration of intangible assets [24]. These practices led to the BEPS Action 5 deals, with two different versions, one focusing on entities and another on the underlying R&D [27]. Three analyses of the respective country's legislation and procedures indicate that these countries modified their Patent Box regimes according to the new standard proposed by OECD or anti-avoidance practices. These new regimes still have pending improvements, such as the law framework, practical applications [27,38], or competition over mobile resources [39]. These examples and the details from other cases served as insight for the proposal of this tax incentive in the United States, recommending special attention to the income generated by patents and their international mobility [23,42].

Quantitative research, on the other hand, is focused on evaluating the Patent Box effects, but some have a broader focus on tax incentives programs for R&D [1,4,43]. Studies in this approach have analyzed the relationship between Patent Box and patent activity such as filing patents [4,6], merger and acquisitions incentives [16], Patent Box and patent location [2,26,43], and Patent Box with other performance variables such as foreign direct investment on R&D [15], innovative firm's performance [1], R&D investment [5,44], R&D expenditure [45], and foreign R&D activity [46].

The most common measure used is the "number of patents" [2,4,6,26]. Other variables are also used to explain the performance of patent boxes: foreign direct investment (FDI) [15], return on assets (ROA) [1] or deals, and the probability of being acquired [16]. The methods used in quantitative papers were diverse. However, panel data techniques were used frequently with regular application of difference-in-differences estimations [5,15], triple differences with event study methods [16], and the Poisson model with fixed and random effects [4,26]. Some studies drew on a particular mathematical model such as the Blundell–Bond Model [1] or the Choice model [43]. Others applied descriptive equations [7,21].

Empirical evidence on the Patent Box's effects on companies, country outcomes, or location choices was mixed. However, there is positive empirical evidence on attracting patents [6], FDI inflows [15], R&D activities [5,16], new patents [2], and company performance [1]. There is also empirical evidence of the Patent Box's adverse effects on localization decisions [26] and complexities arising from the regime [38].

The first papers in the selected period described the Patent Box regime. They studied the location choices compared to other tax incentives, finding positive empirical evidence of the Patent Box on patent applications and the share of new patents [2,43]. The first debates on the application of the Patent Box and criticisms of the nexus approach appeared in 2015. It was concluded that Patent Boxes "are not well targeted to innovative activities." [39].

In 2016, there was a growing interest in this policy (seven papers, the highest in the time range analyzed) with a focus on explaining the Patent Box implementations, analyzing this tool in theoretical microeconomic models of companies' performance, but also determining the feasibility of implementing this measure in the United States. Papers on this last issue, developed in the United States, concurred with the complications of implementing a Patent Box scheme in that country. It is designed to promote lower taxes to spur R&D and investments and compete with other countries [22]. In this regard, the researchers suggested that a competitive scheme would discourage income shifting by reducing tax jurisdictions and encouraging investment in the country. [21,23]. On the other hand, microeconomic theoretical models about welfare and revenues with effects of different tax schemes [44,47] gave a favorable position about Patent Box on innovation and capital investment.

In the next period of the research (2017–2019), scientific production of Patent Box spread to other countries such as the Netherlands, Austria, China, and Russia, with the incursion of works dedicated to the patent box but with the changes implemented by the "Nexus Approach" in one country. For example, the study of the Patent Box in the

Netherlands allowed researchers to determine that the Patent Box in this country simulates R&D [5]. However, in Germany's case, conclusions about Patent Box after the nexus approach discard this incentive as a tool for relocating intellectual property [40]. This was also the case for Portugal, which determined this policy as noncompetitive and without significant changes after the nexus approach was in force [38]. Additionally, papers in this period with data from various countries studied the Patent Box effects with robust methodologies (such as difference in differences, Blundell–Boll equations, and Poisson models). Mixed evidence was found on Patent Boxes' positive effects on company performance variables as attracting patents [1,6] but reducing patent imports [4].

The last analysis period was 2021 (five studies, the second highest after 2016). Evidence developed has considered the changes in the nexus approach in company performance variables. In this sense, empirical evidence shows that the nexus approach decreases the volume of deal activity [2] and is insignificant for the R&D activities in other countries [46].

4.3. Current Patent Box Regimes in the World

To reach objective three on how the Patent Box regime is applied and developed between countries, the following variables have been identified: country, beginning year, type of qualified assets in the PB regime, the PB rate, and the corporate income tax. According to the OECD data [37] and a Tax Foundation report [36], about twenty-six countries have different preferential schemes such as the Patent Box or intellectual property box, see Table 2. According to Table 2, the PB regime among twenty-six countries and regions is heterogeneous. The tax rate, the tax base, and expense considerations differ widely [5,7].

Table 2. Countries with Patent Box/IP Box regimes.

No	Country	Year Implemented	Qualified PI Assets			Patent Box Rate	Corporate Income Tax
			Patent	Software	Others *		
1	Andorra	2010	✓	✓		2%	10%
2	Belgium	2008	✓	✓		3.75%	25%
3	China **	2008	✓			15%	25%
4	Curacao	2018	✓	✓	✓	0%	22%
5	Cyprus	2012	✓	✓		2.5%	12.5%
6	France	2000	✓	✓	✓	10%	28.4%
7	Hungary	2003	✓	✓		0% for qualifying IP and 4.5% in royalties' income	9%
8	India	2016	✓			10.3% to 11.85%	30.91% to 35.45%
9	Ireland	1973	✓	✓	✓	6.25%	12.5%
10	Israel	2017	✓	✓	✓	5%, 7.5%, 8%, 16%	23%
11	Italy	2015	✓	✓		13.91%	27.81%
12	Lithuania	2018	✓	✓		5%	15%
13	Luxemburg	2008	✓	✓		4.99%	24.94%
14	Malta	2010	✓	✓	✓	1.75% minimum (referred to as a deduction of 95% of net income)	35%
15	Netherlands	2007	✓	✓	✓	9%	25%
16	Poland	2019	✓	✓		5%	19%
17	Portugal	2014	✓			10.5%	21%
18	San Marino		✓	✓		0% or 8.5%	17%
19	Slovakia	2018	✓	✓		10.5%	21%
20	Spain (Federal)	2008	✓	✓		10%	25%
21	Spain (Basque Country)	2008	✓	✓		7.8%	25%
22	Spain (Navarre)	2008	✓	✓		8.4%	25%
23	Singapore	2018	✓	✓		5% or 10%	17%
24	Switzerland	2020	✓			Tax base reduction of up to 90% on patent income	11.9–21.6% (canton level)
25	Turkey	2015	✓		✓	12.5%	25%
26	United Kingdom	2013	✓			10%	19%

* Refers to uncommon IP assets, e.g., for SMNE companies. ** China has reduced tax rates for Technologically Advanced Service Companies (TASC) and High and New Technology Enterprises (HNTE).

Sixteen European countries have used this tax incentive, while other countries such as Israel, Singapore, and China implemented the PB regime later. All these countries were listed to declare a Patent Box regime being reported by international organizations such as OECD, Tax Foundation, PWC, or EY. It excludes other special Patent regimes with tax reliefs similar to Patent Box such as Bermuda [48] because this regime does not report a tax relief in the income generated on the patent trading, being the main characteristic of the Patent Box.

In general, the PB regime was new for most countries except Ireland, which started in 1973. Despite being a pioneer, its regime was abolished in 2010 and reintroduced in 2016 [46]. After Ireland, with substantial time differences, France and Hungary were the following countries to implement this tax scheme in the 2000s [7]. Then, between 2007 and 2008, Belgium, the Netherlands, Spain, Luxemburg, and China implemented this regime, making Poland the latest in 2019.

All countries have a tax reduction for incomes derived from patents, but not at all the drop is applied to other IP assets such as trademarks, software, design, and models [46]. Another classification for the coverage of assets refers to specific IP assets generally for Small and Medium Enterprises [37]. For example, 7 of 26 countries in Table 2 allow "category 3" assets. This category refers to other assets such as projects and rights certified by the government institutions (Ireland and Israel), industrial or manufacturing processes involved in the creation of an invention (France), research for the development of new physical products (the Netherlands), or those with the potential of being patentable (Turkey). Consistent with the Nexus Approach, almost all the countries have a regime scheme applied to the net profits or income of the qualifying IP assets.

Regarding the tax rates, Curacao has the lowest profit tax rate with a 0% in the income from IP activities of intangible assets, followed by Andorra, Cyprus, Belgium, and Hungary. However, the most significant difference between the corporate tax income and the preferential IP tax is in Malta, with 33% fewer taxes than the corporate tax income. This fact approximates the Patent Box rate because Malta offers a 95% deduction on income and capital gains. Other countries with wide margins between PB and CIT rates are India, Curacao, Belgium, and Lithuania, with a mean of 20 percentage points of difference.

5. Discussion

The sampling process offered twenty-six documents through the PRISMA method to comply with the first research objective. The scientific production of forty-nine authors is concentrated mainly in the US, Germany, and the United Kingdom, and there are other kinds of studies that investigated the R&D incentives in multiple countries [1,43,45].

In recent years, the Patent Box has received attention again, and there are almost as many research papers produced from 2021 as in 2016.

Upon closer examination, the Patent Box studies explain the phenomenon by analyzing its contextual and legal framework [24,40]. Qualitative studies mainly discuss the Patent Box cases in countries such as the United Kingdom, Portugal, or Luxembourg and relevant topics such as the Nexus approach for the BEPS Action 5 or trust issues [27,38,39]. Although the OECD initiative promotes recommendations to avoid harmful practices and tax competition, establishing these guidelines has had legal, political, and practical implications [27,38,39]. These considerations could be linked to the mixed results of the Patent Box in quantitative research, as shown above. Empirical works explain the relationship with relevant variables such as patent filing, trade, firm performance, and investment [1,4,5,44].

Empirical evidence suggests a positive effect of Patent Boxes but adverse effects too. These mixed effects are similar to the previous evidence found in other kinds of R&D incentives. The most common public incentives for innovation are fiscal incentives and subsidies [32]. In the case of public subsidies, there is evidence of positive effects on R&D outputs [30], limited positive effects on R&D spending [49], or indeed reducing social welfare [50]. In fiscal incentives such as tax credits, there is evidence of positive effects on innovation outputs [51], so it has no effects on these variables [52]. In the Patent Box case,

positive effects on innovation outputs were found [2,6,43], whereas adverse effects were linked to the difficulty in implementing a correct Patent Box scheme, even supported by the modified nexus approach, which could discourage this policy's primary objectives and allow patent migration and complexities in tax administrations [38]. Although fiscal incentives could be preferred to subsidies for simple implementation and lowered administration costs [32], this could not be the case for Patent Box.

The Netherlands, Italy, and Luxemburg are good examples of great changes in legislation to exclude income eligible for the Patent Box regime with the modified nexus approach [15], and the Portugal case shows a negligible impact of the new framework of IP box on corporate taxation [38]. Mixed effects and differences among policies or countries make relevant the works that seek to compare the R&D incentive programs performance to determine best policies to encourage the R&D activities. A study on Italy showed that subsidies were preferred over tax incentives [53]. There is also empirical evidence of various countries about positive effects of Patent Box and tax credits (tax incentives) but not in the super deductions case [1], or Patent Box negatively influencing the patent filling in contrast to tax credits and super deductions [4].

While evidence and studies about Patent Box are still developing, this tax incentive is spreading in other countries such as Singapore, Slovakia, Lithuania, and Poland. These mixed results can serve as a reference to design better schemes in countries that are recently adopting PB or any additional R&D incentive.

6. Conclusions

Patent Box is a tool for encouraging R&D activities in countries through patent benefits [21]. Academics have observed this phenomenon with incipient literature on its effects, but nonacademic works such as reports described more broadly this tax incentive as an applied concept.

Considering the difference in these approaches and the lack of a review for this tax tool, the present paper aims to review the literature of this topic developed since 2010. Based on a comprehensive systematic review of the Patent Box with the PRISMA scheme [20], 26 research studies were gathered and analyzed with R-package Bibliometrix, showing that PB works were focused mainly on: describing the patent regime in the context of different countries, analyzing its effects on company or country performance, and understanding its influence on location choices.

Effects of Patent Box are mixed. There are studies with positive empirical evidence on innovation outcomes [2,5,47], country performance [15], company performance [1], and others. Negative effects such as shift profits [26,45] and raise complexities in tax administrations [38] were found too. This mixed evidence is similar to other R&D incentives. Most of the negative effects could be associated with complications raised in the scheme design due to the recommendations made by the OECD to avoiding harmful practices and tax competition. In this line, empirical literature found that IP Box encourages the merger and acquisitions of IP activities when IP Box nexus requirements were relaxed [16].

Finally, 26 countries with PB regimes were detected by the OECD data [37] and a Tax Foundation report with a spreading in other countries such as Singapore, Slovakia, Lithuania, and Poland [36], and different schemes about its Patent Box regimes.

These findings have some implications for policymakers, academics, and companies. Through the results observed in this review, policymakers need to put efforts in the best way of applying or modifying the Patent Box regimes including OCED recommendations to achieve better innovation levels and avoid harmful practices. For academia, evidence regarding the application of Patent Box means an opportunity to examine the determinants of these mixed effects and trying to reach a consensus about the effectiveness of this tax incentive, so as to determine the best IP characteristics to apply the tax benefits. Giving a record of the countries with Patent Box regimes, companies can take this knowledge as input for future tax planning recognizing the main characteristics of the Patent Box around the world, eligible IP assets, and the difference with the CIT rate. In addition, companies

can use this work to analyze better policies and encourage their innovation activities with an appropriate country and R&D program, according to the empirical literature.

Absent a review of the Patent Boxes in the academic literature, this work contributes with a systematic review and analysis of the documents published in Scopus since 2010. This document also offers a detailed list of the current regimes worldwide. This monitoring of the Patent Box regime around the world can help to determine the direction of the change in Patent Box schemes, especially regarding the adaptation of governments to the reforms and implementation issues (solving legal complexities or adopting new forms of IP assets). A limitation of this review is the lack of sufficient empirical data to develop a meta-analysis and a deeper empirical study of the academic literature. Patent Box is an incipient literature, but this work did not give a detailed examination of accounting or legal issues. With the growth of the studies about Patent Box, the trends on the research agenda and studied sub-topics will become more concrete.

A future research agenda can focus on examining the Patent Box case in countries that have not been examined, with an individual focus as China, Spain, or the new ones: Singapore, Slovakia, Lithuania, and Poland. Additionally, authors could study the best policies for a country context comparing different R&D programs including Patent Box with nexus requirements. Authors could also consider the differences in Patent Box effects between regimes with nexus requirements and the lack of these to examine the contribution of the recommendations of the OECD in an empirical perspective. Lately, evidence with new variables of patent activity needs to be examined, such as the merger and acquisition deals [16] and intangible assets.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su141811423/s1, File S1: The PRISMA checklist 2020.

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Appendix A. Review of Papers, Methods, and Findings

No	Title	Authors	Year	Outcome	Type	Objective	Method	Country
1	Should there be lower taxes on patent income?	Gaessler F., Hall B.H., Harhoff D.	2021	(−) Patents move across jurisdictions	Quantitative	Impact of PB on international Patent Transfers	Random-effects Poisson model	Various (51)
2	Thinking outside the box: The cross-border effect of tax cuts on R&D	Schwab T., Todtenhaupt M.	2021	(+) patent output in other countries	Quantitative	Effects of PB on the R&D in other countries	Using Diff in Diff, Instrumental Variables, and event study methods	Various (9)

No	Title	Authors	Year	Outcome	Type	Objective	Method	Country
3	The Impact of IP Box Regimes on the M&A Market	Bradley S., Robinson L., Ruf M.	2021	(+) On M&A Activity	Quantitative	Effects of the Nexus Approach on M&A transactions	Using Diff in Diff, triple differences, and event study methods	Various (24)
4	Tax Accounting Research on Corporate Investment: A Discussion of The Impact of IP Box Regimes on the M& A Market by Bradley, Ruf, and Robinson (2021)	Lester R.	2021	NA	Qualitative	Discussion about findings of PB on M&A transactions	Descriptive and qualitative	Various (24)
5	State stimulation of innovation activities in Switzerland and Russia	Belozyorov S., Zabolot-skaya V.	2021	NA	Qualitative	Explore the system of State Financing of Research and Development (R&D) of small- and medium-sized enterprises (SME) in Switzerland	Descriptive and qualitative	Switzerland
6	The impact of R&D tax incentive programs on the performance of innovative companies	Makeeva E., Murashkina I., Mikhaleva I.	2019	(+) company performance	Quantitative	Explore the influence of corporate taxation on the performance of innovative companies under various research and development (R&D) tax incentive programs.	Blundell–Bond equation	Various (13)
7	Patent boxes and the erosion of trust in trade and governance	Diaz E.B.	2019	NA	Qualitative	Discuss the BEPS reform and its implications on trust and governance	Descriptive and qualitative	Nonspecific
8	Impact of the Intellectual Property Tax Regime on FDI in R&D Activities at the City Level	Falk M., Peng F.	2018	(+) FDI inflows in R&D and related activities	Quantitative	Determine the impact of the introduction of the patent box/IP regime on foreign direct investment (FDI) inflows in R&D and related activities	Diff in Diff Model	Various (80)
9	Patent boxes design, patents location, and local R&D	Alstadsæter A., Barrios S., Nicodeme G., Skonieczna A.M., Vezzani A.	2018	(+) Attract Patents	Quantitative	Find determinants of the geographical distribution of patent applications in countries.	The structural model proposed by Grif-fith et al.(2014) was estimated with a negative binomial model.	Various (39)
10	The Portuguese intellectual property box: issues in designing investment incentives	Martins A.	2018	(−) Not competitive and raised complexities	Qualitative	Discuss the competitiveness of Intellectual Property Box, effects on tax avoidance, and accounting complexities	Descriptive and qualitative	Portugal

No	Title	Authors	Year	Outcome	Type	Objective	Method	Country
11	Evaluating the innovation box tax policy instrument in the Netherlands, 2007-13	Mohnen P., Vankan A., Verspagen B.	2017	(+) on R&D investment	Quantitative	Effect of the Innovation Box policy on local R&D investment of the firm	Diff in Diff Model	Netherlands
12	R&D tax incentives and the emergence and trade of ideas	Bösenberg S., Egger P.H.	2017	(−) Filling patents	Quantitative	Effects of tax incentives in R&D on the filing and trading of patents	Fixed-country-effects Poisson model for patent filing and a random-country-pair-effects Poisson model for patent trading	Various (106)
13	The Luxembourg effect: Patent boxes and the limits of international cooperation	Faulhaber L.V.	2017	NA	Qualitative	Discuss the Nexus approach's effect on EU Members' regulations	Descriptive and qualitative	Luxembourg
14	Do patent boxes still make sense under the OECD-BEPS nexus approach?	Englisch J.	2017	NA	Qualitative	Examine the effectiveness of a patent box regime that adheres to the nexus approach in attracting or stimulating additional R&D investments	Descriptive and qualitative	Germany
15	Patent boxes: research incentive or tax loophole?	Klodt H., Lang S.	2016	(−) Shift profits to low-tax countries	Quantitative	Impact of the introduction of patent boxes on R&D expenditures and patent applications.	Descriptive	Various (15)
16	A patent/innovation box as a tax incentive for domestic research and development	Gravelle J.G.	2016	NA	Quantitative	Effects of a patent box on encouraging research and development in the United States	Descriptive equations	US
17	Corporate patents, R&D success, and tax avoidance	Gao L., Yang L.L., Zhang J.H.	2016	NA	Quantitative	Examine whether R&D success (expenditures and patent activity) concerning patent output is associated with the level of tax reduction.	Panel Data Regress with firm fixed effects	US
18	Why are researchers paid bonuses? On technology spillovers and market rivalry	d'Andria D.	2016	(+) Increase the capital investment on R&D (−) Overinvest-ment under certain conditions	Quantitative	Analyze the R&D tax incentives' effects on the innovation process and market rivalry	Theoretical Model	Nonspecific

No	Title	Authors	Year	Outcome	Type	Objective	Method	Country
19	Innovation boxes: BEPS and beyond	Merrill P.	2016	NA	Qualitative	Explains the IP box concept, outlines recent US IP box proposals with a focus on the Boustany–Neal discussion draft, and explains changes adopted in 2015 to the OECD standards.	Descriptive and qualitative	US
20	Economic impacts of intellectual property-conditioned government incentives	Prud'homme D., Song H.	2016	NA	Qualitative	Relations between tax incentives and Patent activity	Descriptive and qualitative	Nonspecific
21	Intellectual property box regimes: effective tax rates and tax policy considerations	Evers L., Miller H., Spengel C.	2015	(+) Increase incentives for investment by reducing the EATR	Quantitative	Estimate the cost of capital and the effective average tax rate under Patent Box conditions	Descriptive with effective average tax rates (EATR)	Various (12)
22	Cross-Country Evidence On The Preliminary Effects Of Patent Box Regimes On Patent Activity And Ownership	Bradley S., Dauchy E., Robinson L.	2015	(+) Patent Applications	Quantitative	Effects of Patent Box on extent and location of innovation and patent ownership.	Panel Data regressions including year and country fixed effects.	Various (70)
23	Corporate Tax Changes under the UK Coalition Government (2010-15)	Miller H., Pope T.	2015	NA	Qualitative	Review the policy changes of the UK government. Patent Box between them.	Descriptive and qualitative	UK
24	Taxation and incentives to innovate: a principal-agent approach	d'Andria D.	2014	(+) Aggregate innovation	Quantitative	Effects of different tax schemes on innovation in a pure knowledge economy	Principal-Agent Model	Nonspecific
25	Ownership of intellectual property and corporate taxation	Griffith R., Miller H., O'Connell M.	2014	(+) Share of new patents	Quantitative	Effects of the corporate income taxes in the location of patents.	The choice model estimated with mixed logit random model	Various (15)
26	Technological innovation, international competition, and the challenges of international income taxation	Graetz M.J., Doud R.	2013	NA	Qualitative	Describe the R&D tax incentives and offer recommendations	Descriptive and qualitative	US

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