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Sustainability-Driven Innovation and Financial Performance

How does it pay to be green?

by

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Market and policy pressures increasingly demand a shift towards sustainable means of production; thereby, the inconclusive and long-standing debate between the impact of environmental efforts and economic performance at the firm level has never been so relevant. However, companies who seek to prioritize sustainability on their processes and outputs still need to focus on their financial returns.

Through a panel data analysis using fixed and random effects methods, this thesis quantitatively tests the influence of a sustainability-driven innovation (SDI) strategy on accounting-based financial performance indicators in public companies between the years of 2010 and 2018. To measure the presence of this innovation typology, the number of appearances in the Dow Jones Sustainability Index is employed.

Results suggest that the presence of a SDI mechanism effectively aids in the optimal exploitation of a firm's assets into sales and works as a tool to improve operational efficiency (ATR) rather than operational profitability (ROA) or financial profitability (ROS) in industry sectors that prominently rely on their intangible and fixed assets to produce sales-boosting goods and services. This writing contributes by exposing the benefits and downturns of placing sustainability at the top of the company strategy and prove SDI as a viable alternative to transform the business dynamics.

Keywords: sustainability-driven innovation, financial performance, DJSI, panel data methodology, environmental sustainability, operational efficiency

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1 Introduction

Fuelled by the dynamics of capital growth and innovation-driven development, the *Industrial Revolution* began in the United Kingdom during the late eighteenth century (Perez, 2010). It later expanded to other countries with all its benefits and disadvantages, as Perez states, during five unprecedented waves of economic and social development. Nonetheless, this sustained socioeconomic progress rate for the last two hundred years has been predominantly at the expense of the environment stability through unsustainable extractive techniques and depletion practices of our planet's natural resources, as well as an inextricable reliance on fossil fuels for energy production that resulted in a non-interrupted and dramatic increase of greenhouse gases (GHG) emissions into the atmosphere. The latter being one of the main causes of climate change, an irreversible increase in average global temperatures that will ultimately alter every aspect of life, human and nonhuman, in this planet.

Our Common Future (World Commission on Environment and Development, 1987) and the *World Scientists' Warning to Humanity* (Kendall, 1992) are the first formal approaches to understand this problematic setting through a scientific perspective. Later on, the signing of the Kyoto Protocol in 1997 (UNFCCC, 2020a), and most recently, the Paris Agreement in 2015 (UNFCCC, 2020b) were important milestones that are shaping humanity's commitment into lowering down our negative influence on the ecosystem by limiting GHG emissions and accelerate the transition towards renewable energy sources and production practices. Since then, the scientific community has released two other declarations (Ripple *et al*., 2017; Ripple *et al*., 2019) urging a drastic shift of focus predominantly in governmental policy-making, production schemes and consumption of goods. This transition towards sustainability has gained traction to become a worldwide matter in most productive entities, regardless of their geography, size, sector, or industry (CBBC Newsround, 2019). Equally important, the scientific community established a clear milestone to keep pushing forward with the transition towards major decarbonisation of the world's economies – the year 2030.

In simple terms, a substantial change in the current system that is solely based on wealth generation must be implemented in less than ten years. Meaning a profound re-thinking and empirical experimentation of novel structures for public institutions (i.e. governments) and private organisations (i.e. companies and NGO's) which evolved into their current functional form in the lapse of centuries. This is no easy task and probably the biggest challenge humanity has ever faced. On one side, national, regional, and local governments are striving to write, debate, and implement regulations while also performing systemic modifications that adhere to the Paris Agreement compromises. On the other side, from the perspective of private organisations, transformative initiatives such as the *Davos Manifesto 2020* seek to redefine their essential function: "The purpose of a company is to engage all its stakeholders in shared and sustained value creation. In creating such value, a company serves not only its

shareholders, but all its stakeholders – employees, customers, suppliers, local communities and society at large." (World Economic Forum, 2020). Nevertheless, the dynamics of present-day organisations require incentives that are aligned to the current socio-economic system to accelerate their evolution.

1.1 Research Problem

In most economies, companies are responsible for the whole process of value creation in a product or service, starting from the research and design, passing through the sourcing and manufacturing processes, as well as distribution and marketing. In some industries, companies and the associations they are part of, have an active role in the legislation pertaining to that industry. Even more, when considering the business-to-business activities of enterprises they take an even more important role which also includes the consumption stage. When talking about state-owned firms, they follow the same logic although often with a different internal structure, mission, or objectives.

Hence, it is safe to assume that companies can be situated on the same level of importance as final consumers (e.g. individuals or families) and governments (as regulatory bodies) when it comes to their capabilities to become agents of change. Whereas final consumers represent the *demand* of products and services through their needs and purchase choice, companies characterise the *supply* side who seeks to fulfil the consumer's needs based on their tangible and intangible demands. Therefore, if a system change is looked upon, an understanding of the dynamics and subsequent transformation of companies' *status quo* must be pursued. In words of Iwata & Okada (2011): "…if financial performance is positively related to environmental performance, firms have incentives to reduce their environmental damages." (p. 1691).

1.2 Aim and Scope

Pondering the role that innovation mechanisms have in a company's economic growth and indicators (Schumpeter, 1934), the purpose of this writing is to empirically and quantitatively test the theory that the employment of an innovation mechanism led by sustainability principles is related to a better financial performance at the firm level, controlling for a firm's size, year-over-year growth, investments in R&D and advertising, number of subsidiaries, industry sector, and the HQ's country. This experiment applies a panel data methodology and uses data from public multinational companies where the independent variable is defined by the number of participations of a firm in the Dow Jones Sustainability Index (DJSI) as a proxy to account for the existence of a sustainability-driven innovation (SDI) mechanism in the firm. The dependent variables defined as *financial performance indicators* are ROA (Return

on Assets), ROS (Return on Sales), as well as ATR (Asset Turnover) as a novel contribution to the knowledge space.

Likewise, this thesis seeks to answer the following research question:

What is the relationship between a company's sustainability-driven innovation mechanism and its financial performance?

The expected results from this research will contribute to propelling a system change from the inside by demonstrating how innovation directed towards a sustainability-led innovation strategy, research, and practices can thrust growth within a company while also taking an active role in the pursuit of a comprehensive solution to this striking and potentially devastating situation. The findings from this investigation might be of interest to business leaders, managers, and other company stakeholders who seek to improve a firm's financial performance through innovative and sustainable practices.

1.3 Thesis Outline

The rest of this writing is organised as follows. Section 2 discusses the theoretical framework the research is based upon as well as presenting the working hypotheses. The methodology, variables, and dataset are described in Section 3 followed by the results of the econometrics estimations, discussion of the findings, and robustness checks in Section 4. Lastly, in Section 5, the thesis' concluding remarks and limitations, as well as further directions of the investigation are detailed.

2 Theory and Hypotheses

Concerns about environmental sustainability and footprint of industrialisation were expressed (albeit largely criticised) by Thomas Malthus through the idea of a *Malthusian Catastrophe* (1798) where either the forces of nature or our human praxis will eventually deal with an upcoming overpopulation problem by decimating human population to attain environmental balance. More than a century later, Neurath (1919 cited in Turk, 2018) claimed that the production systems failed to consider future generation's needs. Furthermore, fundamental figures in the economics landscape such as Schumpeter (1942) and Kuznets (1973) focused principally on the exploitation of natural resources as a mean to achieve economic growth and development. While Schumpeter's theory (1942) might consider it as part of a *creative destruction* cycle, Kuznets' *environmental curve* assumes that an incremental degradation of the environment is part of the process to achieve *modern economic growth* (MEG) (Shafik, 1994; Kuznets, 1973). Thus, even though both economic schemes included environmental deterioration in their equations, they fail to account for the long-term consequences of unsustainable social and environmental productive practices and policies.

Thought-provoking information has seen light when reviewing analyses that relate to both subjects of environmental sustainability and a company's economic performance. There is a widespread belief, especially in managers and business leaders, that implementing pro-environmental practices will affect the firm's profitability or 'bottom-line' results. Formal researches have shown vast differences in their analyses with mixed and sometimes contradictory results, triggering an ongoing debate between the two main postures; nevertheless, the extant literature largely demonstrates a positive relationship of the effect between environmental and financial performances of a firm.

Such publications have considered different measures and have analysed the data with diverse techniques that present noteworthy results. The following subsections will portray the taken approaches.

2.1 Environmental Performance as a Competitive Advantage

Different angles have shaped the conversation with alternative yet complementary arguments that apply to the dynamics of the business' ecosystem. '*When* does it pay to be green?' is the main topic of this subsection plus one of the foundational bases of this thesis.

Analyses from Rooney (1993), Porter & van der Linde (1995), and Sroufe (2003) focus their attention in the optimal usage of resources to achieve competitiveness. The logic is that by applying environmental efforts in using and wasting less resources (i.e. materials, energy), the company becomes more efficient, and therefore, gains a competitive advantage. This approach is based on the *resource-based view* (RBV) managerial framework (Barney, 1991; Grant, 1991) which denotes that the source of competitive advantage of a firm is rooted within itself and achieved through an effective handling of its capabilities and managerial abilities to exploit the firm's assets and produce superior performance. This perspective, in combination with the IO (Industrial Organization) paradigm, which attributes a firm's success entirely to external factors (Bain, 1964; Porter, 1981), provides a broader and more robust channel of analysis as it considers the firm's internal strengths *within* the context of its business environment. Two of the most imperative points to consider when building up a business strategy and a managerial scheme that had wide acceptance and evolution from the corporate environmental perspective since the 1990's.

The seminal work by Hart (1995) applies this merged reasoning in his '*natural-resource-based view*' (NRBV) work where he states that if companies want to fully embrace an improved environmental performance a fundamental shift in the organisation's structure and culture must be implemented so that a "…shared vision of 'sustainability' in a firm might help focus and even accelerate the pace of resource accumulation and capability building in pollution prevention and product stewardship, in addition to guiding shifts in technology and market focus called for by sustainable development." (p.1007). Moreover, the author classifies firms in two main categories based on the style of their environmental policy: *compliance* and *prevention*. Companies that barely attain to government regulations and rely on short-term strategies for pollution abatement (i.e. 'end-of-pipe' approach) fall under the first category while firms that adopt a systemic approach towards pollution prevention as well as resource and processes' efficiency exemplify the second categorisation. The latter attitude towards corporate environmental performance is part of the basis of the theory tested in this thesis.

Porter & van der Linde (1995) as well as Esty & Porter (1998) showcase the areas of action where environmental efforts most effectively create a competitive advantage at the firm level. The authors elaborate on the theory that taking a proactive approach to improve environmental performance requires the development of skills such as cross-disciplinary collaboration and complex problem-solving that could end up as a source of competitive advantage. Following the same thought path, other authors have suggested other kind of indirect benefits that arise from the planning and implementation of environmentally thoughtful strategies. Writings from Dechant & Altman (1994), Turban & Greening (1997), and Barnett & Salomon (2006) suggest that a comprehensive outlook towards environmental or social corporate responsibility might help in the recruitment of more innovative and motivated employees that could, consequently, lead to a better firm performance and even an expansion of market opportunities. Further on, von Paumgartten (2003) argues that sustainability standards such as the LEED certification could help in the improvement of employee's productivity and retention.

Lastly, a company's social and environmental management strategies have been proven to aid in the reputation and public's perception of a firm. Conclusions from Dowell, Hart & Yeung (2000) note this effect with a company's pursuit of strict environmental management policies and its change on the overall company's value. Furthermore, alongside with several other authors (Hamilton, 1995; Klassen & McLaughlin, 1996; Stanwick & Stanwick, 1998) they reflect on the importance of the communication channels and messages (i.e. public relations, marketing, and advertising strategies) of the 'green' activities performed by corporations. From the consumer perspective, Hart (1995) suggests that external stakeholders (e.g. the consumer's demands) conduct a decisive role in the transition of corporations towards sustainability when they seek to achieve a competitive advantage through the development of valuable and unique assets as well as a more efficient usage of their resources. Russo & Fouts (1997) support this claim by suggesting that "…this is particularly true when society is demanding a cleaner environment." (p.537). The investigations by Wagner (2010), aside from confirming the relationship of a firm's value and its level of Corporate Sustainability Performance (CSP), also reflect on the role that advertising plays in the equation. By separately considering the social and the environmental dimensions of CSP, the author is able to measure the effect of advertising intensity on an independent basis. As a result, the author suggests that corporate *social* performance associates positively with better economic performance of a firm only when a sufficient level of diffusion is reached. In the author's words, "…without sufficient advertising, the cost for social responsibility activities exceeds [the] benefits…" (p.1559). Also, aligned with the results of the previously detailed literature, Wagner corroborates that the environmental dimension of CSP leads to a direct positive effect on economic performance mainly due to efficiency gains and other optimization factors. Hence, for corporations to capture positive effects from their pro-environmental initiatives, they must proactively implement an efficiency-driven strategy at all levels of the organisation. This strategy must be properly communicated to internal and external stakeholders and should involve an element of novelty that is guided by the development of sustainable solutions.

The recognition of the complex nature of the link between environmental and financial performance (Corbett & Klassen, 2006) and the scientifically confirmed (Ripple *et al*., 2019) systematization of environmental risks (Figge, 2005) has triggered a demand for a profound change in organisations where sustainability does not only encompass a reduction of pollution or a bare compliance of the current regulation; it means a deep transformation in the form companies operate throughout the whole value creation chain. From this viewpoint, the question has shifted from '*When* does it pay to be green?' to a more specific '*How* does it pay to be green?'.

2.2 Sustainability-Driven Innovation

Increasing demand for a systematic change that values not only economic profits but also social and environmental performance as well as the advantageous outcome that could result from a thorough embracement of sustainability in the value creation processes has triggered

an interest in both the academic and the business spheres to propose comprehensive frameworks that impel this transition towards a sustainability-driven growth model. Among these proponents, Mazzucato (2018) with the '*mission-oriented innovation policies'* approach and Raworth (2017) through the *Doughnut Economics* framework standout on the regulatory and economic development spaces. On the private sector, consulting companies such as McKinsey (2019) have also taken positions towards the required evolution from companies to achieve the goals framed in the United Nations Paris Agreement from 2015. Although these approaches work for the purpose, a more pragmatic approach is what is currently needed.

Sustainability-driven innovation (SDI), a term initially coined in a study from the firm Arthur D. Little by Keeble *et al*. (2005), is defined as "the creation of new market space, products & services or processes driven by social, environmental or sustainability issues." (p.3). Furthermore, in the words of Metz *et al*. (2016), it is "an innovation approach that leverages environmental sustainability to drive superior business results." (p.50). One of the findings in the Keeble *et al*., (2005) survey, is that 95% of the companies that participated knew that sustainability-driven innovation could work as a value creation tool but were unsure of the benefits and considered a high level of barriers for success. So, even though several studies have expanded on how SDI delivers tangible benefits to organisations from a qualitative perspective and through different lenses – e.g. Bos-Brouwers (2010) across start-ups and SME's; Thompson, Larsson & Broman (2011) through the linking with Product-Service Systems; Trifilova *et al*. (2013), Kiron *et al*. (2013), and Metz *et al*. (2016) through case studies in global and local firms – there is still a gap in the literature that demonstrates how the implementation of sustainable practices at the firm level quantitatively translates into economic gains. This thesis aims to put clear and quantifiable evidence in relation to the effect of sustainability-driven innovation and a business' economic performance.

In the following subsection, a comprehensive literature review through different perspectives and points in time of the environment-finance relationship is showcased.

2.3 Market-based and Accounting-based Metrics

To assess the fulfilment of a company's economic goals over time, the reviewed literature can be organised into two broad categories depending on the metrics used and analysis approach.

On one hand, the accounting-based approach exclusively considers the reported records in the annual financial statements of a company. Most commonly used metrics are ROA (Return On Assets), ROS (Return On Sales), or ROE (Return on Equity), which measure a firm's profitability relative to its total assets, sales revenue, or shareholder's equity, respectively. On the other hand, market-based metrics approach assesses a firm's returns relative to its performance in the stock market (Hoskisson, Johnson & Moesel, 1994). Examples of market-based metrics include *Tobin's q*, a measure of a firm's market valuation relative to the replacement costs of tangible assets (Lindenberg & Ross, 1981), or the *Sharpe* ratio which

aids in the investor's understanding of a company's return on investment compared to its risk (Hargrave, 2020b). A list of metrics used in the reviewed literature is presented in Table 1.

An ongoing and longstanding debate has been active since the 1980s when market-based metrics started to be considered by researchers to evaluate a firm's financial performance (Gentry & Shen, 2010). The different positions range from a complete superiority of either one of the types (Johnson, Natarajan & Rappaport, 1985; Lubatkin & Shrieves, 1986) to a close intertwining (Jacobsen, 1988) or total disconnection (Chakravarthy, 1986) between them. However, the opinions exposed by Keats (1988) as well as Hoskisson, Johnson & Moesel (1994), argue that each indicator type answers a different question. The researchers conceptually advance the different interpretation of these numbers, asserting that whereas accounting-based metrics are considered indicators of the past and short-term performance, market-based measurements focus on the future performance of a firm. Combs, Crook & Shook (2005) also support this finding when analysing the dimensionality of organisational performance: "…the two empirical studies that include stock market measures found that these are distinct from accounting returns and growth." (p.266). Even more, Gentry & Shen (2010) suggest that "If accounting profitability is assumed to reflect operational efficiency and effectiveness, researchers should focus on how firm actions influence operational efficiency or effectiveness to understand the variation in firm profitability…" (p.526) which is precisely the kind of analysis being carried out in the following sections of this writing.

Thus, since this thesis intents to demonstrate the positive relationship between companies that have already implemented better environmental practices and their financial performance, the measurement of a company's financial performance using accounting-based metrics is the focus of it. Nevertheless, it is important to acknowledge that neither of the measures is perfect and that key concepts used in this thesis are borrowed from both types of researches; therefore, a comprehensive review of both positions is carried out in this subsection. All the reviewed literature on the following subsections follows an empirical analysis nature unless otherwise stated.

2.3.1 Market-based Analysis

Feldman, Soyka & Ameer (1997) analysis' focuses on the relationship between the improvement of environmental performance through the implementation of advanced environment management systems (EMS) and a firm's market value. Evaluating the numbers of 330 firms in the S&P 500 index, the authors put forward an explanation for this phenomenon showing that by enhancing a firm's EMS in a way that it permeates the whole organisation's activities, processes and areas, better environmental performance is achieved. The authors state that aside from any direct environmental and cost reduction benefits, augmenting the firm's EMS is equivalent to lowering its systemic risk. From the investors' and stock markets' perspective, this translates into a reduction in the cost of equity capital as well as an influence in the company's value in the market place. The concept of advanced EMS exposed by the authors is one of the first allusions towards a holistic approach

concerning sustainability-driven organisations which is the core topic of the current paper. Riillo (2017) also confirms the positive effect of adopting more robust EMS, albeit through the perspective of innovation and productivity, suggesting to "…managers having environmental concerns to pursue comprehensive and integrated environmental management systems." (p.636).

King & Lenox's (2001) analysis examines a firm's *stable attributes* (those advantages that persist over time), strategic industrial position (p.106), and relative performance within the industries it belongs, as indirect explanations for a simultaneous impact in both reductions in pollution levels and an improvement in the financial performance of firms. The authors assert an association between the independent variables (i.e. total, relative, and industry emissions) and the companies' *Tobin's q* which shifted the debate later discussed towards '*when'* rather than '*does*' it pays to be green. The researchers discuss the contrasting results obtained by applying different statistical analysis methods (fixed and random effects) where, depending on the used technique, these results suggest that both operating cleaner facilities in any industry and operating in cleaner industries deliver a positive financial performance. Moreover, the difference in these results is interpreted by them as a possibility that "firms benefit from being in cleaner industries but not from moving to cleaner industries." (p.111). However, their results are not conclusive regarding the direction of the relationship, leaving the following question unanswered: "Do more-profitable firms invest more in environmental performance, or does environmental performance lead to profit?" (p.111). A multiple industry approach with relative comparison levels of performance as well as 'sales growth' as a control variable are concepts borrowed from King & Lenox (2001) that are also used in this thesis.

The paper by Colombelli, Ghisetti & Quatraro (2020) investigates the relationship between eco-innovation and a company's market value on a sample of publicly listed European firms between 1985 and 2011. Their research focuses on how the stock markets value the generation of green technologies (GT) of firms when taking into account the stringency level of regulations pertinent to the industries analysed. Among the main findings, the results indicate a positive and significant effect in market valuation triggered by both the GT generation capabilities (in quantity but also in quality) of a company and the stringency of the regulatory framework in the geographies where these entities operate. The mechanism, according to the authors, is that stricter environmental regulations lead to higher production costs in polluting firms which, in turn, develop and introduce innovations that reduce the impact of these policies, thus maintaining profitability levels while producing with a 'cleaner' output. This conclusion supports the idea of legislation as a transformative power when pursuing a transition towards a sustainable *modus operandi* of economies also presented by Hart & Ahuja (1996) - "strict environmental regulation to lower emissions might actually improve competitiveness by encouraging efficiency and innovation." (p. 30) – and later confirmed on Colombelli, Krafft & Quatraro (2019) and Acemoglu *et al*. (2016) writings' that are mainly based on the work by Porter & van der Linde (1995).

2.3.2 Accounting-based Analysis

According to Hart & Ahuja (1996), the effect of environmental efforts (i.e. emissions reduction through pollution prevention) on a firm's performance is evidenced in different points in time depending on the type of indicator measured. Authors claim that operating performance indicators –ROA and ROS – show results within one to two years after implementation, in comparison to the financial performance indicator measured – ROE – which takes at least two years to display the effects. According to the authors, the reasoning behind these differing outcomes relates to the order of the influence mechanism: the effect of emissions reduction works through the operational ground (ROA and ROS) to subsequently affect the capital structure of a firm (ROE). Moreover, they demonstrate how the largest benefits of corporate *greening* are accrued by firms classified as 'high polluters', such as the petrochemical industries. An explanation of this finding, the authors describe, might be due to period of the data (1988-1989) when "petrochemicals, forest products and automobiles had not yet achieved dramatic levels of emission reduction (i.e. there was still a great deal of 'low-hanging fruit' to be picked)." (p.36). The usage of 'industry sector' as a control variable as well as the focus on ROA and ROS as the accounting-based metrics are contributions from Hart & Ahuja (1996) also applied in the current thesis.

The writing from Ghisetti & Rennings (2014) develops on the basis that not all environmental innovations deliver positive financial performance at the firm level. The authors analyse data from German firms and differentiate between innovations that aim to increase efficiency and cost savings (*EREI*), and innovations intended to reduce negative environmental externalities (*ER*) (i.e. pollution or emissions reduction). While they find a positive influence on financial performance from the first typology (*EREI*) when measured through the firm's operating margins, their results suggest that *ER* innovations showcase a negative impact. The authors expand on the idea that the intertwining between a reduction in production costs and the engendered competitive advantages produced by novel combinations of these more efficiently used resources is what defines the magnitude of the positive financial gains achieved by the firms in their sample. Moreover, when testing the motivation behind the implementation of environmental innovations, their findings indicate that regulation might only be beneficial to a company's financial performance if it is centred on thrusting the development of *EREI* solutions. These interesting results expand the conversation to '*when and how does it pay to be green?*', two concepts discussed in previous earlier in this writing.

The research by Gallego-Álvarez, Segura & Martínez-Ferrero (2015) confirms a positive environmental-financial relationship between the reduction of GHG emissions and a better ROE at the firm level by relying on the RBV theory to explain for this outcome where fund-allocation towards a progressive environmental strategy can lead to the development of valuable capabilities such as "…increasing their reputation, creating new market opportunities, improving company morale, and increasing skills and worker productivity." (p.155). Moreover, the paper also puts forward three methodological concepts that are applied to this thesis. Firstly, the theoretical distinction between different types of economic performance that is applicable to the present research through the using of ROA, ROS, and ATR to respectively measure operational profitability, financial profitability and operational efficiency. While the two former metrics focus on a firm's profitability, the latter indicator

focuses on a company's efficiency rates. Further discussion of the economic performance indicators used is presented in Section 3. Secondly, the inclusion of a company's participation in the DJSI as part of the equation being tested and thirdly, an enrichment of the research literature through the utilisation of an international sample of companies that enables the paper to provide more applicable results.

2.3.3 Market- and Accounting-based Combined Analyses

Cohen, Fenn & Konar's (1995) study, through a comparison between low and high pollutant companies that are part of the S&P 500 index, attributes the historical discrepancy of previous papers' results to a "…lack of objective criteria to evaluate environmental performance." (p.2). The authors hypothesize that the low pollutant company portfolio performs equally or often better than the high pollutant one when measured through both accounting (ROA and ROE) and market-based (risk-adjusted cash dividends) indicators. However, the results demonstrate a relatively weak statistic relevance, meaning that there is no strong evidence that 'low pollution' firms deliver better financial performance but rather a strong indication of a no 'green investing penalty' (p.17). Among their findings, it is worth observing the distinct and often opposing effect that the environmental variables trigger in both measurement types (accounting vs. market indicators). For instance, when comparing the within-industry levels of environmental litigation, firms that have a relatively higher level of lawsuits are likely to deliver a lower financial performance when measured through ROA and ROE. However, market-based measures report no differences leading to the assumption that despite "slightly lower current earnings, the market does not react to 10-K disclosures of pending environmental lawsuits." (p.18). This diverging effect (either through a different sign influence or a lack of statistical significance) is similar for other environmental performance measures such as fines, oil and chemical spills, or toxic chemical releases, as examined by Cohen, Fenn & Konar (1995). In some cases (i.e. oil and chemical spills), the authors assert that the underlying reason behind a poor performance on the environmental ground is related to management or efficiency-related issues, two of the topics being explored in this thesis. Additionally, the paper leaves an inconclusive remark concerning the direction of causation, also pronounced by King & Lenox (2001).

Also, Elsayed & Paton (2005) affirm that results from previously published papers might be suffering from a "…model misspecification and/or limited data." (p.395). Therefore, they conduct a study using static and dynamic panel data from firms based in the UK to determine the impact of environmental performance on both market- (*Tobin's q*) and accounting-based (ROA and ROS) metrics. Alongside the control variables included in their model, the approach used to calculate *Advertising Intensity* is worth mentioning. Due to a generalised lack of reported data regarding the annual advertising budget, they follow the example of Chapple *et al*. (2001) to calculate this indicator which is also the approach taken to calculate this control variable for the current research. Worth mentioning is that the authors find evidence of a differential impact between industries only when testing for ROA but not through the other indicators, a conclusion that sheds light into the richness and complexity of

interpretation that using multiple industries and financial indicators bring into this type of research.

Moreover, Iwata & Okada's approach (2011) digs deeper into the characteristics of each environmental issue and the market's response. Their study from companies belonging to the manufacturing industry in Japan considers both waste and GHG emissions (in absolute numbers instead of environmental management scores as most other studies do) and correlates them with seven financial performance indices (ROE, ROA, ROI, ROIC, ROS, *Tobin's q*−1, and the natural logarithm of *Tobin's q*). Among the most interesting findings, the authors denote that the market's response (i.e. a firm's value) towards GHG emissions reduction is positive while waste management improvements are not noticeable. Furthermore, they suggest that whereas financial institutions and investors do consider a firm's long-run emissions' performance (deducted by the significant effect on six out of seven indicators), it is consumers and trading partners the ones who disregard this performance in the short-term, as there is no significant effect on the ROS variable. The latter finding from Iwata & Okada's research exemplifies the different stakeholders involved in the transition of a company towards a greener economy as discussed in subsection 2.1 and 2.2.

2.3.4 The Opposite Side of the Argument

When talking about the opposite end the argument, several studies demonstrate a partial or even complete negative relationship between environmental and financial performances, as well as a possible attribution of diminishing efficiency due to a firm's high investment on pro-environmental activities.

Cordeiro & Sarkis (1997) use a novel indicator (neither accounting- nor market-based) to measure a firm's performance: *security analysts earnings forecast* (p.104). Their results suggest that both in one- and five-year earnings forecasts, the level and increase of green actions in companies during the early 1990s were negatively correlated with their financial performance. Yet, the following points should be addressed regarding these conclusions. First, as it will be discussed in the next section, the context (in time and space) where a company operates is of great importance. Given the period of evaluation used by the researchers (1991-1993), it is likely that the implementation of environmental practices was not an important aspect that security analysts considered in their forecasts. As described in Section 1, proposals for 'greener' production schemes were put forward after this time-lapse. Second, from the methodological point of view, there is a relative weakness found in the model fit as noticed when examining the reported adjusted R^2 coefficients ranging from 0.050 to 0.075 on the different estimation models applied.

The study by Wagner *et al*. (2002) also estimates a uniform and negative effect of environmental practices on economic performance within the paper industry in European companies. The authors include two control variables that are also used in this thesis, ATR (although as a control variable) and firm size measured by the number of employees. Since Wagner *et al*.'s (2002) research only uses data from the paper industry, a sub-sectoral

approach is also tested through a simultaneous equation framework which delivers interesting results and partially questions the findings by Porter & van der Linde (1995) examined in the next section. Nevertheless, the authors acknowledge that these results "cannot be taken as evidence against the Porter hypothesis in general, since the results reported in this paper may be very specific to the paper industry." (p.144) hence a partial but inconclusive relationship is evidenced in the writing.

2.3.5 Summary of Financial Performance Measures

In Table 1, a summarized list of the financial performance variables used in the reviewed literature is presented.

Table 1. Financial performance variables used in reviewed literature

Authors	**Accounting-based**	**Market-based**
Cohen, Fenn & Konar (1995)	ROA, ROE	Stock return
Hart & Ahuja (1996)	ROA, ROS, ROE	-
Russo & Fouts (1997)	ROA	-
Cordeiro & Sarkis (1997) (Neither accounting- nor market-based)	-	Earnings per share forecast
Feldman, Soyka & Ameer (1997)	-	Market value, Capital cost, Stock price
Dowell, Hart & Yeung (2000)	-	*Tobin's q*
King & Lenox (2001)	-	*Tobin's q*
Konar & Cohen (2001)	Intangible Assets	*Tobin's q*
Wagner *et al*. (2002)	ROS, ROE, ROCE	-
Elsayed & Paton (2005)	ROA, ROS	*Tobin's q*
Wagner (2010)	-	*Tobin's q*
Rassier & Earnhart (2010)	-	*Tobin's q,* Market value, Replacement costs
Iwata & Okada (2011)	ROE, ROA, ROI, ROS	ROIC, *Tobin's q*
Ghisetti & Rennings (2014)	Operating Margin (ROS)	-
Gallego-Álvarez, Segura & Martínez-Ferrero (2015)	ROA, ROE	-
Riillo (2017)	Turnover per employee	-
Colombelli, Krafft & Quatraro (2019)	Sales Growth	-
Colombelli, Ghisetti & Quatraro (2020)	R&D Expenditures	Market value, *Tobin's q*

ROA: Return on Assets; ROE: Return on Equity; ROS: Return on Sales; ROCE: Return on Capital Employed; ROI: Return on Investment; ROIC: Return on Invested Capital.

2.4 Hypotheses

Based on the foregoing, the focal point of this thesis is to test if the implementation of a sustainability-driven innovation mechanism positively influences financial performance at the firm level. Thus, differing with the reviewed literature, this thesis evaluates the adoption effect of a work methodology rather than the correlation with other indicators of environmental performance (e.g. GHG emissions levels or toxic waste produced) on the financial performance of a sample of companies.

Since there is no official ranking or listing from where to obtain the companies that have adopted this approach, the number of yearly appearances as constituents in the Dow Jones Sustainability Index (DJSI) will be used as a proxy. This index is managed by Standard & Poors Global and uses a constantly updated methodology specifically developed to assess a company's commitment to Environmental, Social, and Governance (ESG) activities. The employment of the DJSI to measure the presence of an SDI mechanism in companies is a novel contribution from this research to the academic literature. A thorough discussion of the DJSI validity and representativeness is presented in Section 3.

Furthermore, additional to the traditional metrics of accounting-based financial performance (ROA and ROS), this thesis includes aims to understand the effect of this innovation typology on ATR by including it as a dependent variable. This approach could also be considered as a contribution of this thesis towards the knowledge space.

Therefore, the following hypothesis are to be tested:

> **H_1**: A higher number of company participations in the DJSI has a positive effect on financial performance when measured through ROA.
>
> **H_2**: A higher number of company participations in the DJSI has a positive effect on financial performance when measured through ROS.
>
> **H_3**: A higher number of company participations in the DJSI has a positive effect on financial performance when measured through ATR.

3 Methodology, Data & Variables

3.1 Methodology

Considering the concepts and methods exercised by the previously listed studies, a longitudinal analysis is carried out in this thesis. Through fixed (FE) and random effects (RE) methods, the data retrieved from Bureau van Dijk - ORBIS (BvD-ORBIS) database corresponding to a sample of 109 multinational companies from different industry sectors for the years 2010 to 2018 is tested out, delivering mixed albeit interesting results.

Bearing in mind that other factors also affect the financial performance of a firm; the following variables are considered in the model:

$$\boldsymbol{Financial\ Performance} = \boldsymbol{f}(\ \boldsymbol{DJSI}, \boldsymbol{Size}, \boldsymbol{YoY\ Growth}, \boldsymbol{R\&D\ Intensity},$$
$$\boldsymbol{Advertising\ Intensity}, \boldsymbol{Branches}, \boldsymbol{Sector}, \boldsymbol{Country}\ )$$

From this, the following three regression models are formulated where: ' **i** ' refers to the firm and ' **t** ' to the year:

(1) $$\boldsymbol{ROA}_{it} = \beta_0 + \beta_1 \boldsymbol{DJSI}_{it} + \beta_2 \boldsymbol{ln\_size}_{it} + \beta_3 \boldsymbol{growth}_{it} + \beta_4 \boldsymbol{rdint}_{it} + \beta_5 \boldsymbol{adint}_{it} + \beta_6 \boldsymbol{ln\_branch}_{it} + \beta_7 \boldsymbol{sec}_{it} + \beta_8 \boldsymbol{country}_{it} + \varepsilon$$

(2) $$\boldsymbol{ROS}_{it} = \beta_0 + \beta_1 \boldsymbol{DJSI}_{it} + \beta_2 \boldsymbol{ln}_{\boldsymbol{size}_{it}} + \beta_3 \boldsymbol{growth}_{it} + \beta_4 \boldsymbol{rdint}_{it} + \beta_5 \boldsymbol{adint}_{it} + \beta_6 \boldsymbol{ln}_{\boldsymbol{branch}_{it}} + \beta_7 \boldsymbol{sec}_{it} + \beta_8 \boldsymbol{country}_{it} + \varepsilon$$

(3) $$\boldsymbol{ATR}_{it} = \beta_0 + \beta_1 \boldsymbol{DJSI}_{it} + \beta_2 \boldsymbol{ln}_{\boldsymbol{size}_{it}} + \beta_3 \boldsymbol{growth}_{it} + \beta_4 \boldsymbol{rdint}_{it} + \beta_5 \boldsymbol{adint}_{it} + \beta_6 \boldsymbol{ln\_branch}_{it} + \beta_7 \boldsymbol{sec}_{it} + \beta_8 \boldsymbol{country}_{it} + \varepsilon$$

In Table 2, a summary of these variables alongside their data source, calculation procedure and description is presented.

Table 2. Research Variables

Variable	Calculation/Value	Description	Source
ROA	Ratio = Net income / Total Assets	"…how profitable a company is relative to its total assets." (Hargrave, 2020a).	BvD-ORBIS / Corporate websites
ROS	Ratio = Operating Profit / Net Sales	"…how much profit is being produced per dollar of sales." (Hayes, 2020a)	BvD-ORBIS / Corporate websites
ATR	Ratio = Total Sales / ((Beginning Assets + Ending Assets) / 2)	"…efficiency with which a company is using its assets to generate revenue." (Hayes, 2020b).	BvD-ORBIS / Corporate websites
DJSI	"1" for the year when a company is a constituent in the DJSI	Dummy variable for a company's appearance in the DJSI in a certain year	S&P Global
Log Size	Log of numerical variable	Number of direct employees	BvD-ORBIS / Corporate websites
YoY Growth	Ratio = Net sales change per year	Year-on-Year of net sales growth	BvD-ORBIS
R&D Intensity	Ratio = R&D Expenses / Total Assets	Numerical variable representing the ratio of research and development expenses relative to the total assets	BvD-ORBIS / Corporate websites
Advertising Intensity	Ratio = Intangible Assets / Total Sales	Proxy to measure the advertising efforts of a company relative to the total sales in each year	BvD-ORBIS / Corporate websites
Log Branch	Log of numerical variable	Number of subsidiaries or branches belonging to a company	BvD-ORBIS
Sector	"1" for the industry sector a company belongs to	Dummy variable for industry sector according to GICS classification (MSCI, 2020)	BvD-ORBIS
Country	"1" for the country	Dummy variable for the country where the company HQ is based	BvD-ORBIS

Following the path taken by Elsayed & Paton (2005), Rassier & Earnhart (2010), Gallego-Álvarez, Segura & Martínez-Ferrero (2015), and Colombelli, Ghisetti & Quatraro (2020), these models are regressed using a panel data method which permits the assessment of a firm's performance over time by evaluating observations from a continuous period, in this case, the years from 2010 until 2018. One of the advantages of this method is that it unlocks the possibility to control for missing or unobservable variables (Elsayed & Paton, 2005, p.398). This is especially important when considering the heterogeneity of the sample (multi-country and multi-industry firms) and the complex dynamics that affect a business' performance. Moreover, since this method comprises a larger amount of observations (in comparison to a regular OLS regression), more degrees of freedom are obtained and thus, a more accurate inference can be assumed (Hsiao, 2007). Lastly, this method delivers a greater

efficiency from the research since more information can be extracted from the same parameter (Gallego-Álvarez, Segura & Martínez-Ferrero, 2015). For example, it is possible to analyse the differential effect of the pro-environmental activities on financial performance between each year observed.

To determine if a fixed- or random-effects model should be used, the Hausman specification test is run as per King & Lenox (2001), Elsayed & Paton (2005) and Gallego-Álvarez, Segura & Martínez-Ferrero (2015), who follow the route traced by Lee (2006). The results of this test alongside the model regression iteration outputs are discussed in Section 4.

Lastly, STATA software version 14.1 is used to compute the data.

3.2 Data & Variables

In the following paragraphs, a description of the variables used in this thesis as well as the data gathering process and sources are presented.

3.2.1 Data Sources

This thesis uses the components of the Dow Jones Sustainability Index (DJSI) as a proxy to measure the presence of a sustainability-driven innovation mechanism in companies. Through a manual inspection of the data ranging the years 1999 – 2019, only companies that managed to have more than eleven consecutive participations are considered in the study. The reason behind this decision is that for a company to harvest the benefits of implementing a sustainability-driven innovation strategy, there must be a proper transition period with an incremental, iterative, and strategical approach throughout all levels and areas of the organisation. Nidumolu, Prahalad & Rangaswami (2009) describe the five stages for this shift to happen and estimate at least a decade for a company to be able to complete the first iteration using this innovation strategy. Considering that a substantial group of the companies included in the DJSI are multinationals, it is assumed that this timeframe is accurate since it would take an important amount of time for this cultural setting to spread among all the firm's locations. Moreover, following Hart & Ahuja's (1996) and Elsayed & Paton's (2005) reasoning, the effects of better environmental performance on the financial performance may suffer from a time lag to become evident. For this last reason, an additional year is added to the ten-year implementation period required from companies to be considered in this thesis.

The manual cleaning process of the database also involved removing companies that merged or diverged, were acquired or went bankrupt during the 11-year consecutive period. To avoid duplications, only one company was selected in the cases where firms were dual-listed as well as when firms that both the main office and a national branch were selected components of the DJSI, or when companies that are part of a holding company and both the holding and the productive entity applied. Furthermore, if a company caused an environmental disaster or was

involved major corruption scandals and was publicly exhibited (i.e. the event was broadcasted by large news outlets) within the 11-year consecutive period, it was discarded.

Lastly, companies part of the financial sector were discarded for two reasons. First, due to the nature of their business, they do not share the same accountability performance indicators as the rest of the sectors and might bring unnecessary problems in the estimation models. Second, even though the transformative power of financial institutions is crucial when considering the funding of solutions that benefit society through ESG initiatives (a topic beyond the scope of this thesis), including organisations from this sector might skew the estimation results when considering the service-based and relatively low-carbon intensive sector characteristics. The decision to exclude specific sectors from the analysis follows the example of the study by Gallego-Álvarez, Segura & Martínez-Ferrero (2015) that centres its analysis on the industries with most intensive CO_2 emissions (p.152). This decantation procedure resulted in a total of 109 companies with 981 participations (observations) that are the ones used for this experiment. A detailed diagram of the discarded number of entities can be found in Appendix A. From there, a further reduction of the sample was automatically distilled by the computing software due to missing values on the R&D intensity values specifically for companies belonging to the Real Estate industry which do not register any R&D expenses for the period evaluated (and therefore, no R&D Intensity values for those companies) as well as for the reported growth of the year 2010 for the entire sample since sales from 2009 are needed to calculate this number. This resulted in a strongly balanced dataset of 74 companies with 592 observations, as shown in the descriptive statistics on Appendix B.

Since all the companies used for this examination are public, they are required by the law of the countries where they are headquartered and/or listed to publicly disclose their financial statements on a quarterly and yearly basis. Therefore, the data required to calculate the financial indicators described in the next subsection (net profit, total assets, operating profit, net sales, and total sales) was retrieved from the BvD-ORBIS dataset which compiles these numbers from the company's official documents and enables an easier handling for this thesis. This dataset was also used in the reviewed papers by Colombelli, Krafft & Quatraro (2019) and Colombelli, Ghisetti & Quatraro (2020). In cases where there was missing data from BvD-ORBIS, it was manually retrieved from the annual financial statements published on the companies' corporate websites. The BvD-ORBIS dataset was configured to deliver the required data in USD so when a company's main currency diverged from this basis, the same exchange rate used for the rest of the companies was applied to convert the number. Since only ratios are used in the analysis of this thesis, there is no need to normalise the currency into PPP USD. A list of the visited websites can be reviewed in Appendix C. The main limitation with this dataset is the time frame of which it has available information encompassing only the years from 2010 until 2019. Hence, this analysis is limited to the information available from the years 2010 to 2018. Nonetheless, this drawback is overcome by the efficiency in time reduction needed to gather the data provided by this source.

3.2.2 Dependent Variables

As mentioned in subsection 2.3, this research looks to evaluate a company's historic environmental and financial performance so only accounting-based metrics are considered in the analysis. As with any other combination of financial indicators, these metrics and their outcome should be treated as complements rather than substitutes to obtain a sharper picture of a company's financial performance.

Two of the dependent variables (ROA and ROS) are aligned with most of the accounting-based reviewed literature as they are widely accepted as indicators of the financial performance of a firm; however, they address different questions and each one has its own particularities that are exhibited in the following paragraphs. Besides, this thesis aims to contribute to the research literature with the inclusion of ATR as one of the dependent variables.

ROA

The ROA is considered an operational profitability indicator and its main purpose is to understand the efficiency level of a company's management in using its assets to generate profits; therefore, a higher ROA indicates more asset efficiency targeted to generate profits (Hargrave, 2020a). Nonetheless, this indicator does not discern on the type of funding used to acquire these assets which could be in the form of either equity or debt. Besides, considering that every company and industry operates through different levels of indebtedness and capitalisation because of its asset base nature (e.g. a chemical producing company might be more capital intensive than an IT firm), this indicator is best used to compare between companies in the same industry or with previous performances of the same company to understand the changes of its financial performance over time (Hargrave, 2020a). For the usage of this variable, we follow the example of Cohen, Fenn & Konar (1995), Hart & Ahuja (1996), Russo & Fouts (1997), Elsayed & Paton (2005), Iwata & Okada (2011), and Gallego-Álvarez, Segura & Martínez-Ferrero (2015).

ROS

Following the research strategy of Hart & Ahuja (1996), Elsayed & Paton (2005), Iwata & Okada (2011), and partially, Ghisetti & Rennings (2014), this thesis also includes ROS as a dependent variable which is considered a profitability indicator although it provides information from a lower-level operational or tactic perspective. While both ROA and ROS focus on how a company produces more with less, it can be argued that ROA is more influenced by higher-level (i.e. managerial) decisions since they involve a company's totality of assets while ROS has more to do with the lower level (i.e. technical) decisions that mainly affect profitability in the fabrication of the products and/or services of a company. On the downside, similarly to ROA, ROS should only be used to compare companies in the same industry and preferably with similar characteristics (Hayes, 2020a).

ATR

Additionally, this paper seeks to contribute the research space by testing one additional variable - ATR or Asset Turnover Ratio - which indicates how effectively a company is translating its assets into actual sales (Hayes, 2020b). The viewpoint that this indicator provides is important since, contrastingly to the previous metrics described, it portrays the ability of a company to translate the usage of its assets into tangible sales. So, for this case, the emphasis is not on how profitable or efficient a company is but rather how well aligned are both higher and lower levels of the organisation to produce powerful (selling) ideas through their products or services.

Furthermore, the ATR input broadens the conversation when combined with ROA and ROS, in the sense that other aspects could also be considered when evaluating the success of a firm. For example, when a new product is launched, a change in the three parameters might be seen; however, in the case of a successful launch, the needle would move in different directions. While the ROA and ROS might decrease (due to the investment needed to develop this new product), the ATR could increase (due to an increase in sales), providing the company's stakeholders with a fuller panorama in relation to the evolution of the product launch that might otherwise seem like an unsuccessful endeavour. Finally, similarly to the other two financial performance indicators, the ATR is not suitable to compare a company's performance between industries.

3.2.3 Independent Variable

This DJSI has several advantages that were considered when searching for primary sources of information. First, the continuously updated methodology called CSA (Corporate Sustainability Assessment) first ideated by RobecoSAM and now managed by Standard & Poors Global (S&P Global, 2020), has been a standard in the industry and served as the base for numerous financial indexes that track the performance of companies through an Environmental, Social, and Governance (ESG) lens. Second, since its first publication in 1999, the DJSI is the most time encompassing and standardised data source regarding ESG metrics. Third, for a company to become a component of the DJSI, it must pass strict guidelines that on average only 322 companies, out of more than 2,500 surveyed every year, are able to complete.

Regarding the limitations, although the DJSI provides great insights about companies who follow sustainable practices, it has two main problems. Firstly, the survey is mainly applied to medium and large corporations and therefore, a vast amount of smaller companies are left out of the ranking. Secondly, even though there is a verification process involved, all the information used to rank these companies comes from self-declared surveys that might not objectively reflect the reality and could be biased depending on the view that the company wants to give to their stakeholders. Nevertheless, these limitations do not invalidate the analysis since, on one hand, the same findings could be applied to equally-sized companies or from different sectors and, on the other hand, it is unlikely (and legally penalised) that

companies might purposely want to deceive their stakeholders given the public accessibility of their information (financial and non-financial) as required by the stock markets' regulation.

One could also argue the representativeness of the DJSI to know if a company has applied a sustainability-driven innovation mechanism to which diverse alternatives could be considered. Probably, the most encompassing solution would involve data crossing from various sources including other sustainability-related rankings (e.g. The Global 100 by Corporate Knights), innovation rankings (e.g. The Global Innovation 1000 by PwC), company's patent filings or publications, or even the development of a specifically designed survey that detects the presence of this innovation mechanism in a company. Any of these options, by themselves or in combination with the DJSI, would only strengthen the findings of next iterations of this research. However, due to the advantages mentioned in the previous paragraphs, the lack of a specific centre from where to obtain a list of companies that have applied this innovation approach as well as the time constraints for the development of this thesis and its scope, using the DJSI as a proxy the demonstrate the existence of a sustainability-driven innovation strategy in a company is considered the most viable option. Moreover, form the academic perspective, this variable has also been used as a control variable in at least one other peer-reviewed article widely used in the methodology formulation of this thesis (Gallego-Álvarez, Segura & Martínez-Ferrero, 2015).

3.2.4 Control Variables

In relation to the control variables, this thesis includes the companies' size, yearly growth, research and development (R&D) intensity, advertising intensity, company branches, industry sector and country. The following paragraphs elaborate on these variables' description.

In the same manner as the dependent variables, most of the data was retrieved from the BvD-ORBIS database. When missing, the data was directly extracted from the financial statements available at the corporate websites of the companies.

Following the example of Wagner *et al*. (2002), the company size is measured by the number of direct employees reported on a yearly basis. An advantage of this way of measuring the size of a company (instead of sales numbers or company assets) is that it permits an easier comparison considering that all the companies in this analysis have a presence in multiple countries and that the sample is constituted by a variety of industries. Moreover, this measure is considered a standard by the OECD (2017) and is consistently included in most of the reviewed literature. Interestingly, Hart & Ahuja (1996) drops this variable from their study due to its lack of significance in their model. This variable is transformed into its natural logarithmic as a mean to obtain a more normalized dataset.

The yearly company growth is also considered as a control variable calculated by the change in reported net sales from each year between 2010 and 2018. This is a consistently used variable by most of the aforementioned articles either as the dependent variable (Colombelli, Krafft & Quatraro, 2019) or as a control variable (Russo & Fouts, 1997; King & Lenox, 2001;

Wagner, 2010; Iwata & Okada, 2011; Gallego-Álvarez, Segura & Martínez-Ferrero, 2015). A company's growth rate is important to consider since it denotes the performance of both the firm and the context (industry or location) where it operates.

The fund allocation and involvement in R&D activities in a company is an important indicator that has been used in the academic literature to measure innovation both at the firm level but also as a country or industry hierarchies. In the reviewed literature, it is used in different forms ranging from the mere presence of R&D activities (Ghisetti & Rennings, 2014) to being the independent variable measured (Colombelli, Ghisetti & Quatraro, 2020). However, this thesis follows what most of the reviewed articles have applied in their analysis which is including *R&D intensity* - the reported R&D expenses relative to the total assets of the company - as a control variable (Hart & Ahuja, 1996; Russo & Fouts, 1997; King & Lenox, 2001; Konar & Cohen, 2001; Elsayed & Paton, 2005; Wagner, 2010; Iwata & Okada, 2011). When a company did present one value for R&D expenses within the period evaluated (2010-2018), the rest of the years were estimated assuming the same percentage of total revenues for each year was allocated towards the R&D expenses category. Moreover, if more than one year value was reported in the financial statements for the R&D expenses category, the average of the percentage of total revenues of the reported years was applied to estimate the rest of the year's R&D expenses values.

Following up on the discussion in subsection 2.1, when thinking about the expenses on advertising, marketing, or public relations incurred by companies, this thesis utilises advertising intensity as a control variable. This decision goes in line with several of the articles in the reviewed writings (Hart & Ahuja, 1996; Russo & Fouts, 1997; Konar & Cohen, 2001; Elsayed & Paton, 2005; Wagner, 2010; Iwata & Okada, 2011) mainly due to the importance of a company's public perception and its relationship with sales and subsequently, its financial performance. However, an alternative approach is used to calculate this variable due to the previously mentioned limited availability of the data at the firm level but the importance to include it in the econometric models (McWilliams and Siegel, 2000). This strategy is also applied by Elsayed & Paton (2005) where they use the "ratio of total intangible assets to total sales to capture the effect of the advertising." (p.402). Likewise, since R&D activities are also an important share of the intangible assets, the researchers apply a correlation check to discard the existence of multicollinearity between R&D intensity and Advertising intensity, a test also employed in Appendix F of this thesis.

Additionally, this research considers the number of branches or subsidiaries as an independent variable to account for the benefits of the geographical and cognitive expansion of companies into new regions or markets. Given the characteristics of the sample companies, especially considering their focus on R&D, size and environmental performance, it is likely that they have established presence in regions where they can take advantage of industry agglomerations and diversity. Authors such as Jacobs (1969), Carlsson & Stankiewicz, (1991), Saxenian (2006), Frenken, Oort & Verburg (2007), describe how the combination of different industries in a region fosters growth and development both in the region and firm levels through knowledge spillovers and mix of human capital with different, yet

complementary backgrounds. Since this is a metric that only demonstrates the number of branches a company owns, it does not directly indicate that a company is harvesting this kind of benefits; however, a positive coefficient could aid in the understanding and interpretation of the tested theories. Similarly to company size, this variable is also transformed into its natural logarithmic to work with more normalized data.

Lastly, the industry sector and country where the companies are based also included in the control variables to be able to account for the heterogeneity of the sample data. These two variables are used in almost all the studies reviewed and due to the diversity in countries and industry sectors that constitute the sample, both variables are believed to have an important effect on the relationship measured.

3.2.5 Expected Results

Related to the hypotheses described in the previous section, the proposed models seek to understand the influence in terms of magnitude and outcome (positive or negative) from the independent variables on the three dependent variables tested. In Table 3, a summary of these expectations linking the independent variables to the model's expected outcomes is presented.

Table 3. Expected Outcomes on the Dependent Variables

Variable	Magnitude	Expected sign
DJSI	**Strong**	+
Size	**Moderate**	+
Growth	**Moderate**	+ / -
R&D Intensity	**Strong**	+
Advertising Intensity	**Moderate**	+
Branch	**Minor**	+ / -
Sector	**Moderate**	+ / -
Country	**Minor**	+ / -

Assuming statistical significance from all these variables in the estimations, 'Minor' magnitude influence contemplates coefficient values below 0.049, a 'Moderate' effect corresponds to results between 0.05 and 0.149, while a 'Strong' refers to coefficient values above 0.15.

4 Empirical Analysis & Results

In this section, an analysis of the main findings of this research is presented. Firstly, an ocular inspection and brief interpretation of the dataset is exposed with basis on the mean of the reported descriptive statistics (Figure 1). Second, the estimation results are exhibited and deliberated. Thirdly, a discussion of the main findings is carried out. Lastly, a description of the robustness tests utilised and the undertaken actions are showcased.

4.1 Dataset Inspection

In Figure 1, a graphic with the mean value of the variables examined per year is presented. The purpose of this figure is not to compare values between variables but to visually perceive how these variables have changed over time and to obtain a general perspective of their intertwined behaviour.

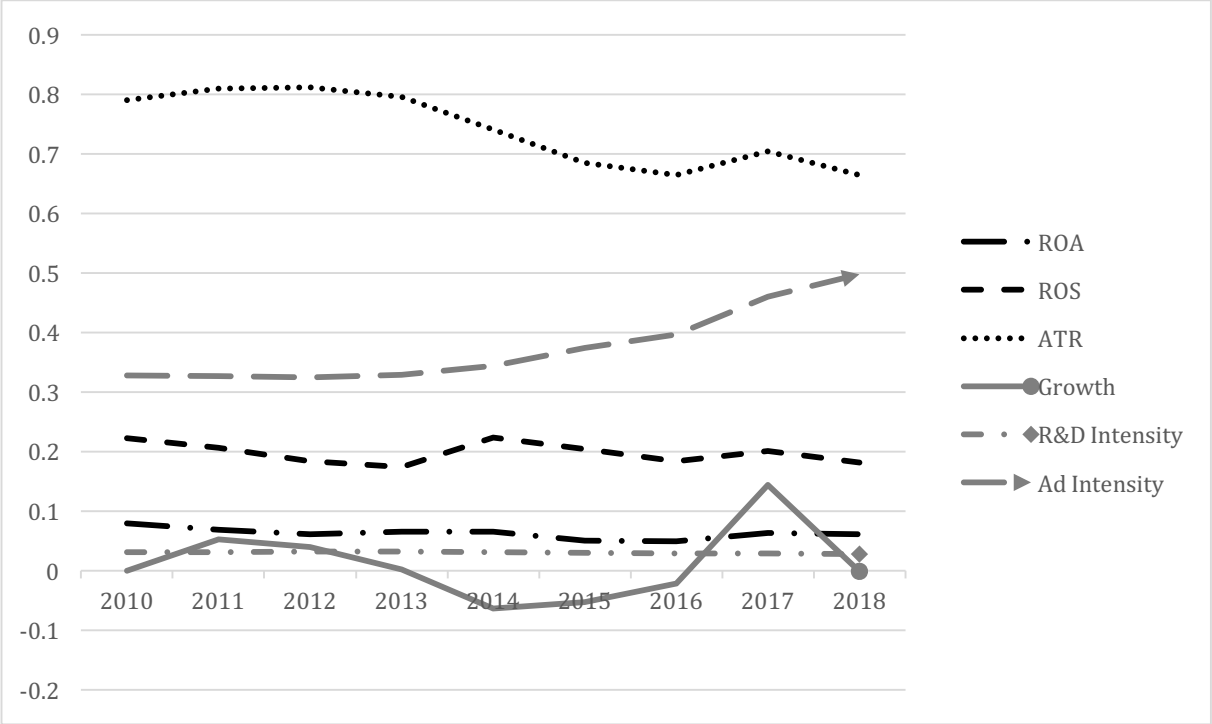


Figure 1. Mean Values of Main Variables

Examining the dependent variables, a downward trend can be seen for the three parameters although ATR's descending performance is considerably more drastic in comparison to what ROA and ROS denote, which can be considered as part of a cyclical pattern based on the observed period. When looking at the independent variables, a continuous upward trend can be observed in the Advertising Intensity while also a possible cyclical pattern can be assumed for the Growth variable and a relatively stable conduct relates to R&D Intensity.

Two inferences can be made from the spotted changes in these average values. First and most important, a company's overall performance is shaped by a combination of internal and external factors. So, even if a company has extraordinary productivity and efficiency levels, there is a high level of influence coming from externalities that affect a business' social, economic, and environmental performance such as macroeconomic cycles, regional or local business dynamics, as well as the political landscape and market preferences, among other variables that are not considered in this thesis. Nevertheless, the most efficient companies have a better position to face these externalities in the case they become a risk to their performance. Second, even though the period analysed might not be enough to determine cyclical behaviours in some of the observed variables (ROA, ROS and Growth), a relative stability in the investment ratio towards R&D as well as a constantly increasing expenditure towards Advertising are two assumptions that are safe to rely on. However, to have a clearer perspective, a much longer time frame would be needed to obtain meaningful trends, especially when analysing the Growth variable patterns.

Worth mentioning is the generalised increase experienced by the exhibited variables in the year 2017 which was followed by a noticeable decrease in all variables, except on Advertising Intensity which continued to grow almost 4%. The greatest change was experienced by the Growth variable that went from a positive average of 14.38% to a virtual zero. This comportment exemplifies the first point on the previous paragraph where an almost entire attribution of this performance can be attributed to external influences. On the other hand, the decrease to sub-zero per cent values from the year 2013 to 2014 in terms of Growth is contrasted by an increase in ROS values possibly meaning that, even though the sample companies in average became more efficient, the overall sales growth was not seen until a few years after. Therefore, to determine if this behaviour is part of a previous efficiency-sales growth performance cycle, a larger time frame is needed.

4.2 Estimation Analysis & Results

To test if the development and adoption of an SDI mechanism deliver better financial performance at the firm level, a panel data method is employed. Hausman tests are performed to determine if a Fixed (FE) or Random Effects (RE) model works better for the purpose (See Appendix D); however, to enhance the results, this thesis examines the effects from both angles. Following the strategy traced by Elsayed & Paton (2005), using a FE model (Models 1 and 2) controls for the time-invariant factors that might affect the relationship (in this case,

the Industry Sector and Country); whereas a RE model considers these variables at the same level as the rest of the independent variables when contemplating their influence in the equation. Moreover, the RE model is also run through two different variations where the first iteration does not include these time-invariant factors (Model 3) while the second iteration does take them into account (Model 4 and 5). Additionally, models 2, 3, and 4 do not include the Advertising Intensity variable to have a better understanding of its contribution to the model. In Table 4 a summary of the estimation results is presented for the three dependent variables for both FE and RE models through its different iterations. In Appendix E, the complete variable estimations can be reviewed.

The principal independent variable of interest (DJSI) delivers relatively similar results in terms of statistical significance and coefficient magnitude for the three dependent variables through both FE and RE models. However, only one of the three dependent variables presents statistically significant results. While ROA and ROS present non-significant statistic values in all models as well as a minor magnitude influence, ATR's results showcase a positive and economically meaningful impact at the 1% (Models 1 and 3) and 5% (Models 2, 4 and 5) confidence level. These numbers result in an acceptance of H_3 and a rejection of H_1 and H_2 reflecting a partial alignment with the reviewed literature. A comprehensive discussion of the main findings of these estimations is carried out in subsection 4.3.

One of the control variables denoting statistical significance at the 1% level on all three dependent variables and across the 5 models is the yearly net sales growth of a company (YoY Growth). This is a logical outcome due to a company's reliance on its product or services sales to produce revenue growth and consequently, an improvement of the financial performance. The consistently higher coefficient's magnitude for the ATR and ROS estimations for the three models is further proof of this underlying logic.

Regarding the R&D Intensity variable (R&DInt), it only presents statistical significance on the estimations for ATR at the 5% (Model 3) and 10% (Models 1, 2, 4 and 5) level; however, the positive magnitude of its influence on ATR is the largest of all the tested variables in the five models ranging from 2.068 to 3.108. Similar to the YoY Growth variable effect, this outcome is an expected one due to the close relationship between investments in R&D and the development of both intangible assets (patents) as well as innovative products that generate larger and broader revenue streams for companies with the characteristics present in our sample (Meliciani, 2000). What is more, these results might indicate the reliance on R&D of the companies that conform the sample to improve and maintain their financial performance over time. The discussion in subsection 4.3 further elaborates on these points.

When observing the Size variable behaviour, the contrasting difference of the estimations' significance and sign between the dependent variables deserves a deeper look. A negative influence (albeit relatively low in magnitude) on ROA and ROS is identifiable across the five models with meaningful statistical significance except from ROA in models 4 and 5. In comparison, the influence of Size in ATR is positive with a weaker performance in terms of

Table 4. Panel Data Summarised Estimation Results

Variables	Fixed Effects (1)			Fixed Effects (2)			Random Effects (3)			Random Effects (4)			Random Effects (5)		
	ROA	**ROS**	**ATR**	**ROA**	**ROS**	**ATR**	**ROA**	**ROS**	**ATR**	**ROA**	**ROS**	**ATR**	**ROA**	**ROS**	**ATR**
DJSI	0.00483 (0.671)	0.0213 (0.143)	0.0644*** (0.00899)	0.00250 (0.824)	0.0163 (0.256)	0.0467** (0.0296)	0.00399 (0.691)	0.0214 (0.104)	0.0630*** (0.00838)	0.00692 (0.470)	0.0212 (0.135)	0.0635** (0.0100)	0.00566 (0.551)	0.0172 (0.224)	0.0457** (0.0341)
Log Size	-0.0747*** (0.000613)	-0.0952*** (0.00106)	0.0333 (0.589)	-0.0733*** (0.000725)	-0.0923*** (0.00103)	0.0439 (0.353)	-0.0110* (0.0566)	-0.0538*** (4.58e-05)	0.0278 (0.540)	-0.00653 (0.159)	-0.0583*** (8.85e-05)	0.0314 (0.529)	-0.00719 (0.124)	-0.0588*** (5.88e-05)	0.0381 (0.342)
YoY Growth	0.0786*** (0.00254)	0.127*** (0.00109)	0.278*** (2.55e-07)	0.0829*** (0.00128)	0.136*** (0.000429)	0.311*** (4.46e-10)	0.0767*** (0.00271)	0.123*** (0.000721)	0.280*** (1.24e-08)	0.0720*** (0.00661)	0.122*** (0.00105)	0.280*** (2.28e-08)	0.0757*** (0.00352)	0.131*** (0.000399)	0.314*** (0)
R&D Intensity	-0.567 (0.325)	0.0361 (0.973)	3.108* (0.0535)	-0.644 (0.253)	-0.127 (0.898)	2.520* (0.0719)	0.429 (0.154)	0.267 (0.605)	2.711** (0.0226)	0.0536 (0.826)	0.446 (0.532)	2.596* (0.0523)	0.0273 (0.910)	0.342 (0.623)	2.068* (0.0764)
Advertising Intensity	-	-	-	-0.0147 (0.189)	-0.0311* (0.0649)	-0.112*** (0.000223)	-	-	-	-	-	-	-0.0130 (0.246)	-0.0289* (0.0824)	-0.115*** (0.000146)
Log Branch^	-	-	-	-	-	-	0.00517 (0.130)	0.00303 (0.578)	0.00824 (0.722)	0.00746** (0.0121)	0.00970 (0.162)	0.0344* (0.0844)	0.00792** (0.0101)	0.0106 (0.138)	0.0360* (0.0518)
Constant	0.884*** (0.000293)	1.163*** (0.000299)	0.268 (0.690)	0.878*** (0.000281)	1.151*** (0.000193)	0.225 (0.658)	0.151** (0.0161)	0.700*** (2.61e-06)	0.320 (0.524)	0.137** (0.0104)	0.857*** (2.26e-07)	-0.0716 (0.905)	0.149*** (0.00579)	0.872*** (7.45e-08)	-0.101 (0.838)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country	-	-	-	-	-	-	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Sector	-	-	-	-	-	-	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Hausman°	-	-	-	-	-	-	25.74***	4.52	-	25.84***	7.47	10.52	26.36***	9.66	17.39
Observations	592	592	592	592	592	592	592	592	592	592	592	592	592	592	592
Companies	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
R^2 Within	0.0932	0.126	0.352	0.101	0.149	0.439	0.0442	0.118	0.352	0.0485	0.118	0.352	0.0573	0.141	0.438
R^2 Between	0.00122	0.174	0.0255	0.00216	0.147	0.122	0.191	0.197	0.0276	0.728	0.604	0.532	0.725	0.594	0.573
R^2 Overall	1.97e-05	0.155	0.0443	4.80e-06	0.137	0.145	0.130	0.178	0.0479	0.452	0.499	0.519	0.454	0.496	0.563

Robust p-value in parentheses: *** p<0.01, ** p<0.05, * p<0.1

^ Due to the time invariant nature of the variables Log Branch, Sector, and Country it is not possible to identify their effect in the Fixed Effects model.
º Hausman are the Hausman Test results for Fixed or Random Effects (used in models 3, 4 and 5). Detailed results can be reviewed in Table A5 in the Appendix section.
Note: All models are run with robust standard errors to account for any signs of heteroscedasticity and serial correlation.

magnitude and statistically insignificant throughout the 5 estimations. What can be inferred from this outcome is that, when measured through its headcount, multinational companies (which generally have a larger operational structure) experience a negative effect on their financial indicators that could be explained by the greater fixed costs they incur that are related to human capital (salaries, work tools, employee benefits, etc.), operations (e.g. larger accounting or human resources departments), and expenditures on workplace facilities, among others. These expenses directly affect the profitability of their sales (ROS) as well as having a diminishing effect on the exploitation of their assets (ROA).

The statistically significant effect of the number of branches or subsidiaries on ATR and ROA on the RE models that include the time-invariant variables (4 and 5) is also an interesting outcome due to its relationship with asset exploitation capabilities. What these results might be exhibiting is that companies with a larger number of branches are able to seize the benefits produced by a multi-regional presence in two fronts. First, through an increase in sales as a consequence of a better understanding of the local business dynamics and the catering to new markets. Furthermore, an increase in sales is also achieved by growing the consumer base, which is generally the reason a company decides to expand into new markets. Second, through the collaboration between local offices that is focused on generating new and enhanced knowledge (e.g. processes, new products development) that benefits the whole organisation. This goes in line with the theory reviewed in subsection 3.2.4. Thus, even though they incur in larger operative expenses, they perceive gains in other strategic areas that are equally important to maintain their global leadership.

In models where the Advertising Intensity (AdInt) variable is included (2 and 5), the negative and relatively high in magnitude of its influence on ATR at a 1% confidence level is worth discussing. One of the possible explanations for this effect is the constantly increasing budget allocated towards this area which decreases the benefits of the operative efficiency gains. This logic can also be applied to the negative effect it has on ROS and ROA where, even though it is not statistically significant, a company's expenses on advertising relative to the total sales lessen the profit rate and asset efficiency for the simple reason that it is not a *productive* expense. Nevertheless, the other side of this argument is that advertising expenditures are fundamental to maintain the revenues needed for this type of companies to effectively commercialize their products and services, which is also valid. Moreover, according to Wagner (2010), for a company to capture the benefits of environmental and socially progressive activities, a certain amount of resources should be directed towards communicating these achievements. Therefore, a viable deduction could be that even though advertising expenses affect the profitability of a company, they are a necessary investment. Another plausible reason for this effect is the calculation formula this thesis is using to obtain the value of Advertising Intensity since the intangible assets of a company also include patents, trademarks and goodwill valuations that might be affecting the outcome. Furthermore, the net negative effect can also be explained by the fact that regardless of their purpose (PR, marketing, advertising, etc.), not all companies and certainly not all industries invest the same amount of monetary resources on communication activities. Market

concentration (as used in Ghisetti & Rennings (2014) is also a factor that is aligned with this reasoning.

Lastly, when analysing the effect of the time-invariant variables, Industry Sector and Country, the effects are diverse in terms of significance, sign, and magnitude. A deeper discussion is carried out in the next subsection. However, the field where they have the most influence is their contribution to the model fit, where the reported R^2 values deliver a promising prediction for the variables considered in the RE models (4 and 5). Their presence enhances the explanatory power by a noticeable amount in comparison with the FE models (1 and 2) as well as with the RE (Model 3). For this reason, and considering the marginal yet controversial contribution of AdInt into the model, the following discussion is built on the 2nd and 4th models that showcase robust results with and without including this variable.

4.3 Discussion of Main Findings

In this section, a deeper analysis of the main relationships tested is carried out through a comparison between the two models which provide the most promising results (2 and 4) as well as presenting a plausible theory behind their outcomes.

Interesting thoughts arise when comparing the two chosen models. On one hand, the effect of Country is diverse and inconclusive when it comes to transforming the benefits of an SDI strategy into better financial performance at the firm level. Even if its inclusion strengthens the model fit in a large measure for all three dependent variables, when observing the statistical significance on the individual basis, there is no clear pattern of influence from this variable. The majority of countries showcase a statistically significant influence when testing for ROA, with effects ranging from a negative 9.1% (Italy) to a uniquely positive 11.8% (Denmark). Likewise, when analysing the effects on ROS, the coefficient's magnitudes present an even broader range covering from a negative 32.9% (Finland) to a positive 9% (Hong Kong), with the latter being the only country on the positive side. However, the results from the ATR regression are radically different. Only five countries present statistical significance (Denmark, Hong Kong, South Korea, Netherlands and Sweden), with a high magnitude effect that goes from -43.6% (Hong Kong being the only negative) to a positive 45% for Denmark. Therefore, aside from stating a generalised conclusion of the importance of including Country in the models, it is not possible to elaborate on the individual outcome of each country. Most likely, this uneven outcome is related to externalities that affect businesses and countries in different manners such as industry maturity level or a market's purchasing power, just to name a few. So, to further understand how the company's HQ geographical location affects the tested relationship, a narrower sample with companies only from one country could deliver more precise results. Furthermore, including variables that account for some of these externalities, like Gallego-Álvarez, Segura & Martínez-Ferrero (2015) does with the classification of legal origin could yield noteworthy results.

On the other hand, when observing the effects of the Industry Sectors, a different and more concise perspective is put forward with varying magnitudes and an overall positive, statistical significance from specific Industry Sectors. Focusing on the ATR estimations, four sectors deliver statistical and economic significance: Consumer Discretionary (61.6%), Consumer Staples (24.2%), Energy (50.6%), and Industrials (37.2%). What is interesting of these four sectors is that are heavily reliant on their assets to produce revenues. More specifically, both their fixed and intangible assets are the engines behind their sales performance that might be boosted in the presence of an SDI mechanism. Whether it is a new soda flavour, a 4-star hotel, a transnational gas pipeline or a production line process for industrial adhesives, the dependency on their assets to grow and transform its output into tangible sales is a crucial fact that not all industry sectors share. A differential effect between industries on the main relationship tested (environmental/financial) is also perceived in the study by Elsayed & Paton (2005) albeit with a substantially different outcome with respect to the industries that showcase statistical significance as well as their influence sign and magnitude. However, what is important is to recognise the effect of firm and industry heterogeneity in this relationship, a concept that other studies such as Russo & Fouts (1997) fail to account for.

Furthermore, this dependency is also directly associated with their ability to both create new assets and exploit the existing ones in the most efficient way possible. So, the extent into which they invest in new ways of increasing efficiency by either reducing time or costs will be favourably visible in their bottom line. This finding could be compared with what Ghisetti & Rennings (2014) highlight about "energy and resources efficiency" (p.115) being the only type of environmental innovations that effectively deliver financial gains at the company level. Although a further estimation of the data through the interaction of these variables is needed to confirm this, a highly significant coefficient of R&D Intensity might likely be related to the presence and development of an SDI mechanism in this type of companies. This connection might also explain the positive influence of the Size variable coefficient in the sense that when high-efficiency levels together with well-defined organisational processes are present, a larger number of employees helps to deliver better asset exploitation. Partly following Wagner's (2010) affirmations, this theory also partially explains the negative influence of AdInt exhibited in model 2 where the communication activities merely work as a tool to amplify the message but are not the fundamental reason behind the economic performance of a firm. However, as mentioned before, the calculation of this variable contemplates more than the advertising expenditures and therefore its interpretation could be biased.

Based on the foregoing, the following assertions can be made. First, the presence of an SDI mechanism effectively aids in the optimal exploitation of a company's assets into sales and works as a tool to improve operational efficiency (ATR) rather than operational profitability (ROA) or financial profitability (ROS). This is a novel yet contrasting outcome with previous literature where profitability ratios were found predominantly significant. A plausible interpretation of this assertion could be that companies who prioritize sustainability in their production chains and organisational structure are better at increasing their sales but not necessarily at becoming more profitable at an organisational or product level. Second, an SDI

strategy works better in companies that prominently rely on their intangible (patents and processes) and fixed (machinery and capital goods) assets to produce sales-boosting goods and services. Therefore, although the gains in operational efficiency from adopting an SDI mechanism could be considered a generalised benefit, not all companies benefit from it in the same magnitude. The influence of DJSI on ATR (6.3%) might be hampered by the wide range of countries and industry sectors included in the sample; however, controlling for these variables is of foremost importance. Interesting findings might see light if these estimations are run through a lower-level classification (e.g. Industry Group) to obtain more precise results. And third, the high magnitude effect from R&D Intensity into the main relationship in question exhibits the large focus of firms towards researching and developing both new products and services but also processes and techniques that improve the efficiency of the company. This finding confirms the widely-accepted relationship between R&D and innovation; however, it might be indicating that companies who follow an SDI strategy are better in transforming their R&D efforts into revenue.

To conclude the discussion, it is important to acknowledge that the methodology used in this thesis does not exhibit a clear direction of causality, leaving this question to be answered by future researches. Additionally, considering that the sample companies are leaders in their respective industries, the results might not be applicable to other companies or industries that are not on the same maturity level. As mentioned earlier in this writing, transitioning to an SDI mechanism is a lengthy and organisational-wide process that might be impelled or hindered by externalities not accounted for in this thesis.

4.4 Tests & Robustness Checks

To ensure the proper method usage and robustness of the results, a series of tests were performed on the data and models. The results are available in Appendix D and F.

As mentioned earlier, Hausman Tests are run to determine whether a Random or Fixed Effects methods fit better for the purpose with results indicating that using RE is a valid strategy for two out of the three variables (ROS and ATR). The tests indicate that ROA, on the other hand, should be regressed through a FE method. Additionally, the Breusch-Pagan Lagrange multiplier test (LM – STATA command ‘xttest2’), as well as a joint test (STATA command ‘testparm’), are run to confirm the validity of regressing through RE and FE methods instead of a simple OLS regression. The mixed outcome from these tests aids in the decision to use both methods for the research analysis.

To test for stationarity of the data, Im-Pesaran-Shin Unit-Root tests are performed for the main variables, positively indicating stationarity throughout the observed period of the tested variables. Furthermore, to examine for collinearity/multicollinearity between the predictors in the model, a Variance Inflation Factor (VIF) is employed revealing a lack of collinearity between most of the variables used, except for a couple of countries.

In terms of heteroskedasticity testing, a modified Wald test (STATA command 'xttest3') is employed to check for this data structure where results indicate the existence of heteroskedasticity in all variables. Moreover, running a Lagram-Multiplier test for serial correlation (Woolridge Test – STATA command 'xtserial') showcases the presence of autocorrelation in the ROA and ROS variables. To correct for the presence of both heteroskedasticity and serial correlation, robust standard errors are used in all regressions and models.

Finally, to following the lines of Elsayed & Paton (2005) to validate the calculation procedure of AdInt, a correlation between R&Dint and AdInt is exhibited, revealing a weak relationship between both variables.

5 Conclusions

Based on the wide yet inconclusive debate between the environmental and financial performances of companies, this thesis seeks to answer the question of whether the development of a sustainability-driven innovation (SDI) strategy exerts a positive influence on the financial performance of multinational firms. To measure the presence of an SDI mechanism in public companies, this thesis employs an innovative approach by measuring the number of appearances in the Dow Jones Sustainability Index (DJSI), the most time-encompassing and comprehensive sustainability assessment currently available. Using panel data methodology through a combination of fixed and random effects methods, the effects of SDI are estimated on the ROA (Return on Assets), ROS (Return on Sales), and ATR (Asset Turnover) indicators between the years of 2010 and 2018 yielding contrasting but interesting results.

First, the presence of an SDI mechanism effectively aids in the optimal exploitation of a company's assets into sales and works as a tool to improve operational efficiency (ATR) rather than operational profitability (ROA) or financial profitability (ROS). This is an unexpected and contrasting outcome with previous literature where profitability ratios were found mostly significant. More importantly, since the inclusion of ATR as a dependent variable is also a novel contribution of this research to the knowledge space, hopefully, this conclusion will lay the ground for further research of this innovation strategy. Second, an SDI strategy works better in industry sectors that prominently rely on their intangible (patents and processes) and fixed (machinery and capital goods) assets to produce sales-boosting goods and services. Therefore, although the gains in operational efficiency from adopting an SDI mechanism could be considered a generalised benefit, not all companies equally benefit from it. Third, the high magnitude effect from R&D Intensity confirms the widely-accepted link between R&D and innovation and is likely to exhibit the large focus of firms towards researching and developing both new products and services but also pioneering processes and techniques that improve the efficiency and productivity of the company.

These findings expose the benefits and downturns of placing sustainability at the top of the company strategy and prove SDI as a viable alternative to transform the business dynamics and collectively work towards solving the most pressing issue of this generation. They could be especially interesting to company managers who aim to implement more sustainable means of production but are uncertain of the outcome of their investments in time and resources of this renovation process. Additionally, policymakers might also be interested in this research's contribution for its practical implications on both the financial and environmental fields as well as to understand which industries benefit the most out of an SDI mechanism and from which sectors they might expect higher levels of efficiency and productivity. Lastly, this information might also be of interest to end-consumers whose

purchasing power drives the demands of the market and pushes both companies and policymakers into more challenging grounds.

Regarding the limitations of this research, the relatively short period and sample size, as well as the omission of relevant variables that are employed in other studies must be acknowledged. Particularly, three variables stand out due to the explanatory power described by the authors that integrated them. The industry yearly growth, a variable included in most of the reviewed literature, could certainly enhance the results by accounting for the dynamic market forces and industry life cycle, two key factors that are crucial in explaining the performance of any type of company. However, due to the multinational and multi-industry nature of the data, it was not possible to obtain. The stringency of environmental laws and the legal framework of the countries where companies have presence could also enrich the results and reduce the unobservable characteristics attributable to the legal system of each country that might be influencing the proposed models. To ponder on the role of end-consumers, incorporating the market share or industry concentration would also improve the models' explicatory degree as well as the research's results. Other variables not considered in the revised studies such as the number of patents per company or the overall economic development of a country might also shed light into the findings.

Nonetheless, these limitations create a motivating space for further researchers whether they want to broaden up or narrow down their analysis. From the methodological perspective, more robust and complex methods to define the direction of causality, such as an IV or 2SLS, in addition to the aforementioned variables, could put forward some interesting practical applications for the business world. Regarding the data and variables, narrowing the analysis to one industry and/or country for deeper and more meaningful analysis or including market-based financial performance measures in the models as well as complimenting the selected companies with other sustainability or innovation indexes or rankings would broaden the research scope and findings. Lastly, increasing the observed period so that it includes at least a full economic cycle with both economic uptrends and downturns would create a more comprehensive panel data that would increment the result's acceptance and validity.

6 References

Acemoglu, D., Akcigit, U., Hanley, D. & Kerr, W. (2016). Transition to Clean Technology, *Journal of Political Economy*, [e-journal] vol. 124, no. 1, p.53, Available Online: https://www.journals.uchicago.edu/doi/pdfplus/10.1086/684511 [Accessed 5 May 2020].

Bain, J. S. (1964). The Impact on Industrial Organization, *The American Economic Review*, [e-journal] vol. 54, no. 3, pp.28–32, Available Through: JSTOR https://www.jstor.org/stable/1818486 [Accessed 5 January 2020].

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage, *Journal of Management*, [e-journal] vol. 17, no. 1, pp.99–120, Available Online: https://doi.org/10.1177/014920639101700108 [Accessed 6 January 2020].

Barnett, M. L. & Salomon, R. M. (2006). Beyond Dichotomy: The Curvilinear Relationship between Social Responsibility and Financial Performance, *Strategic Management Journal*, [e-journal] vol. 27, no. 11, pp.1101–1122, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1002/smj.557 [Accessed 27 May 2020].

Bos-Brouwers, H. E. J. (2010). Corporate Sustainability and Innovation in SMEs: Evidence of Themes and Activities in Practice, *Business Strategy and the Environment*, [e-journal] vol. 19, no. 7, pp.417–435, Available Online: https://onlinelibrary.wiley.com/doi/full/10.1002/bse.652 [Accessed 7 January 2020].

Carlsson, B. & Stankiewicz, R. (1991). On the Nature, Function and Composition of Technological Systems, *Journal of Evolutionary Economics*, [e-journal] vol. 1, no. 2, pp.93–118, Available Online: https://doi.org/10.1007/BF01224915 [Accessed 26 May 2020].

CBBC Newsround. (2019). Climate Change: What Is It and Why Is Everyone Talking about It?, Available online: https://www.bbc.co.uk/newsround/45880633 [Accessed 7 January 2020].

Chakravarthy, B. S. (1986). Measuring Strategic Performance, *Strategic Management Journal*, [e-journal] vol. 7, no. 5, pp.437–458, Available Through: JSTOR https://www.jstor.org/stable/2486059 [Accessed 4 May 2020].

Chapple, W., Cooke, A., Galt, V. & Paton, D. (2001). The Determinants of Voluntary Investment Decisions, *Managerial and Decision Economics*, [e-journal] vol. 22, no. 8, pp.453–463, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1002/mde.1035 [Accessed 5 May 2020].

Cohen, M.A., Fenn, S. & Naimon, J.S., (1995). Environmental and financial performance: are they related?. Washington, DC: Investor Responsibility Research Center, Environmental

Information Service. Available Online: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.498.9820&rep=rep1&type=pdf [Accessed 29 April 2020].

Colombelli, A., Ghisetti, C. & Quatraro, F. (2020). Green Technologies and Firms' Market Value: A Micro-Econometric Analysis of European Firms, *Industrial and Corporate Change*, [e-journal] no. dtaa003, Available Online: https://doi.org/10.1093/icc/dtaa003 [Accessed 5 May 2020].

Colombelli, A., Krafft, J. & Quatraro, F. (2019). Firms' Growth, Green Gazelles and Eco-Innovation: Evidence from a Sample of European Firms, *Small Business Economics*, [e-journal], Available Online: http://link.springer.com/10.1007/s11187-019-00236-8 [Accessed 5 May 2020].

Combs, J. G., Crook, T. R. & Shook, C. L. (2005). The Dimensionality of Organizational Performance and Its Implications for Strategic Management Research, in *Research Methodology in Strategy and Management*, Vol. 2, [e-book] Bingley: Emerald (MCB UP), pp.259–286, Available Online: https://www.emerald.com/insight/content/doi/10.1016/S1479-8387(05)02011-4/full/html [Accessed 4 May 2020].

Corbett, C.J. & Klassen, R.D. (2006). Extending the horizons: environmental excellence as key to improving operations, *Manufacturing & Service Operations Management*, 8 (1), p.5–22, Available Online: https://escholarship.org/content/qt9v94p2hj/qt9v94p2hj.pdf [Accessed 7 May 2020].

Cordeiro, J. J. & Sarkis, J. (1997). Environmental Proactivism and Firm Performance: Evidence from Security Analyst Earnings Forecasts, *Business Strategy and the Environment*, [e-journal] vol. 6, no. 2, pp.104–114, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1002/%28SICI%291099-0836%28199705%296%3A2%3C104%3A%3AAID-BSE102%3E3.0.CO%3B2-T [Accessed 10 January 2020].

Dechant, K. & Altman, B. (1994). Environmental Leadership: From Compliance to Competitive Advantage, *Academy of Management Perspectives*, [e-journal] vol. 8, no. 3, pp.7–20, Available Online: https://journals.aom.org/doi/abs/10.5465/AME.1994.9503101163 [Accessed 27 May 2020].

Dowell, G., Hart, S. & Yeung, B. (2000). Do Corporate Global Environmental Standards Create or Destroy Market Value?, *Management Science*, [e-journal] vol. 46, no. 8, pp.1059–1074, Available Online: https://pubsonline.informs.org/doi/abs/10.1287/mnsc.46.8.1059.12030 [Accessed 5 January 2020].

Elsayed, K. & Paton, D. (2005). The Impact of Environmental Performance on Firm Performance: Static and Dynamic Panel Data Evidence, *Structural Change and Economic Dynamics*, [e-journal] vol. 16, no. 3, pp.395–412, Available Online: http://www.sciencedirect.com/science/article/pii/S0954349X04000384 [Accessed 5 May 2020].

Esty, D. C. & Porter, M. E. (1998). Industrial Ecology and Competitiveness, *Journal of Industrial Ecology*, [e-journal] vol. 2, no. 1, pp.35–43, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1162/jiec.1998.2.1.35 [Accessed 4 January 2020].

Feldman, S. J., Soyka, P. A. & Ameer, P. G. (1997). Does Improving a Firm's Environmental Management System and Environmental Performance Result in a Higher Stock Price?, *The Journal of Investing*, [e-journal] vol. 6, no. 4, pp.87–97, Available Online: http://joi.pm-research.com/lookup/doi/10.3905/joi.1997.87 [Accessed 4 May 2020].

Figge, F. (2005). Value-Based Environmental Management. From Environmental Shareholder Value to Environmental Option Value, *Corporate Social Responsibility and Environmental Management*, [e-journal] vol. 12, no. 1, pp.19–30, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1002/csr.74 [Accessed 9 January 2020].

Frenken, K., Oort, F. V. & Verburg, T. (2007). Related Variety, Unrelated Variety and Regional Economic Growth, *Regional Studies*, [e-journal] vol. 41, no. 5, pp.685–697, Available Online: https://doi.org/10.1080/00343400601120296 [Accessed 26 May 2020].

Gallego-Álvarez, I., Segura, L. & Martínez-Ferrero, J. (2015). Carbon Emission Reduction: The Impact on the Financial and Operational Performance of International Companies, *Journal of Cleaner Production*, [e-journal] vol. 103, pp.149–159, Available Online: https://linkinghub.elsevier.com/retrieve/pii/S0959652614008701 [Accessed 5 May 2020].

Gentry, R. J. & Shen, W. (2010). The Relationship between Accounting and Market Measures of Firm Financial Performance: How Strong Is It?, *Journal of Managerial Issues*, [e-journal] vol. 22, no. 4, pp.514–530, Available Through: JSTOR https://www.jstor.org/stable/25822528 [Accessed 2 May 2020].

Ghisetti, C. & Rennings, K. (2014). Environmental Innovations and Profitability: How Does It Pay to Be Green? An Empirical Analysis on the German Innovation Survey, *Journal of Cleaner Production*, [e-journal] vol. 75, pp.106–117, Available Online: http://www.sciencedirect.com/science/article/pii/S0959652614003370 [Accessed 5 May 2020].

Grant, R. M. (1991). The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation, *California Management Review*, [e-journal] vol. 33, no. 3, pp.114–135, Available Online: https://doi.org/10.2307/41166664 [Accessed 1 May 2020].

Hamilton, J. T. (1995). Pollution as News: Media and Stock Market Reactions to the Toxics Release Inventory Data, *Journal of Environmental Economics and Management*, [e-journal] vol. 28, no. 1, pp.98–113, Available Online: http://www.sciencedirect.com/science/article/pii/S0095069685710078 [Accessed 7 January 2020].

Hart, S. L. (1995). A Natural-Resource-Based View of the Firm, *The Academy of Management Review*, [e-journal] vol. 20, no. 4, pp.986–1014, Available Through: JSTOR https://www.jstor.org/stable/258963 [Accessed 4 January 2020].

Hart, S. L. & Ahuja, G. (1996). Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance, *Business Strategy and the Environment*, Vol. 5, p.30-37, John Wiley & Sons, Ltd and ERP Environment. Available online: https://doi.org/10.1002/(SICI)1099-0836(199603)5:1<30::AID-BSE38>3.0.CO;2-Q [Accessed 5 January 2020].

Hargrave, M. (2020a). Return on Assets, *Investopedia*, Available Online: https://www.investopedia.com/terms/r/returnonassets.asp [Accessed 7 May 2020].

Hargrave, M. (2020b). Sharpe Ratio, *Investopedia*, Available Online: https://www.investopedia.com/terms/s/sharperatio.asp [Accessed 4 May 2020].

Hayes, A. (2020a). Return on Sales (ROS), *Investopedia*, Available Online: https://www.investopedia.com/terms/r/ros.asp [Accessed 7 May 2020].

Hayes, A. (2020b). Asset Turnover Ratio, *Investopedia*, Available Online: https://www.investopedia.com/terms/a/assetturnover.asp [Accessed 10 January 2020].

Hoskisson, R. E., Johnson, R. A. & Moesel, D. D. (1994). Corporate Divestiture Intensity in Restructuring Firms: Effects of Governance, Strategy, and Performance, *The Academy of Management Journal*, [e-journal] vol. 37, no. 5, pp.1207–1251, Available Through: JSTOR https://www.jstor.org/stable/256671 [Accessed 4 May 2020].

Hsiao, C. (2007). Panel Data Analysis—Advantages and Challenges, *TEST*, [e-journal] vol. 16, no. 1, pp.1–22, Available Online: https://doi.org/10.1007/s11749-007-0046-x [Accessed 9 May 2020].

Iwata, H. & Okada, K. (2011). How Does Environmental Performance Affect Financial Performance? Evidence from Japanese Manufacturing Firms, *Ecological Economics*, [e-journal] vol. 70, no. 9, pp.1691–1700, Available Online: https://linkinghub.elsevier.com/retrieve/pii/S0921800911001996 [Accessed 7 January 2020].

Jacobs, J. (1969). The Economy of Cities. New York: Vintage.

Jacobsen, R. (1988). The Persistence of Abnormal Returns, *Strategic Management Journal*, [e-journal] vol. 9, no. 5, pp.415–430, Available Through: JSTOR https://www.jstor.org/stable/2485953 [Accessed 4 May 2020].

Johnson, W. B., Natarajan, A. & Rappaport, A. (1985). Shareholder returns and corporate excellence, *Journal of Business Strategy*, [e-journal] vol. 6, no. 2, pp.52–62, Available Online: https://doi.org/10.1108/eb039109 [Accessed 4 May 2020].

Keats, B. W. (1988). The Vertical Construct Validity of Business Economic Performance Measures, *The Journal of Applied Behavioral Science*, [e-journal] vol. 24, no. 2, pp.151–160, Available Online: https://doi.org/10.1177/0021886388242002 [Accessed 4 May 2020].

Keeble, J., Lyon, D., Vassallo, D., Hedstrom, G., Sanchez, H. (2005). Innovation High Ground Report: How Leading Companies Are Using Sustainability-Driven Innovation to Win Tomorrow's Customers, Arthur D. Little, Available online:

https://www.adlittle.com/sites/default/files/viewpoints/ADL_Innovation_High_Ground_report_03.pdf [Accessed 7 January 2020].

Kendall, H.W. (1992). World Scientists Warning To Humanity, Available online: https://www.ucsusa.org/sites/default/files/attach/2017/11/World%20Scientists%27%20Warning%20to%20Humanity%201992.pdf [Accessed 7 January 2020].

King, A. A. & Lenox, M. J. (2001). Does It Really Pay to Be Green? An Empirical Study of Firm Environmental and Financial Performance, *Journal of Industrial Ecology*, [e-journal] vol. 5, no. 1, pp.105–116, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1162/108819801753358526 [Accessed 7 May 2020].

Kiron, D., Kruschwitz, N., Reeves, M., Goh, E. (2013). The Benefits of Sustainability-Driven Innovation, *MIT Sloan Management Review*, Available Online: https://sloanreview.mit.edu/article/the-benefits-of-sustainability-driven-innovation/ [Accessed 10 January 2020].

Klassen, R. D. & McLaughlin, C. P. (1996). The Impact of Environmental Management on Firm Performance, *Management Science*, [e-journal] vol. 42, no. 8, pp.1199–1214, Available Online: https://pubsonline.informs.org/doi/abs/10.1287/mnsc.42.8.1199 [Accessed 6 January 2020].

Konar, S. & Cohen, M. A. (2001). Does the Market Value Environmental Performance?, *Review of Economics and Statistics*, [e-journal] vol. 83, no. 2, pp.281–289, Available Online: http://www.mitpressjournals.org/doi/10.1162/00346530151143815 [Accessed 7 May 2020].

Kuznets, S. (1973). Modern Economic Growth: Findings and Reflections, *The American Economic Review*, [e-journal] vol. 63, no. 3, pp.247–258, Available Through: JSTOR https://www.jstor.org/stable/1914358 [Accessed 8 January 2020].

Lee, Y. (2006). Diagnostic Testing for Dynamic Panel Data Models, the 14 Conference on Panel Data, 2007, Available Online: http://www.wise.xmu.edu.cn/panel2007/paper/LEE(Yoon-Jin).pdf [Accessed 9 May 2020].

Lindenberg, E. B. & Ross, S. A. (1981). Tobin's q Ratio and Industrial Organization, *The Journal of Business*, [e-journal] vol. 54, no. 1, pp.1–32, Available Through: JSTOR https://www.jstor.org/stable/2352631 [Accessed 8 January 2020].

Lubatkin, M. & Shrieves, R. E. (1986). Towards Reconciliation of Market Performance Measures to Strategic Management Research, *The Academy of Management Review*, [e-journal] vol. 11, no. 3, pp.497–512, Available Through: JSTOR https://www.jstor.org/stable/258307 [Accessed 4 May 2020].

Malthus, T. (1798). An Essay on the Principle of Population, chp. VII, p. 61, Available online: http://www.esp.org/books/malthus/population/malthus.pdf [Accessed 7 January 2020].

Mazzucato, M. (2018). Mission-Oriented Innovation Policies: Challenges and Opportunities, *Industrial and Corporate Change*, [e-journal] vol. 27, no. 5, pp.803–815, Available Online: https://academic.oup.com/icc/article/27/5/803/5127692 [Accessed 7 January 2020].

McKinsey (2019). ESG Framework, Available Online: https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/five-ways-that-esg-creates-value [Accessed 19 December 2019].

McWilliams, A. & Siegel, D. (2000). Corporate Social Responsibility and Financial Performance: Correlation or Misspecification?, *Strategic Management Journal*, [e-journal] vol. 21, no. 5, pp.603–609, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1002/%28SICI%291097-0266%28200005%2921%3A5%3C603%3A%3AAID-SMJ101%3E3.0.CO%3B2-3 [Accessed 11 May 2020].

Meliciani, V. (2000). The Relationship between R&D, Investment and Patents: A Panel Data Analysis, *Applied Economics*, [e-journal] vol. 32, no. 11, pp.1429–1437, Available Online: https://doi.org/10.1080/00036840050151502 [Accessed 20 May 2020].

Metz, P., Burek, S., Hultgren, T. R., Kogan, S. & Schwartz, L. (2016). The Path to Sustainability-Driven Innovation, *Research-Technology Management*, [e-journal] vol. 59, no. 3, pp.50–61, Available Online: https://doi.org/10.1080/08956308.2016.1161409. [Accessed 7 January 2020].

MSCI (2020). GICS - Global Industry Classification Standard, Available Online: https://www.msci.com/gics [Accessed 10 January 2020].

Nidumolu, R., Prahalad, C. K. & Rangaswami, M. R. (2009). Why Sustainability Is Now the Key Driver of Innovation, *Harvard Business Review*, 87(9): p.56-64, Available Online: http://hbr.org/2009/09/why-sustainability-is-now-the-key-driver-of-innovation [Accessed 6 January 2020].

OECD (2017). Entrepreneurship at a Glance 2017, [e-book] OECD, Available Online: https://www.oecd-ilibrary.org/employment/entrepreneurship-at-a-glance-2017_entrepreneur_aag-2017-en [Accessed 11 May 2020].

Perez, C. (2010). Technological revolutions and techno-economic paradigms, *Cambridge Journal of Economics*, 34(1), 185-202. Available online: http://www.jstor.org/stable/24232030 [Accessed 9 January 2020].

Porter, M. E. (1981). The Contributions of Industrial Organization to Strategic Management, *The Academy of Management Review*, [e-journal] vol. 6, no. 4, pp.609–620, Available Through: JSTOR https://www.jstor.org/stable/257639 [Accessed 1 May 2020].

Porter, M. E. & van der Linde, C. (1995). Toward a New Conception of the Environment-Competitiveness Relationship, *Journal of Economic Perspectives*, [e-journal] vol. 9, no. 4, pp.97–118, Available Online: http://pubs.aeaweb.org/doi/10.1257/jep.9.4.97 [Accessed 5 January 2020].

Rassier, D. G. & Earnhart, D. (2010). Does the Porter Hypothesis Explain Expected Future Financial Performance? The Effect of Clean Water Regulation on Chemical Manufacturing Firms, *Environmental and Resource Economics*, [e-journal] vol. 45, no. 3, pp.353–377, Available Online: http://link.springer.com/10.1007/s10640-009-9318-0 [Accessed 10 January 2020].

Raworth, K. (2017). Doughnut economics: Seven ways to think like a 21st century economist. Chelsea Green Publishing.

Riillo, C. A. F. (2017). Beyond the Question "Does It Pay to Be Green?": How Much Green? And When?, *Journal of Cleaner Production*, [e-journal] vol. 141, pp.626–640, Available Online: http://www.sciencedirect.com/science/article/pii/S0959652616313804 [Accessed 7 May 2020].

Ripple, W. J., Wolf, C., Newsome, T. M., Galetti, M., Alamgir, M., Crist, E., Mahmoud, M. I., Laurance, W. F. & 15, 364 scientist signatories from 184 countries. (2017). World Scientists' Warning to Humanity: A Second Notice, *BioScience*, [e-journal] vol. 67, no. 12, pp.1026–1028, Available Online: https://doi.org/10.1093/biosci/bix125 [Accessed 4 January 2020].

Ripple, W. J., Wolf, C., Newsome, T. M., Barnard, P. & Moomaw, W. R. (2019). World Scientists' Warning of a Climate Emergency, *BioScience*, [e-journal] no. biz088, Available Online: https://doi.org/10.1093/biosci/biz088 [Accessed 4 January 2020].

Rooney, C. (1993). Economics of pollution prevention: how waste reduction pays, *Pollution Prevention Review*, Summer edition, p. 261-276. Available online: https://p2infohouse.org/ref/27/26808.pdf [Accessed 8 January 2020].

Russo, M.V., Fouts, P.A. (1997). A resource-based perspective on corporate environmental performance and profitability, *Academy of Management Journal,* 40 (3), p. 534–559. Available online: https://journals.aom.org/doi/10.5465/257052 [Accessed 4 January 2020].

Saxenian, A. (2007). The New Argonauts: Regional Advantage in a Global Economy, Harvard University Press.

Schumpeter, J. A. (1934), The Theory of Economic Development. An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle, Cambridge, MA: Harvard University Press.

Schumpeter, J. A. (1942). Capitalism, Socialism and Democracy, Routledge, Available online:http://search.ebscohost.com.ludwig.lub.lu.se/login.aspx?direct=true&db=cat02271a&AN=atoz.ebs195810e&site=eds-live&scope=site [Accessed 7 January 2020].

Shafik, N. (1994). Economic Development and Environmental Quality: An Econometric Analysis, *Oxford Economic Papers*, [e-journal] vol. 46, pp.757–773, Available Through: JSTOR https://www.jstor.org/stable/2663498 [Accessed 8 January 2020].

Sroufe, R. (2003). Effects of Environmental Management Systems on Environmental Management Practices and Operations, *Production and Operations Management*, [e-journal] vol. 12, no. 3, pp.416–431, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1937-5956.2003.tb00212.x [Accessed 27 May 2020].

Stanwick, P. A. & Stanwick, S. D. (1998). The Relationship Between Corporate Social Performance, and Organizational Size, Financial Performance, and Environmental Performance: An Empirical Examination, *Journal of Business Ethics*, [e-journal] vol. 17, no. 2, pp.195–204, Available Online: https://doi.org/10.1023/A:1005784421547 [Accessed 8 January 2020].

S&P Global (2020). About the CSA, Available Online: https://www.robecosam.com/csa/csa-resources/about-csa.html [Accessed 10 January 2020].

Thompson, A. W., Larsson, T. C. & Broman, G. (2011). Towards Sustainability-Driven Innovation through Product-Service Systems, in J. Hesselbach & C. Herrmann (eds), *Functional Thinking for Value Creation*, [e-book] Berlin, Heidelberg: Springer Berlin Heidelberg, pp.117–122, Available Online: http://link.springer.com/10.1007/978-3-642-19689-8_22 [Accessed 10 January 2020].

Trifilova, A., Bessant, J., Jia, F. & Gosling, J. (2013). Sustainability-Driven Innovation and the Climate Savers' Programme: Experience of International Companies in China, *Corporate Governance: The international journal of business in society*, [e-journal] vol. 13, no. 5, pp.599–612, Available Online: https://www.emerald.com/insight/content/doi/10.1108/CG-06-2013-0082/full/html [Accessed 10 January 2020].

Turban, D. B. & Greening, D. W. (1997). Corporate Social Performance And Organizational Attractiveness To Prospective Employees, *Academy of Management Journal*, [e-journal] vol. 40, no. 3, pp.658–672, Available Online: https://journals.aom.org/doi/abs/10.5465/257057 [Accessed 27 May 2020].

Turk, M. (2018). Otto Neurath and the History of Economics, Routledge, Available online: https://books.google.com/books?hl=en&lr=&id=p35aDwAAQBAJ&oi=fnd&pg=PT9&dq=Otto+Neurath+turk&ots=7OevRBspW9&sig=AqnvgPKCpjwl2doo4wf-xjTKwto [Accessed 7 January 2020].

UNFCCC - United Nations Framework Convention on Climate Change (2020a). What is the Kyoto Protocol?, Available online: https://unfccc.int/kyoto_protocol [Accessed 7 January 2020].

UNFCCC - United Nations Framework Convention on Climate Change (2020b). The Paris Agreement, Available online: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement [Accessed 7 January 2020].

von Paumgartten, P. (2003). The Business Case for High Performance Green Buildings: Sustainability and Its Financial Impact, *Journal of Facilities Management*, [e-journal] vol.

2, no. 1, pp.26–34, Available Online: https://doi.org/10.1108/14725960410808096 [Accessed 8 January 2020].

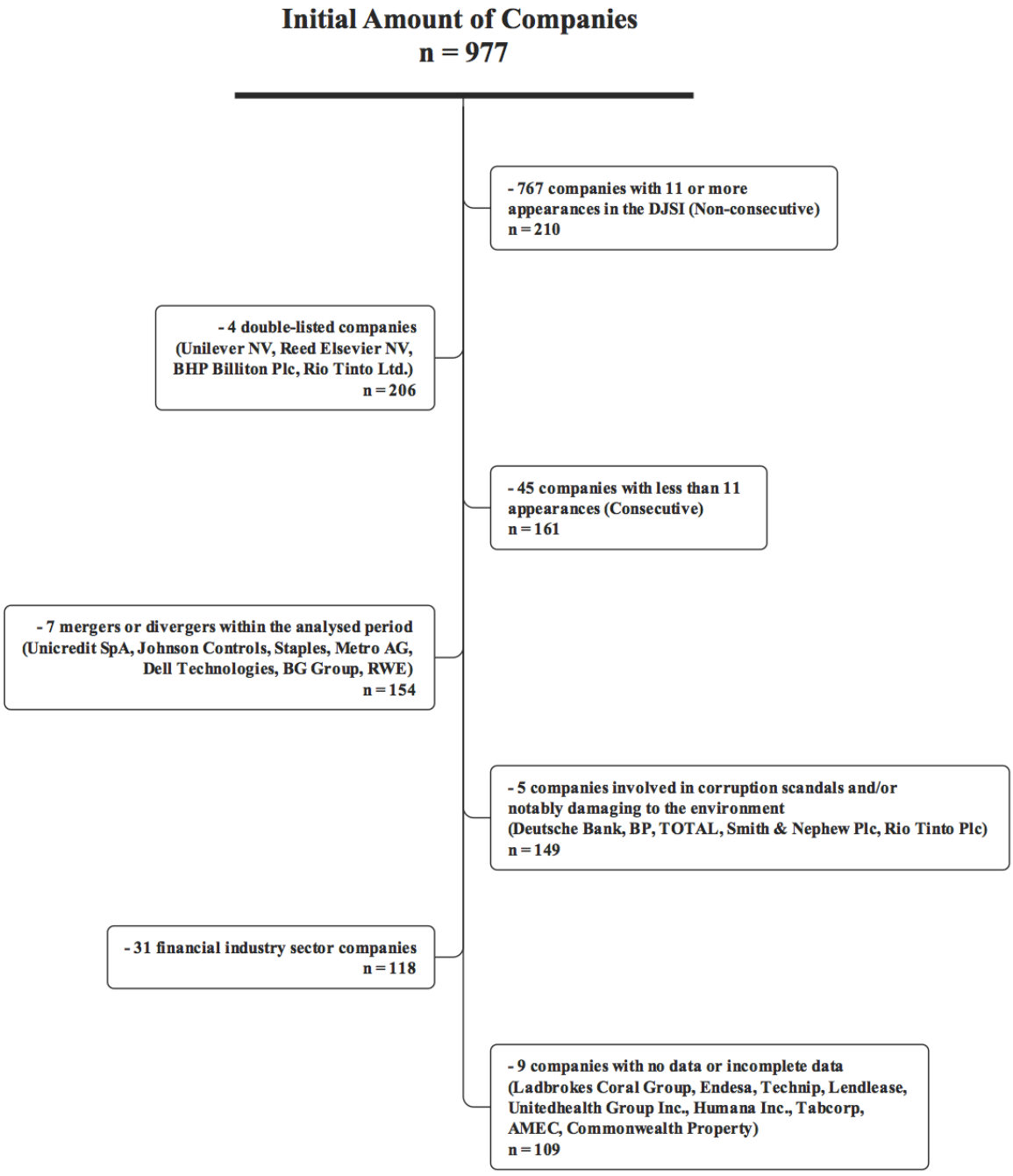
Wagner, M. (2010). The Role of Corporate Sustainability Performance for Economic Performance: A Firm-Level Analysis of Moderation Effects, *Ecological Economics*, [e-journal] vol. 69, no. 7, pp.1553–1560, Available Online: https://linkinghub.elsevier.com/retrieve/pii/S0921800910000741 [Accessed 7 January 2020].

Wagner, M., Phu, N. V., Azomahou, T. & Wehrmeyer, W. (2002). The Relationship between the Environmental and Economic Performance of Firms: An Empirical Analysis of the European Paper Industry, *Corporate Social Responsibility and Environmental Management*, [e-journal] vol. 9, no. 3, pp.133–146, Available Online: https://onlinelibrary.wiley.com/doi/abs/10.1002/csr.22 [Accessed 9 January 2020].

World Commission on Environment and Development (1987). *Our Common Future*: Report of the World Commission on Environment and Development. Transmitted to the United Nations General Assembly as an Annex to document A/42/427 - Development and International Cooperation: Environment. Oxford University Press. Available online: http://www.un-documents.net/wced-ocf.htm [Accessed 7 January 2020].

World Economic Forum (2020). The Davos Manifesto 2020, Available Online: https://www.weforum.org/the-davos-manifesto/manifesto/ [Accessed 7 January 2020].

7 Appendix A


Initial Amount of Companies
n = 977
- 767 companies with 11 or more appearances in the DJSI (Non-consecutive)
n = 210
- 4 double-listed companies (Unilever NV, Reed Elsevier NV, BHP Billiton Plc, Rio Tinto Ltd.)
n = 206
- 45 companies with less than 11 appearances (Consecutive)
n = 161
- 7 mergers or divergers within the analysed period (Unicredit SpA, Johnson Controls, Staples, Metro AG, Dell Technologies, BG Group, RWE)
n = 154
- 5 companies involved in corruption scandals and/or notably damaging to the environment (Deutsche Bank, BP, TOTAL, Smith & Nephew Plc, Rio Tinto Plc)
n = 149
- 31 financial industry sector companies
n = 118
- 9 companies with no data or incomplete data (Ladbrokes Coral Group, Endesa, Technip, Lendlease, Unitedhealth Group Inc., Humana Inc., Tabcorp, AMEC, Commonwealth Property)
n = 109

Appendix B – Descriptive Statistics

VARIABLES	N	MEAN	SD	MIN	MAX
Company	981	55	31.48	1	109
ROA	981	0.0623	0.0858	-0.289	0.890
ROS	981	0.198	0.349	-0.630	5.526
ATR	981	.71602	.42517	.02298	2.4780
DJSI	981	0.791	0.407	0	1
Log of Size	981	10.48	1.542	5.298	13.04
Log of Branch	873	2.454	1.971	0	8.906
YoY Growth	872	0.0122	0.138	-0.551	0.684
R&D Intensity	729	0.0302	0.0357	0.0000308	0.179
Advertising Intensity	981	0.376	0.463	0	5.764
Sector	981	5.440	2.688	1	10
Sec. Industrial	981	0.156	0.363	0	1
Sec. Cons. Discretionary	981	0.138	0.345	0	1
Sec. Health Care	981	0.110	0.313	0	1
Sec. Materials	981	0.138	0.345	0	1
Sec. Consumer Staples	981	0.0734	0.261	0	1
Sec. Utilities	981	0.0734	0.261	0	1
Sec. Energy	981	0.0826	0.275	0	1
Sec. Real Estate	981	0.0642	0.245	0	1
Sec. Comm. Services	981	0.0734	0.261	0	1
Sec. IT	981	0.0917	0.289	0	1
Country	981	12.26	6.412	1	23
Country United States	981	0.138	0.345	0	1
Country Sweden	981	0.0183	0.134	0	1
Country Germany	981	0.0642	0.245	0	1
Country France	981	0.0826	0.275	0	1
Country Netherlands	981	0.0367	0.188	0	1
Country Great Britain	981	0.193	0.395	0	1
Country South Korea	981	0.0275	0.164	0	1
Country Australia	981	0.0550	0.228	0	1
Country Canada	981	0.0183	0.134	0	1
Country China	981	0.0459	0.209	0	1
Country Taiwan	981	0.0183	0.134	0	1
Country Japan	981	0.0642	0.245	0	1
Country Norway	981	0.0275	0.164	0	1
Country Finland	981	0.0183	0.134	0	1
Country Italy	981	0.0459	0.209	0	1
Country Denmark	981	0.0275	0.164	0	1
Country Portugal	981	0.00917	0.0954	0	1
Country Brazil	981	0.00917	0.0954	0	1

Country Curaçao	981	0.00917	0.0954	0	1
Country Hong Kong	981	0.00917	0.0954	0	1
Country Spain	981	0.0642	0.245	0	1
Country Thailand	981	0.00917	0.0954	0	1
Country Ireland	981	0.00917	0.0954	0	1
Year	981	2014	2.583	2010	2018
Year 2018	981	0.111	0.314	0	1
Year 2017	981	0.111	0.314	0	1
Year 2016	981	0.111	0.314	0	1
Year 2015	981	0.111	0.314	0	1
Year 2014	981	0.111	0.314	0	1
Year 2013	981	0.111	0.314	0	1
Year 2012	981	0.111	0.314	0	1
Year 2011	981	0.111	0.314	0	1
Year 2010	981	0.111	0.314	0	1
Number of companies	74	74	74	74	74

Appendix C – Manually extracted Data

Company	Corporate Website
Barrick Gold Corporation	https://www.macrotrends.net/stocks/charts/GOLD/barrick-gold/number-of-employees
British Land Company Plc	https://www.britishland.com/investors/reports/reports-archive/2018
Dexus	https://www.dexus.com/investor-centre/results-and-reporting
Energias de Portugal S.A.	https://www.edp.com/en/annual-report-2016
Ferrovial, S.A.	https://www.ferrovial.com/en/ir-shareholders/financial-information/integrated-annual-report/
GPT Group	https://www.gpt.com.au/investor-centre/results-reports
Hammerson Plc	https://www.hammerson.com/investors/reports/
Industria de Diseño Textil S.A.	https://www.inditex.com/web/guest/inversores/relacion-con-inversores/informes-anuales
Indra Sistemas S.A.	https://www.indracompany.com/en/accionistas/memoria-cuentas-anuales
Kingfisher Plc	https://www.kingfisher.com/en/investors/company-reports.html
Land Securities Group Plc	https://landsec.com/investors/reports
Pirelli & C. S.p.A.	https://corporate.pirelli.com/corporate/en-ww/sustainability/reports
POSCO	https://www.macrotrends.net/stocks/charts/PKX/posco/number-of-employees
RELX Plc	https://www.relx.com/investors/annual-reports/
Siam Cement PCL	https://scc.listedcompany.com/ar.html
SK Telecom Co. Ltd	https://www.macrotrends.net/stocks/charts/SKM/sk-telecom/number-of-employees
Stockland	https://www.stockland.com.au/investor-centre/results
TC Energy Corporation	https://www.tcenergy.com/investors/reports-and-filings/
Telecom Italia S.p.A.	https://www.telecomitalia.com/tit/en/investors.html
Toshiba Corporation	https://www.toshiba-tpsc.co.jp/pdf/english/ir/pdf/AR2017.pdf
Taiwan Semiconductor Manufacturing Company Ltd	https://www.tsmc.com/english/investorRelations/annual_reports.htm
United Microelectronics Corporation	http://www.umc.com/English/investors/Reports/2010-present_report.asp
Wesfarmers	https://www.wesfarmers.com.au/investor-centre/company-performance-news/reports

Appendix D - Summary Table of TestParm (FE), LM (RE), and Hausman Test (RE)

Model	Test	Variable	Chi^2 (#)	Prob > Chi^2	F (7, 73)	Prob > F
1	TestParm	ROA	-	-	1.74	0.1138
1	TestParm	ROS	-	-	2.41	0.0285
1	TestParm	ATR	-	-	3.78	0.0015
2	TestParm	ROA	-	-	1.82	0.0965
2	TestParm	ROS	-	-	2.69	0.0156
2	TestParm	ATR	-	-	4.03	0.0009
3	LM	ROA	438.48	0.0000	-	-
3	LM	ROS	1067.59	0.0000	-	-
3	LM	ATR	1805.17	0.0000	-	-
4	LM	ROA	64.87	0.0000	-	-
4	LM	ROS	607.46	0.0000	-	-
4	LM	ATR	1540.27	0.0000	-	-
5	LM	ROA	66.23	0.0000	-	-
5	LM	ROS	619.81	0.0000	-	-
5	LM	ATR	1505.75	0.0000	-	-
3	Hausman	ROA	25.74 (11)	0.0071	-	-
3	Hausman	ROS	4.52 (11)	0.9523	-	-
3	Hausman	ATR	-1.36 (11)	Chi2<0	-	-
4	Hausman	ROA	25.84 (11)	0.0068	-	-
4	Hausman	ROS	7.47 (11)	0.7598	-	-
4	Hausman	ATR	10.52 (11)	0.4839	-	-
5	Hausman	ROA	26.36 (12)	0.0096	-	-
5	Hausman	ROS	9.66 (12)	0.6456	-	-
5	Hausman	ATR	17.39 (12)	0.1354	-	-

Appendix E – Expanded Estimation Results

Model 1. Fixed Effects Without Including Advertising Intensity.

VARIABLES	ROA	ROS	ATR
DJSI	0.00483	0.0213	0.0644***
	(0.671)	(0.143)	(0.00899)
Log Size	-0.0747***	-0.0952***	0.0333
	(0.000613)	(0.00106)	(0.589)
YoY Growth	0.0786***	0.127***	0.278***
	(0.00254)	(0.00109)	(2.55e-07)
R&D Intensity	-0.567	0.0361	3.108*
	(0.325)	(0.973)	(0.0535)
Year 2012	-0.00977**	-0.0143*	0.00590
	(0.0381)	(0.0615)	(0.537)
Year 2013	0.00175	-0.0191*	0.000251
	(0.846)	(0.0900)	(0.986)
Year 2014	0.00444	0.00406	-0.0306*
	(0.523)	(0.673)	(0.0552)
Year 2015	-0.00727	-0.0129	-0.0502***
	(0.354)	(0.198)	(0.00715)
Year 2016	-0.00453	-0.0130	-0.0764***
	(0.629)	(0.222)	(0.000471)
Year 2017	-0.00724	-0.0159	-0.0822***
	(0.408)	(0.106)	(0.000554)
Year 2018	0.00933	0.00932	-0.0722***
	(0.319)	(0.376)	(0.00247)
Constant	0.884***	1.163***	0.268
	(0.000293)	(0.000299)	(0.690)
Observations	592	592	592
R-squared	0.093	0.126	0.352
Number of company	74	74	74
R^2 Within	0.0932	0.126	0.352
R^2 Between	0.00122	0.174	0.0255
R^2 Overall	1.97e-05	0.155	0.0443

Robust p-value in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Variables not shown here are automatically omitted by STATA due to collinearity (Country, Sector and Log of Branch) or because they work as the baseline for the Year (2011).

Model 2. Fixed Effects Including Advertising Intensity.

VARIABLES	ROA	ROS	ATR
DJSI	0.00250	0.0163	0.0467**
	(0.824)	(0.256)	(0.0296)
Log Size	-0.0733***	-0.0923***	0.0439
	(0.000725)	(0.00103)	(0.353)
YoY Growth	0.0829***	0.136***	0.311***
	(0.00128)	(0.000429)	(4.46e-10)
R&D Intensity	-0.644	-0.127	2.520*
	(0.253)	(0.898)	(0.0719)

Advertising Intensity	-0.0147 (0.189)	-0.0311* (0.0649)	-0.112*** (0.000223)
Year 2012	-0.00962** (0.0420)	-0.0140* (0.0677)	0.00702 (0.452)
Year 2013	0.00190 (0.833)	-0.0188* (0.0939)	0.00136 (0.918)
Year 2014	0.00491 (0.477)	0.00506 (0.595)	-0.0270* (0.0691)
Year 2015	-0.00656 (0.403)	-0.0114 (0.249)	-0.0447** (0.0106)
Year 2016	-0.00367 (0.697)	-0.0112 (0.289)	-0.0698*** (0.000832)
Year 2017	-0.00582 (0.502)	-0.0129 (0.177)	-0.0713*** (0.00182)
Year 2018	0.0116 (0.230)	0.0141 (0.167)	-0.0548** (0.0122)
Constant	0.878*** (0.000281)	1.151*** (0.000193)	0.225 (0.658)
Observations	592	592	592
R-squared	0.101	0.149	0.439
Number of company	74	74	74
R^2 Within	0.101	0.149	0.439
R^2 Between	0.00216	0.147	0.122
R^2 Overall	4.80e-06	0.137	0.145

Robust p-value in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Variables not shown here are automatically omitted by STATA due to collinearity (Country, Sector and Log of Branch) or because they work as the baseline for the Year (2011).

Model 3. Random Effects without including Sector, Country or Advertising Intensity.

VARIABLES	ROA	ROS	ATR
DJSI	0.00399 (0.691)	0.0214 (0.104)	0.0630*** (0.00838)
Log Size	-0.0110* (0.0566)	-0.0538*** (4.58e-05)	0.0278 (0.540)
YoY Growth	0.0767*** (0.00271)	0.123*** (0.000721)	0.280*** (1.24e-08)
R&D Intensity	0.429 (0.154)	0.267 (0.605)	2.711** (0.0226)
Log Branch	0.00517 (0.130)	0.00303 (0.578)	0.00824 (0.722)
Year 2012	-0.0101** (0.0227)	-0.0143* (0.0594)	0.00614 (0.519)
Year 2013	0.00240 (0.785)	-0.0185* (0.0912)	0.000359 (0.979)
Year 2014	0.00584 (0.428)	0.00441 (0.650)	-0.0309* (0.0510)
Year 2015	-0.00533 (0.522)	-0.0125 (0.229)	-0.0509*** (0.00541)
Year 2016	-0.00192 (0.836)	-0.0122 (0.262)	-0.0775*** (0.000236)
Year 2017	-0.00498 (0.580)	-0.0150 (0.142)	-0.0839*** (0.000266)
Year 2018	0.0105 (0.294)	0.00898 (0.403)	-0.0738*** (0.00158)
Constant	0.151**	0.700***	0.320

	(0.0161)	(2.61e-06)	(0.524)
Observations	592	592	592
Number of company	74	74	74
R^2 Within	0.0442	0.118	0.352
R^2 Between	0.191	0.197	0.0276
R^2 Overall	0.130	0.178	0.0479

Robust p-value in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Variables not shown here were automatically omitted by STATA because they work as the baseline for the Year variable (Year 2011).

Model 4. Random Effects including Sector and Country without Advertising Intensity.

VARIABLES	ROA	ROS	ATR
DJSI	0.00692	0.0212	0.0635**
	(0.470)	(0.135)	(0.0100)
Log Size	-0.00653	-0.0583***	0.0314
	(0.159)	(8.85e-05)	(0.529)
YoY Growth	0.0720***	0.122***	0.280***
	(0.00661)	(0.00105)	(2.28e-08)
R&D Intensity	0.0536	0.446	2.596*
	(0.826)	(0.532)	(0.0523)
Log Branch	0.00746**	0.00970	0.0344*
	(0.0121)	(0.162)	(0.0844)
Sec. Consumer Discretionary	0.0376**	0.000237	0.616***
	(0.0492)	(0.995)	(7.08e-06)
Sec. Consumer Staples	0.0591***	0.121***	0.242**
	(0.000221)	(0.00194)	(0.0477)
Sec. Energy	0.00391	0.0280	0.506***
	(0.832)	(0.628)	(0.00829)
Sec. Health Care	0.0399**	0.0517	0.000944
	(0.0376)	(0.291)	(0.994)
Sec. Industrials	0.0201	0.000988	0.372**
	(0.199)	(0.980)	(0.0100)
Sec. Information Technology	0.0102	0.00584	0.0293
	(0.661)	(0.924)	(0.868)
Sec. Materials	-0.0168	-0.00552	0.122
	(0.239)	(0.880)	(0.303)
Sec. Utilities	0.00311	0.0635	0.0671
	(0.855)	(0.237)	(0.592)
Country CH	-0.0298	-0.0977**	-0.000900
	(0.131)	(0.0232)	(0.992)
Country CW	-0.0318*	-0.134**	-0.290
	(0.0963)	(0.0386)	(0.127)
Country DE	-0.0569***	-0.121***	-0.00389
	(0.00560)	(0.000365)	(0.980)
Country DK	0.118***	-0.0906	0.450*
	(0.000631)	(0.166)	(0.0607)
Country ES	-0.0782***	-0.186***	-0.190
	(0.00709)	(0.00123)	(0.259)
Country FI	-0.0654***	-0.329***	0.622
	(0.00425)	(1.09e-06)	(0.160)
Country FR	-0.0711***	-0.173***	0.0253
	(1.75e-05)	(0.000734)	(0.834)
Country GB	-0.0379***	-0.114***	0.0674
	(0.00194)	(0.00530)	(0.500)
Country HK	-0.0428***	0.0904**	-0.436**
	(0.00396)	(0.0308)	(0.0144)
Country IT	-0.0919***	-0.111*	-0.180

	(2.23e-07)	(0.0509)	(0.169)
Country JP	-0.0857*** (3.98e-06)	-0.194*** (5.51e-06)	0.263 (0.215)
Country KR	-0.0462*** (0.000245)	-0.220*** (0)	0.336*** (0.000593)
Country NL	-0.0527*** (0.00869)	-0.226*** (0)	0.257*** (5.08e-06)
Country NO	-0.0508*** (1.23e-07)	-0.176*** (0.000758)	0.103 (0.571)
Country PT	-0.0726*** (2.66e-05)	-0.255*** (2.95e-06)	0.0134 (0.921)
Country SE	-0.0580** (0.0207)	-0.182*** (0.000204)	0.307** (0.0427)
Country US	-0.0458*** (0.00468)	-0.168*** (2.54e-06)	0.0101 (0.929)
Year 2012	-0.00984** (0.0301)	-0.0144* (0.0610)	0.00624 (0.523)
Year 2013	0.00284 (0.756)	-0.0187* (0.0928)	0.000539 (0.970)
Year 2014	0.00541 (0.464)	0.00436 (0.660)	-0.0310* (0.0536)
Year 2015	-0.00582 (0.477)	-0.0124 (0.236)	-0.0510*** (0.00595)
Year 2016	-0.00224 (0.809)	-0.0120 (0.269)	-0.0777*** (0.000273)
Year 2017	-0.00448 (0.629)	-0.0145 (0.153)	-0.0839*** (0.000318)
Year 2018	0.0103 (0.300)	0.00954 (0.383)	-0.0740*** (0.00178)
Constant	0.137** (0.0104)	0.857*** (2.26e-07)	-0.0716 (0.905)
Observations	592	592	592
Number of company	74	74	74
R^2 Within	0.0485	0.118	0.352
R^2 Between	0.728	0.604	0.532
R^2 Overall	0.452	0.499	0.519

Robust p-value in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Variables not shown here were automatically omitted by STATA due to collinearity (Brazil, Canada, Ireland, Thailand, Taiwan), because they work as the baseline for the Year, Sector, or Country variables (Year 2011, Sec. Communication Services, Country Australia), or because missing variables in R&D Intensity (Sec. Real Estate).

Model 5. Random Effects including Sector, Country and Advertising Intensity.

VARIABLES	ROA	ROS	ATR
DJSI	0.00566 (0.551)	0.0172 (0.224)	0.0457** (0.0341)
Log Size	-0.00719 (0.124)	-0.0588*** (5.88e-05)	0.0381 (0.342)
YoY Growth	0.0757*** (0.00352)	0.131*** (0.000399)	0.314*** (0)
R&D Intensity	0.0273 (0.910)	0.342 (0.623)	2.068* (0.0764)
Advertising Intensity	-0.0130 (0.246)	-0.0289* (0.0824)	-0.115*** (0.000146)
Log Branch	0.00792** (0.0101)	0.0106 (0.138)	0.0360* (0.0518)
Sec. Consumer Discretionary	0.0296 (0.122)	-0.0171 (0.604)	0.547*** (2.19e-05)

Sec. Consumer Staples	0.0599*** (0.000543)	0.123*** (0.00362)	0.247** (0.0146)
Sec. Energy	-0.00534 (0.782)	0.00860 (0.883)	0.440** (0.0127)
Sec. Health Care	0.0413** (0.0266)	0.0574 (0.229)	0.0281 (0.792)
Sec. Industrials	0.0144 (0.359)	-0.0110 (0.777)	0.324** (0.0183)
Sec. Information Technology	0.00927 (0.692)	0.00668 (0.910)	0.0401 (0.796)
Sec. Materials	-0.0221 (0.130)	-0.0165 (0.631)	0.0827 (0.447)
Sec. Utilities	-0.00604 (0.730)	0.0444 (0.392)	-0.000337 (0.998)
Country CH	-0.0241 (0.251)	-0.0835* (0.0655)	0.0531 (0.492)
Country CW	-0.0179 (0.436)	-0.103 (0.133)	-0.183 (0.297)
Country DE	-0.0513** (0.0128)	-0.108*** (0.00227)	0.0497 (0.737)
Country DK	0.116*** (0.000470)	-0.0903 (0.149)	0.474** (0.0206)
Country ES	-0.0746** (0.0107)	-0.176*** (0.00255)	-0.142 (0.375)
Country FI	-0.0632*** (0.00636)	-0.321*** (2.42e-06)	0.664 (0.137)
Country FR	-0.0599*** (0.00513)	-0.148** (0.0129)	0.120 (0.251)
Country GB	-0.0318** (0.0126)	-0.0997** (0.0154)	0.125 (0.202)
Country HK	-0.0434*** (0.00398)	0.0895** (0.0353)	-0.432** (0.0129)
Country IT	-0.0821*** (6.36e-06)	-0.0874 (0.129)	-0.0772 (0.538)
Country JP	-0.0826*** (4.57e-06)	-0.186*** (1.80e-05)	0.295 (0.134)
Country KR	-0.0473*** (0.000298)	-0.221*** (0)	0.338*** (0.000138)
Country NL	-0.0500** (0.0166)	-0.218*** (0)	0.295*** (2.69e-08)
Country NO	-0.0491*** (4.05e-06)	-0.172*** (0.00244)	0.123 (0.460)
Country PT	-0.0622*** (0.00110)	-0.230*** (4.31e-05)	0.119 (0.364)
Country SE	-0.0530** (0.0359)	-0.169*** (0.000751)	0.364** (0.0152)
Country US	-0.0419** (0.0111)	-0.157*** (3.13e-05)	0.0634 (0.555)
Year 2012	-0.00973** (0.0325)	-0.0142* (0.0663)	0.00735 (0.442)
Year 2013	0.00297 (0.744)	-0.0185* (0.0960)	0.00161 (0.906)
Year 2014	0.00595 (0.415)	0.00542 (0.578)	-0.0271* (0.0700)
Year 2015	-0.00499 (0.541)	-0.0108 (0.293)	-0.0452*** (0.00968)
Year 2016	-0.00119 (0.898)	-0.0101 (0.347)	-0.0706*** (0.000577)
Year 2017	-0.00284 (0.759)	-0.0115 (0.246)	-0.0725*** (0.00131)

Year 2018	0.0128 (0.217)	0.0145 (0.171)	-0.0557** (0.0109)
Constant	0.149*** (0.00579)	0.872*** (7.45e-08)	-0.101 (0.838)
Observations	592	592	592
Number of company	74	74	74
R^2 Within	0.0573	0.141	0.438
R^2 Between	0.725	0.594	0.573
R^2 Overall	0.454	0.496	0.563

Robust p-value in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Variables not shown here were automatically omitted by STATA due to collinearity (Brazil, Canada, Ireland, Thailand, Taiwan), because they work as the baseline for the Year, Sector, or Country variables (Year 2011, Sec. Communication Services, Country Australia), or because missing variables in R&D Intensity (Sec. Real Estate).

Appendix F – Robustness Checks

F1. Variance Inflation Factor

Variable	VIF	1/VIF
DJSI	1.55	0.647029
ln_size	2.23	0.448348
growth	1.49	0.671993
rdint	3.45	0.289997
adint	1.76	0.567098
ln_branch	3.04	0.328682
sec		
2	3.49	0.286732
3	2.41	0.415443
4	3.59	0.278191
5	4.48	0.223080
6	4.61	0.216784
7	4.22	0.236977
8	4.09	0.244315
10	3.17	0.315221
country		
4	5.54	0.180491
5	2.59	0.385440
6	8.30	0.120420
7	4.77	0.209591
8	8.15	0.122742
9	3.52	0.283955
10	4.84	0.206411
11	12.67	0.078948
12	2.24	0.445966
14	6.00	0.166703
15	6.63	0.150815
16	4.35	0.230026
17	5.07	0.197351
18	3.15	0.317802
19	2.50	0.400597
20	3.46	0.289282
23	13.73	0.072859
yr		
2012	1.75	0.569947
2013	1.77	0.563444
2014	1.94	0.514404
2015	1.91	0.523423
2016	1.89	0.528749
2017	1.95	0.512413
2018	1.97	0.508064
Mean VIF	4.06	

F2. Summary results of heteroskedasticity tests using the "Modified Wald test" (STATA command 'xttest3').

Model	Dependent Variable	Chi^2 (74)	Prob>Chi^2
1	ROA	68057.52	0.0000
1	ROS	86914.83	0.0000
1	ATR	20934.75	0.0000
2	ROA	75658.62	0.0000
2	ROS	1.4e+05	0.0000
2	ATR	16976.02	0.0000
3	ROA	34517.08	0.0000
3	ROS	51942.65	0.0000
3	ATR	1.1e+05	0.0000
4	ROA	32576.73	0.0000

4	ROS	51930.36	0.0000
4	ATR	43828.48	0.0000
5	ROA	27371.50	0.0000
5	ROS	41005.37	0.0000
5	ATR	90721.56	0.0000

Note: In this test, the 'xtgls' STATA command is employed for RE regressions.

F3. Summary results of serial Lagram-Multiplier correlation tests using the "Wooldridge test for autocorrelation in panel data" (STATA command 'xtserial')

All variables	Independent variable	F (1, 73)	Prob > F
Without AdInt	ROA	3.215	0.0771
	ROS	1.390	0.2423
	ATR	166.173	0.0000
With AdInt	ROA	3.420	0.0685
	ROS	1.305	0.2571
	ATR	135.413	0.0000

F4. Summary results of Im-Pesaran-Shin Unit-Root Tests

Variable	Panels	Periods	t-bar	t-tilde-bar	Z-t-tilde-bar	p-value
ROA	109	9	-3.0380	-1.7368	-7.0874	0.0000
ROS	109	9	-2.5711	-1.5706	-4.6973	0.0000
ATR	109	9	-2.3707	-1.6820	-6.2993	0.0000
Growth	109	8	-2.8768	-1.8033	-8.6492	0.0000
R&D Intensity	81	9	-2.5848	-1.6513	-5.0501	0.0000

Note: All tests are panel-specific, include panel means and time trend specifications, and no lags.

F5. Correlation results between Advertising Intensity and R&D Intensity variables

```
. corr adint rdint
(obs=729)

             |    adint    rdint
-------------+------------------
       adint |   1.0000
       rdint |   0.0310   1.0000
```