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The role of innovation in firm performance assessment. Evidence from Dutch listed firms.

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Abstract

This paper attempts to quantify the impact of different dimensions of innovation on financial and corporate social performance using panel- and cross-sectional data for Dutch listed firms. The effects of innovation on financial firm performance is examined using panel data from 2012 to 2020. For corporate social performance, cross-sectional data for 2020 is used to assess possible relationships. Firm performance proxies, namely ROA, ROE, Tobin's Q, operating profits (Turnover), social corporate responsibility (SCR) and environmental, social and corporate governance (ESG) scores are regressed against input and output innovation measures such as R&D expenditure, R&D to Turnover, innovation intensity and granted patents. In order to test the effects of innovation on firm performance, both fixed effects and multiple linear regression models are utilized complementary. The general findings imply that although R&D expenditure is positively related to firm performance, the same cannot be stated for the other tested innovation measures.

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1. Introduction

At the most basic economic model, profit maximization has been for a very long time at the core of performance assessment. Nonetheless, traditional internal characteristics such as R&D[1] intensity, capital intensity, exports of innovative products, market share, and sales as well as industry concentration have a very strong and beneficial influence on company success, according to studies (Favre et al., 2002). Companies have undergone significant changes in their business environments as a result of market rivalry, increased complexity of business activities in the global setting (i.e globalization) and increased customer awareness, shifting towards more ethical approaches of corporate social action in order to achieve long-term goals rather than focusing on short-term profit maximization. It has been observed that in recent years, there is an increasing interest in the social corporate responsibility (CSR) and environmental (ESG) practices of firms[2]. Massive media attention on CSR and ESG issues has drawn a vast amount of research to investigate the quantitative impact of non-financial aspects such as these on firms' performance. As a result, firms are very cautious to retain their corporate image, which is directly linked to these considerations. Therefore, a firm's intention nowadays is not limited to profit maximization but is more about balancing seemingly competing priorities such as maximizing profits for their owners, satisfying various stakeholders' needs, treating its environment, society, employees and customers fairly, while complying with regulatory frameworks. To be able to simultaneously accomplish all these, requires achieving an acceptable overall performance in non-financial aspects such as CSR and ESG, as well.

Innovation may be the connecting link between these competitive goals. Innovating is the way to meet society's needs and build a profitable enterprise. Even a decade ago, Porter and Kramer (2011), have identified that accomplishing those two main objectives would be the next competitive frontier for businesses. There is a plethora of studies examining the impact of innovation measures such as R&D expenditure to financial/accounting metrics such as return on equity (ROE) and return on assets (ROA). There are also studies that link innovation with CSR. According to Scott (1995), it is vital to include institutional theory in determining organization decision and action for conformity of societal influences and pressure in order to link innovation with CSR. Another study between innovation and CSR carried out by Übius, Alas, and Vanhala (2009), discovered that in a sample of 86 Estonian organizations there are motivations towards marketing, sales, and product innovation by adopting R&D in the development of socially innovative products and services.

[1] Note: In the remainder of this paper the terms "R&D" and "Research and Development" will be used interchangeably.
[2] The terms "enterprise" and "firm" will also be used interchangeably.

Another study conducted by Übius (2009) has pointed out a positive relationship between firms that are focusing on innovation objectives and have an innovation climate with CSR. The "moderating effect of innovation on corporate social responsibility and firm performance in realm [sic] of sustainable development" has been documented exceptionally in the study by the same title of Anser et al. (2018). The study's result was that there is a significant and direct relationship between CSR, innovation and firm performance.

By examining innovative[3], publicly listed Dutch firms for a period of 8 years from 2012 to 2020 and 2020 on its own, this paper aims to identify potential impact of innovation input and output on financial- and corporate social performance. Corporate social performance is proxied by CSR, ESG and financial performance is proxied by ROA, ROE, Tobin's Q and Turnover.

This paper contributes to the literature in that it examines both input and output dimensions of innovation and their impact on firms' financial performance but also non-financial performance in conjunction. Past research tends to concentrate on testing any one of the aforementioned dimensions of innovation on financial performance or corporate social performance, mostly separately and not in conjunction.

2. Literature Review and Hypotheses Formation

Two distinct conceptual dimensions of innovation are used to effectively capture the various aspects of innovation heterogeneity which seem to exert an influence on firm performance. I use both input and output measures of innovative activity which may affect the type of firm performance in order to avoid classifying firms by the hypothesis of "homogeneous innovation". This approach effectively allows the examination of differentiated effects of innovation, depending on its type, on firm performance. Innovation input is essentially the resources channeled towards innovative activities such as research and development (R&D), while innovation output is the realized result of these innovation activities which can be quantified as the number of patents a firm owns.

This chapter summarizes key empirical results about the elements that influence innovation input and output. It then goes over some important empirical findings on the link between innovation and the overall firm performance.

[3] "Innovative" in the sense that they have a positive R&D expenditure for the examined period.

2.1 Input measures of innovation

On the foundation of an economic model, the innovation's impact on key performance parameters which include profitability, returns, future growth opportunities or productivity, is evaluated using proxies. This kind of analysis is more commonly found in empirical innovation research. A firm's innovation activities are in-house or external R&D and generally any creative work accomplished that is aimed towards the acquisition of new knowledge that will be utilized to devise new products or services. It might be presumed that innovation output affects firm performance rather than innovation input. However, by also examining the input, researchers can acquire a more thorough sense of the relationship between them. This is a key factor for which traditional research practice examines R&D expenditures so often. High R&D is an essential expenditure, especially in high tech or pharmaceutical industries, but a consensus has not been reached on the relationship between R&D investment and returns. According to Hsu et al (2013), successful R&D efforts can increase a company's performance, whereas failed efforts are considered "sunk costs". However, new technologies emerging from research and development might not always correspond into commercially successful products.As pointed out by Baker and Freeland (1975) R&D and product development processes are rife with uncertainty, which frequently leads to expectations not being realized. Newly designed items, for example, may encounter unanticipated manufacturing issues or prove to be commercially unviable. Furthermore, income from new goods may not be sufficient to cover the R&D costs associated with their development, resulting in R&D costs becoming a sunk cost. Nevertheless, Nelson (1982) claims that gathering R&D experience through time has a favorable impact on current R&D activities. The mere involvement in R&D activities, according to other studies, can boost a company's future performance. In order to improve future business performance, Edvinsson and Malone (1997) demonstrated that in order to boost performance, intellectual property generated by R&D expenditure must be adequately recognized and managed. It is notable that previous studies have shown a temporal lag effect on R&D efforts due to the time required to translate R&D inputs into practical applications. For example, R&D expenditure has a 5- to 10-year deferred return (Hirschey & Weygandt; 1985) as pointed out by Hsu et al. (2013). Finally, it is demonstrated by Lev and Sougiannis (1999) that when R&D expenses are factored into a company's valuation, they constitute a risk element for the firm's future returns, but also have a positive impact on the following stock returns.

As a matter of fact, R&D expenditure is regarded as one of the most important measures of innovation effort in the academic literature. A higher amount of a firm's R&D expenditures would be expected to lead to higher output in the form of intellectual capital and therefore, increase return on assets (ROA)[4] through the income or rent from intellectual property rights based on these assets (granted patents). An increase in R&D expenditure is also expected to lead to an increase in operating profits by providing a firm with added competitive advantage/s in the form of new products or technologies or services, therefore, operating profits (Turnover) and thus ROE[5] are expected to increase as a result. Finally, a company with more intellectual capital will be able to better serve all stakeholders, including investors. Indeed, it has been demonstrated that investors in the capital market express their appreciation for a company's superior intellectual capital by raising demand for its stock, resulting in a rise in the company's value (Nuryaman, 2015). Consequently, it is expected that Tobin's Q[6] will increase. Thus, the first hypothesis:

H1: Higher R&D expenditure will positively impact financial firm performance as measured by ROA, ROE, Tobin's Q and Turnover.

Innovation intensity is another input metric that is examined in this paper. Innovation intensity does not enjoy a consensual definition; however, when compared to the whole firm's or sector's activity, innovation intensity can be expressed as the quantity of resources (financial, human, technological, organizational, etc.) allocated to innovation activities. As highlighted by Vermeulen (2003) and Jong (2000) small businesses with a high level of innovation intensity do better than those with a lesser level of innovation intensity, a fact also backed by earlier studies from Geroski (1995) and others (Banbury & Mitchell, 1995; Soni, et al, 1993). The ability of a firm, and especially small businesses, to produce high-quality products and services that fulfill market expectations determines its strategic position. As a result, maintaining a constant supply of innovations is critical for firm performance. Usually, there are countless measures and indexes used to measure innovation intensity. However, the ratio of innovation expenditure to some reference variable that defines the company's volume of activity is also commonly used to measure innovation intensity. This includes turnover (sales) or assets, which represent the most common approaches for determining the level of innovation (devstat, 2016). In this study, innovation intensity is the ratio of R&D expense to total assets. Based on this reasoning, the following hypothesis is formed:

H2: Innovation intensity will positively affect financial firm performance as measured by ROA, ROE, Tobin's Q and Turnover.

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[4] ROA: the ratio of net income to total assets.
[5] ROE: the ratio of net income over shareholder equity.
[6] Tobin's Q: the ratio of a firm's market value to its replacement value.

The proportion of turnover in a given year that originates from R&D investment realized the previous year is a direct performance metric of product innovation. This ratio is called Return on Research Capital (RORC) and is the division of the operating profits (turnover) of a given year with the R&D expenditure of the previous year. Because the payout is not usually received immediately, the prior year's R&D expenses are employed. Rather, it is frequently understood at a later date. RORC is a measure that describes a company's revenue as a result of capital invested in research and development. It compares the amount of money generated to the amount spent on research. The ratio depicts how much money a corporation may make per unit of research spending. Nonetheless, due to the nature of this study, employing a ratio that depends on more than one year to be calculated, might result in losing a good percent of the sample due to firms having zero R&D expenditures or missing values for some (previous) years. Therefore, the portion of R&D expenses to turnover will be examined instead. The intuition of this metric is similar to this of RORC. This ratio shows the percentage of R&D spending in relation to the gross profit of the firms and thus, it reveals what portion of the operating profits corresponds (quantitatively) to the R&D expenditure yearly. The R&D expenditure of each year will be in the numerator and the operating profit (Turnover) in the denominator. Its components, although similar conceptually with RORC, characterize it as innovation input since its nominator R&D expenditure is an input metric. A similar approach is adopted by VanderPal (2015), who finds a negative relationship between R&D to operating income and revenue. This method aims to provide an instrument for evaluating a company's efficiency in using its intellectual capital and linking it to operating profits. Thus, dissimilar firms in terms of size or otherwise, can be effectively compared in terms of innovation by using this metric. Thus hypothesis 3 is formed:

H3: Higher ratio of Research and Development expenditure to turnover will positively impact financial performance as measured by ROA, ROE, Tobin's Q and Turnover.

2.2 Output measure of innovation

Innovation output can be described as the result of innovation activities and called direct success or output measures. Granted patents are the only ones considered as innovation output, as these are the only patents that are granted and protected under law. In other words, granted patents are the only ones that are lawfully entitled to patent protection, which means that "the invention cannot be commercially used, distributed, imported, or sold by others without the patent owner's consent" (WIPO, n.d).

Patent-based indicators have received a lot of criticism for being a poor predictor of innovation (for example, Scherer, 1965; Griliches, 1990). This may be the result of the diverse incentives for innovation that are observed among the various firms. For example, patenting is often used as an entry barrier imposed from incumbent firms to deter competition. Thus, it is the case that not every patented invention leads to a viable product. The opposite may hold as well; that is, not every invention is patented. An example is trade secrets, which unlike patents, are not limited in time and have no official registration. In addition, patents serve as a tool for preserving the benefits of innovation (Peters, 2008). The number of patents held by firms has increased significantly, but this has not been matched by an increase in R&D spending, but rather by a decrease in the utility of patents as a form of protection. The patent paradox was coined by Hall and Ziedonis (2001), and it is attributed to a variety of factors. For these reasons, patents may be subject to strategic considerations by firms and therefore might be a less reliant indicator of innovation by itself. In general however, innovation incentives aim towards improvement either in services, products or other aspects of performance (financial or otherwise). Nonetheless, since these improvements might be difficult to measure as a result of their qualitative nature, "granted patents" is a solid quantifiable and comparable metric for all companies which if not fully, at least partially captures the outcome of innovation activities of firms. Also, "patents have widely varying commercial value and therefore, significance with respect to innovation" (National Research Council, 1997). In conjunction with the other innovation metrics, including granted patents is an approach adding value in that it serves to better capture the variety of innovation effects on firm performance. Literature evidence about patents, suggests that their role is positive on firm performance, either by directly generating income or by deteriorating competition. Thus, the following hypothesis.

H4: A higher number of granted patents will positively impact financial firm performance as measured by ROA, ROE, Tobin's Q and Turnover.

2.3 Corporate Social Performance

In addition to granted patents, two corporate social performance (CSP; a measure of CSR)[7] aspects will be examined using cross sectional data from the year 2020. As CSP ratings essentially quantify non-financial aspects of firm behavior, the two measures examined in this paper are corporate social responsibility (CSR) and environmental, social and corporate governance (ESG). This approach will make it possible to investigate the relationship between innovation and CSP.

[7] For an extensive analysis, see: "Corporate Social Responsibility, Corporate Restructuring and Firm's Performance" Chapter: 2.2.3.2 CSP and Financial Performance: Previous Empirical Studies. (Zu, 2009).

Because social and environmental issues inevitably become financial risks, in the long run, corporate social performance (CSP) is essentially the process of increasing a company's worth over time (Gasmi, 2021). CSP is linked to expressing the company's character and role, as well as its mission. As a result, businesses see CSP as a strategic investment that is part of a proactive, resilient, and inclusive strategy centered on creating shared value. This approach has the potential to reduce negative societal repercussions of their actions while also boosting their competitive edge if they maintain a hybrid culture.

The link between innovation and financial performance (FP) is documented in the existing literature significantly more than the link between innovation and corporate social performance (CSP). Nonetheless, the latter relationship is also existent in various studies. Just to mention a few, Vázquez et al. (2012) did a study to look at CSR and innovation as independent variables and found that they have a beneficial impact on corporate performance. Bocquet et al. (2013) distinguished between strategic and responsive CSR, adding that strategic CSR organizations are more innovative in their product and process. On the other hand, responsive CSR organizations are found to be less innovative. Gallego-Alvarez et al. (2011) looked at the relationship between CSR and innovation in both directions. Their research yielded both positive and negative outcomes. The reason for the negative results was that strategic decisions took several years to bear fruit. It is known that strategic positioning or innovative efforts may yield outcomes that affect results in the long term, which cannot be captured right away. Thus, to account for this, studies usually examine these effects over a long period of time. Further, Hull and Rothenberg (2008) look into the link between corporate social responsibility and increased firm performance as a result of innovation and differentiation. Padgett and Moura-Leite (2012) studied 418 firms and discovered a negative relationship between innovation with a high social benefit intention and firm performance. They also noted that while innovation with a high social benefit intention did not produce immediate results, it did have long-term effects, such as reputation, and that the government should provide incentives to organizations to encourage them to pursue innovation with a high social benefit intention. There are also other studies that examine the effects of innovation, CSR and firm performance[8], and can be found in the paper of Anser et al. (2018).

As mentioned, there is also extensive literature exploring the effects of CSP on financial performance. A positive CSP-financial performance relationship has been discovered in several

[8] For an extensive analysis see: “Moderating effect of innovation on corporate social responsibility and firm performance in the realm of sustainable development” from Anser et al., (2018).

empirical studies. Waddock and Graves (1997) used regression analysis to look at 469 S&P 500 companies. CSP was measured using a composite measure, and financial performance was measured using three performance metrics; return on equity (ROE), return on assets (ROA), and return on sales (ROS). Size, risk, and industry were used as control variables by Waddock and Graves (1997), who investigated several econometric assumptions of the model, including lagged variables. Their findings pointed to a positive relationship between corporate social performance and financial performance. Further, in a regression analysis of several cross-sections for the years 1987–1992 with around 115 firms in each cross-section, Stanwick and Stanwick (1998) found a significant positive connection between the two. McWilliams and Siegel (2000) utilized a regression model with a financial performance indicator as the dependent variable to investigate the link between CSP and FP; the researchers used an average of annual values for 524 large U.S. corporations from 1991 to 1996. CSP, industry, and R&D spending were the independent variables. However, including the R&D variable in the model rendered the CSP variable useless, leading McWilliams and Siegel (2000) to conclude that there may not be a link between corporate social responsibility and financial success if the regression model is specified correctly.

The second aspect of CSP examined in this paper is the environmental, social and corporate governance (ESG) attributes. Studying the many components of CSP is vital to company value from the standpoint of stakeholder theory. With the increased focus on ESG, Orens et al. (2010) discovered that the ESG component is linked to the predicted cash flow growth rate of the company. This demonstrates that a company's publication of ESG information in several dimensions has a significant impact on future cash flow growth and firm value. According to Qiu et al. (2016), the disclosure of only two dimensions, E and S, can lead to a rise in market value. Qiu et al. (2019) also showed that the environment, society, and government all have varied effects on these financing costs, with only the environmental and governance components having the ability to minimize them in the end. Brogi and Lagasio (2019) discovered that all three dimensions of ESG's three-dimension disclosure ratings were positively connected with ROA, with S being the most correlated with ROA. As a result, the following hypothesis is formed:

H5: Innovation will be positively associated with CSP as measured by CSR and/or ESG.

2.4 Financial firm performance

Several studies show the importance of performance measurement in constructing and reconstructing or adjusting a strategy using functional information feedback mostly in "top-down" manner (Bisbe & Otley, 2004; Tuomela, 2005; Henri, 2006; and Widener, 2007)[9]. This constant feedback based on performance measuring tools is intended to aid in the evaluation and re-evaluation of strategy implementation. Nonetheless, this field of study is still in its early stages. Jaksic, Rakocevic and Martic[10] (2014) analyze the many different approaches and measures for evaluating performance. To capture a company's financial and nonfinancial aspects, performance measures are addressed. Traditionally, financial indices such as return on assets (ROA) and return on equity (ROE) have been used to assess performance. Some consultants recommend using performance evaluation methodologies that examine a company's overall performance, including a set of diverse value-added performance indicators such as economic or market value-based. Many businesses use a balanced scorecard, which is a set of performance indicators that track many areas of corporate strategy (Drake & Fabozzi, 2010).

Even though uncertain, innovation needs to perform positively in order to contribute to a firm's financial results. After all, it is the maximization of the profits that firms are after. Innovation in the form of products or services creation has the purpose of ultimately generating profits through utilization of new more effective business outcomes in the form of products, services or otherwise, or the avoidance of profit losses through shelving for the purpose of deterring competition. There are many studies that are trying to shed light on this effect. Despite the fact that the various studies are not all comparable, the vast majority of them indicate a positive performance effect. As a result, empirical evidence suggests that innovation strategy and performance are positively linked.[11] This part of the paper addresses the connection of financial firm performance measurements and innovation. In particular, whether innovation input or output has an effect on firm performance is the key research question. As follows, this study employs various metrics to capture the multidimensional character of performance and shareholder value to assess its relation with innovation. Innovation or intellectual capital (IC) can help businesses enhance their financial performance. Intellectual capital has been demonstrated in previous studies to have a positive impact on financial performance as measured by revenue growth, return on assets, and return on equity (Pouraghajan 2013; Baroroh 2013; Deep & Narwal 2014).

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[9] Several of these studies are cited in the paper of Milosavljević et al. (2016)
[10] For an analysis see: "Innovative Management and Firm Performance. An Interdisciplinary Approach": p.3, chapter 13, by Jaksic, Rakocevic and Martic (2014)
[11] For a comprehensive overview of the studies see: "Innovation strategy and firm performance" from Nanja Strecker (2007).

Innovation and Turnover

Several studies have found a link between innovation and operating profits. Sougiannis (1994), for example, shows evidence that reported earnings, after adjusting for R&D expenses, indicate the R&D benefits. Over a seven-year period, Sougiannis discovers that on average, a one-dollar rise in R&D expenditures results in a two-dollar gain in profit.

Furthermore, Elena Cefis (2003), in her study “persistence in innovation and profitability” finds that enterprises that are systematic innovators and generate profits above the average have a high likelihood of continuing to innovate and earn profits above the average, and vice versa. In the long run, a firm's relative position in innovation matters: if a firm begins as a systematic innovator, the likelihood of earning profits above the average is higher. Evidence for significantly enhanced abnormal operational performance five years following an increase in R&D spending is presented by Eberhart et al. (2004). The authors analyze the relationship between R&D spending and future profitability by focusing on increases in R&D rather than current and historical R&D levels.

Lastly, an MIT study by Minor et al. (2017) looked at the relationship between ideation rate (the number of accepted ideas by management per 1000 participating employees) and a variety of “several publicly reported financial metrics (based on generally accepted accounting principles [GAAP]) for 28 public companies for the period between 2014 and 2016”. According to this study, there is a strong link between the rate of innovation at these organizations and profit or net income growth.

Innovation and Tobin’s Q

Tobin's Q, which is defined as the ratio of a firm's market value to its replacement value, is a primary indicator of firm performance (Tobin, 1969). Better firms generate more economic value from a given amount of assets, according to the theory. As Dezső & Ross (2012) aptly put it: “Tobin's Q is a forward-looking measure that captures the value of a company as a whole rather than the sum of its parts, and implicitly includes the expected value of a company's future cash flows, which are capitalized in the market value of a company's assets (i.e., the combined market value of a company's debt and equity)”. As a result, in finance, economics, and management, Tobin's Q has long been favored as a proxy for firm performance[12]. In general, if a firm’s Tobin’s Q is high (Q value above 1), the market value of this firm is relatively high compared to the replacement cost of its capital (Mishkin, 1995). This implies that a firm’s market value reflects some aspect of unrecorded or unmeasured asset capability. Tobin’s Q is also a measurable indicator

[12] (See: Lang and Stulz, 1994; Berger and Ofek, 1995)

of a company's present value of growth opportunities. A high Q value will encourage the company to invest more in capital, according to Q theory.

Woolridge (1988) found that increases in R&D expenditures elicited a strong market response. Szewczyk et al. (1996) show that announcing an increase in R&D has a considerable favorable impact on high-Q firms (>1). Low-Q firms (<1) have an insignificant reaction to such announcements. The difference is considerable, and it is consistent with the "investment opportunity hypothesis", which states that R&D investments by companies with high-potential growth opportunities are in general valuable, while R&D spending by other companies may be wasteful.

Innovation and Return On Equity (ROE)

In conjunction with Tobin's Q, which is a forward looking and holistic metric, Return on Equity (ROE) will be used as the second metric for firm performance. ROE is looking back to the historical returns that a firm generated. ROE is a metric that tells investors how well a company manages the money it receives from its shareholders. In other words, it measures a company's profitability in relation to its shareholders' equity. The higher ROE, the more efficiently a company's management generates income and growth from its equity capital. Return on Equity (ROE) shows whether the management is increasing the firm's value at an acceptable rate. The Return on Equity (ROE) is the ratio of net income to shareholder equity, which is comparable to the Earnings per Share (EPS) ratio in that both are influenced by the number of shares outstanding.

Limitations of the ROE metric stem from the fact that it can be manipulated by adjusting the number of outstanding shares. Instead of issuing more common shares, which would reduce the return on equity (ROE dilution), when CEO compensation contracts are linked to ROE performance, managers have compensation-related incentives but also for influencing the number of shares outstanding by changing financing decisions (Huang et al.2014; Zhang et al., 2017). As shareholders' equity equals a company's assets less its debt, when firms have easy access to bank loans, they are more inclined to select debt over equity funding to minimize ROE dilution. Thus, to get a clearer picture, ROA is also used to assess the effect of innovation on financial performance.

Innovation and Return on Assets (ROA)

As mentioned, due to the fact that financial leverage boosts the ROE ratio which might be obscuring the real performance ability of a firm, ROA will also be used. ROA is a strong indicator of a company's profitability. It's calculated as the ratio of net income to total assets. It's widely used to assess a company's short-term performance (Short et al. 2007). This ratio especially considers the assets used to support business operations, such as cash in the bank, accounts receivable, property, equipment, inventory, or furniture. The return on assets (ROA) metric indicates how much profit a business earns on each dollar of invested capital. It provides perspective on management's effectiveness and assesses if the company will be able to make a sufficient profit from its deployed assets. Return on assets (ROA), dissimilar to return on equity (ROE), is not affected by debt; it is an objective measure of a firm's effectiveness in earning returns on its assets, and remains unaffected by the management's financing decisions (Mcclure, 2021). In general the ROA should be measured against cost of capital for the realized returns on assets to be put into perspective. In essence, a positive ROA on its own might seem as a positive factor but for a firm to create shareholder value through acquisitions or expansion projects, it should achieve an ROA that is higher than its cost of capital. If it is less than the cost of capital, shareholder value is effectively destroyed and those projects that display this characteristic would not be recommended as worthy of pursuing.

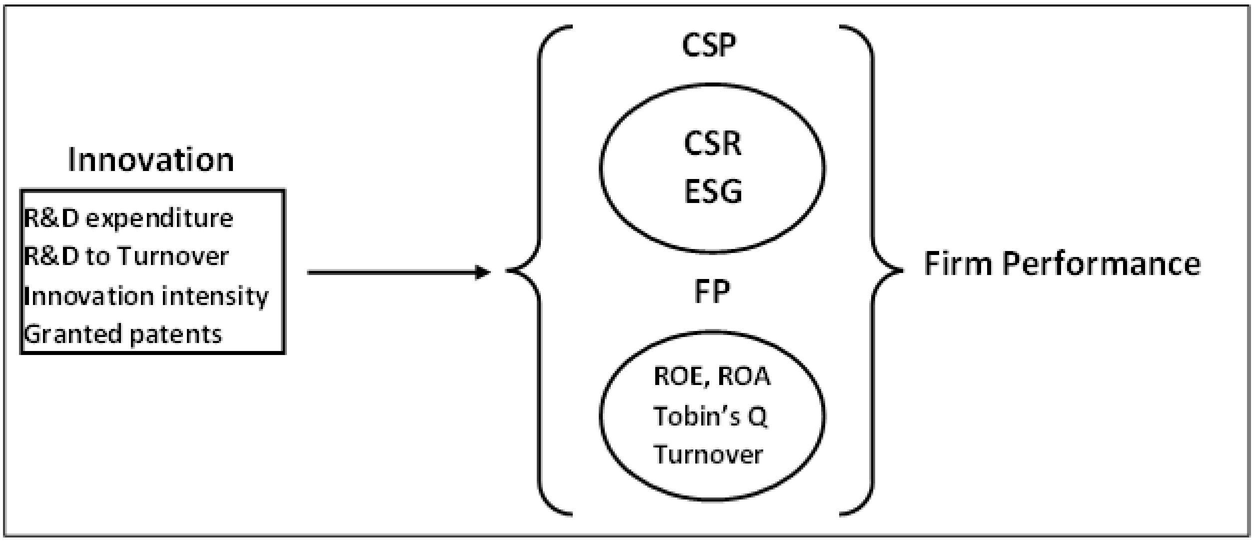
ROA solves the debt issue that ROE is prone to, by having as a denominator the total assets that include liabilities part of which is debt[13]. As a result, in ceteris paribus conditions, the lower the debt, the better ROA is performing. In any case, ROA still is not a perfect metric. To begin with, there are a range of shortcomings with "accrual-based" and "managed" profits that might render the "return" net income numerator, a questionable figure. ROA may not be the optimal measure for comparing organizations because the assets in question are fixed assets which are depicted in financial statements, rather than intangible assets like people or ideas which cannot be accounted for in a similar fashion, according to Mcclure (2021). That happens because some firms' business model is based on intangible assets such as brand reputation, innovative processes, trade secrets, and highly skilled workers or professionals generating ideas that aren't recognized as assets by accounting laws. Therefore, both the two metrics should be taken into account when interpreting the results, in the sense that if only one of two is positively affected by an independent variable while the other is negatively affected, the relationship between the particular innovation measure and firm performance may be ambiguous and not definitive.

Figure 1 below, visually presents the research question of how innovation affects the components that constitute firm performance.

[13] Total assets = liabilities + shareholder equity

Figure 1

Visual Representation of the examined effect of innovation in firm performance components.



3. Methodology and Data Analysis

3.1 Data and Variables

The source for the financial data of this research is the "Orbis" database, which is provided by Bureau Van Dijk (2021) and contains comparable information on private and public companies for which data is retrieved. The dataset is composed of publicly listed enterprises located in the Netherlands. The sample covers the years 2012 to 2020 compiling a panel data of 587 observations for 113 companies. The longitudinal nature of the selected data allows to control for a range of firm- and industry-specific observable and unobservable characteristics that may affect firm performance as a result of individual entity characteristics. To achieve this, firm and industry fixed effects are included in all regressions concerning financial performance.

Data for corporate social performance (CSP) are obtained from two sources. The corporate social responsibility (CSR) scores used in this study are accessed through CSRHub (2021); they are calculated using a number of variables, and the process is typically very sophisticated. For instance, CSR attributes include how a firm treats its community and how much money it donates to local charity. Another example may be the existence of a company's initiatives that allow employees to volunteer for philanthropic causes. A third factor could be the number of charity board members on the company's board of directors. Each is a legitimate estimate of a single aspect of corporate social performance , and each may yield a different result for any specific firm. Corporate social responsibility performance is split into twelve subcategories by CSRHub and these subcategories are grouped into four groups (CSRHub, 2021).

The ESG risk ratings used in this study are accessed through SUSTAINALYTICS (2021); these ratings "measure the degree to which a company's economic value is at risk driven by ESG factors or, more technically speaking, the magnitude of a company's unmanaged ESG risks". There are two parts to an ESG Risk Rating: a numerical score and a risk category. In other words, the ESG risk ratings "measure a company's exposure to industry-specific material, ESG risks and how well a company is managing those risks" (Sustainalytics, 2021).

The aim of this research is to acquire knowledge related to the effect of innovation metrics such as (R&D) on financial and non-financial performance metrics of Dutch firms. Thus, to achieve an unbiased evaluation of the effect of R&D on firm performance, statistical techniques will be utilized to assess the validity of the formulated hypotheses.

3.2 Control and Other Variables

The previous literature has acknowledged a set of characteristics that have been proven to affect firm performance. Thus, a set of control variables have been added to equalize any disparities in firm-level characteristics

Industry:

Many strategy experts recognize the importance of industry characteristics. Some studies have looked at the impact of firm and industry levels on firm performance and found that industry impacts are substantial[14]. Schmalensee (1985) conducted a study which highlighted the central role that industry effects play in determining profitability. Even after correcting for outliers, recent research has indicated that industry impacts account for about 10% of the variance in business performance (McNamara et al. 2005). Short et al (2007) find that 19.23% of the variance was attributed to the industry level. As a result, there is a substantial amount of evidence and theory to support the notion that the industry level is an important aspect of the system that drives corporate performance. This leads to the conclusion that industry effects should be accounted for in the estimation of innovation effects on firm performance.

[14] (For example: Chang and Singh, 2000; Mauri and Michaels, 1998; McGahan and Porter, 1997)

In order to account for industry effects, the universe of economic activities must be broken down in a manner that a specific commercial activity can be linked to a statistical unit that performs that activity. The integrated classification system for products and economic activities is serving this purpose. The NACE[15] codes are a standard classification system of similar European industries that has been established in the European Union since 1970, in accordance with the Standard Industry Classification (SIC) and North American Industry Classification System (NAICS) which are the standard taxonomy systems for assigning enterprises to specific industrial groups, classifying business activities. The NACE Rev. 2 codes are organized into four tiers in a hierarchical structure. Sections are the highest level categories, defined by alphabetical letters A to U; the first two numbers of the code represent the division, the third number represents the group, and the fourth number represents the class. NACE Rev. 2, which incorporates the International Standard Industrial Classification's (ISIC) fourth revision, puts greater emphasis on the production process when defining the various classes (Connects, 2020).

Following Cohen (2010), this study considers only the main section of the business activity rather than the 4-digit codes, to essentially avoid creating too many subsets with very few observations. This may happen as a result of firms (mostly big ones) performing a big chunk of their business beyond the scope of their core industry and is likely to impede the validity of the results by creating mismeasurement errors. To do so, the section letters A to U are matched with numbers from 1 to 21 which are used instead of the letters. To test for industry effects, a separate industry fixed effects model is utilized and the results of this model are measured against the firm fixed effects model.

Size:

According to Schumpeter (1942), as a firm's size grows, innovation activities increase disproportionately. There are several reasons to explain the highly increasing motives to innovate with the rise of the size of an enterprise. To begin with, financial markets may be more accessible to organizations possessing higher market power, because scale and market dominance may enhance the availability and stability of firm resources and thus, riskier innovative ventures can be funded. The availability of capital resources cultivate the necessary mechanisms to enable strategic flexibility, and thus increase organizational performance, according to Greenley and Oktemgil (1998).

[15] Abbreviated from the French **N**omenclature statistique des **A**ctivités économiques dans la **C**ommunauté **E**uropéenne

Secondly, in the R&D production function, there may be economies of scale. Size, for example, is likely to impact the range of activities due to possible economies of scale and scope, according to researchers (Doherty, 1981; Johnson et al., 1981).

Thirdly, in bigger organizations, a considerable amount of innovation expenditures, notably for R&D activities, are fixed costs distributed across a large sales volume. Finally, innovation activities contribute to the development of other activities, most notably management activities, which are more pronounced in larger businesses (Peters, 2008). Excessive bureaucratic control, on the other hand, has been found to stifle innovation in large organizations by Cohen and Levin (1989), a fact which should also be taken into account.

According to numerous surveys, the size of an organization has been demonstrated to be a significant determinant in its ability to innovate[16]. However, the results are mixed when it comes to the level of innovation. R&D intensity rises monotonically with firm size, according to Cohen and Klepper (1996), meaning that R&D intensity is independent of firm size. Recent research, on the other hand, has discovered evidence supporting a non-linear U-shaped link[17]. In any case, there are clear, robust results indicating that innovation is linked to firm size, based on a big amount of studies[18]. Therefore, firm size is included as a control variable. The size is measured by the total assets and the total number of employees.

Age:

According to Shumway (2001), the number of years since a corporation was listed is the most economically important metric of its age. That event is a turning moment in the existence of a corporation. Because there is no appealing alternative to measure how long the firm has been a sustainable enterprise, Shumway (2001) chose the firm's trading age as the variable to measure firm age. The reasoning is that firms are quite similar when they first list since they are obliged to meet a number of conditions to be listed by an exchange. However, as a company can be founded as a small and speculative or major holding company, the age since incorporation is less commercially significant than the age since listing. Listing magnifies growth possibilities, boosts media exposure, transforms capital structure and ownership, and necessitates new corporate governance frameworks according to Loderer and Waelchli (2009). For example, they show that as firms become older, their performance “slows down”. With aging, both return on assets and Tobin's Q decrease. Furthermore,

[16] Cohen and Levin (1989), Cohen (1995), Cohen and Klepper (1996), and more recently, Klette & Kortum (2004) and Ahn (2002) provide an overview of empirical studies assessing the Schumpeter assumptions (2002).
[17] Felder et al., (1996).
[18] For a comprehensive analysis see: “Fifty Years of Empirical Studies of Innovative Activity and Performance”, Cohen (2010), Chapter 4

profit margins are shrinking, sales growth is slowing, and costs are rising. The negative impacts of obsolescence and organizational inertia cannot be addressed by investments or learning. Firms appear to lose impetus as they become older. In the same direction, Pervan et al. (2017) suggest that as businesses grow older, they often strive to formalize decision-making procedures, which makes them more bureaucratic and limits their capacity to make quick adjustments. Rigid rules and procedures can create significant barriers to organizational change and creativity, both of which are critical in today's globalized and highly competitive economic environment. Also, when companies mature, they may choose a "quiet life" strategy, avoiding risks such as major R&D investments, large restructuring, employee conflicts, and so on. In the long run, avoiding organizational changes and R&D investments results in a loss of competitive advantage and lower performance. Pástor and Veronesi (2003) as well as Fama and French (2001), all measure age in the same way, which is age since listing and not incorporation. Following this widely accepted line of research, "firm age" in this article refers to the number of years that have passed since the company's initial public offering.

3.3 Descriptive Statistics

Table 1 presents an overview of the selected variables used in this paper and table 2 presents the descriptive statistics for these variables.

The dependent variables used as proxies for firms' financial performance are the following. For profitability and efficiency the metrics of return on assets and return on equity are employed. These variables are named “ROA” and “ROE” respectively. Another metric of financial performance is Tobin's Q and is named “TobinsQ”. Tobin's Q is the division of market capitalization to total assets and captures the market response for the firm's strategic endeavors and reflects on a firm's growth options. Lastly, “Turnover” represents the operating revenue for the firms and is used to assess direct effects of innovation on firm profits.

Dependent variables proxying corporate social performance (CSP) are the corporate social responsibility variable named “CSRrating” and the environmental, social and corporate governance (ESG) variable named “ESGriskrating”.

Independent variables or variables of interest are the innovation measures. Innovation output is measured by granted patents named as “NoGP”, which is the number of patents owned by a firm and are certified by the law.

On innovation input, three metrics are employed. The first variable used is R&D expenditure, which is abbreviated as “RDExp" and is the sum of each firm's expended amount (in euros) towards R&D. The second variable examined is the ratio of the R&D expenditure to

Turnover, which shows how much of the operating profits corresponds to innovation activities' expenses and is named "RDtoTurnover". The last one is innovation intensity, which is the division of R&D expenditure to total assets and is named "Intensity".

Table 1

Overview of the variables used in the research question.

Variable Name	Type	Description
TobinsQ	Dependent	Market capitalisation / Total assets
ROA	Dependent	ROA (%)
ROE	Dependent	ROE (%)
Turnover	Dependent	Operating revenue (Turnover)
RDExp	Independent	Research & Development expenses
LogRDExp	Independent	Log Research & Development expenses
NoGP	Independent	No of Granted Publications
Intensity	Independent	R&D Expenditures / Assets
CSRrating	Independent	CSR Rating (%)
ESGriskrating	Independent	ESG Risk Rating
NoEmpl	Control	Number of Employees
Log NoEmpl	Control	Log Number of Employees
YSinceIPO	Control	Number of Years Since IPO
Log YSinceIPO	Control	Log of Number of Years Since IPO
Total Assets	Control	Total Assets
NACE	industry-specific	Business Sector (number from 1 to 21)
Company	FE-specific	Company
Fiscalyear	FE-specific	Fiscal Year

The rest of the variables are a set of controlled variables and the fixed effects-specific variables. Namely, control variables are the number of employees named "NoEmpl" and the total assets named "TotAssets" which control for firm size and are used interchangeably in the statistical models. Furthermore, the firm age named "YSinceIPO" is used to control for firm age. The variables "Fiscalyear" and "Firm1" are only used to specify the basic fixed effects model. Lastly, in the complementary model, the sector is controlled for by using industry fixed effects and is named "NACE".

Table 2 summarizes the descriptive statistics for the aforementioned variables. Sampled panel data contains 587 observations (N*T) from 89 clusters for Dutch-based listed firms for which nine continuous years of data exist between 2012 and 2020. This table provides the measure of central tendency which is the mean and measure of dispersion which is the standard deviation. Additionally, "Min" and "Max" columns show the lowest and highest values of each variable.

Table 3 is the correlation matrix. As shown in this figure, there is a high correlation between the R&D expenditures and total assets, implying that larger companies have larger research and development spending and thus size should be controlled for. The respective tables A1 and A2 present in Appendix A, show the descriptive statistics and correlation table for the MLR model.

Table 2

Descriptive/Summary statistics for the variables used in the panel data.

Variable	Observations	Mean	St. Dev.	Min	Max
Tobin's Q	587	1.38	1.48	0.03	12.93
ROA	587	0.03	0.14	-0.76	0.48
ROE	587	6.46	52.98	-531.90	543.24
Turnover	587	6.68e9	1.56e10	10000	1.12e11
R&DtoTurnover	587	0.78	6.39	-0.28	95.86
R&D Expenditure[19]	587	1.98e08	5.6e08	-1424000	3.46e09
Intensity	587	0.04	0.08	-0.08	0.59
No of Employees	587	3.03e4	8.54e4	2	7.1e5
Years Since IPO	587	29.01	84.89	2	117
Total Assets	587	8.54e9	1.88e10	1.58e6	1.15e11
NoGP	93	5995.11	2.61e5	1	2.27e6
CSR Rating	67	70.93	24.78	3	100

[19] A possible reason for the negative R&D expenses might be the "decline of R&D stock" according to Miyagawa and Ishikawa (2019).

Table 3

Panel Data Independent Variables Correlation Matrix

Variable	1	2	3	4	5	6
1 R&D expenditure	1.00					
2 R&D to Turnover	-0.03	1.00				
3 R&D Intensity	-0.08	0.36	1.00			
4 Years since IPO	0.09	-0.11	-0.16	1.00		
5 Number of Employees	0.27	-0.04	-0.10	0.09	1.00	
6 Total Assets	0.84	-0.05	-0.07	0.10	0.41	1.00

3.4 Methodology and Econometrics

As noted, in this study, the hypotheses about potential effects of innovation on firm performance are studied while taking into consideration idiosyncratic and unobservable characteristics that may influence a firm's performance. In order to achieve this, firm fixed effects are included in all financial performance regressions. Fixed effects remove individual time invariant characteristics, to investigate the link between predictor and response variables within an entity -here a firm- (Reyna-Torres, 2007). Fixed effects should be used when there is reason to believe that something about the individual entity (firm, industry, etc.,) has the potential to influence or skew the predictor or response variables, and we must account for this. Lastly, to be able to deploy this model, the examined independent variables should vary over time. Given the fact that individual - idiosyncratic and unobservable characteristics affecting financial firm performance is most likely the case, fixed effects model is the model of choice for testing hypotheses regarding the relationship between innovation and financial performance. The fixed effects model serves as an antidote to the effects of these unobserved characteristics, as they are eliminated during the time-demeaning process of the model (Wooldridge, 2013).

Following this approach, I construct the generic fixed effect model specifications in the following expression:

$$E(Y_{FP}) = \alpha_i + \beta_0 + \sum_{c=1}^{3} \beta_c Innovation.Measures_{it} + \beta_4 Firm.Characteristics_{it} + \varepsilon_{it}, \text{–(1)}$$

Where $E(Y_{FP})$ are the dependent variables that indicate financial performance (FP). “Innovation.Measures”, the central variables to our analysis, are the innovation metrics for each firm, proxied by R&D Expenditure, R&D to Turnover and innovation intensity. "Firm.Characteristics" is the vector of firm's unique characteristics such as firm age and size, ε_{it} is the error term with i=1,2,3,...,n and t = 2012, ..., 2020, and α_i captures the fixed effects. The constant term β_0 is the entity-specific intercepts that capture heterogeneities across entities. Following the relative literature, firm-specific characteristics are added to capture the differential effect of the direct relation between firm performance and innovation.

In addition to firm specific variables, I also include an industry dummy variable constructed at a 1-digit industry level to control for industry effects. The 21 NACE Rev. 2 industry letters are matched to numbers from 1 to 21. Appendix A, Table A3 shows the breakdown of the sampled firms into industry groups and their respective sections. A large number of firms are found to be related to manufacturing, professional, scientific and technical activities, and information technology and communications (IT). Since there are companies that provide services and thus are more employee oriented (i.e., IT) and other companies in the production sector which are more asset oriented (i.e., Manufacturing), firm size is controlled with both total assets and employee number in alternate specifications and their respective coefficients are presented in the regressions' table in different columns. In general, the underlying sample is diverse, covering many industries and economic activities.

3.5 Complementary Model - Multiple Linear Regression

MLR is also utilized complementary with the fixed effects models. It is necessary to use this model due to the fact that the data source provides the number of granted patents as a fixed number, -that is the number of granted patents is the same regardless of the given year. Similarly, CSR and ESG data are not available for years past 2020. As the data for these variables are cross-sectional, these predictors are omitted from the fixed effects model due to their time invariant nature and their collinearity with the fixed effects' component of the model. Therefore, I construct the following multiple linear regression equation to test the effects of innovation on CSP and financial firm performance for 2020.

$$E(Y) = \beta_0 + \sum_{c=1}^{2} \beta_c Innovation + \beta_5 Firm.Characteristics + \varepsilon \text{ , –(2)}$$

Where $E(Y)$ represents firm performance as proxied by both the financial and non-financial metrics. More specifically, the financial variables are ROA, ROE, Tobin's Q and Turnover. The corporate social responsibility (CSP) dependent variables are the corporate social responsibility (CSR) rating and the environmental, social and corporate governance (ESG) risk rating. “Innovation” represents the central independent variables of R&D expenditure and number of granted patents. “Firm.Characteristics” are the number of employees and sectors as measured by the NACE Rev. 2 classification. A sample of 64 and 61 companies are used to test the effects of innovation on CSR and ESG respectively.

3.6 Multiple Linear Regression Diagnostics (Robustness Checks)

As granted patents is an endogenous variable which may be affected by the R&D expense magnitude, Structural Equation Modeling (SEM)[20] is used to assess if granted publications is a variable that is mediated by R&D expenditure. The null hypothesis of granted patents being mediated by R&D expenditures is rejected for all dependent variables and hence, granted patents and R&D expenditures can both be included among the independent variables simultaneously. In other words, there is no case of the independent variable (R&D expenditure) impacting the granted patents variable, which in turn affects the dependent variables.

In addition, in the MLR model the residuals should be normally distributed. This means that there should be no trend in the residuals’ plot against the “fitted values” for a model to be well-fitted. Heteroskedasticity refers to the phenomenon where residual variance is not constant across observations; in this case the variance of the errors is called "heteroscedastic." In order to test whether the homoscedasticity assumption holds, the Breusch-Pagan and Cook-Weisberg test for heteroskedasticity is performed. This test works off the null hypothesis that variance is homoskedastic. The numeric results of this test confirmed the presence of heteroscedasticity and thus, to obtain unbiased standard errors of coefficients under heteroscedasticity, the robust standard errors technique is used in all equations.

Lastly, omitting a squared variable or forcing dy/dx to be constant are examples of function form misspecification (Wooldridge, 1994). To test whether the model used is properly specified, I perform the Ramsey Regression Specification Error Test (RESET) test. This is a broad p-value-based misspecification error test for linear regression models and returns p-values which are not statistically significant at a 5% significance level for all dependent variables, except for Turnover. This means that apart from the latter, all the equations for the dependent variables are specified correctly. In order to reach a properly specified model (without functional form misspecification error), some of the included variables are accompanied by their log-transformation. However, there is no combination of the variables of interest or their log-transformations that can be

[20] For an overview of structural equation modeling see: “Introduction to structural equation modeling (SEM)” in: https://www.stata.com/stata12/structural-equation-modeling/explanation/

used to avoid the functional form misspecification error when the dependent variable is Turnover. Since a misspecified model might not be accounting for some important nonlinearities or might be suffering from omitted variable bias, turnover cannot be used as a dependent variable proxying performance metric in the MLR model. Nonetheless, performing the RESET test does not exclusively reject the omitted variable bias possibility for the rest of the equations. This possibility is not explicitly rejected by this test. Thus, these results should only be indicative of the presence of relationships rather than definitive or conclusive in any way.

4. Results

The results section will present the results obtained from the empirical equations (1) and (2) that formulate the relationship between innovation and the examined components of firm performance. Firm performance is constituted of financial performance (FP) proxied by ROA, ROE, Tobin's Q and Turnover and corporate social performance (CSP) proxied by CSR and ESG ratings. A variety of metrics for firm performance and innovation is examined to identify the many and/or different possible relationships between individual aspects of innovation on firm performance.

In the literature part we have argued theoretically that innovation should increase performance either in financial or societal terms. Financially, higher innovation performance can lead to new products or services that may lead to higher sales growth and even market domination by deterring competition. Thus, ultimately increasing firm valuation and in turn be portrayed in financial metrics such as Tobin's Q, Turnover, ROE or ROA. Moreover, strong patents and a solid reputation earned by CSR, may assist companies in gaining social credibility, which can lead to increased sales and consumer loyalty (Fombrun et al. 2000). Therefore, the combination of innovation and social performance may reinforce financial performance and eventually prove to be a leveraging tool for a further increase in financial performance.

4.1 Impact of innovation on the firm's ROA

This subsection presents results obtained from the empirical equation 1 that formulates the relationship between innovation and return on assets (ROA). Table 4.1 reports the regression results for the impact innovation has on ROA. First, ROA is regressed against the innovation proxies in isolation to examine their effects and then control variables are added. Lastly, all the innovation measures and controls are examined in conjunction. Columns I-VI account for the firm and industry fixed effects.

In table 4.1, I estimate the innovation's effects by regressing ROA on innovation proxies. As shown in column I, the coefficient of R&D to Turnover and this of the Intensity variable are negative and significant at a 10% and 1% significance level, respectively. This implies that return on assets is reduced when firms perform higher R&D expenditure against turnover or total assets. More specifically, it appears that for every 1% increase in intensity, ROA decreases about 1%, on average. This is significant at a 1% significance level. I then test whether this relationship is due to firm-specific characteristics such as firm age or size as measured by total assets and number of employees. In model II and III, the coefficients remain negative and significant. These results indicate that the negative relationship between innovation and ROA is not due to the characteristics of size or age, but occurs regardless of them. In addition, R&D to Turnover is negatively impacting ROA. Specifically, a 1% increase in R&D to Turnover, decreases ROA by 0.0012% in all 3 models I, II and III. This is statistically significant at the 10% significance level.

To test if the results are subject to industry-specific characteristics, I employ the industry fixed effects and regress ROA on the same independent variables, as shown in columns IV-VI. The results generally persist in their direction and significance levels but slightly differ in magnitude. In the VI model where both the central and control variables are examined in conjunction, R&D to turnover is still significantly negative in a 10% significance level and amplified while the Intensity result while still negative at a 1% significance level is decreased in magnitude with a 1% increase in Intensity resulting in 0.92% decline in ROA.

In all models, R&D expenditure is not significant, which suggests that its effect is not statistically different from zero. However, firm age is negative and significant when controlling for firm fixed effects and positive when controlling for industry specific characteristics which is indicative of the differences between the two fixed effects. Lastly, the reported intercept is the average value of the fixed effects which is positive for all models. The results indicate that there is empirical evidence for the negative impact of innovation measures (at least two) on ROA. This is the first evidence in favor of rejecting hypothesis 2 stating that Intensity will positively affect financial firm performance (finding 2.i). Also, there is evidence against hypothesis 3 stating that a higher ratio of Research and Development expenditure to Turnover will positively impact financial performance (finding 3.i) both in the firm level as well as the industry level.

Table 4.1

Impact of innovation on the firm's ROA

	ROA					
Ind. Vars	**I**	**II**	**III**	**IV**	**V**	**VI**
R&D Expenditure	6.45e-12 (2.17e-11)	1.44e-11 (2.10e-11)	7.22e-12 (2.16e-11)	2.68e-12 (4.91e-12)	2.95e-11* (1.51e-11)	4.44e-12 (4.47e-12)
R&D to Turnover	-0.0012* (0.0004)	-0.0012* (0.0006)	-0.0012* (0.0006)	-0.0022 (.0008)	-0.0021 (0.0008)	-0.022** (0.0008)
Intensity	-1.0092*** (0.2119)	-1.0194*** (0.2125)	-1.0101*** (0.2122)	-0.9235* (0.3012)	-0.9513*** (0.2826)	-0.9174*** (0.2928)
Control Variables						
Total Assets		-1.57e-12 (8.00e-13)			-9.74e-13** (3.96e-13)	
Number of Employees			-1.52e-07 (9.50e-8)			-4.73e-08 (8.97e-08)
Firm Age		-0.0003*** (0.0000)	-0.0003*** (0.0000)		0.0004** (0.0002)	0.0004** (0.0002)
Constant	0.0688*** (0.0054)	0.0894*** (0.0104)	0.0816*** (0.0083)	0.674*** (0.0092)	0.0619*** (0.0099)	0.0586*** (0.0087)
Firm Effects	Yes	Yes	Yes	No	No	No
Industry Effects	No	No	No	Yes	Yes	Yes
Observations	587	587	587	587	587	587

Note. This table reports the regression results after regressing ROA against various innovation proxies including R&D expenditure, R&D to Turnover, R&D Intensity abbreviated as Intensity, and a vector of firm-specific characteristics for Dutch listed firms over the period 2012-2020. ROA is the return on assets and it represents the ratio of net income to total assets. Intensity is the ratio of R&D expenditure to total assets. Columns I-III control for firm fixed effects and columns IV-VI control for industry fixed effects. Firms are matched with the NACE 21 industry groups. Robust standard errors are clustered at firm and industry levels respectively and are reported in the parentheses. ***, **, and * indicate 1%, 5%, and 10% level of statistical significance. The data are retrieved from Orbis database. All variables are defined in Table 1 of the descriptive statistics section.

4.2 Impact of innovation on the firm's ROE

To test whether innovation measures positively affect a firm's return on equity, the dependent variable ROE is regressed against the innovation metrics employed in equation 1 and a set of firm-specific characteristics such as size and age. Columns I-III account for firm fixed effects, while the rest (IV-VI) account for industry fixed effects. Table 4.2 reports the regression results for the impact innovation has on ROE. Similarly, ROE is first regressed against innovation proxies in isolation and then controls are added to test whether the results are subject to firm size or age.

Table 4.2 shows the estimated results of innovation's effects by regressing ROE on innovation proxies. As shown in column I, the coefficient of Intensity is negative, with a 1% increase in R&D intensity leading to a 184% reduction in ROE[21], on average. This is statistically significant at a 1% significance level. When adding control variables, the effect persists in direction and magnitude. This finding has serious economic implications as it implies that return on equity is greatly reduced when R&D intensity is higher.

Table 4.2

Impact of innovation on the firm's ROE

	ROE					
Ind. Vars	**I**	**II**	**III**	**IV**	**V**	**VI**
R&D Expenditure	5.97e-09 (5.82e-09)	7.06e-09 (5.34e-09)	6.02e-09 (5.82e-09)	7.99e-09*** (5.78e-10)	1.09e-08*** (2.94e-09)	5.91e-09*** (1.58e-09)
R&D to Turnover	0.1612 (0.1342)	0.1650 (0.1342)	0.1616 (0.1344)	0.1454*** (0.0326)	0.1570*** (0.0292)	0.1455*** (0.0340)
Intensity	-184.0583*** (31.8287)	-185.5076*** (31.5982)	-184.1978*** (31.8680)	-215.6307*** (7.5152)	-218.7599*** (9.8939)	-212.1602*** (8.9857)
Control Variables						
Total Assets		-2.16e-10 (2.51e-10)			-1.05e-10 (1.05e-10)	-
Number of Employees			-0.000 (0.000)		-	0.000 (0.000)
Firm Age		-.0809*** (0.0020)	-0.080*** (0.002)		0.0347 (0.0650)	0.0242 (0.0665)
Constant	11.6626*** (1.4545)	15.4154*** (2.5902)	14.1259*** (2.2574)	12.3929*** (0.3535)	11.9286*** (2.0869)	10.828*** (1.9861)
Firm Effects	Yes	Yes	Yes	No	No	No
Industry Effects	No	No	No	Yes	Yes	Yes
Observations	587	587	587	587	587	587

[21] The decrease is higher than 100% because it implies that ROE is more than halved (i.e, a reduction of 184% means that the resulting number is approximately 54.4% less than the initial number since 1/1.84=0.544 -or 54.4%).

Note. This table presents the regression results after regressing ROE against various innovation proxies including R&D expenditure, R&D to Turnover, R&D Intensity abbreviated as Intensity, and a set of firm-specific characteristics such as firm size and age for Dutch listed firms over the period 2012-2020. ROE is the ratio of net income over shareholder equity. Intensity is the ratio of R&D expenditure to total assets. Columns I-III control for firm fixed effects and columns IV-VI control for industry fixed effects. Firms are matched with the NACE 21 industry groups. Robust standard errors are clustered at firm and industry level respectively and are reported in the parentheses. ***, **, and * indicate 1%, 5%, and 10% level of statistical significance. The data are retrieved from Orbis database. All variables are defined in Table 1 of the descriptive statistics section.

To test whether these results are altered due to industry-specific characteristics, I employ the industry fixed effects reported in columns IV to VI. The results of Intensity persist despite controlling for industry-specific characteristics and are amplified; a 1% increase in Intensity leads to about 215% decrease in ROE, statistically significant at a 1% significance level, when ROE is regressed in isolation against innovation metrics. Intensity remains similarly negative and significant at a 1% significance level when adding the controls, which suggests that industry effects only tend to amplify the negative relationship between innovation intensity and ROE. On the other hand, there is a positive and statistically significant relationship at a 1% significance level between R&D expenditure and ROE when controlling for industry effects. Nevertheless, the order of magnitude of this relationship is very close to zero and thus, it cannot be compared to that of Intensity. Likewise, R&D to Turnover presents a positive relationship, with a 1% increase of it leading to an increase of about 0.15% in ROE, on average. This is statistically significant at the 1% significance level. As with the previous metric, its effect cannot be compared with that of Intensity.

In all models, innovation intensity is negative and significant at the 1% significance level. This implies that higher innovation intensity leads to a decrease in return on equity, despite any firm or industry specific characteristics. When controlling for industry effects, the other two innovation measures appear to positively affect ROE, but the order of magnitude cannot offset the negative influence of the third one, Intensity, the effect of which is over 1000 times stronger than the effect of the others. It is worth mentioning that firm age slightly decreases ROE in models II and III. Lastly, the reported intercept is the average value of the fixed effects which is positive for all models. The results suggest that there is evidence against hypothesis 2, which states that Intensity will positively affect financial firm performance (finding 2.ii). They also suggest that there is empirical evidence in favor of hypothesis 1 stating that higher R&D expenditure will positively impact financial performance (finding 1.i) and hypothesis 3 that the R&D to Turnover ratio will positively impact financial performance (finding 3.ii).

4.3 Impact of innovation on the firm's Tobin's Q

Previous results indicate a mixed effect of innovation on financial performance. At this stage, I test whether innovation affects Tobin's q which is defined as the ratio of a firm's market value to its replacement value. Since this is a forward-looking financial performance indicator, a positive effect would mean that innovation adds to a company's value as well as to the present value of its growth opportunities, while a negative effect would mean the opposite. Table 4.3 reports the regression results for the impact innovation has on Tobin's Q. As before, Tobin's Q is first regressed against innovation proxies in isolation to examine their effects and then controls are added to test whether the results are subject to characteristics such as firm size or age.

Table 4.3

Impact of innovation on the firm's Tobin's Q

	Tobin's Q					
Ind. Vars	**I**	**II**	**III**	**IV**	**V**	**VI**
R&D Expenditure	7.92e-10* (4.74e-10)	8.58e-10* (4.97e-10)	8.02e-10* (4.81e-10)	-1.82e-10*** (4.44e-11)	3.51e-10 (2.09e-10)	1.84e-13 (1.07e-10)
R&D to Turnover	-0.0067 (0.0056)	-0.0065 (0.0056)	-0.0067 (0.0056)	-0.0060 (0.0064)	-0.0058 (0.0062)	-0.0070 (0.0065)
Intensity	-5.8997*** (1.5014)	-5.9881*** (1.4964)	-5.9130*** (1.5034)	4.7851* (2.4840)	3.7832 (2.427)	4.2638 (2.5523)
Control Variables						
Total Assets		-1.32e-11 (1.79e-11)			-1.82e-11 (6.00e-12)	
Number of Employees			-2.04e-06** (8.73e-07)			-3.26e-06 (2.21e-06)
Firm Age		-0.0050*** (0.0001)	-0.005*** (0.000)		-0.0124* (0.0085)	-0.0116 (0.089)
Constant	1.4401*** (0.1010)	1.6704*** (0.1913)	1.6276*** (0.1099)	1.2541*** (0.0760)	1.6562*** (0.2481)	1.6338*** (0.2284)
Firm Effects	Yes	Yes	Yes	No	No	No
Industry Effects	No	No	No	Yes	Yes	Yes
Observations	587	587	587	587	587	587

Note. This table presents the regression results after regressing Tobin's Q against various innovation proxies including R&D expenditure, R&D to Turnover, R&D Intensity abbreviated as Intensity, and an array of firm-specific characteristics such as firm size and age for Dutch listed firms over the period 2012-2020. Tobin's Q is the ratio of a firm's market value to its replacement value. Intensity is the ratio of R&D expenditure to total assets. Columns I-III control for firm fixed effects and columns IV-VI control for industry fixed effects. Firms are matched with the NACE 21 industry groups. Robust standard errors are clustered at firm and industry level respectively and are reported in the parentheses. ***, **, and * indicate 1%, 5%, and 10% level of statistical significance. The data are retrieved from Orbis database. All variables are defined in Table 1 of the descriptive statistics section.

Table 4.3 presents the estimated results for the innovation's effects on Tobin's Q metric. By regressing Tobin's Q on innovation proxies in isolation, as shown in column I, the coefficient of Intensity is negative, with a 1% increase in R&D intensity leading to a 5.90% reduction in ROE, on average. This is statistically significant at a 1% significance level. This negative relationship persists when adding firm size and age as control variables and a statistically significant at 1% significance level. R&D expenditure on the other hand, appears to be positively related with Tobin's q, although this effect is almost zero in all three models of the firm fixed effects. It is noteworthy that firm age once more is (slightly) negative and statistically significant at the 1% significance level. Lastly, size seems to negatively impact Tobin's Q, which suggests that smaller companies may have higher market value compared to replacement value, further suggesting that they may have lower cost of capital, contrary to traditional financial intuition, or they may have higher present value of growth opportunities.

To further assess the impact of innovation on Tobin's q, columns IV to VI present the industry fixed effects' results. Intensity is positive in this case. More specifically, a 1% increase in innovation intensity increases Tobin's Q. This is significant at a 10% significance level. When adding control variables however, this effect disappears which means that when controlling for age and size this effect is not significantly different from zero. Alongside Intensity, R&D expenditure also changes the direction of its effect which is positive when examining innovation measures in isolation. As intensity however, this statistical significance is diminished when controlling for firm size and age and thus, cannot stand as empirical evidence in favor or against their respective hypotheses. Again, there is a negative effect of firm age on Tobin's Q ratio at 10% significance level, indicating once more that the older firms get the worst for their financial performance. Lastly, firm and industry effects represented by the constant are positive and statistically significant at a 1% significance level.

To sum up, there is clear evidence that innovation intensity hinders Tobin's Q, which adds to the rejection of hypothesis 2 which states that Intensity will positively affect financial firm performance (finding 2.iii). Furthermore, despite weak correlation, there is empirical evidence of the positive influence of R&D expenditure on Tobin's Q which reinforces the acceptance of hypothesis 1 stating that higher R&D expenditure will positively impact financial performance (finding 1.ii).

4.4 Impact of innovation on the firm's operating revenue (Turnover)

So far, the effects of innovation metrics on ROA, ROE and Tobin's Q have been examined. This subsection examines the association between innovation and operating profits from sales (Turnover). Operating profit is a very straightforward proxy of financial performance that shows whether profits from sales increase or decrease as a result of increasing innovation input. Table 4.4 reports the regression results for the impact innovation has on Turnover. As before, Tobin's Q is first regressed against innovation proxies in isolation to examine their effects and then controls are added to test whether the results are subject to characteristics such as firm size or age.

Table 4.4 reports regressions' results for innovation's effects on Tobin's Q. Column I, presents the innovation regressors in isolation; the coefficient of Intensity is negative and statistically significant at a 5% significance level. More specifically, a 1% increase in innovation intensity is shown to decrease operating profits by approximately €2.89 billion, ceteris paribus. This finding has vast economic implications. Despite the effect disappearing when controlling for firm size in terms of total assets, it reappears when size is proxied by number of employees. More specifically, a 1% increase in Intensity decreases operating profits by €2.41 billion, on average. This is statistically significant at a 5% significance level. In the III model, it is shown that for every employee added, the firm's operating profit increases by €125,221.4 on average. This is statistically significant at a 1% significance level. Also, for every added year of operation, the firm's operating profit decreases by €950,431 on average. This is statistically significant at a 5% significance level. This is an interesting finding because it is observed only when firm size is proxied by number of employees, indicating that firms that are more people oriented (i.e, service providers) may increase their profits by increasing the number of people working for them, but may also suffer from diminishing profits over their lifespan. Lastly, there is a statistically significant relationship (at a 5% significance level) between size in model II, indicating that for every euro invested in assets, there is an increase of about €0.57 in operating profit.

Table 4.4

Impact of innovation on the firm's Turnover

	Turnover					
Ind. Vars	**I**	**II**	**III**	**IV**	**V**	**VI**
R&D Expenditure	6.0733*** (0.7243)	3.1167 (2.5280)	5.3565*** (0.978)	21.5551*** (0.3069)	1.0479 (2.9676)	12.8137*** (2.447)
R&D to Turnover	5,808,992 (4,654,946)	-3,554,566 (5,156,135)	4,675,818 (3,972,509)	5.61e+07 (5.54e+07)	-3,739,719 (6,699,838)	3.93e+07 (3.69e+07)
Intensity	-2.89e+09** (1.33e+09)	7.18e+08 (1.93e+09)	-2.41e+09** (1.16e+09)	-2.89e+10 (2.13e+10)	-2.02e+09 (3.72e+09)	-1.83e+10 (1.40e+10)
Control Variables						
Total Assets		0.5739** (0.2345)			0.729*** (0.105)	
Number of Employees			125,221.4*** (41,659.1)			177,107.6*** (52,484.41)
Firm Age		-392,470.1 (734,522.2)	-950,431** (431,073)		-3.13e+07** (1.26e+07)	-7.26e+07** (2.41e+07)
Constant	5.57e+09*** (1.47e+08)	1.15e+09 (1.84e+09)	1.94e+09 (1.26e+09)	3.39e+09*** (6.52e+08)	1.12e+09 (6.40e+08)	1.26e+09** (6.52e+08)
Firm Effects	Yes	Yes	Yes	No	No	No
Industry Effects	No	No	No	Yes	Yes	Yes
Observations	587	587	587	587	587	587

Note. This table presents the regression results after regressing Turnover against various innovation proxies including R&D expenditure, R&D to Turnover, R&D Intensity abbreviated as Intensity, and an array of firm-specific characteristics such as firm size and age for Dutch listed firms over the period 2012-2020. Intensity is the ratio of R&D expenditure to total assets. Columns I-III control for firm fixed effects and columns IV-VI control for industry fixed effects. Firms are matched with the NACE 21 industry groups. Robust standard errors are clustered at firm and industry level respectively and are reported in the parentheses. ***, **, * indicate 1%, 5%, and 10% level of statistical significance. The data are retrieved from Orbis database. All variables are defined in Table 1 of the descriptive statistics section.

To further assess the innovation effects on Turnover, industry effects are utilized. As shown in columns IV to VI, Intensity loses statistical significance when controlling for industry. Thus, it is apparent that industry is key to the existence of this relationship. On the other hand, the

R&D effect is amplified when controlling for industry effects both in the case of examining innovation effects in isolation as well as when controlling for age and size in terms of number of employees. More specifically, when examined in isolation, a €1 increase in R&D expenditure increases operating profits by €21.5 on average. That is statistically significant at a 1% significance level. This effect is not statistically significant from zero when controlling for age and size as measured by total assets, however, it is only moderated by controls when controlling for age and size as measured by number of employees. More specifically, a €1 increase in R&D expenditure increases operating profits by €12.8 on average and this is statistically significant at a 1% significance level. Again, for every one employee added, the firm's operating profit increases by €177,107.6 on average, with a statistical significance of 1%. Also, for every added year of operation, the firm's operating profit decreases on average by €31,300,000 when size is proxied by total assets and €72,600,000 when size is proxied by number of employees. These are statistically significant at a 5% significance level. The effect of total assets remains and is statistically significant at a 1% significance level, with a €1 increase in total assets, leading to an increase of about €0.73 in operating profit.

To sum up, there is a very large and negative -significant at a 5% significance level- relationship between Intensity and operating profits. This finding (2.iv) is the last piece of evidence adding to the rejection of hypothesis 2, which states that Intensity will positively affect financial firm performance. On the other hand, there is empirical evidence presented in favor of the positive relationship between R&D expenditure and financial performance as measured by turnover. This is another piece of evidence in favor of the acceptance of hypothesis 1 stating that higher R&D expenditure will positively impact financial performance (finding 1.iii).

4.5 Impact of innovation on the firm's CSP

Thus far, the effect of innovation on financial measures has been explored using firm and industry fixed effects for the period 2012-2020. In this subsection, I use multiple linear regression to identify the effects of innovation on corporate social performance CSP, but also on financial performance for 2020 as a robustness check for all the previous results. The models presented below are tested and are certainly not suffering from 'form misspecification error', based on the results of the Ramsey (1969) RESET test (RESET stands for: "Regression Specification Error Test"). Nonetheless, the results presented here should be cautiously treated, since there might be other factors and forces interfering with the causal inferences, not entirely captured by the specified models. It is, however, worthy of exploring potential relationships between innovation and CSP even if they may only be indicative. In the MLR model, the approach is to use the central variables with some of their log transformations in order to achieve a properly specified model, thus R&D expenditure, number of employees and firm age are accompanied by their log transformations.

Table 4.5 presents the MLR results. As shown in the 1st column, ROA does not present statistically significant relationships with the central variables of interest, but rather with control variables such as number of employees, the log of firm age and industry. More specifically, a one percentage increase in the number of employees will result in a 0.02% increase in ROA, ceteris paribus. Similarly, a 1% increase in firm age will increase ROA by 0.1%, ceteris paribus. These findings are statistically significant at a 5% significance level.

Table 4.5

Impact of innovation on the firm's CSP

	I	II	III	IV	V
Ind. Vars	**ROA**	**ROE**	**Tobin's Q**	**CSR**	**ESG**
R&D Expenditure	-1.03e-11 (1.84e-11)	-4.74e-09 (5.10e-09)	-1.28e-10 (5.33e-10)	-7.11e-09** (2.74e-09)	1.69e-09 (1.65e-09)
Log(R&D Expenditure)	-0.0027 (0.0017)	-0.7169 (0.4513)	0.0756*** (0.0233)	0.5320* (0.2895)	-0.0927 (0.1139)
No Granted Patents	1.18e-07 (3.28e-07)	0.0001 (0.0001)	-8.09e-06 (5.84e-06)	0.0000 (0.0001)	0.0000 (0.0000)
Control Variables					
No of Employees	-1.84e-07 (1.18e-07)	0.0001 (0.0000)	6.96e-07 (1.67e-06)	0.0000 (0.0000)	2.43e-06 (8.22e-06)
Log(No of Employees)	0.0198** (0.0077)	5.7159** (2.2806)	-0.1182 (0.0891)	7.4347*** (1.6952)	-1.5398*** (0.5687)
Firm Age	-0.0025 (0.0015)	-0.4862 (0.4356)	0 .0428* (0.0216)	-0.2419 (0.2080)	-0.04307 (0.0720)
Log(Firm Age)	0.0982** (0.0405)	17.6377 (12.0467)	-1.4839** (0.6937)	15.8223*** (4.9331)	-0.8603 (1.8121)
Industry	Yes	Yes	Yes	Yes	Yes
Constant	-0.2774** (0.1088)	-72.0680** (35.1805)	5.1458*** (1.9479)	-25.1501 (19.0896)	40.0076*** (5.3415)
Observations	86	83	82	64	61

Note. This table presents the regression results after regressing CSP proxies such as CSR and ESG scores against various innovation metrics including R&D expenditure, R&D to Turnover, R&D Intensity abbreviated as Intensity, and a set of firm-specific characteristics such as firm size and age for Dutch listed firms for the year 2020. Intensity is the ratio of R&D expenditure to total assets. Columns I-V correspond to the regressions for each of the proxies for FP and CSP. Firms are matched with the NACE 21 industry groups. Robust standard errors are clustered at firm and industry level respectively and are reported in the parentheses. ***, **, * indicate 1%, 5%, and 10% level of statistical significance. The data are retrieved from Orbis database. All variables are defined in Table 1 of the descriptive statistics section.

Column II, once more shows no relationship between ROE and the innovation independent variables. Similar to ROA, there are significant relationships between the log of number of employees with a 1% increase in the number of employees leading to a 5.72% increase of ROE, on average. This is significant at a 5% significance level.

Column III shows that there is a statistically significant effect of the log of R&D expenditure on Tobin's Q. More specifically, a 1% increase in R&D expenditure increases Tobin's Q by 0.08%. This is significant at a 5% significance level. This is the last piece of evidence which supports hypothesis 1 stating that higher R&D expenditure will positively impact financial performance (finding 1.iv). Again, firm age is negatively associated with Tobin's Q.

Column IV and V present evidence of the relationship between innovation and CSP only for the CSR metric. There is a discrepancy between the coefficients of the log transformation of R&D expenditure and the variable itself. The variable itself has a negative coefficient which is very close to zero, but statistically significant at a 5% significance level. The log transformation has a positive coefficient with a 1% increase in R&D expenditure leading to a 0.53% increase in CSR score, but is statistically significant at a 10% significance level. A possible reason for this discrepancy might be that the variable itself is not normally distributed or that outliers are in play. Therefore, the effect of the log transformation will be the one accepted as a positive driving force of innovation to CSP. Again, there is also an association of CSP with control variables. However, it is interesting to mention that column IV displays the only case where firm age is positively associated with a performance measure. More specifically, it appears that every added year in a firm's lifespan increases CSR rating by about 0.16 points. This is significant at a 1% significance level.

To sum up, the multiple linear regression approach offers only the indication of a positive relationship between R&D expenditure and CSR. Thus this is the only supportive evidence in favor of hypothesis 5 (finding 5.i).

5. Discussion

In this section hypotheses 1 to 5 will be accepted or rejected based on the findings of the results section. For hypothesis 1, all findings (1.i-1.iv) are in line and supporting the acceptance of it. Thus, hypothesis 1 stating that “higher R&D expenditure will positively impact financial firm performance as measured by ROA, ROE, Tobin’s Q and Turnover” is accepted.

For hypothesis 2 there is significant evidence that it should be rejected. Specifically all empirical findings (2.i-2.iv) point towards its rejection. Thus, hypothesis 2 stating that “innovation intensity will positively affect financial firm performance as measured by ROA, ROE, Tobin’s Q and Turnover”, is rejected.

Hypothesis 3 does not enjoy a consensus in favor or against, based on its findings (3.i and 3.ii). The first finding (3.i) suggests that hypothesis 3 should be rejected. However, the second (finding 3.ii) is both statistically significant at a higher significance level than that of the first one (i.e, 5% versus 10%) and its magnitude is about 7 times larger[22]. Thus, hypothesis 3, stating that “higher ratio of Research and Development expenditure to turnover will positively impact financial performance as measured by ROA, ROE, Tobin’s Q and Turnover”, is accepted.

Supportive evidence for hypothesis 4, which claims that “a higher number of granted patents will positively impact financial firm performance as measured by ROA, ROE, Tobin’s Q and Turnover”, was not found and thus, it is rejected due to this absence.

Lastly, empirical evidence is found to be in favor of hypothesis 5 stating that “innovation will be positively associated with CSP as measured by CSR and ESG” as depicted by the finding (5.1) in the MLR model. Thus, hypothesis 5 is also accepted. However it is clear that further research may be needed to explore the relationship between innovation and corporate social performance (CSP).

A last note worth mentioning is the strong and statistically significant impact of control variables such as firm age on firm performance. Firm age negatively affects all cases of financial firm performance with the most outstanding result in the Turnover regressions. Nonetheless, firm age is shown to have a beneficial effect on the firm’s CSR score.

The versatile findings for innovation effects on firm performance are very interesting and could be seen as colliding with each other. The conflicting results could have more than one possible explanations. One might be that there is an optimal level of innovation input with respect to other financial attributes. While R&D expenditure may boost firm performance, when comparing

[22] (-0.022** in the ROA model vs 0.157*** in the ROE model)

it to other potential uses, it might be lacking in return level. This proposition stems from the financial concept that like any capital investment project, its returns are measured against other competing projects, and if it does not add at least as much value as other asset-based projects, then it destroys value (their difference). Nevertheless, it would be unfair to assume a comparison between the returns of tangible assets and that of intangible assets is possible. The reason for this is that intangible assets like reputation, brand awareness, and intellectual capital (i.e., patents, trademarks & copyrights), all share a common quality; it is very hard, in many instances, to quantify their returns. Secondly, it is a fact that many companies are "lighter" than others in the sense that they own assets with indefinite lifespans that aren't recognized as assets by accounting laws because they cannot be amortized. Thus, a direct comparison of intangible-based returns with return on assets is hard to perform and more importantly it would be uneven.

There is another plausible explanation, however. That is, in the words of the author: "if the financial performance of the company improves, the level of R&D expenses relative to operating income will decline due to the increased efficiency of the intellectual, technological and human capital" (VanderPal, 2015; p.145) and thus, in this case the opposite might be true. In essence, by showing that an increase in R&D expenses relative to Turnover is decreasing financial performance, it may be the result of the inefficiency of the intellectual, technological or human capital which in turn hinders ROA, ROE or operating profits.

6. Limitations

Specific challenges affect the panel data analysis in terms of limitations. The study's findings were most probably affected by the "under-coverage" issue (eurostat, n.d). Initially, the sample consisted of 113 companies that provided partial data, making interpolation impossible. As a result, only 89 companies were selected as stable enough to match the panel regressions.

Furthermore, as discussed, the MLR model although well specified under the Ramsey Test (RESET), it still may indeed suffer from omitted variable bias, due to unobservable characteristics. In this case, the coefficients might present biased results in any direction. Nonetheless, findings for the CSP do not seem unreasonable, because firms that are more responsible in terms of investments are more likely to be absent from exploiting business activities that would be characterized as "irresponsible" or "unsustainable" regarding societal impact and thus have a direct and negative impact on their ROE or ROA.

Last but not least, this study is based on the publicly listed firms located in the Netherlands. This renders the study quite insightful for these companies but it does not take into consideration unlisted firms. The inclusion of unlisted firms would bring new insights into how firms which are not publicly held can benefit from innovation and if the observed effects apply to these firms.

7. Conclusion

This study examines the effect of innovation in financial and non financial firm performance. I conjecture that firms with higher innovation inputs and/or output enjoy better firm performance. In order to test the 5 hypotheses, this study employs two firm samples. The first consists of 587 Dutch-based publicly listed firms for the years 2012 to 2020 and the second set consists of 67 publicly listed firms for the year 2020. Statistically significant evidence points towards a positive effect of R&D expenditure on ROE, Tobin's Q and Turnover. In line with literature from Nelson (1982) and Edvinsson and Malone (1997), it is shown that an increase in R&D expenditure is shown to positively impact the ROE metric, although that does not seem to be the case for ROA. The context of complementarity should be considered when examining the two metrics and the contradicting findings might raise questions about discussed phenomena such as ROE dilution, mentioned in the literature review section. Thus, although ROE is more heavily affected by innovation and hypothesis 3 is accepted, this finding should be treated cautiously for its applicability in real terms. The acceptance of this hypothesis illuminates a new possibility; that when R&D expenditure increases as compared to the operating profits, it positively impacts firm performance as measured by ROE. This finding is in contrast with the findings of VanderPal (2015), that finds a negative relationship between the "ratio" as he calls it. On the innovation input, therefore, the seemingly conflicting evidence of the innovation effects on firm performance may have more than one possible explanation.

Lastly, hypotheses 2 and 4, regarding innovation intensity and granted patents respectively, are rejected. The rejection of the second hypothesis points towards the conclusion that despite R&D expenditure having a favorable influence on company performance when measured on its own, as the ratio of R&D spending to total assets rises, it has a negative impact on firm performance as assessed by all four financial performance metrics[23]. This is a finding contrary to the aforementioned research line of Geroski, (1995), Banbury and Mitchell (1995) and Soni et al (1993). Hypothesis 4 is rejected as there is no supportive evidence to back it up. This might be the

[23] In at least one model or specification.

result of a cross sectional model not being able to capture the many versatile forces shaping firm performance.

Next, the study attempts to identify the effect of innovation on corporate social performance (CSP), separately. There is evidence that R&D expenditure increases CSR rating for the year of 2020. This implies that firms that spend more on R&D, tend to perform better in terms of social responsibility and thus, that innovation and more socially responsible practices may be intertwined. To some, it might only be natural that innovative companies should perform well in CSP. Further studies might illuminate in depth this relationship.

This study contributes to the existing literature on several fronts. Prior research largely focuses on the link between innovation metrics such as R&D expenditure and specific financial performance such as ROE, ROA, etc or corporate social performance but separately. The large body of the literature lacks the combined examination of financial and non-financial firm performance. In contrast, this study examines both these aspects: FP and CSP. In doing so, it provides an overview of the effect of innovation on firm performance and shows empirically that there is a positive relation with both aspects of firm performance.

This study has potential implications for academics, investors, firms and policy makers alike. To academics, it offers new insights based on a sample of Dutch publicly listed firms for how they can identify the innovation effects on firm performance more holistically. To investors, it presents evidence for the impact of innovation in firms' financial results. For firms, it serves as an example of how R&D expenditure boosts financial performance and how engaging in it may result in increasing social responsibility which can further boost financial performance and thus, create a win-win situation for maximizing profits while being socially responsible. For policy makers, it provides reasons to motivate firms to invest in R&D, since innovation seems to boost both financial but also corporate social performance.

Further studies should be conducted, however, in order to identify possible reasons for why R&D expenditure is positively affecting firm performance when examined standalone, and why when it is examined as a ratio against another measure, such as total assets (i.e., R&D intensity) may negatively impact firm performance.

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Appendix A

Table A1

Descriptive/Summary statistics for the variables used in Multiple Linear Regression model

Variable	**Obs**	**Mean**	**St. Dev.**	**Min**	**Max**
Tobin's Q	92	1.77	1.93	0.01	12.26
ROA	96	-0.03	0.21	-1.34	0.20
ROE	92	-8.29	43.33	-218.85	95.95
R&D expenditure	96	1.63e+08	5.05e+08	0	2.98e+09
Log R&D expenditure	96	8.41	8.99	0	21.82
CSR Rating	67	70.93	24.48	3	100
ESG Risk Rating	63	22.02	6.63	9.5	36.14
Number of Granted Patents	93	5995.11	26060.53	1	227,106
Years Since IPO	100	21.76	20.49	1	114
Log Years Since IPO	100	2.68	0.97	0	4.74
Number of Employees	92	29,028.45	86,083.89	8	603,480
Log Number of Employees	92	7.91	2.46	2.08	13.31
CSR Rating	67	70.93	24.48	3	100

Table A2

Correlation matrix for independent variables used in the Multiple Linear Regression model

Variable	1	2	3	4	5	6	7	8	9
1 R&D expenditure	1.00								
2 Log R&D expenditure	0.50	1.00							
3 CSR Rating	0.18	0.11	1.00						
4 ESG Risk Rating	0.00	0.00	-0.57	1.00					
5 No of Granted Patents	0.54	0.32	0.19	-0.03	1.00				
6 Years since IPO	0.10	-0.04	0.46	-0.20	0.47	1.00			
7 Log Years since IPO	0.06	-0.04	0.62	-0.28	0.28	0.89	1.00		
8 No of Employees	0.16	-0.18	0.16	-0.23	0.07	0.08	0.14	1.00	
9 Log No of Employees	0.38	-0.09	0.47	-0.38	0.28	0.23	0.28	0.65	1.00

Table A3

Number of firms according to NACE industry classification over 2012-2020

Industry Group (Letter)	NACE Number	Obs.	%	Cum. %
Agriculture, forestry and fishing (A)	1	4	0.68	0.68
Mining and quarrying (B)	2	18	3.07	3.75
Manufacturing (C)	3	320	54.51	58.26
Electricity, gas steam and air conditioning supply	4	6	1.02	59.28
Construction (F)	6	24	4.09	63.37
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	7	46	7.84	71.21
Transportation and storage (H)	8	11	1.87	73.08
Information and communication (J)	10	66	11.24	84.33
Financial and insurance activities (K)	11	6	1.02	85.35
Professional, scientific and technical activities (M)	13	71	12.10	97.44

Administrative and support service activities (N)	14	7	1.19	98.64
Human health and social work activities (Q)	17	1	0.17	98.81
Other service activities (S)	19	7	1.19	100.00
Total:		587	100.00	

Table A4.

Firm industry for 2020 according to NACE classification

Industry Group (Letter)	NACE Number	Obs.	%	Cum. %
Mining and quarrying (B)	2	4	5.97	5.97
Manufacturing (C)	3	35	52.24	58.21
Construction (F)	6	2	2.99	61.19
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	7	4	5.97	67.16
Transportation and storage (H)	8	3	4.48	71.64
Information and communication (J)	10	8	11.94	83.58
Financial and insurance activities (K)	11	1	1.49	85.07
Professional, scientific and technical activities (M)	13	9	13.43	98.51
Administrative and support service activities (N)	14	1	1.49	100.00
Total:		67	100.00	