# Design Rights, Profitability and Performance in Swedish Firms

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# Abstract

Generation of designs allow firms to gain more competitive advantages and attract more potential customers over their competitors. This is a reason why design protection is important. Design protection plays an important role in preventing the authorised use of a firm's designs by their competitors and the number of applications for design rights each year are high. Apart from a solution to the appropriation problem that design protection provides, firms may have other motivations for seeking its use. This study aims to understand financial motivations of having designs protected, and as such examines the relationship between design rights, profitability and performance of Swedish firms. Pooled OLS regression is applied to analyze the design and financial data from 1,735 Swedish firms from 2003 to 2016. It is shown that European and Swedish national design rights are negatively related to subsequent profitability of Swedish firms. However, for only European design rights, they do show a positive relationship with subsequent performance of Swedish firms.



**Key words:** Design, Design rights, Profitability, Performance, Intellectual property

# Content

# 1. Introduction

In recent news on design rights, the tyre company Bridgestone announced that it won its design rights infringement lawsuit against some Chinese tyre manufacturers, a lawsuit that was filed in 2017 (Bridgestone, 2020). The company has in the past, been on the benefiting end of other design right infringement lawsuits and has said that it is very concerned with any unauthorised use of their intellectual property which includes design rights (Bridgestone, 2020). Another case can be found involving the infringement of a hair dryer design of Mitsubishi Electric Corporation, where the Shanghai High People's Court in China ruled that both the design rights and patents regarding the product had been infringed upon (Mitsubishi, 2019). It was ordered that manufacturing and sale by the Defendants, both Chinese companies, should stop and that compensation should be paid (ibid).

In earlier news, we find a similar case of design infringement. Swedish skin tech brand Foreo was awarded €400,000 by the Shanghai intellectual property court.[1] This was on account of the creation of a counterfeit product by a Chinese company of one of Foreo's beauty devices. Even though changes were made to the design of the product to establish some distinguishing features, the court still found the company guilty of infringement. The court case lasted for two years and by copying Foreo's design, the Chinese company managed to amass about €4.4 million in sales.[2] Foreo's founder, Filip Sedic, expressed the judgement of the court as a great victory for the company. These cases show that firms are interested in protecting their design rights which indicates that they could be an important aspect of their assets.

With the increasing competition among firms, most are choosing to invest in innovation in a bid to distinguish themselves and provide them with some competitive advantages. The existence of many similar products has made it important for firms to be able to make products that are different and would attract attention of potential customers and maintain regular customers as well. A way firms achieve this is through their designs, which most often require substantial investments on the firm's part. This explains the need for design rights; the protection of designs and the benefits they provide to firms that own them. The

[1] Foreo, at https://www.foreo.com/mysa/trial-of-the-fake-lunas/ (accessed 19 March 2020)
[2] See footnote 1

cases described above are just a few examples of the importance companies attach to having their design rights protected.

Along with evidence of importance, there is a significant increase in the number of design registrations. The European Union Intellectual Property Office (EUIPO) reports that the number of registered community designs received in 2019 was about 96,000 compared to approximately 40,000 in 2003[3] when registration started at the European level. Despite this evidence of growing importance of and interest in design protection, there is a lack of research regarding the matter. Previous research demonstrates that firms are able to derive financial benefits from their designs (Candi, 2010; Gemser and Leenders, 2001; Platt et. al., 2001), which are the innovations protected by design rights. This financial benefit is usually in the instance that designs are an integral part of the products of the company, as was the case with Bridgestone and Foreo. In spite of this, there is not much known about the financial contributions design rights make to firm performance.

There are some interesting findings in research on intellectual property in general and specifically, patents and trademarks. Research on intellectual property in general, attributes the increased recognition of it to the investment in research and development as a result of increased competition (Artz et. al., 2010). Obtaining intellectual property tends to benefit companies that do, such that they gain returns from their ideas and inventions. When making these investments, firms are anticipating the generation of some profits (Rogers, 2002). However, if firms are unable to appropriate their intellectual property, they lose their competitive advantage as competitors that make no or little investment may copy these inventions (Teece, 1986). This is one reason why firms are concerned with protecting their investments in intellectual property. A similar reasoning about protection should be applicable to design rights.

There is research on patents, ranging from their contribution to market value (Griliches, 1981; Hall et. al., 2007) to their relation to firm profitability (Smyth et. al., 1972; Yu, Wang and Liu, 2010). There has been quite an amount of recognition when it comes to research in

[3]https://euipo.europa.eu/tunnel-web/secure/webdav/guest/document_library/contentPdfs/about_euipo/the_office/statistics-of-community-designs_en.pdf

patents, trademarks to show their positive relationship with performance or profitability (Ernst, 2001; Tsai 2010; Suh et. al., 2008; Markman et. al., 2004; Crass, et. al. 2019; Yu, Wang & Liu, 2010). But this research has not been done for design rights.

Research on the various IP rights and their connection to firm performance and profitability are interesting and provide good insights for further research. Bascavusoglu-Moreau and Tether (2011) provide some insight on the relationship between design protection and firm performance in UK firms. While we could infer that a similar relationship between patents and firm performance would exist for design rights due to their classification as intellectual property, it is important to consider that these two IPRs have different definitions and so there is a benefit to examining separate relationships.

In this paper, the attempt is made to contribute to research on intellectual property and the profitability of firms while also examining performance, with a focus on design protection. The relationship between a firm's profitability, performance and whether the number of design rights owned can serve to explain some aspect of a firm's profitability and performance is examined. This study focuses on private Swedish firms. Specifically, the research question is:

*What is the relationship between the design rights, profitability and performance of Swedish firms?*

This study uses panel data over a 13-year period (2003-2016). The focus is on Swedish private firms in multiple industries. Data about design rights that is publicly available from both Swedish and European databases is used. For the data on proxies for profitability and performance, focus is on firms' publicly reported values. The dataset consists of financial data from the Swedish House of Finance's Serrano database, Swedish national (SE) design rights data from the Swedish Patent and Registration Office (PRV) and European (EU) design rights from EUIPO.

The results show that EU and SE design rights are negatively related to subsequent profitability of Swedish firms, when a one-year lag is observed. They do appear to have a

positive relationship with subsequent performance of Swedish firms which is proxied for by net sales per employee, also using a lag of one year. The result for this however, is only significant for EU design rights. Based on results of descriptive statistics, design rights appear to be most applied for by the industrial goods industry, followed by the shopping goods industry.

The results show that design rights could impact positively on a firm's performance to some extent. However, the negative relationship found between design rights and profitability suggest that the returns from design protection may not be realised till a much later period after publication. Further research could be done to include firms without design rights in the sample, which would allow for assessment of the effect of design rights rather than a relationship alone.

The remainder of this paper continues with a literature review on the general background of design and design protection in section 2. The literature review, critically analyses and summarises all theories, definitions and regulations in Sweden that are related to profitability, performance and design rights. Following this, the data collection process is presented, which gives the dataset for our research in section 3 as well as the methodology applied in this paper. Section 4 provides the results of the analysis on design protection, profitability and performance as well as a discussion of findings. The conclusion is provided in section 5.

# 2. Literature Review

## 2.1 Intellectual Property

The presence of rivalry and competition increases the incentive for firms to innovate in order to gain competitive advantage or at least to stay in competition (Ganslandt, 2007). In some instances, the result of this innovation is intellectual property. Intellectual property are intangible products of the mind. Forms of intellectual property are patents, trademarks and designs amongst others. The intellectual property that results from firms' innovative activities does provide them with an advantage over competitors, however there is the issue of appropriation that most firms face.

Appropriation is a term that comes up often in innovation studies. It refers to being able to capture value from one's innovation (Freel and Robson, 2016). In reference to intellectual property, it simply means that firms should be able to generate monetary returns or obtain value-adding benefits (ibid). It is not always the case that firms are immediately able to appropriate the results of their innovations which creates room for imitation by competitors. As such, while there is the incentive to innovate because of competition, there is also the concern for the protection for the intellectual property that would be the result of said innovation. The opportunities for exploitation of a firm's or individual's research as well as the expensive cost of developing would serve as a disincentive to innovation which is why having ownership of intellectual property is seen to be important (Hallenborg et. al., 2008).

Hence, there is the need for mechanism, sometimes referred to as appropriation mechanisms, to prevent or at least delay imitation or exploitation. One such mechanism has been highlighted by some studies (Cohen et. al., 2000; Levin et. al., 1987) to be legal mechanisms, specifically, intellectual property rights. According to Bascavusoglu-Moreau and Tether (2011), intellectual property rights seek to promote innovation and creativity by allowing ideas to be legally protected for a specified period of time. The legal protection of innovation output delays imitation and allows enough time for appropriation. As the focus of this paper is on design protection, literature referencing this is examined before returning to the connection between intellectual property rights, performance and profitability.

## 2.2 Design

Industrial design is an important aspect in the development of new products (Hertenstein et. al., 2005) as they provide companies with the opportunity to be more noticeable than others (Kotler and Rath, 1984) through product differentiation. According to Henegahn (2015), the commercial success of many consumer products is dependent on their design because customers are first attracted to the physical form of things. Therefore, product differentiation is important, and design is important as it plays a major role in this.

Companies are able to generate benefits from their designs in various ways. Candi and Gemser (2010) divided the operationalization of industrial design (ID) into four different categories while measuring the effects between industrial design and performance. Firstly, industrial design emphasis is explained as to what extent that the industrial design is considered in their strategy of new product development (NPD) and usually is measured by, for instance, the decision making of the involvement of design at a strategic level. Secondly, industrial design capabilities describe the resources that are available for firms to utilize during innovation of new products and services, such as the number of available designers or budget for innovation. Thirdly, industrial design outcomes define the goodness of products or services and are measured by evaluations of customers or design experts and peers, which is a relatively subjective way. Lastly, industrial design management means that efficient strategies should be developed to organise all industrial design outcomes, maximising the design contribution to performance.

Candi (2010) finds that new technology-based firms paying more attention to aesthetic design (i.e. ID emphasis) in new services development have greater profit and sales growth than the firms that pay less attention to aesthetic design due to the marketing effect of aesthetic design. Similar financial success results from ID are found by Gemser and Leenders (2001) on the ID capability aspect. They suggest that ID intensity has a significant and positive effect on company performance in both furniture and industrial instrument industries but particularly, when the strategy of adding designs in products is relatively new for the industry the firm involved i.e. level design in industry environment. Platt et al. (2001) and Hertenstein et al. (2005) both explain that ID outcomes (design effectiveness), on a firm level, have

positive relation with financial performance (i.e. market return, growth, return on assets and profit margins). Both of them choose to focus on the manufacturing industry but the latter has extended the year period from 1995 to 2001(former is from 1995 to 1999) and higher number of selected sample companies (172 while Platt et al. select 51).

The interesting aspect of these two articles is that they have different conclusions towards the growth in firms even though they use similar methods and data. Platt et al. (2001) find that all three growth ratios (% changes in net sales, net income and net cash flow) are significantly and positively related to good design while Hertenstein et al. (2005) say that there is no significant relationship between good design and financial performance. This may be due to the changes in firms' design strategy or the environmental factors. A similar conclusion is also verified by Guo (2010) at the global firm level that good designs have an influence generally, and positively on firms' financial performance in different geographical segments. Specifically, he points out that designs' financial effects are different in countries and industries, which is also confirmed by Gemser and Leenders (2001) that designs in industries that are emerging have stronger financial contribution than the industries that have mature design history. In brief, all these studies suggest that design is playing a key role in a firm's financial performance.

The above-mentioned studies suggest that design has a positive association with a firm's financial performance. Hence, protecting designs is also important for not only protecting firms' own IP but also keeping their competitive advantages (Filitz et al., 2015), distinguishing themselves from peers (Heer & Kutsyna, 2019), forming a favourable firm image, and being more successful in marketing (Candi, 2010). Protection of design rights could also to some extent help with the problem of appropriation, a major issue that innovative firms face. As mentioned earlier, firms often seek protection of their intellectual property to prevent others from using it without authorization. Others are able to imitate the intellectual property (Teece, 1986) and derive benefits from it as a result. The possibility of an intellectual property being appropriated is determined by the extent and effectiveness of legal protection (Artz et. al., 2010). When there is protection such as the available protection for design, according to Teece (1986), this protection can allow the innovator to gain the returns and value of the intellectual property for an amount of time.

## 2.3 Design Protection in Sweden

Design protection in Sweden is regulated by The Design Protection Act, a part of the Swedish Code of Statutes (SFS) (1970:485) which defines a design as "the appearance of the whole or a part of a product resulting from the features of the details of the product or of the details of the ornamentation of the product, in particular as regards the lines, contours, colours, shapes, textures or materials". This regulation is on the national level. Once a design has been created, the creator is allowed to obtain exclusive rights to the designs by registering them.[4] On the national level, registration of designs is done by applying through the Swedish Patent and Registration Office (PRV, n.d.). The Swedish Patent and Registration Office (PRV) provides design protection once an application has been approved. The protection is valid for a period of 25 years[5], which is the maximum number of years it can be provided for (Design protection's validity, n.d.). Registered designs have validity for five-year periods and the creator may state how many periods are preferable or could opt for renewing the registration every five years (ibid). More than one design may be registered in each application (ibid). Design protection at only the national level may be desired if the owner is only concerned with protecting the design in one country and also concerned with differences in costs of registration at the national and international level (Filitz, et. al., 2013).

As well as being regulated on the national level, design protection in Sweden is regulated on the European level by the EU Community Designs Regulation (6/2002). This regulation defines designs in a similar manner as the Design Protection Act which can be attributed to the EU directive (98/71/EC) which provided the unified definition (Filitz et. al., 2013). Under the EU Community Designs Regulation (6/2002) there are two design protections that may be used, the registered community design and the unregistered community design[6]. An important criterion for both types of protection is that designs must be new and different from already existing products (European Commission, 2003).

Registered community designs (RCDs) correspond to national design protection earlier explained. They also afford protection for a maximum of twenty-five years with necessary

[4] Swedish Code of Statutes (SFS) (1970:485)
[5] Designs relating to spare parts have a 15 year registration validity period.
[6] Council Regulation (EC) No 6/2002 of 12 December 2001 on Community designs (OJ EC No L 3 of 5.1.2002, p. 1)

renewals every five years, exclusive use of the design and the right to seek legal action should others use the design without authorisation (ibid). Renewals are granted on the basis that the renewal fee has been paid[7].

Designs may also be registered internationally. As a member of the EU, Swedish designs qualify to be registered outside the EU using the Hague system (Hallenborg, et al. 2008). Registration is done by applying to the World Intellectual Property Organisation[8] through their Hague System. By submitting a single application, the design can be registered in multiple countries and multiple designs can be registered[9]. As such, users of the Hague System can save time and money using this quick application process (WIPO, 2019).

Owners of designs also have the option to not register their designs nationally or internationally (Filitz et. al., 2013). This is where the unregistered community designs under the EU directive can be employed. This type of protection grants the creator or owner of the design the exclusive right to the design for a period of three years beginning from the date the design was made public[10]. Being made public in this circumstance relates to the design being "published, exhibited, used in trade or otherwise disclosed in such a way that, in the normal course of business, these events could reasonably have become known to the circles specialised in the sector concerned, operating within the Community" (Article 11.2 (EC 6/2002)). The unregistered community design option is likely to be the most popular protection option in instances where the design is expected to have a short life cycle (Filitz et. al., 2013)

## 2.4 Intellectual Property and Performance and Profitability

There is a limited amount of research on relationships between design rights, firm performance and profitability. However, there is quite an amount on the link between patents and firm profitability and patents and also to some extent, trademarks. A look at such existing research forms a background for this paper, as we look to shed more light on the relationship between intellectual property and firm performance by focusing on a less explored area; design rights.

[7] see footnote 5
[8] Industrial design protection https://ec.europa.eu/growth/industry/intellectual-property/industrial-design/protection_en
[9] see footnote 7
[10] see footnote 5

Some research has been able to establish a positive relationship between patents and firm performance (Ernst, 2001; Tsai 2010; Markman et. al. 2004; Suh et. al., 2008). Software firms are an intellectual property intensive industry as they have more intangible assets than tangible, as such patenting is important for the protection of said property (Hall and MacGarvie, 2010; Mann, 2005). Patents in this industry are found to have a positive effect on the performance of firms in South Korea (Suh et. al. 2008). The patenting firms within the study showed higher average efficiency than the non-patenting firms. The realised positive relationship could relate to this as higher efficiency of these firms suggests they could be better at managing their patents in ways that guarantee them increased performance. Patents within the machine-tools industry are also associated with subsequent (accounting for time-lags) increases in sales of the German firms that have them, an indication of a positive relationship between patents and performance (Ernst, 2001). This result confirms the arguments about intellectual property and appropriation, that delay may be required for firms to capture value from their intellectual property (Cohen et. al., 2000).

The pharmaceutical industry also presents a positive relationship between patents and firm profitability as discovered in the study by Markman et. al. (2004), that patents were positively related to the net income of US pharmaceutical firms. Further on the relationship with profitability within the pharmaceutical industry, a positive relationship is empirically proven to exist with the findings that return on equity (ROE) and earnings per share (EPS) are subsequently positively affected by the impact of patents (Ken and Tsai, 2010). The pharmaceutical industry is one that can be classified as patent-intensive which explains the positive relationship. Another profitability measure, the rate of return on assets (ROA) has been positively associated with patents. Semiconductor firms with patents are seen to have a higher ROA than those firms that do not have patents (Tsai, 2010). This established a positive link between patents and profitability of Taiwanese semiconductor firms (ibid).

On the contrary, according to Artz et. al (2010), who studied firms in 35 industries, empirically showed the existence of a negative relationship between firm performance and patents. The results of their tests showed specifically that there was a negative association between patents and ROA as well as sales growth. Improper or inadequate management of

patent resources could be the reason for this negative relationship as the authors argue. Griliches et. al. (1991) look at firm performance in terms of market value, and find that for US firms, there is no evidence that their patenting activities impact their firm's market value. Others find that patent impacts are specific to certain industries. Mansfield (1986), although finding importance of patents to performance, explained that this qualified for certain industries such as chemical and pharmaceuticals.

Distinguished from patents, trademark is more like a company or brand "identity" and considered as brand-related investment i.e. brand equity (Crass et. al., 2019). With regards to profitability and performance, Crass et. al. (2019) explain that trademark registrations are brand equity that have long-run value to the firm. They especially find that the food and beverage industry has the highest percentage of annual profit attributed to brand equity when they aggregate to industry level. This conclusion can be verified in one of early related articles. Yu, Wang and Liu (2010) elaborate that trademark has a positive impact on firm's profitability and especially, the correlation becomes more significant after adding uncapitalised brand-related investment.

While literature on design rights is limited, one study looks at design rights and firm performance of UK firms. Bascavusoglu-Moreau and Tether (2011) look at UK designs that have been registered both nationally and within Europe and seek to investigate, using a matched sampling approach, whether there exists an association between design rights and business performance (p.4). The results of their study were that there was an evident performance benefit to firms that had design rights from late 1990s to 2006 but from then till 2010 they found no benefit. They find evidence that may possibly explain this being that most productive firms may have moved their design registrations to Europe (p.23). The literature presents us with conflicting empirical evidence regarding the various IPRs and firm performance and profitability.

Ernst (2001) while examining the relationship between patents and firm performance proxied by the natural log of sales, suggests that European patents are of higher quality than the national patents. Due to this, he hypothesises that European patents have a stronger impact on subsequent performance than national designs. This view is considered in the analysis within this paper by the inclusion of separate variables to represent EU and SE design rights.

Overall, the literature examined provides conflicting results on the relationship between intellectual property rights, performance and profitability. It does appear that most of the studies included here that communicate the existence of a positive relationship are focused on specific industries, while negative relationships are identified when the study is cross-sector. This suggests that a positive relationship between intellectual property and performance could be specific to certain industries such as pharmaceuticals, chemicals, software and manufacturing - industries which are IP intensive. However, the study on design protection and performance which shows a performance premium in some years, is a cross-sector analysis, providing evidence that results may not be specific to industry Although the literature presents these conclusions, this paper investigates the link between design rights, performance and profitability across multiple industries that Swedish firms belong to. The expectation of this paper is to find positive associations with these variables based on findings of the reviewed literature and the assumption that design rights can be argued in the same way as other forms of intellectual property.

# 3. Data and Methodology

## 3.1 Data Collection

In examining the relationship that exists between design rights and the financial profitability of Swedish firms that hold said rights, this research paper makes use of data on design rights held by firms in Sweden and their financial information. Thus, this paper relies on primary data that has been collected from various sources.

### 3.1.1 Financial Data

To investigate the relationship between firm profitability and design rights, this study requires data on the financial information of Swedish firms. The financial history of Swedish firms which is accessed through the Serrano database is used. The Serrano database is provided by the Swedish House of Finance using a few sources to construct it. The Swedish Companies Registration Office (Bolagsverket) is the source of all financial data while the general company data, bankruptcy information and group data are from Statistics Sweden (SCB), Swedish Companies Registration Office and Bisnodes group register respectively.

The Serrano Database includes organisation numbers, names and the corresponding financial information for each calendar year. Information about firms' legal form, industry and registration date is also included in the database. The organisation number, which is unique to the firm, enables the matching of the Serrano Database to the Swedish Design data for further analysis. The Database contains approximately 11 million observations representing the financial information of Swedish firms from the year 1998 to 2016.

### 3.1.2 Design Rights Data

Information was required on the design rights held by Swedish firms that were registered at the national level (PRV) or at the European level.

#### SE Design Data

The national design data, that is, the data on the designs registered in Sweden, was from the Swedish Design Database. The access to this database was through the Swedish Patent and Registration Office. From this database, data on design rights granted in Sweden from 1993

to 2018 was obtained. This provides approximately 6000 observations consisting of data on design rights applications by Swedish and other firms as well as individuals, the dates on which they were granted and the date on which their validity expires. The database also provided data on the design application number, registration number, the organisation number as well as organisation name.

From the SE design rights dataset, data was collected on Swedish firms only. Using this data, the number of design rights that were granted to each firm in each calendar year was calculated. Also the number of design rights each firm holds at the end of each year, was found. This was done using Excel. The resulting data was representative of 667 firms that owned design rights. In Stata, this data was matched to the Serrano Database using the organisation number and the corresponding year. Keeping the matched data provided a sample of firms owned Swedish national design rights and their corresponding financial data for the period 2003 to 2016.

**EU Design Data**

The data on European registered designs was obtained from the EUIPO Open Dataset which provides access to data on applicants, trademarks as well as designs. This EUIPO Database includes European-wide design rights applications from 2003 to 2019.

The data that could be accessed influenced the choice of the time period that the study is based on. Considering, EUIPO database provides data from the year 2003, the relationship is investigated looking at the period 2003 to 2016. It is limited to 2016 because the Serrano database provides financial history up to this period.

The data from the EUIPO Open Dataset had to first be downloaded then uploaded and finally coded in SQL to form a large database which included information on designs and the applicants. The data on designs included among others, application numbers, design identifiers, application, registration, publication and expiry dates, status code of the designs (whether they had lapsed). Data on applicants and their details was also coded into this database. As such the dataset needed for the study could be compiled. From three tables within the database (applicant table, applicant details table and design table) matches were made using application numbers and applicant identifiers. See Figure 1 in Appendix B for an

illustration of this matching. The applicant details table provided essential data on the corporations' country code, entity type, as well as organisation name. This allowed for the creation of a dataset of firms with country code 'SE' representing Swedish firms that are a 'legal entity'. The exported dataset then contained data on applicant numbers, applicant identifiers, organisation name, design identifiers and dates relating to design application, registration, publication and expiry. The dataset was based on a criterion of Swedish firms with designs registered in the period 2003 to 2016.

The same procedure used with the SE design rights is followed, that is, finding the number of design rights held by each firm at the end of each year. However, unlike the data on the SE design rights, the unique organisation number for each firm is not available. EU design rights are matched with the Serrano Database using the firm name and year. Doing a match using firm names required standardising the names because some firms had name changes in later years. It was also the case that some of the same firms were recorded differently in both datasets, for example "STARLITE AB" in EU design rights data but identified as "STARLITE AKTIEBOLAG" in the Serrano Database. Standardising the data was a time-consuming activity. After standardising, the two datasets were matched to get the financial data of the Swedish firms that owned EU design rights.

**Merge SE Design Data and EU Design Data**

Having created datasets of SE design rights and EU design rights with corresponding financial data, the two datasets are merged. This is to create the main dataset for which the analysis is based on. Specifically, this dataset contains financial and design rights data on firms that own SE designs right, EU design rights or both. The financial information required for the analysis was not available for every observation in the sample. Hence observations for which data on both return on assets and net sales per employee was unavailable in the financial data, were dropped. The data was also adjusted for outliers. Resulting from this, the final and unbalanced dataset for the analysis included 12,810 observations relating to 1,735 Swedish firms.

## 3.2 Variables

### 3.2.1 Dependent Variables

*Return on Assets*

Since one relationship being examined is the relationship between design rights and profitability, the dependent variable should be a measure of firm profitability. To measure this, the rate of return on assets (ROA) is used. The ROA measures a firm's ability to generate returns from the assets it owns (Artz el. al., 2010). The Serrano data expresses ROA as adjusted operating profit/loss after financial income/total income.

*Net Sales per employee*

For analysing the relationship between design rights and firm performance, net sales per employee is used as a proxy for measuring performance. The natural logarithm of net sales per employee is used as the dependent variable for the second regression model. Using the natural logarithm of sales per employee is a method that has been used in previous studies on firm performance (Mehran, 1995; Lemmon et. al., 2008). Studies assessing the links between intellectual property and performance have also used the natural log of net sales per employee as a measure of performance (Bascavusoglu-Moreau and Tether, 2011; OHIM, 2015). As the data on this variable is highly skewed, taking the natural log adjusts it for normality.

### 3.2.2 Independent variables

*Design Rights*

The SE design rights and EU design rights have separate variables within the study in order to assess the relationships each has with the dependent variables. The independent variables for both SE and EU design rights stock represents the stock of live design rights a Swedish firm holds. Live design rights here, refer to the design protections of Swedish firms that have not expired or been surrendered. The designs held in a previous year, year $t-1$ which are still valid in the year under consideration, year $t$ are added to get the present number of live designs, see Equations (1) and (2). A constant depreciation rate is also applied to the design stock, since design rights have a limited validity period with a maximum of 25 years.

$$SERights_{i,t} = (1 - \delta)SEdesignstock_{i,\,t-1} + SEdesigns_{i,t} \qquad (1)$$

$$EURights_{i,t} = (1 - \delta)EUdesignstock_{i,\,t-1} + EUdesigns_{i,t} \qquad (2)$$

$SEdesigns_{it}$ and $EUdesigns_{it}$ are the numbers of design rights granted in year ***t*** and ***δ*** is the constant rate of depreciation of 15%. The 15% depreciation rate has been used in previous studies when computing stock of patents (Czarnitzki and Kraft, 2010) and R&D capital stocks (Hall, 2007) and since design rights are related to research and development based on technological innovation (Filitz et al., 2015) and are a type of intellectual property like patents are, we choose to use the same depreciation rate of 15%. The motivation for using the depreciation rate of 15% lies in the fact that renewal data could not be retrieved.

A dummy variable is included to represent the interaction between owning both SE and EU design rights. It expresses the relationship between owning both designs and firm performance and profitability. The variable *BothRights* is coded 0 if only one of the two is owned, i.e. SE or EU design rights, and 1 if both are owned.

### 3.2.3 Control variables

*Size control*

The size of a firm can affect the dependent variables. Hall and Weiss (1957) in their paper on firm size and profitability, find that a higher size does usually result in higher profits for the firm. In a later study and based on evidence from US public firms, Lee (2009) has results that confirm the existence of a positive relationship between firm size and profit. Roberts (1991) on the other hand, explained that new and young firms, which initially are smaller in size, could attract more customers than older ones, which results in a rapid growth and leads to better performance. The effects of firm size on the dependent variables are controlled for by including it in the models. Total assets are used as a proxy for firm size. As with the dependent variable net sales per employee, the natural logarithm of the total assets is used in the regression model for the purpose of normality.

*Research and Development Expenditure*

Previous research finds a positive relationship between R&D expenditure and firm performance. R&D expenditure is found to be positively related to growth in sales for firms that are classified as high growth and technology-intensive (Coad and Rao, 2009). Other studies have pointed to the existence of a negative relationship. One example is a paper by Caves (1996), where a negative relationship is found to exist between R&D spending and performance for UK firms. The study was inclusive of different industries. By including R&D expenditure as a variable, the impact it may have on the dependent variables is controlled for and the relationship it may have with the dependent variables can be investigated. Also, some firms may have higher R&D expenditure depending on industry and so this is controlled for.

*Intangibles Ratio*

To calculate the Intangibles Ratio, the intangibles of each firm is divided by the corresponding total assets of the firm. The intangibles ratio tracks the size of a firm's intangible assets in relation to its total assets, measuring that proportion of total assets covered by intangibles. The inclusion of this variable is to control for the situation where some firms may have more intangible assets compared to other firms. Megna and Muller (1991) suggest that high levels of intangibles, those mostly resulting from R&D can explain this existence of differences between profitability rates among different industries. It would be interesting to see the relationship between intangibles intensity and firm profitability, another motivation for including it in the regression model.

*Year and Industry controls*

The effects that time would have on the dependent variables are taken into account by the inclusion of year dummies. As previous research has highlighted the existences of differences in results based on industry classifications (Mansfied,1986) the study controls for the effect that industry may have. The Serrano database provides classifications for the industries the firms in the dataset belong to and a dummy variable for each of the industries is included.

The data on design rights contained 12 industries; Energy and Environment (10), Materials (15), Industrial goods (20), Construction industry (22), Shopping goods (25), Convenience

goods (30) Health Education (35), Finance Real estate (40), IT and Electronics (45), Telecom & Media (50), Corporate services (60) and other (98), also SN107 missing (99). The missing classification is kept because there are companies which belong to this section that own live design rights. The proportions of each industry that make up the dataset of firms with design ownership is shown in Table 3 further down in the paper.

A summary of the variables used in the research is reported in *Table 1* below.

*Table 1: Summary of variables.*

| Types of Variables | Name of variables | Measures |
|---|---|---|
| **Dependent** | Profitability | ROA: Return on Assets |
| | Performance | SPE: Net Sales per Employee |
| **Independent** | SE/EU Design Rights Stock | SERights, EURights |
| | Both Design Rights | Interaction Variable: BothRights |
| **Control** | Firm Size | TA: Total Assets |
| | R&D Expenditure | R&D |
| | Intangibles Ratio | IntRatio: Intangibles Ratio |
| | Industry | Dummy variables : Industry Dummies |
| | Year | Dummy variables: Year Dummies |

## 3.3 Methodology

The data is analysed using two types of methodology. Descriptive statistics are used to illustrate the characteristics of Swedish firms that own design rights. Trends in the data are also examined through the use of descriptive statistics. Further, there is the examination of the classes of EU design rights that Swedish firms apply for. Design classes for SE design rights are excluded from the descriptive statistics due to the lack of information on them.

Econometrics is used to analyse the data on design rights, firm performance and profitability. The dataset is in the format of an unbalanced panel. This is because not all firms in the sample hold live design rights in all the years under consideration, that is, the period 2003 to 2016, and also all required financial data may not be available in reference to these years. Specifically, a pooled OLS regression model is estimated for the econometric analysis of the dataset using Stata. To meet the condition of normality in the data, the natural log of the variables that are highly skewed is used. There is also no multicollinearity, meaning the correlation between the independent variables are not high.

The dataset meets some of the assumptions of the pooled OLS model (Greene, 2008). However, there are problems associated with using this regression model. One such problem is the issue of heteroscedasticity. The data is tested for homoscedasticity and it is found that the dataset is heteroscedastic, meaning the variance of the error terms are different across observations within the sample. To account for this, robust standard errors are used (Hoechle, 2007). There is also the issue of endogeneity which is explained as independent variables being correlated with the error term. It is likely that some omitted independent variables may be correlated with the error term. It is, however, not possible to include all independent variables that may influence the dependent variable in the regression model.

While it is possible to use fixed-firm effects to address this issue, for many of the firms within the sample, the number of designs they have do not change over the period under analysis. Since this is the case, should a fixed effects panel regression model be used, the effect of the design rights are unlikely to be observed (Grazzi et. al., 2019). There is the possibility of them being confused with the fixed-firm effects. The pooled OLS regression model is appropriate for this study due to this. The general model for the regression is presented in Equation 3 below.

$$Y_{it} = \alpha_o + \beta_1 SERights_{i,t-1} + \beta_2 EURights_{i,t-1} + \beta_3 BothRights_{i,t-1} + X'_{it}\beta + \varepsilon_{it} \qquad (3)$$

Firms and years are denoted by $i$ and $t$ respectively. $Y_{it}$ represents the dependent variables return on assets and natural log of sales per employee. A 1-year lag is applied for the

independent variables of SE and EU design rights stock. This is in line with previous studies on various forms of intellectual property (IP) that have used the lag effect based on the conclusion that the impact or effect of the IP may not be realised in the same year in which it was registered, granted or applied for (Ernst, 2001; Artz et. al., 2010). Also design registrations are usually published six months after registration, barring any exceptions (European Commission, 2003). This information and the earlier assumption of the delayed impact are the basis of a justification for using a 1-year lag on the design rights variables. The lagged variables also help with concerns of endogeneity (Grazzi et. al., 2019). The variable *BothRights* represents the interaction of SE and EU design rights ownership and is also lagged. Control variables are represented by $X'_{it}$. Firm size (lnTA), R&D expenditure and intangibles ratio are controlled for. Industry dummy variables and year dummy variables are also included as controls. The inclusion of these specific binary variables allow for the control of the economic cycle and time-invariant industry effects. $\alpha_o$ represents the constant term and $\varepsilon_{it}$, the error term.

# 4. Results and Analysis

## 4.1 Descriptive Statistics

### Descriptive Statistics of Variables

During the research time period, 12,810 observations pertaining to 1,735 companies were collected. Outliers within the data are excluded with consideration for the biased results that may be caused by the removal of extreme values. *Table 2* below presents all the variables that are included in the regression models with the exception of the dummy variables.

*Table 2: Descriptive Statistics of all Variables*

| Variables | Observations | Mean | Min. | Max. | Std. Dev |
|---|---|---|---|---|---|
| Net Sales per Emp.[a] | 10,579* | 3,690.84 | 0 | 1,328,333 | 19,699.74 |
| ROA | 12,810 | 0.042 | -10.42 | 3.00 | 0.44 |
| SERights | 12,810 | 0.47 | 0 | 125.19 | 2.00 |
| EURights | 12,810 | 1.18 | 0 | 96.30 | 3.52 |
| Total Assets[a] | 12,810 | 1,359,710 | 2 | 293,000,000 | 10,700,000 |
| R&D Expenditure[a] | 12,806[b] | 5,774.81 | 0 | 8,373,150 | 134,057.8 |
| Intangibles Ratio | 12,810 | 0.059 | 0 | 0.996 | 0.161 |

*Notes:*n=10,579 observations of net sales per employee is lower than n=12,810 observations. This is because of missing values pertaining to this variable.*
*[a]Amounts in SEK.*
*b n=12,806 observations of R&D Expenditure is lower than n=12,810 observations. This is because of missing values pertaining to this variable.*

Both SE and EU design rights stocks are not integers, this is attributed to the application of the depreciation rate of 15% which was used in computing the design rights stock values. To examine the relationship with profitability and performance, we required data on both return on assets and net sales per employee. Our dataset excludes observations that have missing values for both these variables. However, the observations that remain, still contain missing values for net sales per employee and R&D expenditure. Due to this, the number of observations for data on net sales per employee is relatively lower than others. Only a few are missing for R&D expenditure. The second regression model which has *lnSPE* as the dependent variable, accounts for this and is run on the reduced number of observations as will show in the regression results. From the table, it can be seen that there are differences

between the minimum values and maximum values of R&D Expenditure and Intangibles Ratio. This may result from the different firm sizes, which also carries a big gap between the minimum and maximum. Suggesting that larger firms invest more in R&D as well as intangible assets.

**Yearly Means of Variables**

*Table 3* presents the means of all variables in each year, which shows how they change over time. SE design rights stock has been decreasing since 2003 while the stock of EU design rights has been increasing. Ernst (2001) mentioned in his study, the superior quality of European patents to national patents. This is a possible explanation for what is shown here. Swedish firms are registering more design rights at the European level than at the national levels over the years possibly due to the international level of protection that would be obtained.

For performance and profitability of the companies within the dataset, they reached the peak during 2004 to 2008 but started declining after that period. The results show that mean net sales per employees has doubled (comparing the 2016 mean value to that of 2003). Missing values of net sales per employee make its observation numbers different from the numbers presented for other variables in the table. Actual observation numbers relating to this variable can be found in Appendix C *Table 10*, clarifying the differences. Furthermore, the results show that the total assets are decreasing over the period. With the exception of the peak value in 2004, the results show that the mean total assets of firms within the sample shrunk by almost 40%. A possible interpretation is that there has been an increase in the number of smaller firms that have applied for design rights during this time period. It is possible that small firms are realising that intellectual property can improve their competitiveness and also be another avenue of revenue for them[11]. An overall rising trend is found in Intangibles Ratios, which could possibly be explained to be that more and more firms are realising the importance of intangible assets. However, the results show fluctuations in the R&D expenditure of firms within the sample firms over the period.

[11]https://ec.europa.eu/growth/industry/policy/intellectual-property/smes_en

*Table 3: Means of All Variables in Each Year*

| Year | OBS | OBS (%) | Net Sales per Emp.[a] | ROA | SERights | EU Rights | Total Assets[a] | R&D Expendeture[a b] | Intangibles Ratio |
|---|---|---|---|---|---|---|---|---|---|
| 2003 | 302 | 2.36 | 2,283.5 | 0.08 | 1.446 | 0.351 | 1,909,820 | 21,057.8 | 0.031 |
| 2004 | 369 | 2.88 | 2,710.5 | 0.099 | 1.237 | 0.547 | 1,918,226 | 14,956.1 | 0.038 |
| 2005 | 439 | 3.43 | 3,198.9 | 0.111 | 0.979 | 0.769 | 1,785,495 | 8,681.8 | 0.043 |
| 2006 | 499 | 3.90 | 3,470.1 | 0.111 | 0.797 | 0.935 | 1,732,938 | 4,522.1 | 0.041 |
| 2007 | 584 | 4.56 | 3,512.8 | 0.116 | 0.631 | 1.107 | 1,661,001 | 2,767.3 | 0.047 |
| 2008 | 685 | 5.35 | 3,421.9 | 0.108 | 0.547 | 1.223 | 1,568,957 | 4,732.4 | 0.049 |
| 2009 | 782 | 6.10 | 3,007.2 | 0.052 | 0.462 | 1.256 | 1,377,482 | 2,088.0 | 0.059 |
| 2010 | 859 | 6.71 | 3,262.2 | 0.043 | 0.407 | 1.234 | 1,569,237 | 3,022.5 | 0.058 |
| 2011 | 950 | 7.42 | 3,670.3 | 0.061 | 0.368 | 1.247 | 1,464,400 | 3,024.5 | 0.061 |
| 2012 | 1,108 | 8.65 | 3,536.2 | 0.027 | 0.311 | 1.301 | 1,275,930 | 12,313.1 | 0.070 |
| 2013 | 1,328 | 10.37 | 3,184.5 | 0.006 | 0.339 | 1.302 | 1,143,664 | 9,359.5 | 0.071 |
| 2014 | 1,526 | 11.91 | 3,391.4 | 0.013 | 0.332 | 1.261 | 1,107,564 | 3,616.2 | 0.065 |
| 2015 | 1,697 | 13.25 | 4,585.8 | 0.01 | 0.319 | 1.216 | 1,174,940 | 3,414.5 | 0.064 |
| 2016 | 1,682 | 13.13 | 5,089.9 | 0.016 | 0.353 | 1.272 | 1,193,283 | 3,968.8 | 0.061 |
| **Total** | **12,810** | **100** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

*Notes: [a]Amounts in SEK.*
*b Observations in 2015 and 2016 of R&D Expenditure are missing 2 respectively.*

**Distribution of Design Rights by Industry**

The industry classifications provided by the Serrano database allowed for the identification of industries that are most likely to hold live design rights. The results in *Table 4* show most of the observations relating to live stock of SE design rights relate to firms belonging to the industrial goods industry.

The shopping goods and corporate services sectors follow in that order. The same can be observed for the data on live stock EU design rights, with the industrial goods industry accounting for the highest number of observations, followed by the shopping goods industry and then corporate services. Also, the shopping goods and corporate services industries account for approximately 30% of all observations in both SE and EU design rights. The results pertaining to the industrial and shopping goods industries are not surprising, as they

are likely to be classified as manufacturing companies using a different industry classification system and this industry is seen to be IP-intensive (Pham, 2017).

*Table 4: Industry Proportion of Active Designs*

| | SE Design Rights | | EU Design Rights | |
|---|---|---|---|---|
| **Industry** | **Freq.** | **Percent (%)** | **Freq.** | **Percent (%)** |
| Energy & Environment | 53 | 0.86 | 7 | 0.08 |
| Materials | 179 | 2.90 | 224 | 2.57 |
| Industrial goods | 3,033 | 49.13 | 3,612 | 41.44 |
| Construction Industry | 108 | 1.75 | 103 | 1.18 |
| Shopping goods | 1,048 | 16.98 | 1,536 | 17.62 |
| Convenience goods | 177 | 2.87 | 355 | 4.07 |
| Health & Education | 432 | 7.00 | 718 | 8.24 |
| Finance & Real Estate | 155 | 2.51 | 262 | 3.01 |
| IT & Electronics | 152 | 2.46 | 392 | 4.50 |
| Telecom & Media | 25 | 0.40 | 32 | 0.37 |
| Corporate services | 744 | 12.05 | 1,288 | 14.78 |
| Other | 64 | 1.04 | 161 | 1.85 |
| SN107missing | 3 | 0.05 | 27 | 0.31 |
| **Total** | **6,173** | **100.00** | **8,717** | **100.00** |

*Notes: n=12,810 observations and n=1,735 firms.*

*2,080 observations have designs in both SE and EU.*

**Design classes of European Design Rights**

The earlier analyses have been based on the dataset which focuses on observations of live design stock. For this section, results and analyses are based on data relating to all European design registrations applied for by Swedish firms over the period 2003--2016. Here not only live design rights are examined. Rights that may have expired during the period are included unlike with the main dataset. All design rights applications in the period are analysed to understand and make inferences about the type of design rights Swedish firms apply for and are granted. Over the period, we find that there were 6,581 applications for EU design rights by Swedish firms. While these represent design rights, they often contain more than one design because more than one design can be covered by a single design right application[12].

[12] see footnote 8

From this data, the classes of design Swedish firms tend to apply for are identified. Table 5 shows the results.

From the table below it can be seen that of the EU design rights granted over the period 2003 to 2016 to Swedish firms, the highest number of these was within the design class of 8. Design classes 12, 14, 6, 9 and 23 are the next classes in order of highest number of applications. The class descriptions are specified in the table below. The EU design rights that were applied for by Swedish firms from 2003 to 2016, were mostly in the class of tools and hardware. This class represents 10.41% of the design rights that were applied for and granted. These results are interesting because Ernst's (2001) study on patents and subsequent performance is done in the machine-tools industry and he finds a positive association. The design classes and their descriptions are those provided by the WIPO Locarno classification[13]

*Table 5: Design classes*

| **Class description** | **Class** | **Number of Designs** | **Percentage(%)** |
|---|---|---|---|
| Tools and hardware | 8 | 685 | 10.41% |
| Means of transport or hoisting | 12 | 610 | 9.27% |
| Recording, telecommunication or data processing equipment | 14 | 557 | 8.46% |
| Furnishing | 6 | 474 | 7.20% |
| Packages and containers for the transport or handling of goods | 9 | 430 | 6.53% |
| Fluid distribution equipment, sanitary, heating, ventilation and air-conditioning equipment, solid fuel | 23 | 430 | 6.53% |

*Notes: Class descriptions correspond to Locarno classifications.*
*Numbers based only on European design data.*

The data used here also allows for the identification of subclasses that Swedish firm design rights relate to. Refer to *Tables 8 and 9* in Appendix A. The subclass 14.03 has the highest

[13] https://www.wipo.int/classifications/locarno/locpub/en/fr/

number of design rights applications, after which follows classes 12.16, 9.03, 8.08 and 32. The number of lowest design rights were for the subclasses of 26.99, 27.01, 27.04, 27.99, 28.99. The subclass of 14.03 has the description of telecommunications equipment, wireless remote control and radio amplifiers and about 4% of the design fillings from Swedish firms in the period 2003 to 2016 were in this category. Design rights applications relating to the miscellaneous classification of pharmaceuticals and cosmetic products represent the subclass of designs with the lowest applications for Swedish firms.

## 4.2 Regression results

In this part of the paper, the results of the investigation into the relationship between design rights held by Swedish firms and the profitability and performance of these firms are presented. The dependent variables are $ROA_{i,t}$ (return on assets) and $LnSPE_{i,t}$ (natural log of sales per employee), which are proxies for firm profitability and firm performance, respectively. The relationships between these two dependent variables and the explanatory variables are accessed. The regression model specification is once again presented below:

$$Y_{it} = \alpha_o + \beta_1 SERights_{i,t-1} + \beta_2 EURights_{i,t-1} + \beta_3 BothRights_{i,t-1} + X'_{it}\beta + \varepsilon_{it}$$

where *i* and *t* denote firms and years respectively. The aim of this paper is to investigate the relationship with design rights and so the interest here is in the explanatory variables $SERights_{i,t-1}$ and $EURights_{i,t-1}$ which represent the stock of design rights held by each firm *i* in year *t-1*. The results of the pooled OLS regressions are presented in Tables 6 and 7 below.

### 4.2.1 Design Rights and Firm Profitability

The results in *Table 6* are based on the dataset which consists of 12810 observations with the dependent variable $ROA_t$. The reduced number of observations that appear in columns 4, 5 and 6 are due to the use of the 1-year time lag with our independent variables, $SERights_{i,t-1}$ and $EURights_{i,t-1}$ and $BothRights_{i,t-1}$.

The results show a negative relationship between design rights and subsequent firm profitability (see columns 4, 5 and 6). This is the case for live stock of both SE and EU

design rights as all coefficients relating to these variables are significant and negative. The findings indicate that increased stock of either SE or EU design rights result in a decrease in subsequent firm profitability. Referring to the complete model in column 6, a one-unit increase in SE design rights reduces subsequent *ROA* by approximately 0.0032 units, while a one-unit increase in EU design rights results in an approximate 0.0029 unit decrease in subsequent *ROA*. The effects of these variables are quite small as can be seen from the values of the coefficients (columns 4, 5 and 6). The conclusion from these results is that neither of the design rights positively contribute to the subsequent return on assets, our proxy for profitability, of the firms within our sample. From this, it is inferred that an increase in stock of these design rights is not associated with an improvement in profitability. On the other hand, the dummy variable *BothRights* is positive and significant at the 95% confidence level. This suggests that for Swedish firms, holding both SE and EU design rights and not one or the other is associated with an increase in subsequent profitability.

The results in column 1 indicate in line with earlier research (Hall and Weiss, 1957; Lee 2009), that a positive relationship exists between firm size (natural logarithm of total assets) and firm profitability. The coefficient of firm size is positive and significant at the 99.9 percent level of confidence. It remains positive and significant at this level in all columns as more explanatory variables are added to the model. Referring specifically to column 6, the results indicate that for every 1% increase in firm size, return on assets increase by about 0.0004 units. Results in other columns (1-5) indicate the same approximate change in *ROA* resulting from increase in total assets. For R&D expenditure, the coefficient is negative and significant in only the second column. When other explanatory variables are added, significance of the coefficient is lost. Intangibles ratio is significant and negative throughout, indicating a negative relationship with the dependent variable *ROA*. A one-unit increase in the intangibles ratio is associated with an approximate 0.4 decrease in the profitability of firms within the sample.

Looking at the first two columns, it can be seen that they have a reported $R^2$ value of about 0.06. The inclusion of the intangibles ratio variable appears to increase the explanatory power of the model. The $R^2$ value increases to about 0.08 after it is added. The addition of the independent variables specific to design rights do not add much to the explanatory power.

Overall, the explanatory power of the first regression specification, which has return on assets as the dependent variable, is quite low meaning the independent variables only explain a small portion in the variation of firm profitability.

### 4.2.2 Design Rights and Firm Performance

The results of Table 7 have the natural logarithm of sales per employee as the dependent variable. The number of observations here are lower due to some missing values for sale per employee in the data. The use of a 1-year lag further reduces the number of observations used in the regression analysis. The results in Table 7 are indicative of a positive relationship between design rights and subsequent firm performance.

For EU design rights, the coefficients in both columns 5 and 6 are positive and significant at the 99% confidence level. This suggests that an increase in stock of EU design rights positively contributes to the subsequent performance of firms within the sample. SE design rights are also shown to have a positive relationship with subsequent net sales per employee as can be seen in columns 4, 5 and 6 of Table 7 below. The results of the full model in column 6 show that for every one-unit increase in live stock of EU design rights subsequent performance is increased by 1.06%. For SE design rights, a one-unit increase results in a 1.7% increase in subsequent performance. However, the coefficient of this explanatory variable is not significant so it cannot be said, based on the results that a definite positive relationship is found within this study. Surprisingly, the dummy variable *BothRights*, is negative and significant, suggesting that owning both design rights is associated with lower subsequent performance. Specifically, owning both designs in year t-1 is related to 11.3% lower performance in year t.

As with the regression results in Table 6, the results in Table 7 show that the natural logarithm of total assets is positive and significantly related to the natural logarithm of sales per employee. An increase in firm size positively contributes to the performance of firms within this sample. The results indicate that for every 1% increase in firm size, this is an approximate 0.2% increase in performance (columns 1 to 6). R&D expenditure is negative and significantly related to performance when it is first included in the model. Subsequently adding the other control and explanatory variables, changes the coefficient to positive and

significant. Significance is lost in the final model which includes all independent and control variables. Generally, it appears that increased R&D expenditure results in higher firm performance. Intangibles ratio is significant and negative throughout, indicating a negative relationship with the dependent variable *lnSPE*. The same significant and negative relationship was found to exist with the dependent variable *ROA*.

In this regression estimation where the natural log of sales per employee is the dependent variable, the $R^2$ values in all columns are higher than they were with the first regression which assessed the relationship with profitability. A likely explanation for this is that firm size explains more of the variation in net sales per employee than it does for return on assets.

*Table 6: Regression Results: Dependent Variable, ROA*

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | $ROA_t$ | $ROA_t$ | $ROA_t$ | $ROA_t$ | $ROA_t$ | $ROA_t$ |
| $lnTA_t$ | 0.0363*** | 0.0366*** | 0.0351*** | 0.0348*** | 0.0357*** | 0.0354*** |
| | (12.67) | (12.7) | (12.08) | (10.58) | (10.25) | (10.14) |
| $R\&D_t$ | | -6.87e-08** | -3.08e-08 | -2.19e-08 | -1.93e-08 | -1.85e-08 |
| | | (-2.87) | (-1.36) | (-0.96) | (-0.89) | (-0.86) |
| Intangibles $Ratio_t$ | | | -0.388*** | -0.408*** | -0.406*** | -0.404*** |
| | | | (-15.24) | (-14.63) | (-14.50) | (-14.45) |
| $SERights_{t-1}$ | | | | -0.00316** | -0.00255* | -0.00316** |
| | | | | (-2.93) | (-2.38) | (-3.05) |
| $EURights_{t-1}$ | | | | | -0.00252* | -0.00288** |
| | | | | | (-2.51) | (-2.84) |
| $BothRights_{t-1}$ | | | | | | 0.0159* |
| | | | | | | (1.99) |
| Industry Dummies | YES | YES | YES | YES | YES | YES |
| Year Dummies | YES | YES | YES | YES | YES | YES |
| Constant | -0.320*** | -0.322*** | -0.310*** | -0.270*** | -0.284*** | -0.279*** |
| | (-7.30) | (-7.34) | (-7.07) | (-5.59) | (-5.59) | (-5.47) |
| N | 12810 | 12806 | 12806 | 11061 | 11061 | 11061 |
| $R^2$ | 0.0629 | 0.0633 | 0.0824 | 0.0839 | 0.0842 | 0.0844 |

*Notes: Robust standard errors in parentheses.*
** p<0.05, ** p<0.01, *** p<0.001*
*Year dummies variables and industry dummies are included in all models.*

*Table 7: Regression Results: Dependent Variable, lnSPE*

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | $lnSPE_t$ | $lnSPE_t$ | $lnSPE_t$ | $lnSPE_t$ | $lnSPE_t$ | $lnSPE_t$ |
| $lnTA_t$ | 0.203*** | 0.203*** | 0.203*** | 0.196*** | 0.193*** | 0.195*** |
| | (41.39) | (41.25) | (39.69) | (37.98) | (35.97) | (35.92) |
| $R\&D_t$ | | -8.32e-08** | 6.84e-08* | 6.78e-08* | 6.03e-08* | 5.33E-08 |
| | | (-2.74) | (2.38) | (2.49) | (1.98) | (1.67) |
| Intangibles $Ratio_t$ | | | -1.651*** | -1.458*** | -1.466*** | -1.473*** |
| | | | (-11.03) | (-9.40) | (-9.48) | (-9.53) |
| $SERights_{t-1}$ | | | | 0.0149 | 0.013 | 0.017 |
| | | | | (1.41) | (1.23) | (1.56) |
| $EURights_{t-1}$ | | | | | 0.00804** | 0.0106** |
| | | | | | (2.59) | (3.29) |
| $BothRights_{t-1}$ | | | | | | -0.113*** |
| | | | | | | (-4.86) |
| Industry Dummies | YES | YES | YES | YES | YES | YES |
| Year Dummies | YES | YES | YES | YES | YES | YES |
| Constant | 5.881*** | 5.877*** | 5.866*** | 6.056*** | 6.108*** | 6.064*** |
| | (37.06) | (37.03) | (36.74) | (36.81) | (36.79) | (36.39) |
| N | 10424 | 10421 | 10421 | 9082 | 9082 | 9082 |
| $R^2$ | 0.2622 | 0.2622 | 0.2965 | 0.2899 | 0.2905 | 0.2920 |

*Notes: Robust standard errors in parentheses.*
** p<0.05, ** p<0.01, *** p<0.001*
*Year dummies variables and industry dummies are included in all models.*

## 4.3 Discussion

This study looked at the relationship between design rights, performance and profitability of Swedish firms in terms of net sales per employee and return on assets. The focus was on stock of live design rights and estimated these stocks by considering a depreciation rate of 15%. For the analysis a dataset was created which contained information on financial history and stock of live EU and SE design rights of Swedish firms. The sample consisted of 1,735 Swedish firms and 12,810 observations relating to the time period 2003-2016. All of these firms had live stock of design rights within the period.

The results provide new information on the relationship between design rights held by Swedish firms and their performance and profitability. Separate regression for the two dependent variables (*ROA* and *lnSPE*) we ran. The relationship between subsequent firm performance and design rights is found to be significantly positive for EU design rights, indicating that an increase in stock of said design rights contribute to the performance of Swedish firms. Hence the more designs that firms register at the European level in one period, the better they perform in terms of sales per employee, in the next period. The results showing the positive association are in line with the research on UK firms done by Bascavusoglu-Moreau and Tether (2011) who find a positive performance difference between firms that own live stock of design rights and firms that do not. Possible explanations for these results can be gained from economic theory. Intellectual property rights provide an incentive for innovation through the legal protection that is offered to firms. This way, through the use of design rights, firms are able to exclude competitors (OHIM, 2015) and hence have competitive advantages over opportunities presented in the markets they operate in which could lead to higher revenue. Also, design rights delay imitation by competitors enough for the firms to generate benefits to their revenues.

However, the results also show that the relationship between subsequent firm profitability and stock of design rights is negative and significant for both EU and SE design rights. There was the expectation of a positive association between these factors. This expectation was based on the results of literature pertaining to intellectual property, especially patents and firm performance and profitability. Research suggests that patents are positively associated

with performance and profitability (Ernst, 2001; Markman, 2004; Ken and Tsai, 2010; Tsai, 2010). The negative relationship found is interesting. Due to the lack of research in the area of design rights and firm profitability, it cannot be said that these results are in line with any previous research in the field. The results possibly point to the costly process related to creating and defending intellectual property, so while it may positively impact sales it is possible that the costs associated with it negatively impact returns. It could be that a positive association with profitability is specific to IP-intensive industries and this study is cross-industry and as such that relationship may be missed. It is also possible that a one year lag is not sufficient in assessing the relationship with subsequent profitability. Given that design registrations are publicized six months after registration, it could be that a positive contribution to returns may not be realised until much later. The results motivate the question of why firms may choose to have their design protected if there appears to be no immediate benefit to profitability, but consideration of lag periods provides that answer, that they may be considering longer-term profitability in seeking design protection. Artz et. al. (2010), in their study on patents and performance found a similar negative relationship between patents and return on assets. They consider the possibility that patenting causes managers to underestimate competition and as such ignore skills needed to compete (ibid). Given the positive relationship between design rights and net sales per employee, this conclusion does not tie in with the results of this study. The cost explanation as well as the conclusion on lag periods may be the most plausible reason for the results.

Further a positive relationship is found between firm size and both dependent variables. This confirms the findings in corporate finance research on the links between firm size and performance (Lee, 2009; Pervan and Višić, 2012;). The findings can be explained to be as a result of the theory that larger firms have more market power and as such, are able to set higher prices and earn more income and profits. Also, the economies of scale that large firms benefit from provide them with better bargaining power (Jónsson, 2007) which positively influence their performance.

The negative association found between R&D expenditure and profitability is interesting although not surprising. While it may be expected to see a positive relationship with

profitability as is sometimes the case, heavy spending on R&D may not always prove profitable if the results of that effort are not successful. It is also possible that a lag needs to be recognised when assessing the relationship between R&D expenditure and profitability. This is because large R&D expenditure may not always yield positive returns immediately and R&D period may take years. The costs could be so high in the year that the expenditure is incurred that they negatively affect returns. As explained by Lev and Aboody (2001), investments in R&D usually generate returns with a time lag. This is also the view of Busru and Shanmugasundaram (2017) who find that R&D expenditure negatively impacts profitability but subsequent profitability is positively affected when time lags are taken. On the other hand, a positive relationship is found in general for R&D and firm performance. An early study by Morbey and Reithner (1990) showed that R&D per employee was positively associated with sales per employee but not return on assets. This suggests that R&D expenditure may result in immediate successful projects that a firm is able to generate sales from, but the associated costs do not facilitate the immediate generation of profits.

The negative relationships that the results show for the intangibles ratio is somewhat surprising. Seeing as the design rights are positively associated with performance at least, it would have been interesting to see that this variable also has the same positive association as previous studies have shown (Gamayuni, 2015; Zhang, 2017). It should be noted that these studies were focused on specific industries. There are possible explanations for the results of the regression. For one, the potential for measurement error must be recognised, as there are various ways of computing intangibles ratio. Amadieu and Viviani (2010), who identify a negative relationship with intangibles and performance suggest a risk factor motivation for intangibles investment. They explain that although investments in intangible assets negatively impact performance, these assets may mitigate risk issues related to cash flow stability, making them worthwhile. Lastly, the impact of intangible assets may not be realised in the short term.

# 5. Conclusion

The results indicate that design rights are negatively related to the subsequent profitability of Swedish firms. This is the case for both European design rights and Swedish national design rights that present negative and significant coefficients in the regression results. It is also shown that design rights are positively related to performance, although they are only significant for EU design rights. This paper provides contributions to design protection research which is an area that has not been explored enough. From a practical point of view, the empirical results inform firms that investments in design rights have some positive although small contributions to performance in terms of sales. Though a positive relationship is not seen with a one year lag effect on profitability, which may infer that more lag periods are needed for the effect of design rights to show with profitability. This provides a possible conclusion that design protections are beneficial to the performance of firms but benefits to profitability may only manifest later on. It also suggests that firms need to be cautious with their expectations from design protection. They offer some value in protecting design assets of companies from competitors, but may not always provide significant positive returns. Firms should not always be expectant of short term benefits to profitability from design protection. The negative associations seen suggest that firms could benefit from assessing their management of design rights. The conclusions raised here need to be understood while considering the limitations of the research.

## 5.1 Limitations of the study

The results are not sufficient to form a conclusion that owning registered design rights has the effect of causing better or worse firm performance. Holding registered design rights could possibly have direct effects on firms' performance but the results here should be understood more carefully. Only an association between these factors of interest is explained. The study is also limited by the assumption of the 15% depreciation rate in calculating our design stock. This rate is used because of unavailability of renewal data. While this rate is commonly used in this area of research, making it comparable, it still must be acknowledged that it is a possibly flawed assumption. Hall (2007) finds that different approaches to estimating depreciation rates show differing rates depending on the period. Li and Hall (2018) explain

from their findings that depreciation rates vary with industries and are generally higher than the 15 percent that is usually assumed.

The results in this paper were developed on a firm level but it is hard to tell or observe the differences among firms only by financial data. Better performance or profitability measurements may also result from their efficient management systems on designs, innovation or their businesses as a whole (Bascavusoglu-Moreau and Tether, 2011), which could be explained by the lower $R^2$ in the regression results of the first model. There are explanatory variables not included in our study that are likely to have effects on performance and profitability. Given availability of other data-financial or non-financial-relating to firms that hold design rights, including them as explanatory variables could help with studying the differences among the firms and finding out the main drivers of their performance and profitability.

In addition, the industry sector is treated as a control variable in this paper and we do not give more detailed classification on it or develop any relative hypotheses. As such, information on the influence that design rights have on the performance and profitability of firms within different industries is not obtained. Mansfied (1986) mentions that different industry classifications may give different results. It is possible that design rights held by firms within the sectors of industrial goods and shopping goods, as well as the other industries, would have different relationships with their profitability and performance.

## 5.2 Further Research

Considering research on design protection is not as extensive as with other intellectual property, there is a lot of opportunity for further studies. For one, the incorporation of renewal data in the calculation of design stocks is an initiative that could be undertaken, given the availability of data on the subject. Extended research on the topic of design protection may also include the use of more lag periods as Ernst (2001) does in his study on patents and subsequent firm performance. Accounting for other forms of intangible capital, as well as using other indicators of performance and profitability could also provide valuable insights on the role design rights play with firm performance. Further research can be done to

compare profitability and performance of Swedish firms that own design rights to those that do not. This would provide even more interesting insight on the relationship here as results could show the presence of performance premiums associated with owning design rights. Another suggestion for future studies is the addition of other explanatory variables to assess the relationship depending on availability of data such as design use and management because it could be argued that firms that seek out design protection more are those that are intensive in its use and management.

## Appendix A

In section 4 of this paper, the classes that Swedish firms register designs in are discussed. Tables 8 and 9 below, provide some extended information on what is presented on design subclasses.

*Table 8: Design Subclasses*

| Class | Number of Designs | Percentage(%) |
|---|---|---|
| 14.03 | 263 | 4.00% |
| 12.16 | 259 | 3.94% |
| 9.03 | 220 | 3.34% |
| 8.08 | 199 | 3.02% |
| 32 | 153 | 2.32% |
| 26.99 | 1 | 0.02% |
| 27.01 | 1 | 0.02% |
| 27.04 | 1 | 0.02% |
| 27.99 | 1 | 0.02% |
| 28.99 | 1 | 0.02% |

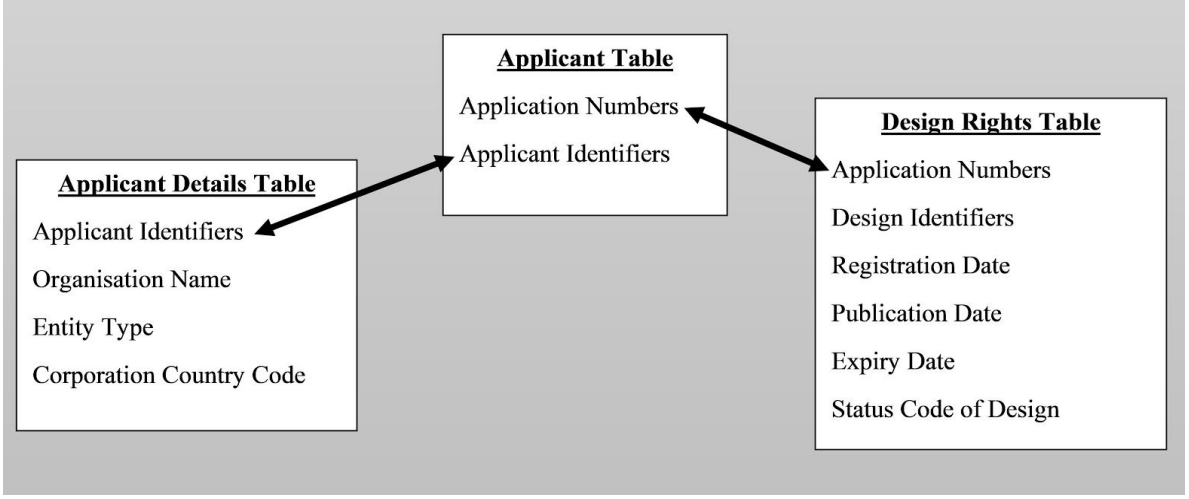
*Table 9: Subclass Descriptions*

| Class | Class Description | Class | Class Description |
|---|---|---|---|
| 14.03 | Telecommunications equipment, wireless remote controls and radio amplifiers | 26.99 | Lighting apparatus miscellaneous |
| 12.16 | Parts, equipment and accessories for vehicles, not included in other classes or subclasses | 27.01 | Tobacco, cigars and cigarettes |
| 9.03 | Boxes, cases, containers, (preserve) tins or cans | 27.04 | Matches |
| 8.08 | Fastening, supporting or mounting devices not included in other classes | 27.99 | MISCELLANEOUS: Tobacco and smokers' supplies |
| 32 | Graphic symbols and logos, surface patterns, ornamentation | 28.99 | MISCELLANEOUS: Pharmaceutical and cosmetic products |

## Appendix B

Section 3.1.2 of this paper presents the extraction of the EU design rights data from the EUIPO database. Figure 1 below is a representation of how the matching of relevant tables was done.

*Figure 1: EUIPO Database matching*



## Appendix C

In section 4.1 the yearly mean values of each variable is presented. Due to the missing values of net sales per employee, the observations of each year are different from other variables, which means that it cannot be presented with other variables together in the table and the observation numbers and percentages differ for net sales per employee. Here are the actual observation numbers and percentages for Net Sales per Employee in each year.

*Table 10: Yearly Means of Net Sales of Employee*

| Year | OBS | OBS (%) |
|---|---|---|
| 2003 | 269 | 2.54% |
| 2004 | 328 | 3.1% |
| 2005 | 387 | 3.66% |
| 2006 | 438 | 4.14% |
| 2007 | 503 | 4.76% |
| 2008 | 586 | 5.54% |
| 2009 | 665 | 6.29% |
| 2010 | 730 | 6.9% |
| 2011 | 796 | 7.52% |
| 2012 | 901 | 8.52% |
| 2013 | 1,070 | 10.11% |
| 2014 | 1,228 | 11.61% |
| 2015 | 1,348 | 12.74% |
| 2016 | 1,330 | 12.57% |
| **Total** | **10,579** | **100%** |

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