Value Relevance of Accounting Information: Platform Businesses

Master Thesis Accounting, Auditing and Control

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Abstract

This thesis examines the value relevance of accounting information concerning platform businesses using the CART analysis method. The value relevance of platform businesses is compared with the value relevance of non-platform firms. Examination results show that the value relevance increases for both types of firms. Also, the dominant accounting amount does not differ, as the gross profit seem to be the most value relevant accounting amount. The results however, does show several differences between the two types of firms. This is mostly related to the R&D expenses, where for non-platform firms, the accounting amount seem to be not value relevant at all.

Keywords: Value relevance, CART, platform firms, platform business, platform organization, accounting, accounting information

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1. Introduction

1.1 Social Relevance

The rise of platform-based companies such as Uber, Facebook and Airbnb, brought us to a so-called 'platform economy' (Hamari, Sjöklint, & Ukkonen, 2015), in which one could share goods and services through various platforms. According to the Forbes list of 2019, the top five most valuable brands contain of platform-based business models. This makes it interesting to question what the drivers are, leading to such high values. The popularity of the platform economy started to rise during the period of 2007-2008. The financial crisis left people in difficult financial situations. But for the sharing economy, it was the start of new opportunities (Görög, 2018). Due to the changing economy, people were also ready to change their behavior. Not only were they ready to change their consumption pattern. Many of them were jobless and therefore open to new job opportunities. This is where organizations started to create social networks and electronic markets. Internet and mobile apps were crucial for these organizations to develop. Also, technology developments seem to increase the number of companies with a platform business model. An example for a well-known listed platform company is: Twitter. The Nasdaq market activity analysis reveals an increasing trend in Twitter's share price over the period 2016-2020. This raises the question: what drives these share prices? Hence, increasing share price values will often lead to more new platform firms entering the stock market. Therefore, it is important to question whether financial accounting provides value relevant information for platform organizations. Accounting information is used to make decisions by insiders and outsiders such as a company's management and it's (possible) investors. Accordingly, it is important for this information to be able to capture firm's value. As the economy is constantly changing, it is essential to investigate the changes in the value relevance of accounting information. The goal of value relevance studies is to examine the association between stock prices and accounting information. In this specific paper, the focus will be on the association between stock prices and financial accounting information of platform organizations. The obtained results in this paper are highly relevant for investors as they are one of the main users of accounting information.

1.2 Scientific Relevance

Prior research discussed the value relevance of accounting information in many different perspectives. Back in the 1960s, there was already a discussion going on about the

value relevance of accounting information. Ball and Brown (1968) reacted to this discussion by examining the usefulness of this information and they provided evidence by showing that the market does react to earnings announcements. After this, value relevance has been a popular topic in papers. However, there is still not much evidence about the value relevance for platform-based firms. In the 2000s, value relevance started to become a discussion topic again. This time because of the upcoming 'internet firms'. Davis (2002) examined the value relevance of these firms and again concluded on a positive association between earnings announcements and stock prices. Value relevance is often measured as the adjusted R-squared of an OLS regression. In 2017, Barth, Li, & McClure address the evolution of value relevance of accounting information and provide evidence of an increase in value relevance. Instead of using the OLS method, they choose for a non-parametric approach: the use of CART. The authors concluded that the value relevance of financial information did not decrease over time. In fact, accounting amounts tend to be more value relevant than before, regarding book value of equity, intangible assets, growth opportunities and alternative performance measurements. The only component that seem to be less value relevant are earnings. Later on, this has also been examined and concluded by the research of He, Tan, & Wong (2018). Conducted research also found a decline in the relation between revenues and expenses due to the changing economy (Donelson, Jennings, & McInnis, 2011). This decline is mainly a consequence of a steady increase in the frequency of special items in which the authors claim, are due to changes in specific economic activities that lead to an increase in special items and the changes in accounting regulations that require to report more on special items. On the whole, further evidence on value relevance of accounting information specifically for platform businesses are relevant to create a better understanding of accounting information in the sharing economy.

1.3 Research Question

Various studies have identified a decrease or change in the relevance of accounting information for investors (Dontoh, Radhakrishnan, & Ronen, 2004; Lev & Gu, 2016), while others show the opposite and reveal that the relevance of individual accounting amounts are just shifting (Core, Guay, & Buskirk, 2003; Barth, Li, & McClure, 2018). Given that there has been much talk about platform firms, the purpose of this thesis is to examine whether the relevance of accounting amounts differ for platforms, compared to linear firms during the period 2008-2019. Therefore, the main question is stated as:

"Is there evidence that the ability of accounting information to capture firm's value differ for platform firms in relation to linear firms during the period 2008-2019?"

More specifically, this thesis considers the value relevance of accounting information by including amounts that are possibly representing firm's value, such as intangible assets and other special items. Comparatively as Barth, Li & McClure (2017), this paper also uses the classification and regression trees (CART) method. The remainder of this thesis proceeds as follows: chapter 2 focuses on the definition of a platform firm and how the characteristics of such firms impact the value relevance of accounting amounts. Chapter 3 describes the data and sample selection. The methodology is explained in chapter 4 and in chapter 5 are the findings presented. The conclusion and discussion are presented in chapter 6.

2. Theoretical Framework

2.1 Definition of a Platform Business

Technological developments make it possible for people to collaborate through platforms. The technological affordance of platforms enhances the scope of a platform. This concept concerns the possibilities for an individual or for organizations within a technology system (Majchrzak & Markus, 2012). Kumar, Lahiri, & Dogan (2018) state that the preference of freedom and independence nowadays, contributes to the success of platform businesses in the platform economy. Additionally, the platform economy makes it possible for micro entrepreneurs to act with a fraction of risk, regarding to traditional entrepreneurs. In general, prior literature defines platform businesses as a business model with an open collaboration or "ecosystem" (Jacobides, Cennamo, & Gawer, 2018). This definition refers to the interaction between different groups of users which makes them dependent on each other's activities. These platform systems are also called "multi-sided" platforms (Hagiu & Wright, 2015). It has the goal to match buyers and sellers through these platform network systems and therefore exchange values (Zhao, von Delft, Morgan-Thomas, & Buck, 2019). This is the main difference between linear businesses and platform firms. Platform businesses do not take ownership of products, but on resources. These resources can be used for product service systems (e.g. Uber), redistribution of pre-owned products or intangible assets (e.g. Lendingclub) (Botsman & Rogers, 2010). It is important for these platforms to create generativity, because the positive impact of generativity will lead to a spillover effect (Cennamo & Santaló, 2019). The ability for different groups of users to generate or produce, reinforces positive expectations about the user satisfaction. Therefore, others will have the incentive to participate in this ecosystem. This

might be both as a buyer or seller. The extent of the spillover effects is dependent on the complements of the platform and whether they create value for consumers and producers.

2.2 Platform Characteristics

Looking at the 2020 Forbes' list of most valuable brands, it is clear to say that several platform firms are performing at a certain level of market dominance. An important characteristic that can be linked is: the indirect network effect (Gawer & Cusumano, 2013; Parker & Van Alstyne, 2005; Evans & Gawer, 2016). Network effects can be direct or indirect. Direct networks are present when individual utility increases if total number of users increases (Clements, 2004). Indirect network effects are more applicable for platform firms and show an increase in utility for all groups that are involved, for example for both the buyers and sellers group. With the indirect network effects, platforms could emerge into dominant businesses and create competitive advantage (Eisenmann, Parker, & Van Alstyne, 2011). Individuals on the supply-side, also called "complementors" are more willing to join a dominant platform because of the large user base (McIntyre & Srinivasan, 2016). Eventually, this might result in a winner-takes-all outcome, where generally initial platforms become the winner (Eisenmann, 2006). Network effects can be beneficial but might also be bounded to national borders (Stallkamp & Schotter, 2019). For example, platforms for job seekers tend to match job seekers with employers in the same country. Also on crowdfunding platforms people tend to connect with others that are in the same cultural group, this is related to the home bias that some people are sensitive for. Moreover, borders might arise on an even smaller level. This mostly relates to platforms that are highly independent on the location, for example food delivery (e.g. Just Eat) or transportation (e.g. Uber) platforms. So, network effects are advantageous but can also be constrained for several platform firms.

Another important characteristic are economies of scope or scale. The more consumers prefer product variety, the more the pricing structure shifts towards making larger profits on producers (Hagiu, 2009). More product variety means less competition between the producers and therefore gain added wealth. Then, most platforms will integrate this added wealth this into their pricing structure. Conversely, consumers can also choose to use multiple platforms for the same product or service, this is called "multi-homing" (Corts & Lederman, 2009). This phenomenon limits both the network effects and economies of scope or scale. When consumers have the possibility to multi-home, competition between platforms will be more intense (Rochet & Tirole, 2003). Consequently, platforms will seek for more producers to attract. Yet, it is not always practical and desirable for consumers to multi-home. So in contrast to multi-homing,

the platform could ask the producers for an entry price to gain access to the exclusive consumer base that choose to single-home (Armstrong, 2006). Overall, network effects and economies of scope or scale could empower platform firms and lead them to a winner-takes-all outcome.

2.3 Accounting Amounts

The accounting amounts are selected from the papers of Barth, Li and McClure (2018). However, the relevance of every accounting amount will be motivated in the following subsections regarding the characteristics of a platform firm.

2.3.1 Earnings and Book Value of Equity

In the paper of Barth, Li and McClure (2018), the authors conclude on a decline in value relevance of earnings, whereas the value relevance of book value of equity increases. For the 'new economy' firms, the decline of earnings is even more pronounced. The shift in relevance from earnings to book value of equity has been explained as a result of the changes in the economy as technology becoming more important (Collins, Maydew & Weiss, 1997). Considering technology as the enabler for the existence of platforms, a decline (increase) in the value relevance of earnings (book value of equity) is also expected in this paper.

2.3.2 Intangible Assets

The next important accounting amount to examine is the intangible asset. Brand is one of the components that can impact the value relevance. Capitalization of brands increase owners' equity, because the amounts that are capitalized should otherwise be classified as expenses and therefore lower the owners' equity (Kallapur & Kwan, 2004). According to Aaker and Jacobson (2001), the value relevance of brand equity is reported to be even greater for high-technology firms. As platform businesses are highly dependent on technology, value relevance of brand equity is expected to be higher than other accounting amounts. Another aspect to consider is intellectual property. The (technological) design and functionalities are what will make platforms unique (Gawer & Cusumano, 2015). It can make platforms successful and even lead them to a platform leadership. Intellectual property has a direct and indirect link to value relevance (Abhayawansa, Aleksanyan, & Cuganesan, 2018). It has an indirect effect through the gained or lost competitive advantage. Overall, intangible assets are expected to be value relevant for platform firms.

2.3.3 Operating Cashflow

According to Barth, Li and McClure (2018), cash flows are more persistent than earnings and therefore also more value relevant. However, for organizations with extreme cash flows and moderate earnings, Mostafa (2016) shows a decrease in the value relevance of cash

flows. This is firm-specific and not generalized for industries, so for this paper, cash flows are expected to be value relevant.

2.3.4 Special Items

In contrast to operating cash flows, special items are less persistent. Donelson, Jennings, and McInnis (2011) declare that the value relevance in special items increase, because of the changing economy. Hence, as the expectation is to conclude on special items to be value relevant.

2.3.5 Revenues

According to Davis (2002), revenues are highly relevant for internet firms and provide incremental information to earnings. Although internet- and platform firms are not exactly similar too each other, they do share some characteristics.

2.3.6 Capital Expenditures

Capital expenditures are reflections of investments in tangible assets (Barth, Li & McClure, 2018). As already mentioned in section 2.2.2, platform firms are expected to be more focused on intangible assets and therefore capital expenditure should be less value relevant.

2.3.7 Cost of Goods Sold

Following Barth, Li and McClure (2018) costs of goods sold are also an important accounting amount as it implies the gross margin of an organization. The results show an increase in value relevance of costs of goods sold in the new economy.

2.3.8 R&D expenses

Barth, Li and McClure (2018) also examined research and development (R&D) expense. The results indicate an increase in the value relevance of R&D, especially within the new economy. According to Saunila and Ukko (2014), R&D expenses are beneficial for organizations in the long-term. R&D expenses made now are expected to increase future profits. For digital companies, these expenses are even more significant than for physical product companies (Govindarajan, Rajgopal, Srivastava, & Enache, 2019). Digital firms invest in R&D components such as engineering employees, product management and information technology. The focus for these firms to maintain growth is by creating scientific power. Whereas for physical product companies, the focus is around financial capital. Therefore, scientific talent can be stated essential for digital firms. As a matter of fact, R&D expenses are necessary for digital firms to survive. For platforms to connect several user groups, it is crucial to have the right capacity to do so. Secondly, they have to make sure they compute with customers' needs. When the needs are continuously changing, platforms have to evolve to meet those customers' needs. Next, since the interaction between user groups are mainly digital, data protection and

security is a big focus point for the integrity of the platform system. To summarize, platform firms are spending considerable amounts on R&D expenses to make sure the platform is continuously operating and growing. Therefore, it is expected for the R&D expenses to be value relevant.

2.3.9 Gross profit

Gross profit is a new variable that has not been added in any examination of value relevance. This paper includes this specific variable, because of the importance to platform organizations. As have been explained earlier, network effects are a key characteristic of platform organizations. These network effects are linked to low additional costs per extra user or customer. Resulting in a possible winner takes all outcome. Therefore, it can be expected that gross profit, which indirectly represents revenues and cost of sales, will result in a value relevant accounting amount. A platform business generates revenue by providing services through their own platform. Cost of sales for platform firms can therefore be defined as costs that are directly related to the development of the platform. This could be for example design costs, personnel expenses of the platform developers or software costs. Regarding traditional firms, cost of sales are mostly defined as cost of goods sold, representing the value of the purchased goods they have sold. This is the case for manufacturers as well for firms selling finished products. The revenues and cost of sales / cost of goods sold accounting factors are also included in the examination, however it is not stated that the result of gross profit will be equivalent to the value relevance of revenues minus cost of goods sold. Therefore, it is expected for the gross profit to be even more value relevant than the cost of goods sold and revenue.

The paper of Barth, Li and McClure (2018) combined with additional prior literature, led us to the following assumption: earnings and capital expenditures are expected to be less value relevant related to other accounting amounts especially intangible assets and R&D expenses.

3. Data and Sample Selection

3.1 Data selection

The first step regarding the data, is the collection of platform firms. Platform businesses operate in many different industries. Therefore, it is not possible to search within a database with a specific code such as the SIC-code. To identify these platform firms, certain criteria have been set. First of all, the main goal of the firm's business model should be to interact between

two or more groups. The platform acts as a (virtual) meeting place for these groups to connect (Banker, 2016). Secondly, the business model involves network effects, where the value of the service becomes proportional more valuable when the number of users rises. It gives platform firms the advantage to achieve economies of scale. Thirdly, the firms do not own their inventory (Moazed, 2020). While linear businesses are focusing on what they own and therefore create value through (re)selling the goods and services, the focus point for platform firms is not what they own, but about building a network. These three criteria are used to identify platform businesses. In addition, two more criteria have been included to match the accounting amounts and share prices. For a platform firm to include, it should be identified as an US firm, as the database that is used to obtain the accounting amounts only provides information of US firms. Next, as the purpose of this paper is to measure value relevance of accounting amounts, in terms of stock prices, all firms should be listed. After the criteria establishment, the search for platform businesses actually started. The manual search for platform firms started at several websites such as: Forbes, Deloitte and CNBC. From here, the following firms could be identified as a platform: Amazon, Facebook, Alibaba, Indeed, Google and Salesforce. The website of tech consulting firm Applico has also been used to identify other platform firms such as: Uber, Linkedin, Twitter, Snapchat, Etsy and Dropbox. Subsequently, additional platform firms have been identified by examining the main competitors. For example, a competitor of Uber that have been identified is Lyft. Based on the five criteria that are mentioned earlier, the decision is made on whether to incorporate the firm in the sample or not. The explanation below will give examples of several types of platform organizations that I have identified while searching and analyzing the firms.

A good example and well-known platform firm is "Uber". Uber as an organization, provides the possibility of suppliers to connect with customers. Uber started originally as a platform to connect drivers with (possible) customers. Nowadays Uber also operates in the food delivery industry and therefore connects restaurants with customers. The main business of Uber is clearly to connect two or more groups and therefore includes in the data as a platform organization. Starting with Uber, I have also been able to include their main competitor Lyft. Another famous platform that is not operating in the service industry but operates in the product industry is "Amazon". Amazon is specialized in connecting buyers and suppliers of products. All products on the platform are not owned by Amazon itself, the platform only facilitates the suppliers to sell their products through the platform. The same holds for organizations that are almost similar to Amazon, for example: Etsy and Ebay. Another common platform firm is Twitter. As a social networking platform, the objective is to connect people with each other all

over the world. Again, like other platform organizations Twitter only provides the platform for people to connect with each other. The indirect network effect can be explained for Twitter, due to the benefits and so the importance of the amount of people that are using Twitter. It will be only relevant for someone to use Twitter, when there are enough people in their surroundings that are Twitter users as well. The same holds for other social networking and communication platforms such as Facebook, Snapchat and Whatsapp. Almost similar to social networking platforms are the content platforms. Youtube is one of the most popular content platforms. This organization provides the opportunity for people to create and upload videos on their own channel on the Youtube platform. Dependent on the number of views and subscribers, videos will attract sponsors and accordingly create income for both Youtube itself and the "Youtuber" who uploads the video. There are at least three user groups to identify here: a group of viewers, a group of content creators and a group (most of the time other organizations) of sponsors that use Youtube mainly to advertise. Each group will benefit from an increase in user amount. Other organizations with quite similar business models are Instagram and Twitch.

3.2 Sample Selection

Table 1a presents the sample selection. The full sample consists of 1334 firm-year observations, including 130 individual firms. Company financial statements are obtained from Compustat and the stock prices are from CRSP, both from 2008-2019. As 2008 is the year that the sharing economy started to emerge (Schor & Cansoy, 2018), the sample starts with firm-year observations of 2008 and ends with the the last available year in both databases, which is 2019. To examine whether the value relevance of accounting amounts for platform firms differ from non-platform firms, the same examination is performed for non-platform firms (Table 1b). From the 1334 observations, the missing values of share price, net income and total revenue are removed. Therefore, the modified data contains 830 firm-year observations. For the other amounts, the missing values are set to zero. To mitigate the effect of outliers, the variables for all accounting amounts, are truncated at the 1st and 99th percentiles. Leaving the final data with a number of 728 firm-year observations.

TABLE 1A: Sample selection platform firms

	Observations
Observations with raw data	1.334
Less:	
Observations with missing values for share price, net income and total revenue	(504)
Outliers at the 1st and 99th percentiles	(102)
Total observations	728

Note: This table shows the sample selection that is used to examine the research question. All observations contain platform organizations.

To examine whether the effect concerns platform firms in particular or that it also affects other firms, the same examination has been performed for non-platform firms. The non-platforms are selected based on the characteristics. To compare the results, I selected the non-platforms within the same industry as the selected platform firms. Based on the SIC-code, I identified the following industries: (telephone) communication, software services, electronica, travel services, catalog and mail-order houses, personal credit institutions, computer processing and data preparation services, real estate, household audio and video, construction services, security brokers and dealers, drug and proprietary stores, video rental, employment agencies, television programming and broadcasting, manufacture of small electronics, electronic books and loan brokers. While selecting all firms within this industry in WRDS, the results showed 1542 firms. The 130 platform firms that are selected earlier had to be excluded yet, which led to 1412 non-platform firms. After the mitigation of missing values and outliers, the non-platform firm data consists of 8.326 firm-year observations.

TABLE 1B: Sample selection non-platform firms

	Observations
Observations with raw data	12.531
Less:	
Observations with missing values for share price, net income and total revenue	(2.100)
Outliers at the 1st and 99th percentiles	(2.105)
Total observations	8.326

Note: This table shows the sample selection of the control group that is used to examine the research question. All observations contain non-platform organizations.

3.3 Descriptive Statistics

Table 1c shows the descriptive statistics of the accounting amounts. The table reveals that for almost every accounting amount, the standard deviations are higher than the mean. Therefore, the data is revealed to be spread out widely. This aligns with the expectation, as there are different types of platform organizations. Also, every platform organization is included in the sample selection, regardless of the size of the firm. The number of outstanding shares per organization can differ, therefore all the accounting amounts have been divided per number of outstanding shares.

Table 1C: Descriptive Statistics (platform)

	Mean	**Std. Dev**	**P25**	**Median**	**P75**
P	82.590	173.708	17.930	36.150	83.58
NI	2.439	9.705	- 0.007	0.673	2.442
CEQ	21.598	49.090	3.617	10.661	21.455
COGS	11.872	28.811	0.870	3.269	9.010
INTAN	30.435	81.994	1.304	6.470	27.172
GP	12.798	31.353	24.311	63.543	11.781
CAPX	1.346	5.159	0.143	0.465	1.062
OANCF	4.982	13.531	0.200	2.160	4.776
REVT	26.898	53.398	7.391	12.376	28.012
SPI	-0.182	1.220	--0.162	-0.016	0.001
XRD	1.732	6.286	0.001	0.468	1.504

Note: The table above shows the mean, standard deviation, 1st quartile, median and 3rd quartile of the share price and accounting amounts of the 130 platform firms during the period 2008-2019.

The descriptive statistics of the non-platform firms are shown in Table 1d. Similar as for the platform firms, the table shows high standard deviations, revealing a widely spread distribution. Also, it is remarkable that the share price and intangible assets are higher for platform firms in comparison to non-platform firms. Although the data might suggest that the intangible assets and share prices for platform firms are higher than for non-platform firms, it does not affect the examination as I examine the incremental effect of the accounting amounts on share price.

Table 1D: Descriptive statistics (non-platform)

	Mean	Std. Dev	P25	Median	P75
P	26.56	34.29	6.45	16.31	33.53
NI	0.733	5.046	-0.356	0.2327	1.259
CEQ	14.973	5.046	2.848	7.354	14.632
COGS	3.473	18.258	1.237	3.473	11.010
INTAN	3.376	7.215	0.541	1.644	4.079
GP	7.883	37.418	1.704	3.552	7.746
CAPX	0.971	2.296	0.090	0.268	0.782
OANCF	2.395	5.570	0.184	1.010	2.788
REVT	17.930	25.865	4.051	8.322	20.254
SPI	-0.327	2.280	-0.222	-0.033	0.001
XRD	0.677	2.265	0.001	0.001	0.746

Note: The table above shows the mean, standard deviation, 1st quartile, median and 3rd quartile of the share price and accounting amounts of 1412 non-platform firms during the period 2008-2019.

The Pearson and Spearman correlations are showed in Table 1e. It shows a positive correlation between price and any other accounting amount except for special items (-0.036), according to the spearman correlation. The highest correlations are revealed to be between price and R&D expenses (XRD) with a Pearson correlation value of 0.549 and between price and gross profit (GP) with a value of 0.409. This corresponds with the expectation as created in the theoretical framework (chapter 2) and the results of Barth, Li and McClure (2018).

Table 1E: Pearson and Spearman Correlations (platform)

	PRC	NI	CEQ	COGS	INTAN	GP	CAPX	OANCF	REVT	SPI	XRD
PRC		0.295	0.384	0.344	0.090	0.409	0.384	0.330	0.394	-0.036	0.549
NI	0.486		0.852	0.680	0.388	0.840	0.672	0.931	0.796	-0.061	0.645
CEQ	0.509	0.622		0.602	0.458	0.820	0.752	0.875	0.743	-0.261	0.746
COGS	0.290	0.516	0.666		0.444	0.809	0.664	0.782	0.955	-0.268	0.639
INTAN	0.431	0.581	0.813	0.699		0.660	0.687	0.575	0.576	-0.362	0.264
GP	0.566	0.665	0.835	0.767	0.838		0.806	0.907	0.947	-0.299	0.802
CAPX	0.484	0.587	0.792	0.798	0.781	0.902		0.846	0.806	-0.357	-0.180
OANCF	0.575	0.788	0.784	0.712	0.779	0.887	0.833		0.907	-0.258	0.699
REVT	0.451	0.619	0.804	0.917	0.826	0.938	0.907	0.853		-0.297	0.754
SPI	0.011	-0.071	-0.209	-0.217	-0.355	-0.246	-0.203	-0.185	-0.247		-0.172
XRD	0.282	0.198	0.437	0.265	0.346	0.484	0.424	0.370	0.390	0.004	

Note: The table above shows the Pearson (above the diagonal) and Spearman (below the diagonal) correlations.

The same applies to the non-platform firms, where Table 1f reveals a negative correlation between the share price and special items (-0.188). However, in contrast to platform firms, Table 1f also shows high correlations between share price and operating cash flows (0.784) and between share price and revenues (0.753), according to the Pearson correlation. Differences

between these two types of organizations could suggest that there might be differences in the value relevance of the accounting amounts as well. Lastly, it should be noted that the correlations do not affect our CART approach, as CART estimations are non-parametric and therefore not affected by any skewness in the distribution (Barth, Li & McClure, 2018).

Table 1F: Pearson and Spearman Correlations (non-platform)

	PRC	NI	CEQ	COGS	INTAN	GP	CAPX	OANCF	REVT	SPI	XRD
PRC		0.739	0.606	0.445	0.299	0.833	0.600	0.784	0.753	-0.188	0.621
NI	0.443		0.718	0.288	0.190	0.829	0.701	0.918	0.631	-0.230	0.560
CEQ	0.589	0.395		0.326	0.563	0.641	0.772	0.765	0.576	-0.339	0.652
COGS	0.074	0.307	0.149		0.181	0.596	0.571	0.523	0.872	-0.278	0.698
INTAN	0.482	0.287	0.587	0.147		0.146	0.159	0.157	0.162	-0.132	0.091
GP	0.443	0.533	0.420	0.619	0.238		0.776	0.932	0.891	-0.313	0.754
CAPX	0.348	0.377	0.298	0.640	0.210	0.790		0.851	0.753	-0.435	0.891
OANCF	0.521	0.725	0.448	0.531	0.348	0.826	0.698		0.814	-0.339	0.763
REVT	0.444	0.346	0.550	0.648	0.325	0.628	0.503	0.518		-0.342	0.808
SPI	-0.022	0.087	-0.085	-0.020	-0.218	-0.036	0.025	0.025	-0.137		-0.324
XRD	0.238	0.090	0.224	0.205	0.101	0.497	0.403	0.365	0.168	0.112	

4. Research Design

4.1 What is CART?

To examine the value relevance during the period 2008-2019, a time-trend analysis has been performed, with the use of the CART model. The CART method is used to test the value relevance of accounting information. Like the name says, this method can be used to create classification and regression trees. Classification trees are used for categorical variables and regression trees for continuous variable (STHDA, 2018). This paper focuses on the regression tree to test the value relevance of the continuous accounting amounts. CART distinguishes itself from other traditional data analysis methods, due to it's tree-building technique. Prior literature that also examined the value relevance of accounting information often used an OLS regression. But a main difference between the OLS regression and the CART method is that CART is non-parametric and non-linear. Which means, that the underlying data does not necessarily needs to have a normal distribution or linear relation. Another advantage of the CART method, is that it splits variables based on a search for all possible outcomes even when there is a large number of predictors.
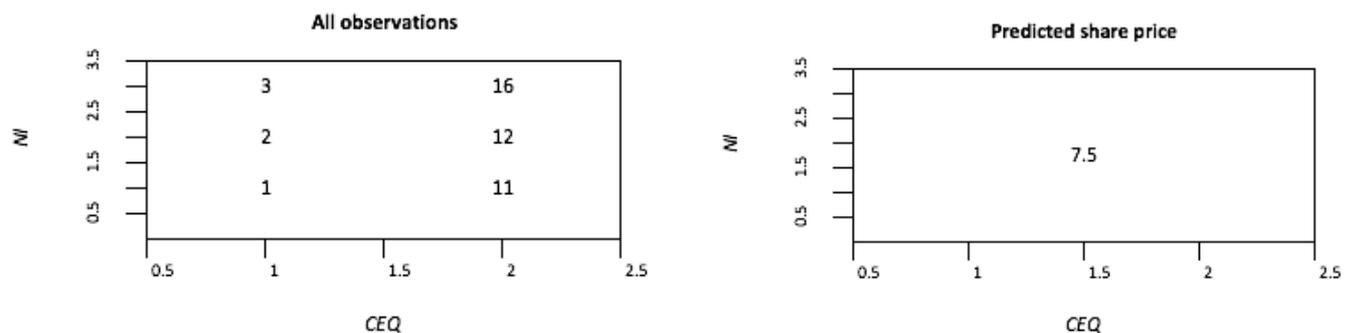
4.2 How does CART work?

The CART-model starts with an estimation process. Based on all the observations that are incorporated in the data, CART will predict the share price. To give a clear example, consider the following observations from Barth, Li and McClure (2018):

Observation #	*NI*	*CEQ*	*P*
1	1	1	1
2	2	1	2
3	3	1	3
4	1	2	11
5	2	2	12
6	3	2	16

The data shows six observations of the net income, book value of equity and share price. Within CART, the process starts with a region of all the observations where it can predict the share price, which is the average of all observations. See figure 1 for a visualization:
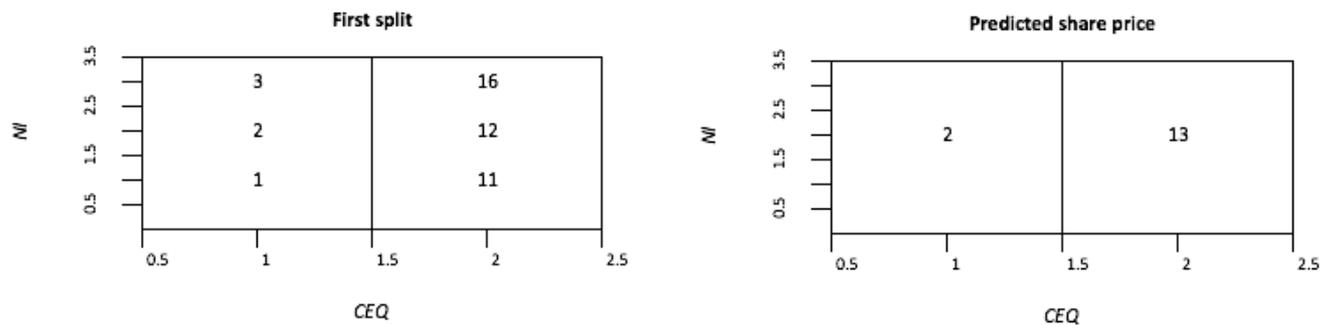
Figure 1

CART estimation process

The figure above shows that CART's estimated share price is 7.5. Therefore, the residual sum of squares can be determined through the following sum:

$$(1-7.5)^2 +(2-7.5)^2 +(3-7.5)^2 +(11-7.5)^2 +(12-7.5)^2 +(16-7.5)^2 =197.5$$

Then, CART splits the observations into two sub-regions with a predicted share price per sub-region. CART provides a split by searching over all the possible values and decides to make a split where the residual sum of squares will be at it's lowest. The example in figure 2 shows that CART decided to make a split between the CEQ observations 1 and 2, revealing the predicted share prices of 2 and 13.

Figure 2

CART splitting process – Split 1

Again, the residual sum of squares is determined by:

$(1-2)^2 +(2-2)^2 +(3-2)^2 +(11-13)^2 +(12-13)^2 +(16-13)^2 =16$.

Next, CART will perform a second split. For CART to minimize the residual sum of squares it decides to split based on NI, resulting in the following split and predicted share prices (figure 3)
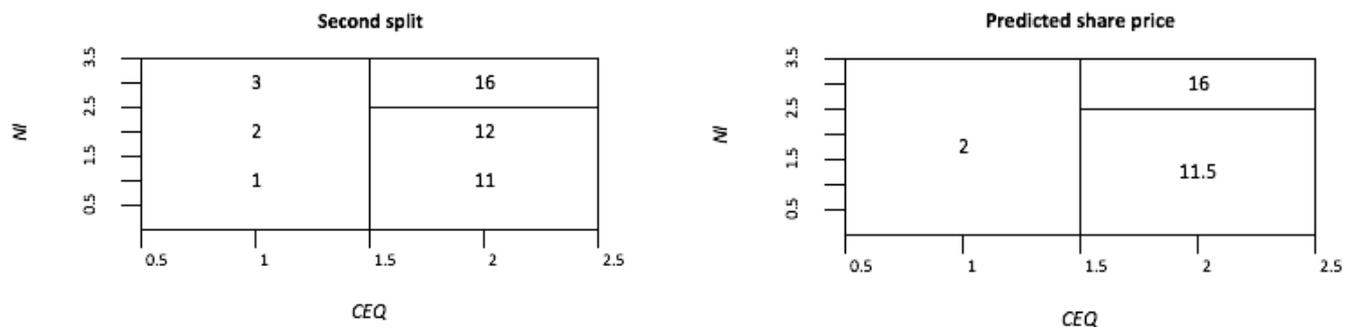
Figure 3

CART splitting process – Split 2

Figure 3 shows that CART decided to add a split at NI = 3, resulting in a predicted share price of 16 when the NI is 3 and a predicted share price of 11.5 when the value of NI is under the 3. Generally, CART continues the splitting process until each observation has its own region. However, this could be manipulated by specifying the parameters.

At the start of the implementation of CART in R, it is highly important to make sure that the dataset is valid. To prevent the data to be overfitted, the bootstrapping method is used. Following Friedman, Hastie & Tibshirani (2001), the minimum observations in a subset is five

and the data has been bootstrapped for 500 times. More about the implementation will be explained in paragraph 4.3.

To obtain a better understanding on the development in value relevance of the accounting amounts during 2008-2019, I will start with an estimation of the value relevance per year. Therefore, the following equations are used:

$$P_i = CART(VAR_i) \tag{1}$$

$P_{i,}$ represents the share price per year and VAR is a vector for the accounting amounts. The accounting amounts are *NI* (net income), *CEQ* (book value of equity), *INTAN* (intangible assets), *GP* (gross profit), *OANCF* (operating cash flow), *SPI* (special items), *REV* (revenues), *CAPX* (capital expenditures), *COGS* (cost of goods sold) and XRD (R&D expenses). To compute the value relevance, I will use the out-of-sample R^2 metric. Which will lead to the following equation:

$$OOSR^2 = B_0 + B_1 YEAR_t + \varepsilon_t \tag{2}$$

The out-of-sample r-squared is used, to avoid overstating value relevance (Friedman, Hastie, Tibshirani, 2001; Barth, Li & McClure, 2018), representing the following formula:

$$OOSR2 = 1 - \frac{\sum_{n=1}^{N}(P_n - \widehat{P_n})^2}{\sum_{n=1}^{N}(P_n - \bar{P})^2}$$

where P is the share price, $\hat{P}$ the average value of the out-of-bag observations and $\bar{P}$ the average share price value of all observations. The out-of-bag observations represent the remaining observations that are not included in the bootstrapped samples. To obtain the trend, the value relevance is examined for each year during the period 2008-2019.

4.3 CART implementation

The implementation in CART has been performed with the use of the "caret" package. Within this package the function "TrainControl" is used to take the bootstrapping samples. The function allows multiple methods; therefore, the specified method is "repeatedcv". As I have mentioned earlier in paragraph 4.2, the minimum number of observations in each node are set on 5 (number = 5) and the number of times the sample have been bootstrapped are set on 500 (repeats = 500). Then, for each bootstrapping sample, a decision tree is created by using the "rpart" package. A model is created by using the "train" function, with equation (1) installed as

the model formula. The predicted share price is then determined by taking the average of all share prices that has been resulted from all 500 decision trees that are now included in the model. The same prediction is performed for the remaining observations which are called out-of-bag (OOB) observations, retrieved by using the "residuals" function.

To calculate the value relevance of individual amounts, I examined the incremental $OOSR^2$. This has been done by calculating the difference in OOSR2 of a model including all accounting amounts and a model without the accounting amount that is examined. For example, to calculate the value relevance of net income, I created a model including all the other accounting amounts apart from the net income accounting amount itself, to calculate the effect of net income on the share price. The difference in $OOSR^2$ of the model with all the accounting amounts minus the difference in $OOSR^2$ of the model without the net income amount is the incremental $OOSR^2$.

5. Results

5.1 Combined Value Relevance

The results of the combined value relevance of accounting amounts regarding platform firms are presented in Table 2a. It confirms a mean $OOSR^2$ over the period 2008 – 2019 of 44.19%. Moreover, it reveals an increase of the combined value relevance of 0.437 percentage point per year. Which in other words reveals that the value relevance of accounting amounts increases over time. It is also remarkable that the mean combined value relevance has been increased from 43.71% in 2012 to 74.14% in 2013, however it does not remain constant for the period as the value relevance decreases to 46.37% in 2014. In 2018, the same happens after a relatively low value relevance of 27.36%, an increase is also noticed in 2019 with a value relevance of 59.47%. Focusing on 2018, it has not been a good year for the stock market. There were certain factors that led to uncertainties on the market. At first, the uncertainty regarding the global economy, caused by the high import tariffs that were announced by president Trump. The high import tariffs even resulted in a trade war between the US and China later that year (Frazee, 2018). A second consideration are the high interest rates. The Fed chose to increase the interest rates four times in 2018, which resulted in dissatisfied investors and a downfall in the American stock markets. Another consideration concerns the role of tech firms in the stock market. The five biggest tech companies: Apple, Amazon, Facebook, Google and Netflix (some are also platform companies), were under deep pressure during 2018. Criticism from news publishers and regulators concerned the (missing) regulations around data privacy. While the

profits of these firms were healthy, media attention and lawsuits have created many uncertainties on the stock market. All these considerations might explain why there is such a decrease in the mean value relevance of accounting information in 2018. Overall, there is no indication of a decline in the value relevance of accounting amounts. Table 2b shows several differences in the combined value relevance of non-platform firms in relation to platform firms. At first, it reveals a lower mean value relevance (31.10 vs 44.19). Indicating a lower value relevance of accounting amounts for non-platform firms. Although the trend in Table 2b also acknowledges a positive trend, the value of the trend (0.121) is relatively lower for non-platform firms, indicating a smaller growth in value relevance. The results also show that for the years 2016 and 2018, the value relevance has been higher for non-platform in 2016 and 2018. This could be an indication for platform firms to be more sensitive for global economic events than non-platform firms.

TABLE 2A: Combined Value Relevance of Accounting Amounts (Platform)

	Mean	**SD**
All	44.19	14.90
2008	43.82	7.99
2009	43.42	15.84
2010	36.12	9.89
2011	42.56	12.75
2012	43.71	13.39
2013	74.14	19.43
2014	46.37	7.18
2015	41.32	6.91
2016	23.61	8.11
2017	48.35	19.32
2018	27.36	17.47
2019	59.47	21.83
	Trend	**(t-stat)**
All	0.437**	-2.835

Note: This table shows the results of the combined value relevance of accounting amounts regarding platform firms during the period 2008-2019. The table includes all the accounting amounts: NI, INTAN, XRD, SPI, OANCF, REVT, CAPX, COGS, CEQ and GP. The significance level is shown as *, ** and ***, representing the values: 0.1, 0.05 and 0.01.

TABLE 2B: Combined Value Relevance of Accounting Amounts (Non-platform)

	Mean	SD
All	31.10	17.99
2008	13.27	8.74
2009	17.10	11.07
2010	29.62	13.08
2011	17.02	22.12
2012	29.72	13.72
2013	31.87	14.03
2014	36.52	14.70
2015	37.75	15.44
2016	32.62	39.35
2017	34.15	41.53
2018	41.46	17.85
2019	51.99	21.81
	Trend	**(t-stat)**
All	0.121*	-2.139

Note: This table shows the results of the combined value relevance of accounting amounts regarding non-platform firms during the period 2008-2019. The table includes all the accounting amounts: NI, INTAN, XRD, SPI, OANCF, REVT, CAPX, COGS, CEQ and GP. The significance level is shown as *, ** and ***, representing the values: 0.1, 0.05 and 0.01.

5.2 Value Relevance Individual Amounts

The value relevance of individual amounts is presented in Table 3a. It shows the mean value relevance over the period 2008-2019, which is represented by the incremental out-of-sample R^2. To begin with gross profit (GP), the table shows that the mean value relevance of GP dominates the other amounts. During the period, the mean value relevance of the GP seems to increase starting with a value relevance of 11 and ending with a relevance of 18. In Table 4a, the trend shows a significant increase of the mean value relevance of GP of 0.011. Prior theory, as described in chapter two, revealed the main characteristic of a platform business model: network effects. As platforms face low additional costs per customer, network effects eventually might lead to a winner-takes-all outcome. This leads to the indication of high revenues, paired with low costs. Therefore, it can be stated that the results of GP align with the expectation. The value relevance of net income has been fluctuating and the results show a decrease from 2016-2019. This also aligns with the results of the paper by Barth, Li & McClure (2018), where the authors concluded on a decline in value relevance of NI.

In contrast to the paper of Barth et al (2018), Table 4a shows that the value relevance of book value of equity (CEQ) is decreasing over time. Just like NI, Table 3a shows that the CEQ has been decreasing during the last few years 2016-2019. The value relevance of intangible

assets (INTAN) are, in contrast to the results of Barth et al (2018), not increasing. Table 4a shows the trend of the intangible assets, revealing a significant negative value. Therefore, stating that the value relevance decreases. Looking at the mean value relevance, a fluctuation is revealed during the whole period, with a relevance of the last three years of slim to none. R&D expenses (XRD) on the other hand became more relevant during the last years. This aligns with the characteristics of platform organizations, investing big amounts in R&D, where the benefit will be visible on the long term. The trend however, shows an insignificant result, therefore it is not possible to say that the value relevance increases. Operating cash flows (OANCF) are also revealed to be a relevant accounting vector. During the entire period, the operating cash flows are relatively constant with the highest relevance through the last four years. The trend also shows a significant increase in relevance of the operating cash flows. These results are in accordance with the expectations.

Another accounting vector with a fluctuating relevance, are the revenues (REVT). The first three years reveal a quite high value relevance, however in the years after, revenue becomes less value relevant. The big fluctuations could reveal that the revenues are not something that might be taken in consideration in general, but might be really dependent on the economical situation. Almost the same applies for the capital expenditures (CAPX). Although Table 4a shows a significant increasing trend, Table 3a shows that the mean value relevance is fluctuating during the whole observation period. Contrary to the results of the paper of Barth et al (2018), the results in Table 3a shows a decline in mean value relevance of cost of goods sold (COGS) with even a zero relevance during the period 2015-2018. According to this table, cost of goods sold are also the second lowest relevant amount. Finally, Table 3 shows a zero relevance of special items. There has been no year where special items are relevant. With the knowledge from Barth et al (2018), it seems that the special items itself become more relevant during the period, but is still irrelevant compared to the other accounting amounts.

Again, the value relevance of the individual accounting amounts has been examined for the non-platform firms. Table 3b shows that the gross profit (GP), as dominant value relevant accounting factor for platform firms, has been replaced for operating cash flows (OANCF) and revenues (REVT) for non-platform firms. Not only does Table 3b shows that these factors are dominant, Table 4b also shows significant increasing trends for both OANCF and REVT. This is in contrast with the negative trends as shown in Table 4a for the platform firms. Unfortunately, it is not possible to compare the trend of GP as the result in Table 4b is not significant. The book value of equity (CEQ) has for both type of organizations the same overall mean value relevance amount: 14. However, Table 4b shows that the CEQ has an increasing

trend for non-platform firms while Table 4a showed us a decreasing trend before. Net income (NI) has the same overall value for both type of organizations, although Table 3a and 3b shows a difference in the development of the mean value relevance during the period of 2008-2019. Where the net income seems to develop at a constant level for platform firms starting from 2014. The opposite has been noticed for non-platform firms, where the net income becomes less value relevant from the year 2014 onward. Also in this case it is not possible to conclude on the trend for non-platform firms, as the result is not significant. CAPX is the third accounting amount with the same overall mean value relevant amount, however the trends in Table 4a and 4b show a major difference between the two organization types. While the platform firm shows an increasing trend, the trend for non-platform firms is actually significantly decreasing. The cost of goods sold (COGS) has not been stable during the whole period, for both organization types. Although Table 3b reveals that the overall mean value relevance of COGS for non-platform firms are higher than platform firms, it still appears to have a significant decreasing trend. Surprisingly, Table 3b shows a zero relevance of the R&D expenses for non-platform firms. This is a big difference with the overall value relevance of 10 for the platform firms. Again, it is not possible to conclude on the trend for non-platform firms, as the result is not significant. Regarding the special items, it does not seem to be relevant for both types of organizations.

TABLE 3A: Mean Value Relevance of Individual Accounting Amounts (Platform)

	CAPX	COGS	CEQ	GP	INTAN	NI	OANCF	REVT	SPI	XRD
All	8	3	14	16	13	12	12	12	0	10
2008	11	7	9	4	31	4	8	17	0	9
2009	10	4	4	9	27	8	11	17	0	10
2010	7	5	17	14	9	8	15	23	0	2
2011	12	1	26	17	11	14	14	1	0	4
2012	6	6	30	7	18	23	7	1	0	2
2013	8	1	19	9	18	2	9	19	0	15
2014	1	1	7	13	22	13	14	15	0	14
2015	11	0	6	19	4	14	17	18	0	11
2016	0	0	30	17	11	17	11	0	0	14
2017	13	0	12	19	0	15	13	14	0	14
2018	14	0	13	21	1	12	13	13	0	13
2019	14	12	2	23	1	13	22	1	0	12

*Note***:** This table reveals the mean value relevance for each individual accounting amount regarding platform firms during the period 2008-2019. A higher value represents a higher value relevance.

TABLE 3B: Mean Value Relevance of Individual Accounting Amounts (Non-platform)

	CAPX	COGS	CEQ	GP	INTAN	NI	OANCF	REVT	SPI	XRD
All	8	8	14	15	11	12	16	16	0	0
2008	9	19	8	20	1	23	15	5	0	0
2009	0	0	31	12	12	13	15	17	0	0
2010	0	0	37	12	11	12	13	15	0	0
2011	16	0	22	17	13	16	17	0	0	0
2012	1	10	18	13	2	26	17	13	1	0
2013	8	11	11	14	4	24	14	12	2	0
2014	0	0	33	11	12	12	14	19	0	0
2015	12	17	0	16	14	0	14	27	0	0
2016	16	0	0	17	20	14	17	17	0	0
2017	14	0	13	18	15	0	25	15	0	0
2018	12	17	0	17	14	0	13	27	0	0
2019	12	17	0	16	8	5	21	21	0	0

Note: This table reveals the mean value relevance for each individual accounting amount regarding non-platform firms during the period 2008-2019. A higher value represents a higher value relevance.

TABLE 4A: Trend in Value Relevance of Individual Accounting Amounts (Platform)

	Coef.	(t-stat)
CAPX	0.021***	(4.402)
COGS	0.004	(1.750)
CEQ	-0.003***	(-4.095)
GP	0.011**	(2.896)
INTAN	-0.003	(-3.870)
NI	0.005*	(1.270)
OANCF	-0.025***	(-5.849)
REVT	-0.003	(-1.261)
SPI	0.009	(1.496)
XRD	0.011**	(2.896)

Note: This table shows the trend in value relevance of the individual accounting amounts regarding platform firms during the period 2008-2019. The significance level is shown as *, ** and ***, representing the values: 0.1, 0.05 and 0.01.

TABLE 4B: Trend in Value Relevance of Individual Accounting Amounts (Non-platform)

	Coef.	(t-stat)
CAPX	-0.658***	(-6.536)
COGS	-0.107***	(-4.501)
CEQ	0.180***	(9.105)
GP	0.643	(1.488)
INTAN	-0.295***	(-4.241)
NI	0.737	(1.736)
OANCF	0.218***	(3.518)
REVT	0.994***	(4.210)
SPI	0.927***	(4.486)
XRD	-0.904	(-0.555)

Note: This table shows the trend in value relevance of the individual accounting amounts regarding non-platform firms during the period 2008-2019. The significance level is shown as *, ** and ***, representing the values: 0.1, 0.05 and 0.01.

6. Conclusion

The question whether accounting amounts of platform firms are value relevant has been the focus of this paper. This paper examined whether the special characteristics of platform businesses also affect the value relevance of accounting amounts. Prior research showed changes in the value relevance due to the changing economy. More specifically, the net income has become less relevant while other accounting vectors such as R&D expenses and intangible assets are becoming more value relevant. The accounting amounts that are examined are: earnings, book value of equity, intangible assets, operating cash flows, special items, revenues, capital expenditures, cost of goods sold and R&D expenses. Although prior literature reveal that these amounts will contribute significantly to the value relevance, it does not take into account, the specific characteristics of a platform firm. As used in the paper of Barth, Li and McClure (2018), the CART (Classification and Regression Trees) method has been chosen to examine the value relevance for this paper. With the CART method, the approach is non-parametric and therefore no specific distribution is required. CART also incorporates bootstrapped samples, therefore overstating of the value relevance can be avoided.

The results reveal an increase in the value relevance of accounting amounts, which corresponds with the results of Barth, et al. (2018). The individual value relevance amounts however, do not all correspond. At first, the results reveal that for as well platform as non-platform organizations, gross profit is a dominant accounting vector with a significantly increasing trend regarding platform firms. Although it does not differ between the two types of organizations, I could determine that it aligns with the expectation based on prior literature. The net income however, does not align with prior literature. NI is expected to have a declining

trend, however the results showed the opposite. According to the CART results in chapter 5, the only accounting factors that are declining in value relevance regarding platform firms are: book value of equity, operating cash flows and revenues. This is not in accordance with prior literature, where all the factors are increasing over the period. A factor with zero relevance are the special items. Another unexpected outcome refers to the value relevance of capital expenditures. It is expected to reveal a decline in value relevance of capital expenditures as it reflects the investments in tangible assets. However, this paper reveals that the capital expenditures are the third most value relevant accounting vector and significantly increasing over 2008-2019.

Overall, it can be concluded that the value relevance of accounting amounts for platform firms are increasing. To conclude whether these effects really differ for non-platform firms I had to reevaluate the mean value relevance per individual accounting amount. For both firm types, it can be concluded that the gross profit amount is the dominant value relevant accounting factor. The results showed that the major difference between these two firm types relate to R&D expenses. Where the R&D expenses are value relevant and significantly increasing for platform firms, the results showed a zero relevance for non-platform firms. Based on prior knowledge, it could be determined that the specific characteristics of platform firms could be the explanation of the difference in value relevance.

7. Discussion

The results indicate an increase in value relevance of accounting amounts for platform firms. Also, there are noticeable differences between the mean value relevance of accounting amounts for platform firms and non-platform firms. It is therefore suggested, to perform further research on this topic. This paper addresses the importance of research on platform firms. Regardless of the results above, there are some challenges when considering the examination of platform organizations. At first, it is not easy to focus on platform firms only as some of the firms are hybrid, half platform half linear. This could make the data impure and therefore misrepresented results. Another great challenge is the selection of platform firms. With no clear classification code, such as the SIC Code, finding all the platform organizations within a database will be quite a challenge. This requires judgment, which could also lead to incorrect results. Further research could also be done by taking other accounting components into accounting. This paper only focused on the specific accounting vectors on the balance and profit and loss accounts. Prior research however also shows the importance of the market share in the

platform industry. Therefore, further research is suggested on the combination of accounting vectors and market share in the platform industry and maybe even include items such as: number of users, daily number of users/transactions. Overall, this paper showed the importance the examination of platform firms. However, further research is required to obtain a clear conclusion on the value relevance of accounting amounts for platform firms.

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