Are Firms with More Intangible Assets Credit Constrained?

Afonso Matias

Dissertation written under the supervision of Professor Diana Bonfim

Dissertation submitted in partial fulfilment of requirements for the MSc in Finance, at the Universidade Católica Portuguesa, December 2023.

Are Firms with More Intangible Assets Credit Constrained?

Afonso Matias

December 2023

Abstract

Increasingly more firms have come to rely mainly on intangible capital for some decades now, and, as technology still continues to develop, all signs point to this trend persisting in the foreseeable future. However, pledging intangible capital as collateral for loans is not a common practice, which makes it harder for them to get access to credit as they have scarce physical collateral to pledge. While some authors argue that these firms are able to self-finance themselves, others do not, and so there is still an ongoing debate about whether or not companies with considerable amounts of non-physical assets are credit constrained. This thesis aims to address this question specifically for companies within the European Union, a subject that has not been extensively studied before. By concluding that corporations in the EU with more intangible assets (in relative terms) are statistically associated to having lower cash holdings and to being more prone to financial constraints, this dissertation supports the view that these firms lack credit. Additionally, I also found that these corporations make higher investments while not rewarding their employees more with stock options, further increasing their need for cash.

Keywords: Intangible capital, credit scarcity, European Union, leverage, cash holdings, investment, employee stock options, payouts, financial constraint.

As Empresas com mais Ativos Intangíveis têm Escassez de Crédito?

Afonso Matias

Dezembro 2023

Cada vez mais empresas têm vindo a depender principalmente de capital intangível ao longo das últimas décadas, e, à medida que a tecnologia se continua a desenvolver, todos os sinais apontam que esta tendência irá persistir no futuro próximo. Porém, utilizar capital intangível como garantia para empréstimos não é uma prática comum, o que lhes dificulta o acesso a crédito dado que possuem pouco capital físico para oferecer como garantia. Enquanto alguns autores argumentam que estas empresas conseguem-se autofinanciar, outros discordam, e, como resultado, existe ainda um debate sobre se empresas com quantidades consideráveis de ativos não tangíveis sofrem de escassez crédito. Esta tese pretende abordar esta questão especificamente para empresas dentro da União Europeia, algo que ainda não foi estudado extensivamente. Ao concluir que as empresas na UE com mais ativos intangíveis (em termos relativos) estão estatisticamente associadas a terem reservas de caixa mais baixas e a serem mais propensas a escassez financeira, esta dissertação apoia o lado que argumenta que estas empresas têm escassez de crédito. Adicionalmente, também é concluído que as mesmas empresas realizam mais investimento ao mesmo tempo que não dão aos seus empregados mais opções de ações, o que aumenta a necessidade de caixa.

Palavras-chave: Capital intangível, escassez de crédito, União Europeia, alavancagem, reservas de caixa, investimento, opções de ações de empregados, distribuição de lucros, escassez financeira.

Table of Contents

List of Tables

List of Figures

Abbreviations

D/E - Debt-to-Equity

EBITDA - Earnings Before Interest, Taxes, Depreciations, and Amortizations

EU - European Union

HINT - High-Intangibles

LINT - Low-Intangibles

PPE - Property Plant and Equipment

R&D - Research and Development

SG&A - Selling, General and Administrative

Yrs. - Years

%ile. - Percentile

1. Introduction

With the technological advancements of the last decades, investments in intangible assets have become increasingly more common. According to Corrado et al., 2022, accounting for intangible assets would lead to an increase in investment as a share of GDP in the U.S. since 1985. Moreover, Corrado et al., 2018, conclude that, after the 2008 financial crisis, investment in tangible assets has experienced a disproportionate decline in comparison to investment in intangible assets, both in the European Union and in the U.S. At the same time, more and more firms have come to rely mainly on intangible capital.

Due to its intrinsic nature, intangible assets are hard for lenders to appropriate in case of default (Hart and Moore, 1994) and, as a result, are not typically used as pledgeable collateral in loans. This creates a problem for firms which mainly have non-tangible capital in being able to secure loans, as they have very few physical collateral to pledge. It has been documented multiple times that these companies, often times referred to as companies from the knowledge economy, have lower leverage (Rampini and Viswanathan, 2013; Falato et al., 2022) and higher cash holdings (Bates et al., 2009; Pinkowitz et al., 2016).

Some authors argue that firms with high amounts of intangible capital relative to tangible are able to self-finance themselves as the investments made by them are mostly human capital ones. These investments, typically associated with the know-how of the employees, cannot be bought upfront and must be built over time by the workers, thus requiring lower upfront amounts of funds and, consequently, reducing the need for credit. Furthermore, this side of the literature also argues that these firms can retain the employees responsible for the investments by granting them stock options, what also diminishes demand for credit (Döttling et al.et al., 2018; Sun and Xiaolan, 2019).

However, other authors argue that corporations with few physical assets often do not seize investment opportunities, especially when cashflows are low (Rampini and Viswanathan, 2010), due to being hard for them to get access to credit. Moreover, evidence from the U.S. suggests that, as firms increase their reliance on intangibles, local banks shift their loan portfolio towards mortgage lending (Dell'Ariccia et al., 2021), what could worsen the problem. Thus, there is an ongoing debate about whether or not these corporations are credit constrained.

There is little research available that studies specifically if predominantly relying on intangible capital is associated with credit scarcity, the most extensive study having been carried out in Döttling et al., 2018. Yet, this paper, in similarity to most of the literature developed around the

effects of having more non-physical assets in some firm characteristic, uses a sample that only has U.S. companies. Therefore, I found it relevant to study whether companies from the knowledge economy face credit constraints, from a European Union perspective.

To investigate the main theme of this thesis, I addressed four key questions (while not all of them are directly connected with the theme of credit scarcity, they are crucial to understand how companies with high amounts of intangible capital operate, what is very valuable to answer the main question of the thesis). The first question is if firms with more intangible capital have lower leverage and higher cash holdings. This question serves more as a way to confirm if previous empirical findings based on U.S. firms also apply to European Union ones. As already said, they have been shown to have lower leverage (Rampini and Viswanathan, 2013; Falato et al., 2022) and higher cash holdings, specially as a way to "hold a greater cash buffer against future shocks to internally generated cash flow" (Bates et al., 2009) as it is hard for them to get access to credit. The second question is how much and in what firms with more intangible capital invest. According to literature, firms from the knowledge economy should invest more in intangible capital and less on tangible. Furthermore, their total investments should be lower, as intangible investments, the ones mainly made by these firms, do not require high upfront payments, as already explained. The third question is directly connected to this, and it is whether firms with more intangible capital reward their employees more with stock options. Firms that invest more in intangible assets should reward the employees more in order to maintain them in the company. The most common way to do so is by granting them stock options. This in turn reduces their need for cash to maintain their workers. The last question is if firms with more intangible capital are more prone to financial constraints, which were analyzed through potential indicators that can signify if a firm does not have enough cash for its activities. In case that they are indeed more prone to financial constraints, this can be a strong signal that they need more credit in order to have the needed cash for their operations.

In order to address these questions, the variable *Intangible Ratio* was created. It is equal to intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets (more details about the variable in Section 3.2 Intangible Ratio). Thus, a higher ratio indicates that a firm has more intangible assets, in relative terms. The sample of this thesis has data for 1,781 firms from all the different countries of the European Union from 2001 until 2022 (both inclusive). The sample starts in 2001 as Refinitiv Eikon's DataStream, the database used to obtain the sample, does not have information for many variables needed before the 21st century (more details about the sample in Section 3.1 Sample).

Having the *Intangible Ratio* variable, I regressed it on *Leverage* and *Cash Holdings* in order to answer the first question, that is if firms with more intangible capital have lower leverage and higher cash holdings. The relationship between the ratio was negative for both *Leverage* and *Cash* Holdings, both at a 1% significance level. This means that companies with more intangible assets are statistically associated with having lower leverage and cash holdings.

Regarding the second question of how much and in what firms with more intangible capital invest, I regressed the *Intangible Ratio* on *Tangible Investment*, *Intangible Investment,* and *Total Investment.* The first relation was negative while the last two were positive, all at a 1% significance level. This indicates that firms that have more intangible capital are associated with investing more in it, less in tangible capital, and investing more in total terms.

In relation to the third question of whether firms with more intangible capital reward their employees more with stock options, I regressed the *Intangible Ratio* on *Stock Options* and *Share Repurchases/Total Payouts*. The rationale for choosing this second variable is that, if firms grant to more equity to their employees, by repurchasing shares, the value of this unvested equity increases, and so they should favor them more relative to dividends (especially considering that both are seen favorably by all shareholders and not just employees who are granted with stock options). Nonetheless, the two coefficients obtained for the *Intangible Ratio* were not statistically significant, indicating that corporations with a higher ratio do not give more stock options to their employees and do not repurchase more shares in relative terms.

Finally, regarding the fourth question that is if firms with more intangible capital are more prone to financial constraints, I chose to analyze this issue by seeing the relation between the *Intangible Ratio, Total Payouts* and *Cash Shortfalls*. *Cash Shortfalls* is a dummy variable that takes the value of one if a firm does not have enough internal funds to continue its recent investment trend. The logic behind choosing to analyze payouts to study financial constraint is that, if firms with a higher *Intangible Ratio* have similar payouts as firms with a lower ratio, this is a sign that they do not have a higher necessity to preserve case, what would be the case if they are credit constrained. The coefficient of the *Intangible Ratio* was negative for *Total Payouts*, at a 5% significance level, and positive for *Cash Shortfalls*, at a 1% significance level, what indicates that a higher *Intangible Ratio* leads to a higher probability of experiencing financial constraint.

Based on the results mentioned in the previous paragraph, I conclude that firms with more intangible capital in the European Union are credit constrained. The fact they are more prone

to having lower payouts, experiencing more often not having enough cash to continue recent investment trends and having lower cash holdings (when they should "hold a greater cash buffer against future shocks to internally generated cash flow" (Bates et al., 2009) as they struggle more to get access to credit) seem to be solid indicators of lacking credit. The fact that they do not reward their employees more with stock options, that could attenuate the need for cash to retain them, further increases this problem, as well as investing more than other firms.

This thesis is divided as follows. Section 2 reviews relevant literature related to the topic of intangible capital. Section 3 describes in detail the methodology used to arrive at the results. Section 4 presents and analyzes the empirical results obtained. Section 5 concludes.

2. Literature Review

There is a wide literature examining the role that the collateral that can be pledged by firms has on their capital structure and cash holdings. The characteristics of collateral are a key determinant of leverage and debt maturity (Benmelech, 2009; Campello and Giambona, 2013). In particular, companies that rely mostly on intangible assets have considerably lower leverage and higher cash holdings (Bates et al., 2009; Rampini and Viswanathan, 2013; Pinkowitz et al., 2016; Falato et al., 2022).

The main reason that has been pointed out for this type of firms having lower leverage is due to the fact that intangible capital is hard for lenders to appropriate in case of default (Hart and Moore, 1994). Therefore, financial frictions come into play and they are less willing to lend. Moreover, firms that engage in research and development and take on loans suffer a lot of financial distress (Opler and Titman, 1994) as debt contracts are not effective in investments marked by a substantial likelihood of failure, despite a possibility of great potential gains. Even though some forms of intangible assets, such as patents, can be used as valuable collateral (Mann, 2018), this is still not a common practice, which, all in all, leads to lower leverage.

As for cash holdings, firms from the knowledge economy have higher ones for the same reason. As it is harder for them to borrow money to finance their investments, they end up financing them mainly with retained earnings or deferred equity (Döttling et al., 2018). As a consequence, they "hold a greater cash buffer against future shocks to internally generated cash flow" (Bates et al., 2009), so as to ensure that they can continue to invest even in times of lower profits (Opler et al., 1999).

Authors have documented that this trend regarding cash holding and leverage as a result of higher intangible assets has been happening since the 80s, becoming more noticeable as time goes by as increasingly more firms rely considerably on intangible capital (Bates et al., 2009; Corrado et al., 2009). Consequently, the topic of whether or not firms from the knowledge economy experience credit scarcity has started to attract more attention in the last few years.

On one hand, some authors believe that there are times where these firms do not seize investment opportunities, especially when cashflows are low (Rampini and Viswanathan, 2010; Dell'Ariccia et al., 2021), as a result of the difficulty of getting loans. This is the case in which we are in the presence of a market imperfection as a firm's investment decision should only be based on future expected cash flows.

On the other hand, it is argued that there is no credit scarcity for companies with a high ratio of intangible assets to tangible assets for two main reasons. Firstly, the type of investments they engage in, which in the majority of the time are human capital ones, require lower upfront outlays. Secondly, these can be financed by granting deferred equity compensation to the employees (Döttling et al., 2018; Sun and Xiaolan, 2019).

It is worth noticing that most of the literature developed around the topic of the effects of having mainly intangible capital is based on US firms. Nevertheless, shareholder protection and better access to stock market financing have significant impacts on investment in intangible assets (Borisova et al., 2013). Additionally, there are few companies outside the US that have such a high ratio of intangible to tangible assets (Pinkowitz et al., 2016). Thus, there currently is a lack of empirical evidence concerning if the previous conclusions also hold for firms from other countries, including European Union member states.

3. Methodology

As mentioned in the introduction, Döttling et al., 2018, is the only paper that analyzes extensively the possible existence of credit scarcity for firms from the knowledge economy. Thus, many aspects of the methodology used in this dissertation are somewhat similar to the one of this paper. However, it is important to note that the way some of these variables were measured is different, as well as the methods used to analyze specific topics. Additionally, Döttling et al., 2018, studies certain aspects that were not relevant for this thesis and vice-versa.

3.1 Sample

The sample has 1,781 firms from all the different countries of the European Union which were active from 2001 until 2022 and that are available in Refinitiv Eikon's DataStream[1] [2]. Firms from countries that joined the EU in the 21st century are in the sample starting from their nation's adhesion year. Companies whose average total assets for the sample period were less than five million euros were excluded, as were those that operate in the financial and utilities sectors (similar to Döttling et al., 2018). Additionally, corporations that were available in DataStream starting only from 2019 and those that do not have any data for variables used were also kept out of the sample[3]. Firms are classified yearly as HINT if their *Intangible Ratio* falls within the highest tercile of the sample distribution of this variable for that year, and LINT if it falls in the lowest tercile (similar to Döttling et al., 2018).

3.2 Intangible Ratio

In order to answer the four questions stated previously I run various regressions where the dependent variable is always the *Intangible Ratio* (similar to Döttling et al., 2018). This way, all the results express the effects of having, in relative terms, more intangible assets. The *Intangible Ratio* variable is equal to intangible assets divided by total assets. Intangible assets were measured as the firm's sum of the value of total intangible other assets net, present and past R&D expenses and 30% of present and past SG&A expenses, as "some of these business expenses increase the value of organizational capital" (Döttling et al., 2018). Present and past SG&A expenses are subtracted by the respective year's R&D expense since that in DataStream SG&A expenses include R&D expenses. This was how intangible capital was also measured in Peters and Tayor, 2016. For the past years' R&D and SG&A expenses, a depreciation rate of 20% was assumed, which is the value that has been widely used in literature to capitalize depreciations for R&D stock (Bronwyn Hall, 2007). In years where SG&A or R&D expenses had missing values, these were replaced with zero. Tangible assets were measured as the value of Property, Plant and Equipment net and total assets as the sum of tangible and intangible assets.

[1] Slovakia does not have any firm in the sample as none of its firms that are available in DataStream complied with the set criteria (described throughout the paragraph).
[2] The sample starts in 2001 as DataStream did not have data for many variables used before the 21st century.
[3] The variable *Cash Shortfalls* (description of variable later) requires firms to have at least four years of data, so, firms that are available starting only from 2019 were excluded.

3.3 Dependent Variables

Moving on to how the answers to the four questions mentioned in the introduction were arrived to, to know if firms from the European Union with a higher *Intangible Ratio* also have lower leverage and higher cash holdings, as it has been widely shown in the literature (Bates et al., 2009; Rampini and Viswanathan, 2013; Falato et al., 2022), I regressed the *Intangible Ratio* on *Leverage* and *Cash Holdings*. *Leverage* corresponds to the debt-to-equity ratio and *Cash Holdings* to cash & equivalents divided by total assets.

Regarding the question of how much and in what firms holding a greater amount intangible assets invest, the variables *Tangible Investment, Intangible Investment* and *Total Investment* were created. *Tangible Investment* corresponds to the annual change in Property, Plant and Equipment net. If this change was negative, it takes the value of zero (results did not change when this particularity is not incorporated, in terms of significance levels and signs of the coefficients). *Intangible investment* is the annual change in total intangible other assets net, plus the R&D and 30% of the SG&A annual expenses (the value of the R&D expense was also subtracted to the one of the SG&A expenses for the same reason stated previously). If the annual change in total intangible other assets net was negative, it also assumes the value of zero for this item (results also did not change when this particularity is not incorporated). *Total Investment* is the sum of the two. For every year these variables were divided by the annual amount of cashflows available to fund investments at the start of the year. I considered these to be the operating earnings (EBITDA) minus the interest and tax expenses, all of the previous year, plus the values of tangible and intangible investment of the current year. Having these variables, the *Intangible Ratio* was regressed on them (while Döttling et al., 2018, regresses the *Intangible Ratio* on *Tangible* and *Total Investment*, the way these variables were measured is slightly different).

In relation to the topic of whether companies with a higher amount of non-tangible assets reward their employees more, I analyzed this by seeing the relation between the *Intangible Ratio* and *Stock Options* compensation expense and *Share Repurchases/Total Payouts* (through regressions, once more, and similar to what is done in Döttling et al., 2018). *Stock Options* was divided by market capitalization and *Share Repurchases* was obtained by dividing the value of the acquisition cost of shares held by the company by total assets.

Finally, with respect to financial constraints, two measures were used to try to understand if corporations with a bigger portion of intangible assets lack internal funds, the first one being

Total Payouts. *Total Payouts* was measured as common dividends plus the value of the acquisition cost of shares held by the company, both divided by total assets. The second variable used to analyze financial constraint was *Cash Shortfalls*. This is a dummy variable takes the value of one if the firm's cashflows available to fund investment plus its cash & equivalents, both at the beginning of the year, are less than the average total investment of the past three years (as this could indicate that the firm lacks funds to continue its recent investment policy). Otherwise, it takes the value of zero. Once again, a regression was used for each of these two variables where the dependent variable is the *Intangible Ratio*. While the practice of analyzing financial constraint through total payouts is a common practice in literature (Almeida et al., 2004; Denis and Sibikov, 2010), the choice of also studying this problem through the variable *Cash Shortfalls* is something that was done in Döttling et al., 2018.

3.4 Control Variables

All the regressions include four control variables, which are *Ln Total Assets*, *Net Leverage*, *Cashflow* and *Tobin's Q* (these four variables are also present in the regressions of Döttling et al., 2018). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is equal to total debt minus cash & cash equivalents, both divided by total assets. *Cashflow* corresponds to cashflows available to fund investment divided by total assets. Lastly, *Tobin's Q* is total debt plus market capitalization minus current assets, everything divided by total assets, as in Peters and Tayor, 2016, in which the authors show that this formula accounts more accurately for potential investment opportunities. These control variables were selected to be in all the regressions because of potential omitted variable bias, as they influence significantly many of the dependent variables stated previously, and even the *Intangible Ratio*. All the regressions have year and firm fixed effects, and the previous stated four control variables are all lagged one year. All dependent and independent variables were winsorized at the 5-95 level.

4. Results

4.1 Statistics

Starting by looking at some statistics regarding the evolution of the *Intangible Ratio*, Table 1 (in the appendix) indicates that its average value for every country in the sample increased during the time period being analyzed (with the exception of Hungary and Luxembourg). The

average full sample increase for all the countries combined that have data starting from 2001 was 0.205 units. Czech Republic, Spain, Finland, Netherlands and Denmark registered the highest increases out of all countries in the sample, with these being higher than 0.300 units. In 2022, Sweeden, France, Finland Germany and Denmark were the countries with the highest average *Intangible Ratio*. Lithuania, Malta, Hungary, Slovenia and Cyprus, on the other hand, were the ones with the lowest, having the last four also had the lowest changes in the *Intangible Ratio*.

Both HINT and LINT firms also saw their average *Intangible Ratio* increase during these two decades, as it can be seen in Panel A of Figure 1 (in the appendix), with the trend being actually slightly steeper for LINT firms. Nonetheless, this might be partially explained due to HINT firms already having a very high *Intangible Ratio* in 2001, thus not being possible to increase it much more. Still concerning these two types of firms, Table 2 shows many differences between them based on average values for different variables used, taking into consideration the entire sample. Some results that are worth to stand out are that HINT firms have a much higher average *Intangible Ratio* (0.909 units versus 0.213 units), as one would, of course, expect after seeing Panel A of Figure 1. In terms of the natural logarithm of total assets, the companies seem to have somewhat identical sizes, though, LINT companies are slightly bigger. Doing the ratio exp(11.526)/exp(11.387) (11.525 units is the average value of the *Ln Assets* for LINT firms and 11.387 units is the one for HINT), the result obtained is 1.15. This means that, on average, LINT corporations are 1.15 times bigger than HINT during the sample period in question. This is a bit surprising as in Döttling et al., 2018, LINT firms were found to be almost 2.5 times bigger than HINT. Looking at the average values of *Tobin's Q*, HINT companies have one higher than one (1.486 units) while LINT have it lower than one (0.899 units). This means that the investment opportunities for HINT firms have been higher than for LINT. The average values obtained for *Cashflow* points to both types of firms having, in relative terms, similar amounts of funds to invest with (0.271 units for HINT firms and 0.261units for LINT). Lastly, Table 2 also shows that both firms invest more in intangible capital than tangible, which is an interesting finding regarding LINT firms as one could think that, since they have a low *Intangible Ratio*, they make few non-physical investments. As indicated by the number of stars in the last column of the table, all these previously mentioned differences are statistically significant at a 1% significance level.

Table 2 - High-Intangible and Low-Intangible Firms Summary Statistics

Firms are classified yearly as HINT if their annual *Intangible Ratio* is in the highest tercile of the sample distribution of this variable and LINT if it is in the lowest. *Intangible Ratio* is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively. For a detailed description of all the variables of this table and the sample used to compute it check Table 2 in the appendix.

	HINT Firms				LINT Firms				
	Mean	Median	St. Dev	No. Obs	Mean	Median	St. Dev	No. Obs	Diff.
Intangible Ratio	0,919	0,937	0,069	10029	0,256	0,240	0,148	9935	0.663***
Ln Total Assets	11,387	11,078	2,295	10028	11,526	11,224	2,020	9935	-1.39***
Net Leverage	-0,061	0,001	0,453	9932	0,215	0,249	0,417	9890	-0.277***
Cashflow	0,271	0,246	0,226	9163	0,261	0,236	0,189	9142	0.011***
Tobin's Q	1,486	0,844	1,825	9119	0,899	0,582	1,280	9177	0.587***
Leverage	0,533	0,256	0,714	9878	0,727	0,482	0,772	9854	-0.194***
Cash Holdings	0,332	0,176	0,379	10024	0,212	0,097	0,296	9925	0.120***
Tangible Invest.	0,029	0,000	0,069	8629	0,151	0,049	0,185	8694	-0.122***
Intangible Invest.	0,579	0,591	0,367	8629	0,278	0,230	0,258	8694	0.301***
Total Investment	0,615	0,623	0,394	8629	0,452	0,429	0,317	8694	0.163***
Stock Options	0,003	0,002	0,003	1921	0,002	0,001	0,003	674	0.001***
Share Repurchases /Total Payouts	0,376	0,174	0,416	3911	0,260	0,000	0,386	4577	0.117***
Total Payouts	0,029	0,009	0,042	6434	0,032	0,016	0,042	6188	-0,003***
Cash Shortfalls	0,151	0,000	0,358	7864	0,109	0,000	0,312	7706	0.041***

4.2 Leverage and Cash Holdings

As mentioned previously, the literature has made it clear that firms with more intangible assets have lower leverage (Rampini and Viswanathan, 2013; Falato et al., 2022) mainly because this type of capital is hard for lenders to appropriate in case of default and, consequently, they are less willing to give them funds. Moreover, empirical findings have also demonstrated that, as a result of being difficult to get access to credit, HINT firms hold more cash in order to continue being able make their investments in times of lower cash flow (Bates et al., 2009; Rampini and Viswanathan, 2013). Panels B and C of Figure 1 seem to confirm that both these findings are also true for European firms. There is not a single year in the sample in which the average D/E ratio of HINT firms is higher than LINT, and the difference in the ratio between the two types of corporations seems to have increased considerably from 2019 onwards, being quite stable before that. The average Cash/Total Assets was also always higher for HINT firms, though the difference has decreased since 2005 due to lower cash holdings by HINT firms.

Doing a regression analysis of the *Intangible Ratio* on *Leverage* (also having as dependent variables the other control variables mentioned previously), as one would expect, it is concluded that a higher one is correlated with lower leverage, as demonstrated by column 1of Table 3, at a significance level of 1%. On average, and everything else constant, when the ratio increases by 1 unit, the D/E decreases by 0.296 units.

Regarding *Cash Holdings*, surprisingly, column 2 of Table 3 shows that a higher *Intangible Ratio* is associated with lower cash holdings (-0.095 units), at a 5% significance level. This is considerably unexpected as it goes against previous empirical findings. Firms with less collateral to pledge face greater difficulties in getting access to credit, and, consequently, should have higher cash holdings as a way to being able to keep investing during potential future financial downturns (in which it would be hard to get access to credit). Nonetheless, it is worth mentioning that the majority of research related with cash holdings and the physical nature of firm's assets uses exclusively U.S. firms (Bates et al., 2009; Falato et al., 2022).

Table 3 - *Intangible Ratio*: Effects on *Leverage* and *Cash Holdings*

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively. For a detailed description of all the variables of this table and the sample used to compute it check Table 3 in the appendix.

Dependent Variable	*Leverage*	*Cash Holdings*
Intangible Ratio	-0.382***	-0.095***
	(4.73)	(2.75)
Ln Total Assets	0.147***	-0.062***
	(9.24)	(10.87)
Net Leverage	-	-0.260***
	-	(20.68)
Cashflow	-0.095***	0.023*
	(2.65)	(1.72)
Tobin's Q	-0.012**	0.024***
	(2.09)	(8.89)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	25,184	25,304
Adjusted R^2	0.13	0.23

4.3 Investments

It has been argued in the literature that companies which rely mainly on intellectual property mostly make human capital investments and these in turn require lower amounts (Döttling et al., 2018; Sun and Xiaolan, 2019). To test this hypothesis, I run three regressions, the first one having as the dependent variable *Tangible Investment*. As expected, the *Intangible Ratio* has a negative relationship with the dependent variable. On average, and everything else constant, an increase of one unit in the *Intangible Ratio* is associated with a decrease of 0.318 units on the predicted variable, at a 1% significance level, as column 1 of Table 4 shows. Also, as predicted by the hypothesis, a higher *Intangible Ratio* is statistically associated at a 1% significance level with more investment in intangible assets (more than 0.600 units, on average and everything else constant, for a one unit increase in the *Intangible Ratio*), which can be seen in column 2 of the same table. Unexpectedly, the last regression regarding investments, which has *Total Investment* as the outcome variable, is positively associated with the intangible ratio at the 1% significance level. On average, and everything else constant, a one unit increase in the *Intangible Ratio* is associated with an increase of 0.120 units in *Total Investment*. All these findings are also consistent with the conclusions that one could derive from the information displayed on three panels of Figure 2 (in the appendix).

These results indicate that, while it is true that firms with more non-physical assets tend to invest more in non-tangible assets and less in tangible ones, their total investments are actually higher, what goes against the findings in Döttling et al., 2018.

Table 4 - *Intangible Ratio*: Effects on Investment Types and Amounts

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively. For a detailed description of all the variables of this table and the sample used to compute it check Table 4 in the appendix.

Dependent Variable	*Tangible Investment*	*Intangible Investment*	*Total Investment*
Intangible Ratio	-0.318***	0.644***	0.274***
	(21.37)	(22.20)	(7.73)
Ln Total Assets	-0.018***	0.005	-0.018***
	(7.57)	(0.77)	(2.70)
Net Leverage	-0.020***	0.019*	0.000
	(4.48)	(1.90)	(0.01)
Cashflow	0.063***	-0.012	0.042**
	(9.75)	(0.77)	(2.33)
Tobin's Q	0.004***	-0.005*	-0.002
	(3.50)	(1.90)	(0.74)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	24,946	24,946	24,946
Adjusted R^2	0.14	0.08	0.03

4.4 Employee Compensation

According to the view that firms with more intangible assets make mostly human capital investments, these firms should reward their employees more (Döttling et al., 2018; Sun and Xiaolan, 2019). One common way to do so is by granting them stock options. Furthermore, by repurchasing shares, the value of the unvested equity increases, so they should favor them more relative to dividends (especially considering that both are seen favorably by all shareholders and not just employees who are granted with stock options) than firms who do not have such big needs to reward their employees. Regressing the *Intangible Ratio* on *Stock Options*, column 1 of Table 5 shows that the relation between a higher *Intangible Ratio* and *Stock Options* is statistically indistinguishable from a lower one. While Panel A of Figure 3 (in the appendix) indicates that HINT firms give more stock options to their employees than LINT, and the last

column of Table 2 confirms that this difference between the two types of firms is statistically significant at the 1% significance level, it cannot be forgotten that there are firms that do not fall under the classification of HINT but still have, in relative terms, considerable amounts of non-tangible capital. Thus, statistically speaking, European corporations with a higher *Intangible Ratio* do not seem to reward their employees more with stock options. However, it is worth pointing out that the number of observations included in this regression was quite small in comparison to all other regressions, at just 4,150. This small number of observations was due to a lack of data regarding this variable (for the sample used) on the database used for this thesis (Refinitiv Eikon's DataStream). Furthermore, it is the only regression that only has one statistically significant coefficient. Granting stock options to employees is not a common practice in Europe and so these results seem to be more indicative of a global trend regarding the dependent variable itself across all the corporations in the sample rather than the relation between it and the independent variables.

The coefficient obtained for the *Intangible Ratio* regressed on *Share Repurchases/Total Payo*uts is also not statistically significant. Share repurchases increase the value of stock options granted to employees, and so firms that give more stock options should favor repurchases more. Nonetheless, as firms with a higher *Intangible Ratio* do not seem to give more stock options, it is no longer relevant to analyze this variable.

Table 5 - *Intangible Ratio*: Effects on Employee's Stock Options Compensation and on the Relative Amount of Share Repurchases

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively. For a detailed description of all the variables of this table and the sample used to compute it check Table 5 in the appendix.

Dependent Variable	*Stock Options*	*Share Repurchases/Total Payouts*
Intangible Ratio	0.000	0.070
	(0.59)	(1.36)
Ln Total Assets	0.000	-0.023*
	(0.32)	(1.88)
Net Leverage	0.000	0.063***
	(0.76)	(3.49)
Cashflow	0.000	-0.156***
	(1.10)	(5.86)
Tobin's Q	0.000**	-0.018***
	(2.54)	(4.28)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	4,150	13,086
Adjusted R^2	0.05	0.04

4.5 Financial Constraints

Regarding the question of whether or not firms with a high amount of intangible assets relative to tangible ones experience more financial constraints, as mentioned previously, two variables were chosen to analyze this issue, the first being *Total Payouts*. Column 1 of Table 6 demonstrates that a higher *Intangible Ratio* is statistically significantly associated with lower payouts, at a 5% significance level. When the *Intangible Ratio* increases by one unit, on average, and ceteris paribus, *Total Payouts* decreases by 0.011 units. Furthermore, regressing the *Intangible Ratio* on the dummy variable *Cash Shortfalls*, which takes the value of one if a corporation experienced not having enough cash to continue its recent investment trend according to its definition, leads to a statistically significant positive relation between the

variables at a 1% significance level, as it can be seen on the last column of Table 6. On average, and everything else constant, when the *Intangible Ratio* increases by one unit the odds of experiencing *Cash Shortfalls* increases by 12.6% (exp(0.119 is equal to 1.126).

Table 6 - *Intangible Ratio*: Effects on Financial Constraints

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Cash Shortfalls* is a dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents, both at the start of the year, are lower than the average *Total Investment* of the past three years (otherwise, it takes the value of zero). The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively. For a detailed description of all the variables of this table and the sample used to compute it check Table 6 in the appendix.

Dependent Variable	*Total Payouts*	*Cash Shortfalls*
Intangible Ratio	-0.011**	0.119***
	(2.31)	(4.11)
Ln Total Assets	-0.002**	0.050***
	(2.48)	(7.98)
Net Leverage	-0.023***	0.176***
	(11.24)	(15.08)
Cashflow	0.020***	-0.090***
	(8.89)	(4.95)
Tobin's Q	0.004***	-0.013***
	(9.25)	(5.08)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	17,427	23,760
Adjusted R^2	0.13	0.07

Considering this information, it seems that companies with a higher amount of intangible capital are indeed financially constrained when compared to companies with lower amounts. Firstly, the fact their payouts are lower can indicate that they have a higher necessity to retain cash. Secondly, they experience more often not having enough internal funds to continue with recent investment trends. As panel A of Figure 4 (in the appendix) shows, almost 15% of HINT corporations between 2001 and 2022 experienced this situation every year, and it became more

common since 2017. Even so, I decided to analyze it more extensively in "4.6.2 Financial Constraints – Robustness Checks" as this can be a very strong indicator that firms could use more money lent by banks. The answer to the question of credit scarcity is in "4.7 Credit Scarcity Qualitative Analysis".

4.6 Robustness Checks

4.6.1 Results Using Only Firms from Countries that were Already in the European Union at the Start of the 21st Century

As it can be seen in Table 1 the average *Intangible Ratio* in 2022 is higher for countries that were already in the European Union at the beginning of the 21st century than those that joined it during this time period. While the average ratio in 2022 for the first ones was 0.647 units, it was only 0.444 units for the second group. Thus, I decided to run all the previous regressions again but this time only with firms from countries that were already in the EU at the start of the century. The results, which can be seen in Table 7 to Table 10 (in the appendix), show that all the conclusions that were derived previously are maintained when using this sub-sample. Looking at the new coefficients of the *Intangible Ratio* for all the different regressions and comparing them to those from the original ones it can be seen that, the ones who were already statistically significant remain so, the ones who were not are still not statistically significant, and all the relationships between the *Intangible Ratio* and the dependent variables are the same in terms of directions of movements when this independent variable increases. When looking at the number of observations included in the new regressions this was somewhat to be expected as they are not that distant from the number of observations of the regressions that used all the firms from all the countries. The nations that entered the union during this century have much less companies that, after the criteria chosen for excluding firms, made it into the final sample. This can be explained mainly due to the fact that most of these countries have low populations (Cyprus, Estonia, Latvia, Lithuania, Malta and Slovenia in 2021 had less than three million people, and only Romania and Poland had populations considerably above the ten million mark) and, consequently, less companies, especially public ones (which are the ones that are mainly available in Refinitiv Eikon's DataStream, the database used for this dissertation).

4.6.2 Financial Constraints – Robustness Checks

In respect to financial constraint, I decided to run the *Intangible Ratio* (together will the other control variables, of course) on other independent variables related to this subject. The first one is a variation of the variable *Total Payouts*, where the only difference is that, instead of dividing the sum of common dividends and the value of the acquisition cost of shares held by total assets, they are divided by operating earnings, as in Almeida et al., 2004, and in Denis and Sibikov, 2010. The results, which can be seen in the first column of Table 11, differ from the ones obtained previously since the value of the *Intangible Ratio* is no longer statistically significant. This means that the relation between having more non-physical assets and total payouts is statistically indistinguishable from having less and, consequently, when focusing the analysis solely on this metric, HINT corporations do not appear to be more financially constrained.

Given this difference in results regarding total payouts, I decided to run two more regressions involving total payouts. In Chen and Lai, 2012, one of the metrics that the authors use to analyze the issue of financial constraint through total payouts is to assign firms to a financially constrained group in case that their total payouts divided by operating income are in the bottom three deciles of the sample distribution of this variable. I decided to use this method both for total payouts divided by total assets and operating earnings. Thus, I created the dummy variables *Total Payouts/EBITDA 30th %ile.* and *Total Payouts/ 30th* %ile.. Total *Payouts/EBITDA 30th %ile.* takes the value of one for firms whose annual value of the sum of common dividends and the value of the acquisition cost of shares divided by operating income (that is, the variable Total *Payouts/EBITDA*) is in the lowest three deciles of the sample distribution of this variable for that year, and zero otherwise. *Payouts/Total assets 30th* %ile. is exactly the same, the only difference being the denominator (total assets instead of operating income). The results, present in the last two columns of Table 11, indicate that this methodology, regardless of the denominator used, shows that a higher *Intangible Ratio* is statistically significantly associated with more financial constraints. On average, and everything else constant, when the *Intangible Ratio* increases by one unit, the odds of being in the lowest three deciles of *Payouts/EBITDA 30th %ile.* increases by 13.8% (exp(0.129) is equal to 1.138), at a 1% significance level, and the odds of being in the lowest three deciles of *Total Payouts 30th %ile.* increases by 8.8% (exp(0.084) is equal to 1.088), at a 10% significance level.

Table 11 - *Intangible Ratio*: Effects on Financial Constraints (1st Robustness Checks)

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. Total *Payouts/EBITDA 30th %ile.* is a dummy variable that takes the value of one if a firm's Total *Payouts/EBITDA* is in the lowest three deciles of the sample distribution of this variable (zero otherwise). *Total Payouts 30th %ile.* is a dummy variable that takes the value of one if a firm's *Total Payouts* is in the lowest three deciles of the sample distribution of this variable (zero otherwise). ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively. For a detailed description of all the variables of this table and the sample used to compute it check Table 11 in the appendix.

Dependent Variable	*Total Payouts /EBITDA*	*Total Payouts/EBITDA 30th %ile.*	*Total Payouts 30th %ile.*
Intangible Ratio	0.008	0.129***	0.084*
	(0.43)	(2.72)	(1.71)
Ln Total Assets	0.017***	-0.039***	-0.045***
	(4.36)	(3.59)	(4.00)
Net Leverage	-0.082***	0.112***	0.122***
	(11.74)	(6.92)	(7.18)
Cashflow	0.054***	-0.167***	-0.178***
	(5.88)	(6.45)	(6.78)
Tobin's Q	0.007***	-0.012***	-0.009**
	(4.10)	(3.23)	(2.35)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	17,279	17,279	17,427
Adjusted R^2	0.06	0.03	0.03

Lastly, still regarding financial constraints, I decided to run two more regressions. As the variable *Cash Shortfalls* used previously only considers investments made on the three previous years, I decided to regress the *Intangible Ratio* on it again, but, this time, *Cash Shortfalls 5yrs.* takes the value of one if the sum of cashflows available to invest and cash holdings, both at the start of the year, are less than the average total investments of the five previous years (instead of three). The rationale behind this is that many investments made by firms require high amounts and are not made frequently. Thus, by increasing the years considered, the values of these investments are diminished. As it can be seen in first column of Table 12, the value of the coefficient of the *Intangible Ratio* practically does not differ from the first one. It is still statistically significant at the 1% level and the value of the coefficient is 0.131, while the

original one was 0.119. Companies with a higher *Intangible Ratio* still seem more likely to experience cash shortfalls.

To try to understand if the signs of financial constraints that come with having a higher *Intangible Ratio* could translate into financial distress problems, I decided to regress it on a slightly different version of the interest coverage ratio, that is EBITDA divided by the interest expense. The result obtained for the coefficient, present in the second column of Table 12, is not statistically significant, what points to firms having more intangible assets not struggling more to pay the interest on their debt than firms with less. Considering that their D/E ratios are also lower (the average D/E for HINT firms during the sample period is 0.533 while the average for LINT is 0.727, as shown in Table 2), it seems unlikely that corporations with more non-physical assets, in relative terms, are more prone to financial distress.

Table 12 - *Intangible Ratio*: Effects on Financial Constraints (2nd Robustness Checks)

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Cash Shortfalls 5yrs.* is a dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents, both at the start of the year, are lower than the average *Total Investment* of the past three years (otherwise, it takes the value of zero). *Interest Coverage Ratio* is operating earnings divided by the interest expense. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively. For a detailed description of all the variables of this table and the sample used to compute it check Table 12 in the appendix.

Dependent Variable	*Cash Shortfalls 5yrs.*	*Interest Coverage Ratio*
Intangible Ratio	0.131***	2.768
	(3.86)	(0.69)
Ln Total Assets	0.038***	-0.799
	(4.96)	(0.91)
Net Leverage	0.165***	-30.067***
	(12.71)	(16.48)
Cashflow	-0.186***	10.063***
	(9.37)	(4.50)
Tobin's Q	-0.009***	4.385**
	(3.19)	(8.63)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	20,863	24,478
Adjusted R^2	0.07	0.11

4.7 Credit Scarcity Qualitative Analysis

All in all, companies from the European Union with a higher *Intangible Ratio* seem to be credit constrained. As already said, the fact that their total payouts are lower is indicative of a higher necessity to retain cash and they do experience more often not having enough internal funds to continue recent investment trends. This is not surprising as we have seen that a higher *Intangible Ratio* is both statistically associated with more investments and lower cash holdings. Additionally, the fact that granting stock options to employees is also not a common practice for European firms with more intangible capital further increases the need for cash. This is due to corporations being able to "self-finance the retention of human capital by granting deferred equity compensation" (Döttling et al., 2018), which they do not, and, consequently, they need cash to retain human capital, which is crucial for investing is intangible assets. Taking into consideration that literature has shown that it is harder to get access to credit when a company's assets are mainly non-physical (Hart and Moore, 1994) and that these companies should "hold a greater cash buffer against future shocks to internally generated cash flow" (Bates et al., 2009) as they struggle more to get access to credit, all the signs point to European Union firms with a higher Intangible Ratio being credit constrained.

These results differ from the ones reached in Döttling et al., 2018, in which the authors conclude that companies with a higher relative amount of intangible capital are able to self-finance themselves. Firstly, I found that a higher *Intangible Ratio* was associated with less *Cash Holdings* and more *Total Investment*, both in opposition to what the cited paper concluded. Secondly, a higher *Intangible Ratio* was not associated with more stock options given to employees, but it was with more financial constraints, both in contrary to what their paper found.

5. Conclusion

Corporations with few physical collateral to pledge have been proven to face difficulties in getting access to credit. Due to the growing number of firms that rely mainly on intangible assets, the lack of consensus about whether or not they are credit constrained, and the existence of very few analyses of this topic regarding firms outside the U.S., I studied this possibility with a dataset composed by companies from all European Union Member States during the 21st century.

I concluded that having in relative amounts more intangible capital is statistically associated with lower leverage and cash holdings. Firms with this characteristic were also shown to invest more, but, at the same time, to not reward their employees more with stock options, which is often the case when human capital investments are frequently made, as it diminishes the need for cash to retain employees responsible for them. Finally, I found that these types of companies are more prone to experience financial constraints, what seems like a natural consequence of investing more and, at the same time, having lower cash holdings and not rewarding their employees more with stock options. Considering their difficulty to get access to credit, their higher probability of experiencing financial constraints and lower cash holdings (when they should "hold a greater cash buffer against future shocks to internally generated cash flow" (Bates et al., 2009) as they struggle more to get access to credit), I concluded that they do indeed lack credit.

Although most was developed around U.S. firms, these findings go against the literature that found that companies with higher amounts of non-physical assets hold more cash holdings (Bates et al., 2009; Falato et al., 2022). Furthermore, it supports the hypothesis that they are indeed credit constrained, in contrary to the side that argues that they are able to self-finance themselves.

To conclude, given the importance of this topic as increasingly more companies invest, and mainly have intangible assets, a trend that all signs seem to point will continue happening in the foreseeable future as technology keeps on developing, it is fundamental to have a clear answer to the ongoing debate of credit scarcity regarding these companies. While this dissertation analyzes this problem solely in the European Union, something that is not common, it relied on a database that mainly has information for large publicly traded firms (Refinitiv Eikon's DataStream). Consequently, it would be important to know if these results are maintained using samples that include SME and private corporations, for example. Additionally, there are different measures of accounting intangible assets/investment and analyzing financial constraint, which, for length and simplicity reasons, this thesis could not go into. Nonetheless, if further research confirms the stated findings, it is crucial for the banking system and governments to rethink how firms like these can get access to the needed credit.

Bibliography

Almeida, Heitor, Murillo Campello, and Michael S. Weisbach, 2004, The cash flow sensitivity of cash, *The Journal of Finance* 59, 1777-1804.

Bates, Thomas W., Kathleen M. Kahle, and Ren M. Stulz, 2009, Why do U.S. firms hold so much more cash than they used to?, *Journal of Finance* 64, 1985-2021.

Benmelech, Efraim, 2009, Asset salability and debt maturity: evidence from nineteenth-century American railroads, *The Review of Financial Studies* 22, 1545-1584.

Borisova, Ginka, and James R. Brown, 2013, R&D sensitivity to asset sale proceeds: New evidence on financing constraints and intangible investment, *Journal of Banking & Finance* 37, 159-173.

Bronwyn H. Hall, 2007, Measuring returns to R&D: the depreciation problem, Working Paper, National Bureau of Economic Research.

Campello, Murillo, and Erasmo Giambona, 2013, Real assets and capital structure, *Journal of Financial and Quantitative Analysis* 48, 1333-1370.

Chen, Chen, and Shufang Lai, 2012, Financial constraint and tax aggressiveness, *Journal of Financial Economics* 11, 1-41.

Corrado, Carol A., Charles R. Hulten, and Daniel Sichel, 2009, Intangible capital and U.S. economic growth, *The Review of Income and Wealth* 55, 661-685.

Corrado, Carol A., Haskel, Jonathon, Jona-Lasinio, Cecilia, and Iommi Massimiliano, 2018, Intangible investment in the EU and US before and since the great recession and its contribution to productivity growth, *Journal of Infrastructure, Policy and Development* 2, 11-36.

Corrado, Carol A., Haskel, Jonathon, Jona-Lasinio, Cecilia and Iommi M Massimiliano, 2022, Intangible capital and modern economies, *Journal of Economic Perspectives* 36, 3-28.

Dell'Ariccia, Giovanni, Dalida Kadyrzhanova, Camelia Minoiu, and Lev Ratnovski, 2021, Bank lending in the knowledge economy, *The Review of Financial Studies* 34, 5036-5076.

Denis, David J., and Valeriy Sibilkov, 2010, Financial constraints, investment, and the value of cash holdings, *Review of Financial Studies* 23, 247–269.

Döttling, Robin, Tomislav Ladika, and Enrico Perotti, 2018, The (self-)funding of intangibles, CEPR Discussion Paper Series, 2444.

Falato, Antonio, Dalida Kadyrzhanova, Jae Sim, Roberto Steri, 2022, Rising intangible capital, shrinking debt capacity, and the U.S. corporate savings glut, *The Journal of Finance* 77, 2799-2852.

Hadlock, Charles J., and Joshua R. Pierce, 2010, New evidence on measuring financial constraints: Moving beyond the kz index, *Review of Financial Studies* 23, 1909–1940.

Hart, Oliver, and John Moore, 1994, A theory of debt based on the inalienability of human capital, *The Quarterly Journal of Economics* 109, 841-879.

Mann, William, 2018, Creditor rights and innovation: Evidence from patent collateral, *Journal of Financial Economics* 130, 25-47.

Opler, Tim C., and Sheridan Titman, 1994, Financial distress and corporate performance, *The Journal of Finance* 49, 1015-1040.

Opler, Tim, Lee Pinkowitz, Rene Stulz, and Rohan Williamson, 1999, The determinants and implications of corporate cash holdings, *Journal of Financial Economics* 52, 3–46.

Peters, Ryan H., and Lucian A. Taylor, 2016, Intangible capital and the investment-q relation, 2017, *Journal of Financial Economics* 123, 251-272.

Pinkowitz, Lee, René M. Stulz, and Rohan Williamson, 2016, Do U.S. Firms hold more cash than foreign firms do?, *The Review of Financial Studies* 29, 309-348.

Rampini, Adriano A., and Sridhar Viswanathan, 2010, Collateral, risk management, and the distribution of debt capacity, *The Journal of Finance* 65, 2293-2322.

Rampini, Adriano A., Sridhar Viswanathan, 2013, Collateral and capital Structure, *Journal of Financial Economics* 109, 466-492

Sun, Qi, and Mindy Z. Xiaolan, 2019, Financing Intangible Capital, *Journal of Financial Economics* 133, 564-588.

Appendix

Variables Definition (1/2):

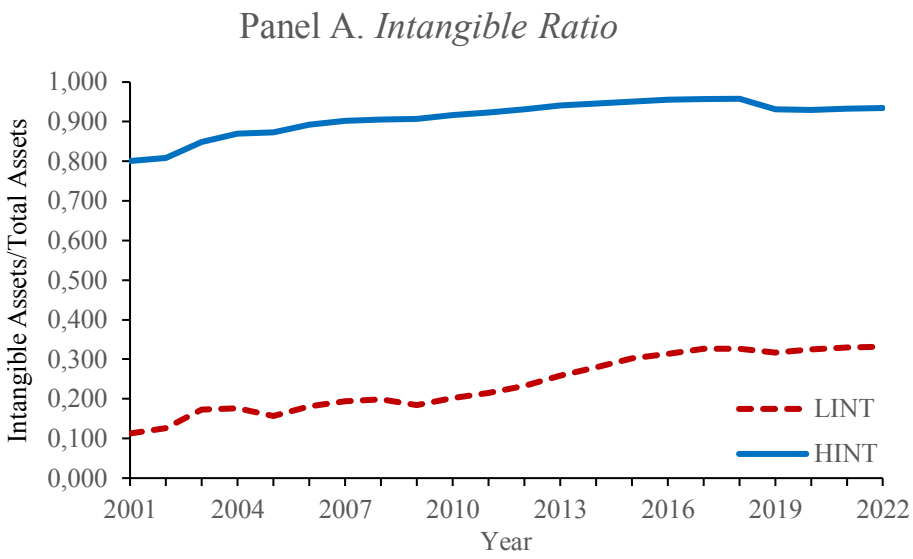
Variable	Definition
Cashflows Available to Fund Investment	Operating earnings (EBITDA - WC18198) minus interest expense on debt (WC01251) and income taxes (WC01451), all of the previous year, plus tangible investment and intangible investment of the current year.
Intangible Assets	The value of total intangible other assets net (WC02649) plus current and past years' R&D expenses (WC03255) plus thirty percent of the value of current and past years' SG&A expenses (WC01101), each subtracted by the respective year's R&D expense. For past years' expenses a depreciation rate of 20% was assumed.
Tangible Assets	The value of PPE net (WC02501).
Total Assets	The sum of intangible and tangible assets.
Intangible Ratio	Intangible assets divided by total assets. This variable is winsorized at the 5-95 level.
Ln Total Assets	The natural logarithm of total assets. This variable is winsorized at the 5-95 level.
Net Leverage	Total debt (WC03255) minus cash & equivalents (generic) (WC02005), both divided by total assets. This variable is winsorized at the 5-95 level.
Cashflow	Cashflows available to fund investment divided by total assets. This variable is winsorized at the 5-95 level.
Tobin's Q	Total debt (WC03255) plus market capitalization (WC08001) minus current assets (WC02201), all divided by total assets. This variable is winsorized at the 5-95 level.
Leverage	The value of the D/E ratio (WC08231). This variable is winsorized at the 5-95 level.
Cash Holdings	Cash & equivalents (generic) (WC02005) divided by total assets. This variable is winsorized at the 5-95 level.
Tangible Investment	The annual change in PPE net (WC2501) divided by cashflows available to fund investment. If this change was negative it takes the value of zero. This variable is winsorized at the 5-95 level.
Intangible Investment	The annual change in total intangible other assets net (WC02649) plus the annual R&D expense (WC01201) plus thirty percent of the value of the annual SG&A expense (WC01101) subtracted by the annual R&D expense. Everything is divided by cashflows available to fund investment. If the annual change in total intangible other assets net was negative, it assumes the value of zero for it (for the annual change in total intangible other assets net and not for *Intangible Investment*). This variable is winsorized at the 5-95 level.
Total Investment	The sum of *Tangible Investment* and *Intangible Investment*. This variable is winsorized at the 5-95 level.
Stock Options	Stock option compensation expense net of tax (WC18321) divided by market capitalization (WC08001). This variable is winsorized at the 5-95 level.
Share Repurchases /Total Payouts	The value of acquisition cost of shares held by the company (Treasury Stock - WC03499) divided by total assets, divided by *Total Payouts*. This variable is winsorized at the 5-95 level.
Total Payouts	Common dividends (cash) (WC05376) divided by total assets, plus the value of the acquisition cost of shares held by the company (Treasury Stock - WC03499) divided by total assets. This variable is winsorized at the 5-95 level.
Cash Shortfalls	Dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents (generic) (WC02005), both at the start of the year, are lower than the average *Total Investment* of the past three years. Otherwise, it takes the value of zero.

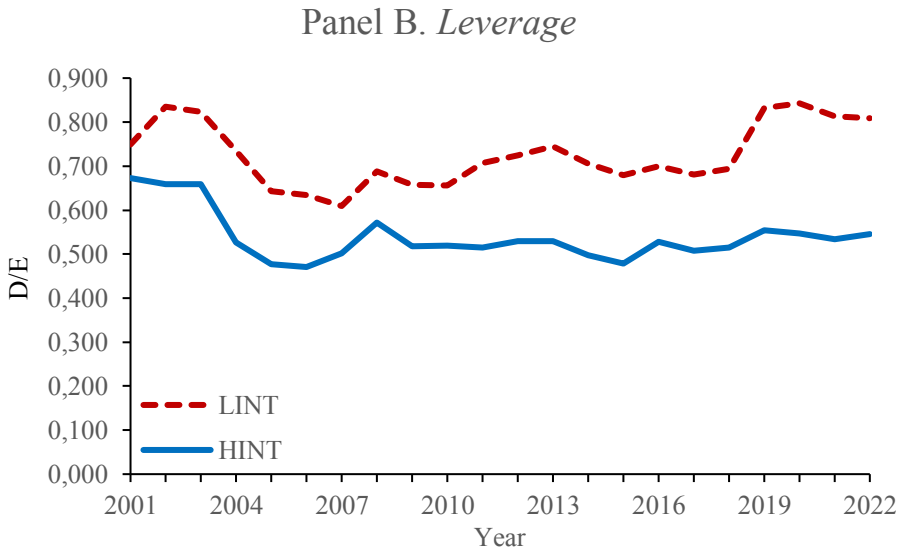
Variables Definition (2/2):

Variable	Definition
TotalPayouts/ EBITDA	Common dividends (cash) (WC05376) divided by operating earnings, plus the value of the acquisition cost of shares held by the company (Treasury Stock - WC03499) divided by operating earnings (EBITDA - WC18198). This variable is winsorized at the 5-95 level.
TotalPayouts /EBITDA 30th %ile.	Dummy variable that takes the value of one if a firm's annual *Payouts/EBITDA* is in the lowest three deciles of the sample distribution of this variable. This variable is winsorized at the 5-95 level.
Total Payouts 30th %ile.	Dummy variable that takes the value of one if a firm's annual *Total Payouts* is in the lowest three deciles of the sample distribution of this variable. This variable is winsorized at the 5-95 level.
Cash Shortfalls 5yrs.	Dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents (generic) (WC02005), both at the start of the year, are lower than the average *Total Investment* of the past five years. Otherwise, it takes the value of zero.
Interest Coverage Ratio	Interest expense on debt (WC01251) divided by operating earnings (EBITDA - WC18198). This variable is winsorized at the 5-95 level.

Figure 1 – High- vs Low-Intangibles Firms: *Intangible Ratio*, *Leverage* and *Cash Holdings*

The panels show the yearly average values for each type of firm. Firms are classified yearly as HINT if their annual *Intangible Ratio* is in the highest tercile of the sample distribution of this variable and LINT if it is in the lowest. *Intangible Ratio* is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses).





Panel C. *Cash Holdings*

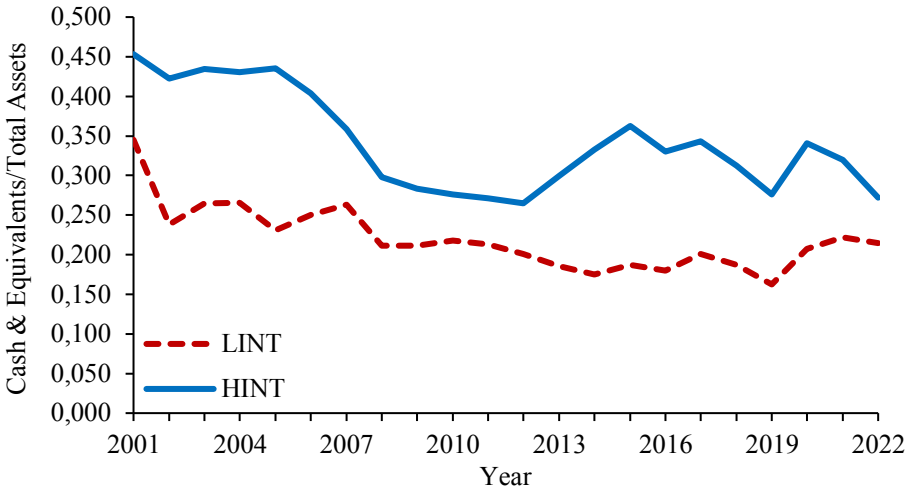
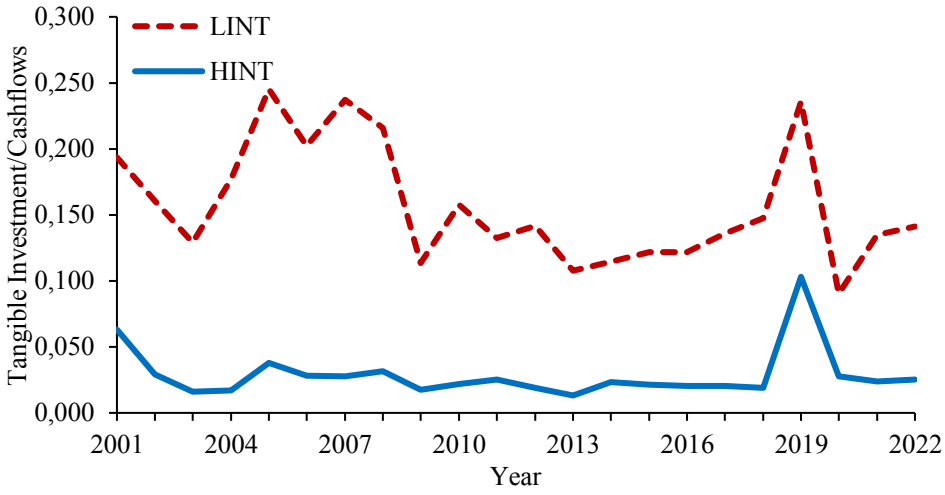


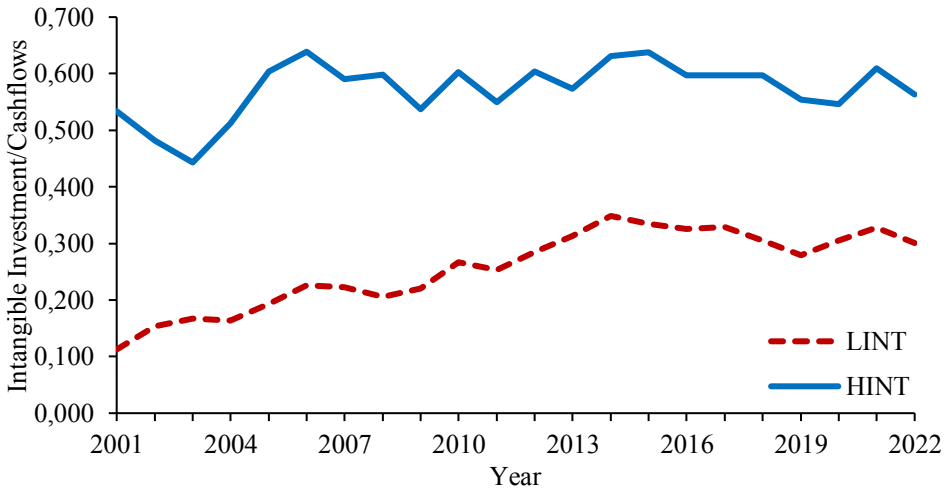
Figure 2 – High- vs Low-Intangibles Firms: *Tangible*, *Intangible* and *Total Investment*

The panels show the yearly average values for each type of firm. Cashflows in the denominators correspond to cashflows available to fund investment. Firms are classified yearly as HINT if their annual *Intangible Ratio* is in the highest tercile of the sample distribution of this variable and LINT if it is in the lowest. *Intangible Ratio* is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Tangible Investment* is the annual change in PPE net divided by cashflows available to fund investment. Cashflows available to fund investment is operating earnings (EBITDA) minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year. *Intangible Investment* is the annual change in total intangible other assets net plus the annual R&D expense plus thirty percent of the value of the annual SG&A expense subtracted by the annual R&D expense, everything divided by cashflows available to fund investment. *Total Investment* is the sum of *Tangible Investment* and *Intangible Investment.*

Panel A. *Tangible Investment*



Panel B. *Intangible Investment*



Panel C. *Total Investment*

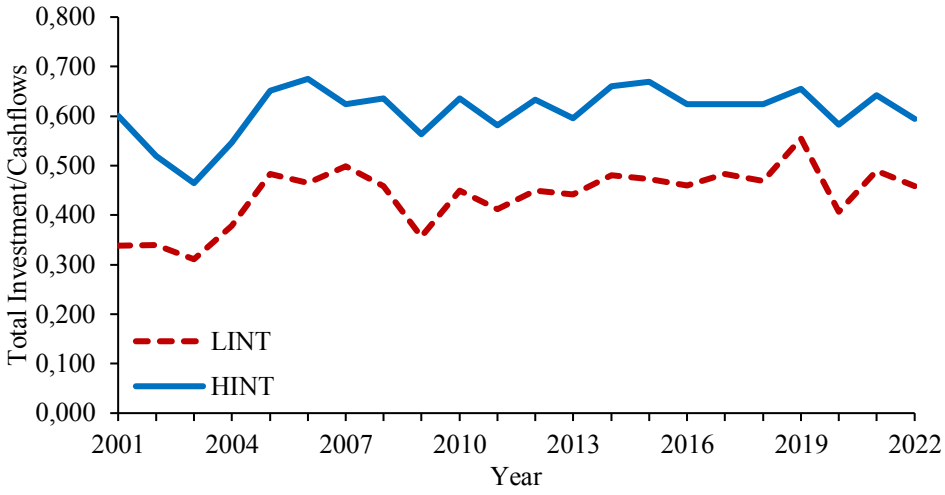
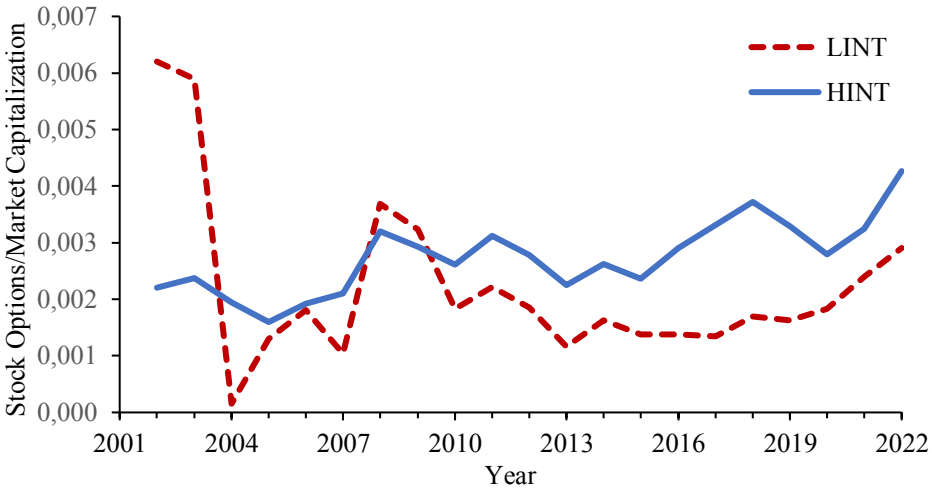


Figure 3 – High- vs Low-Intangibles Firms: *Stock Options* and *Share Repurchases/Total Payouts*

The panels show the yearly average values for each type of firm. Firms are classified yearly as HINT if their annual *Intangible Ratio* is in the highest tercile of the sample distribution of this variable and LINT if it is in the lowest. *Intangible Ratio* is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Stock Options* is stock option compensation expense net of tax divided by market capitalization. *Share Repurchases/Total Payouts* is the value of the acquisition cost of shares held by the company divided by total assets, divided by *Total Payouts*. *Total Payouts* are common dividends divided by total assets, plus the value of the acquisition cost of shares held by the company divided by total assets.

Panel A. *Stock Options*



Panel B. *Share Repurchases/Total Payouts*

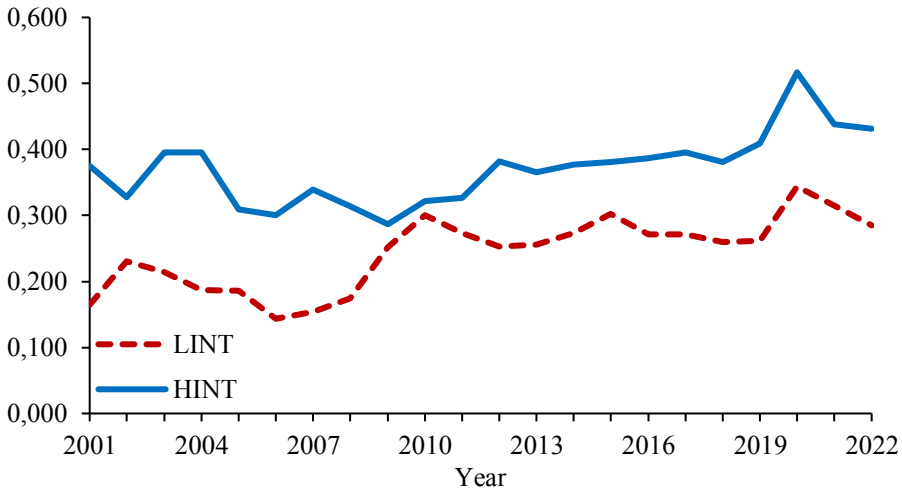
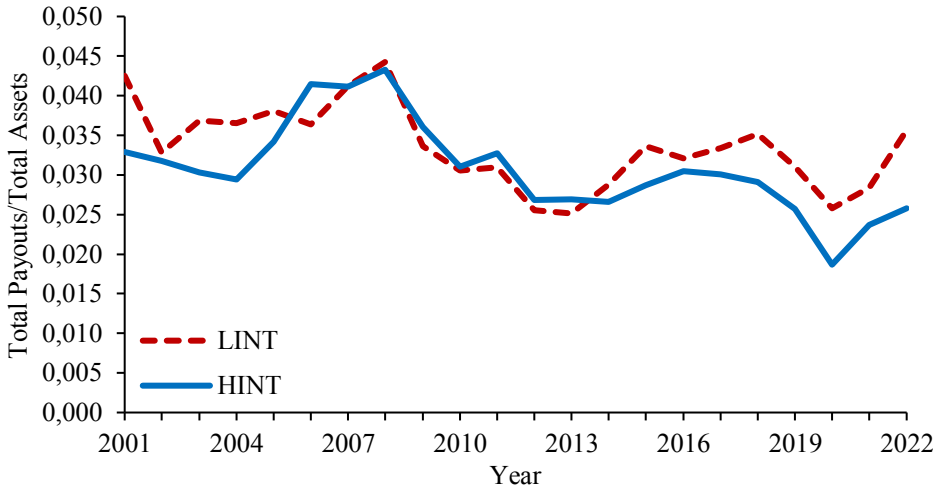


Figure 4 - High- vs Low-Intangibles Firms: *Total Payouts* and *Cash Shortfalls*

The panels show the yearly average values for each type of firm. Firms are classified yearly as HINT if their annual *Intangible Ratio* is in the highest tercile of the sample distribution of this variable and LINT if it is in the lowest. *Intangible Ratio* is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Total Payouts* are common dividends divided by total assets, plus the value of the acquisition cost of shares held by the company divided by total assets. *Cash Shortfalls* is a dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents, both at the start of the year, are lower than the average *Total Investment* of the past three years (otherwise, it takes the value of zero). *Tangible Investment* is the annual change in PPE net divided by cashflows available to fund investment. Cashflows available to fund investment is operating earnings (EBITDA) minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year. *Intangible Investment* is the annual change in total intangible other assets net plus the annual R&D expense plus thirty percent of the value of the annual SG&A expense subtracted by the annual R&D expense, everything divided by cashflows available to fund investment. *Total Investment* is the sum of *Tangible Investment* and *Intangible Investment.*

Panel A. *Total Payouts*



Panel B. % of Firms That Expirience *Cash Shortfalls*

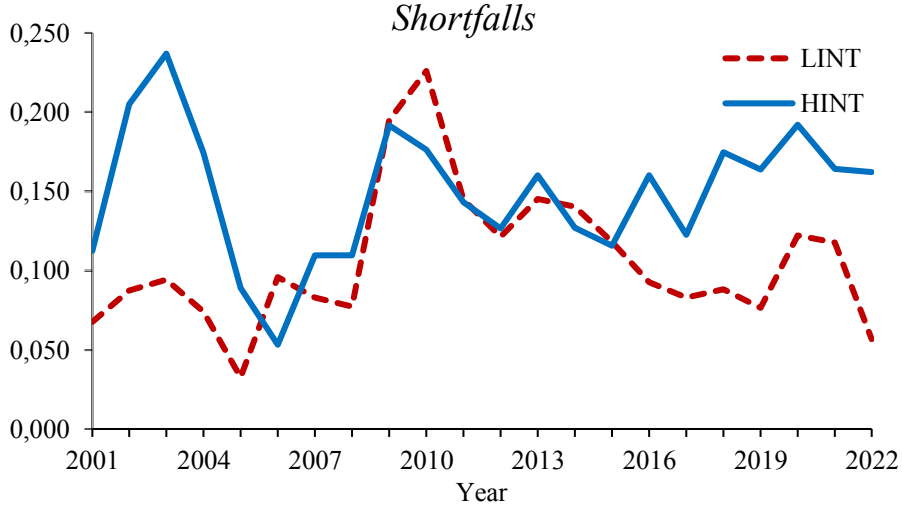


Table 1 - *Intangible Ratio* Growth Across European Union Member States

The first three columns show the average *Intangible Ratio* value for each country (the first two of the first year in which each nation is in the sample). *Intangible Ratio* is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). Countries that joined the European Union after 2006 are not present in this table for presentation reasons. The sample has 1,781 firms from all the different countries of the European Union and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, or were not active until 2022. Firms from countries that joined the European Union during the 21st century are included in the sample starting from their nation's adhesion year.

Country	*Intangible Ratio* in 2001	*Intangible Ratio* in 2006	*Intangible Ratio* in 2022	Change
Spain	0,291	-	0,646	0,355
Finland	0,402	-	0,739	0,336
Netherlands	0,406	-	0,717	0,311
Denmark	0,377	-	0,682	0,305
Belgium	0,372	-	0,657	0,285
Sweeden	0,569	-	0,821	0,251
Austria	0,229	-	0,496	0,268
Germany	0,498	-	0,729	0,231
Ireland	0,373	-	0,554	0,180
Greece	0,262	-	0,438	0,177
France	0,596	-	0,758	0,163
Italy	0,560	-	0,713	0,153
Portugal	0,545	-	0,709	0,164
Luxembourg	0,505	-	0,402	-0,103
Sub-Sample Average	0,428	-	0,647	0,220
Czech Republic	-	0,066	0,617	0,550
Lithuania	-	0,212	0,405	0,193
Estonia	-	0,345	0,544	0,199
Poland	-	0,392	0,557	0,165
Latvia	-	0,302	0,481	0,179
Cyprus	-	0,230	0,332	0,102
Slovenia	-	0,271	0,313	0,041
Malta	-	0,344	0,376	0,032
Hungary	-	0,447	0,369	-0,078
Sub-Sample Average	-	0,290	0,444	0,154
Entire Sample Average	-	-	0,568	0,194

Table 2 - High-Intangible and Low-Intangible Firms Summary Statistics

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Leverage* is the debt-to-equity ratio. *Cash Holdings* is cash & equivalents divided by total assets. *Tangible Investment* is the annual change in PPE net divided by cashflows available to fund investment. Cashflows available to fund investment is operating earnings (EBITDA) minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year. *Intangible Investment* is the annual change in total intangible other assets net plus the annual R&D expense plus thirty percent of the value of the annual SG&A expense subtracted by the annual R&D expense, everything divided by cashflows available to fund investment. *Total Investment* is the sum of *Tangible Investment* and *Intangible Investment. Stock Options* is stock option compensation expense net of tax divided by market capitalization. *Share Repurchases/Total Payouts* is the value of the acquisition cost of shares held by the company divided by total assets, divided by *Total Payouts*. *Total Payouts* are common dividends divided by total assets, plus the value of the acquisition cost of shares held by the company divided by total assets. *Cash Shortfalls* is a dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents, both at the start of the year, are lower than the average *Total Investment* of the past three years (otherwise, it takes the value of zero). The sample has 1,781 firms from all the different countries of the European Union and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, or were not active until 2022. Firms from countries that joined the European Union during the 21st century are included in the sample starting from their nation's adhesion year. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

	HINT Firms				LINT Firms				
	Mean	Median	St. Dev	No. Obs	Mean	Median	St. Dev	No. Obs	Diff.
Intangible Ratio	0,919	0,937	0,069	10029	0,256	0,240	0,148	9935	0.663***
Ln Total Assets	11,387	11,078	2,295	10028	11,526	11,224	2,020	9935	-1.39***
Net Leverage	-0,061	0,001	0,453	9932	0,215	0,249	0,417	9890	-0.277***
Cashflow	0,271	0,246	0,226	9163	0,261	0,236	0,189	9142	0.011***
Tobin's Q	1,486	0,844	1,825	9119	0,899	0,582	1,280	9177	0.587***
Leverage	0,533	0,256	0,714	9878	0,727	0,482	0,772	9854	-0.194***
Cash Holdings	0,332	0,176	0,379	10024	0,212	0,097	0,296	9925	0.120***
Tangible Invest.	0,029	0,000	0,069	8629	0,151	0,049	0,185	8694	-0.122***
Intangible Invest.	0,579	0,591	0,367	8629	0,278	0,230	0,258	8694	0.301***
Total Investment	0,615	0,623	0,394	8629	0,452	0,429	0,317	8694	0.163***
Stock Options	0,003	0,002	0,003	1921	0,002	0,001	0,003	674	0.001***
Share Repurchases /Total Payouts	0,376	0,174	0,416	3911	0,260	0,000	0,386	4577	0.117***
Total Payouts	0,029	0,009	0,042	6434	0,032	0,016	0,042	6188	-0,003***
Cash Shortfalls	0,151	0,000	0,358	7864	0,109	0,000	0,312	7706	0.041***

Table 3 - *Intangible Ratio*: Effects on *Leverage* and *Cash Holdings*

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Leverage* is the debt-to-equity ratio. *Cash Holdings* is cash & equivalents divided by total assets. The sample has 1,781 firms from all the different countries of the European Union and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, or were not active until 2022. Firms from countries that joined the European Union during the 21st century are included in the sample starting from their nation's adhesion year. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Leverage*	*Cash Holdings*
Intangible Ratio	-0.382***	-0.095***
	(4.73)	(2.75)
Ln Total Assets	0.147***	-0.062***
	(9.24)	(10.87)
Net Leverage	-	-0.260***
	-	(20.68)
Cashflow	-0.095***	0.023*
	(2.65)	(1.72)
Tobin's Q	-0.012**	0.024***
	(2.09)	(8.89)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	25,184	25,304
Adjusted R^2	0.13	0.23

Table 4 - *Intangible Ratio*: Effects on Investment Types and Amounts

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Tangible Investment* is the annual change in PPE net divided by cashflows available to fund investment. Cashflows available to fund investment is operating earnings (EBITDA) minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year. *Intangible Investment* is the annual change in total intangible other assets net plus the annual R&D expense plus thirty percent of the value of the annual SG&A expense subtracted by the annual R&D expense, everything divided by cashflows available to fund investment. *Total Investment* is the sum of *Tangible Investment* and *Intangible Investment.* The sample has 1,781 firms from all the different countries of the European Union and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, or were not active until 2022. Firms from countries that joined the European Union during the 21st century are included in the sample starting from their nation's adhesion year. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Tangible Investment*	*Intangible Investment*	*Total Investment*
Intangible Ratio	-0.318***	0.644***	0.274***
	(21.37)	(22.20)	(7.73)
Ln Total Assets	-0.018***	0.005	-0.018***
	(7.57)	(0.77)	(2.70)
Net Leverage	-0.020***	0.019*	0.000
	(4.48)	(1.90)	(0.01)
Cashflow	0.063***	-0.012	0.042**
	(9.75)	(0.77)	(2.33)
Tobin's Q	0.004***	-0.005*	-0.002
	(3.50)	(1.90)	(0.74)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	24,946	24,946	24,946
Adjusted R^2	0.14	0.08	0.03

Table 5 - *Intangible Ratio*: Effects on Employee's Stock Options Compensation and on the Relative Amount of Share Repurchases

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Stock Options* is stock option compensation expense net of tax divided by market capitalization. *Share Repurchases/Total Payouts* is the value of the acquisition cost of shares held by the company divided by total assets, divided by *Total Payouts*. *Total Payouts* are common dividends divided by total assets, plus the value of the acquisition cost of shares held by the company divided by total assets. The sample has 1,781 firms from all the different countries of the European Union and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, or were not active until 2022. Firms from countries that joined the European Union during the 21st century are included in the sample starting from their nation's adhesion year. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Stock Options*	*Share Repurchases/Total Payouts*
Intangible Ratio	0.000	0.070
	(0.59)	(1.36)
Ln Total Assets	0.000	-0.023*
	(0.32)	(1.88)
Net Leverage	0.000	0.063***
	(0.76)	(3.49)
Cashflow	0.000	-0.156***
	(1.10)	(5.86)
Tobin's Q	0.000**	-0.018***
	(2.54)	(4.28)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	4,150	13,086
Adjusted R^2	0.05	0.04

Table 6 - *Intangible Ratio*: Effects on Financial Constraints

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Total Payouts* are common dividends divided by total assets, plus the value of the acquisition cost of shares held by the company divided by total assets. *Cash Shortfalls* is a dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents, both at the start of the year, are lower than the average *Total Investment* of the past three years (otherwise, it takes the value of zero). *Tangible Investment* is the annual change in PPE net divided by cashflows available to fund investment. Cashflows available to fund investment is operating earnings (EBITDA) minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year. *Intangible Investment* is the annual change in total intangible other assets net plus the annual R&D expense plus thirty percent of the value of the annual SG&A expense subtracted by the annual R&D expense, everything divided by cashflows available to fund investment. *Total Investment* is the sum of *Tangible Investment* and *Intangible Investment.* The sample has 1,781 firms from all the different countries of the European Union and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, or were not active until 2022. Firms from countries that joined the European Union during the 21st century are included in the sample starting from their nation's adhesion year. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Total Payouts*	*Cash Shortfalls*
Intangible Ratio	-0.011**	0.119***
	(2.31)	(4.11)
Ln Total Assets	-0.002**	0.050***
	(2.48)	(7.98)
Net Leverage	-0.023***	0.176***
	(11.24)	(15.08)
Cashflow	0.020***	-0.090***
	(8.89)	(4.95)
Tobin's Q	0.004***	-0.013***
	(9.25)	(5.08)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	17,427	23,760
Adjusted R^2	0.13	0.07

Table 7 - *Intangible Ratio*: Effects on *Leverage* and *Cash Holdings* (Sample Only with Firms from Countries that were Already in the European Union at the Start of the 21st Century)

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Leverage* is the debt-to-equity ratio. *Cash Holdings* is cash & equivalents divided by total assets. The sample used for this table has 1,345 firms from all the different countries that were already in the European Union before 2001 and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, were not active until 2022, or if they are from a country that joined the European Union during the 21st century. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Leverage*	*Cash Holdings*
Intangible Ratio	-0.288***	-0.124**
	(3.31)	(3.06)
Ln Total Assets	0.066***	-0.067***
	(3.95)	(10.62)
Net Leverage	0.687***	-0.264***
	(20.32)	(18.68)
Cashflow	0.012	0.023
	(0.31)	(1.44)
Tobin's Q	0.011*	0.025***
	(1.92)	(8.27)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	19,895	19,977
Adjusted R^2	0.14	0.26

Table 8 - *Intangible Ratio*: Effects on Investment Types and Amounts (Sample Only with Firms from Countries that were Already in the European Union at the Start of the 21st Century)

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Tangible Investment* is the annual change in PPE net divided by cashflows available to fund investment. Cashflows available to fund investment is operating earnings (EBITDA) minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year. *Intangible Investment* is the annual change in total intangible other assets net plus the annual R&D expense plus thirty percent of the value of the annual SG&A expense subtracted by the annual R&D expense, everything divided by cashflows available to fund investment. *Total Investment* is the sum of *Tangible Investment* and *Intangible Investment.* The sample used for this table has 1,345 firms from all the different countries that were already in the European Union before 2001 and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, were not active until 2022, or if they are from a country that joined the European Union during the 21st century. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Tangible Investment*	*Intangible Investment*	*Total Investment*
Intangible Ratio	-0.295***	0.660***	0.320***
	(17.57)	(19.51)	(7.62)
Ln Total Assets	-0.011***	0.002**	-0.014*
	(4.61)	(0.24)	(1.69)
Net Leverage	-0.020***	0.010	-0.006
	(4.01)	(0.86)	(0.45)
Cashflow	0.055***	0.006	0.046**
	(7.98)	(0.29)	(2.18)
Tobin's Q	0.002**	-0.005*	-0.004
	(2.05)	(1.71)	(1.12)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	19,710	19,710	19,710
Adjusted R^2	0.15	0.09	0.04

Table 9 - *Intangible Ratio*: Effects on Employee's Stock Options Compensation and on the Relative Amount of Share Repurchases (Sample Only with Firms from Countries that were Already in the European Union at the Start of the 21st Century)

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Stock Options* is stock option compensation expense net of tax divided by market capitalization. *Share Repurchases/Total Payouts* is the value of the acquisition cost of shares held by the company divided by total assets, divided by *Total Payouts*. *Total Payouts* are common dividends divided by total assets, plus the value of the acquisition cost of shares held by the company divided by total assets. The sample used for this table has 1,345 firms from all the different countries that were already in the European Union before 2001 and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, were not active until 2022, or if they are from a country that joined the European Union during the 21st century. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Stock Options*	*Share Repurchases/Total Payouts*
Intangible Ratio	0.000	0.153***
	(0.46)	(2.99)
Ln Total Assets	0.000	-0.027**
	(0.52)	(2.10)
Net Leverage	0.000	0.070***
	(0.82)	(3.51)
Cashflow	0.000	-0.193***
	(1.05)	(6.46)
Tobin's Q	0.000***	-0.019***
	(2.63)	(4.16)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	4,028	10,590
Adjusted R^2	0.05	0.05

Table 10 - *Intangible Ratio*: Effects on Financial Constraints (Sample Only with Firms from Countries that were Already in the European Union at the Start of the 21st Century)

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Total Payouts* are common dividends divided by total assets, plus the value of the acquisition cost of shares held by the company divided by total assets. *Cash Shortfalls* is a dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents, both at the start of the year, are lower than the average *Total Investment* of the past three years (otherwise, it takes the value of zero). *Tangible Investment* is the annual change in PPE net divided by cashflows available to fund investment. Cashflows available to fund investment is operating earnings (EBITDA) minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year. *Intangible Investment* is the annual change in total intangible other assets net plus the annual R&D expense plus thirty percent of the value of the annual SG&A expense subtracted by the annual R&D expense, everything divided by cashflows available to fund investment. *Total Investment* is the sum of *Tangible Investment* and *Intangible Investment.* The sample used for this table has 1,345 firms from all the different countries that were already in the European Union before 2001 and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, were not active until 2022, or if they are from a country that joined the European Union during the 21st century. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Total Payouts*	*Cash Shortfalls*
Intangible Ratio	-0.017***	0.141***
	(3.12)	(4.63)
Ln Total Assets	-0.002**	0.041***
	(2.14)	(6.07)
Net Leverage	-0.021***	0.171***
	(9.59)	(13.15)
Cashflow	0.022***	-0.089***
	(8.56)	(4.29)
Tobin's Q	0.005***	-0.012***
	(9.07)	(4.36)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	13,901	19,104
Adjusted R^2	0.15	0.06

Table 11 - *Intangible Ratio*: Effects on Financial Constraints (1st Robustness Checks)

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. Total *Payouts/EBITDA* are common dividends divided by operating earnings, plus the value of the acquisition cost of shares held by the company divided by operating earnings. Total *Payouts/EBITDA 30th %ile.* is a dummy variable that takes the value of one if a firm's Total *Payouts/EBITDA* is in the lowest three deciles of the sample distribution of this variable (zero otherwise). *Total Payouts* are common dividends divided by total assets, plus the value of the acquisition cost of shares held by the company divided by total assets. *Total Payouts 30th %ile.* is a dummy variable that takes the value of one if a firm's *Total Payouts* is in the lowest three deciles of the sample distribution of this variable (zero otherwise). The sample has 1,781 firms from all the different countries of the European Union and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, or were not active until 2022. Firms from countries that joined the European Union during the 21st century are included in the sample starting from their nation's adhesion year. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Total Payouts /EBITDA*	*Total Payouts/EBITDA 30th %ile.*	*Total Payouts 30th %ile.*
Intangible Ratio	0.008	0.129***	0.084*
	(0.43)	(2.72)	(1.71)
Ln Total Assets	0.017***	-0.039***	-0.045***
	(4.36)	(3.59)	(4.00)
Net Leverage	-0.082***	0.112***	0.122***
	(11.74)	(6.92)	(7.18)
Cashflow	0.054***	-0.167***	-0.178***
	(5.88)	(6.45)	(6.78)
Tobin's Q	0.007***	-0.012***	-0.009**
	(4.10)	(3.23)	(2.35)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	17,279	17,279	17,427
Adjusted R^2	0.06	0.03	0.03

Table 12 - *Intangible Ratio*: Effects on Financial Constraints (2nd Robustness Checks)

Intangible Ratio is intangible assets divided by total assets, which are measured as the sum of tangible and intangible assets. Tangible assets are the value of PPE net. Intangible assets are measured as the value of total intangible other assets net plus current and past years' R&D expenses plus thirty percent of the value of current and past years' SG&A expenses, each subtracted by the respective year's R&D expense (a depreciation rate of 20% was used for past years expenses). *Ln Total Assets* is the natural logarithm of total assets. *Net Leverage* is total debt minus cash & equivalents, both divided by total assets. *Cashflow* is operating earnings minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year, everything divided by total assets. *Tobin's Q* is total debt plus market capitalization minus current assets, all divided by total assets. *Cash Shortfalls 5yrs.* is a dummy variable that takes the value of one if the sum of cashflows available to fund investment with cash & equivalents, both at the start of the year, are lower than the average *Total Investment* of the past five years (otherwise, it takes the value of zero). *Tangible Investment* is the annual change in PPE net divided by cashflows available to fund investment. Cashflows available to fund investment is operating earnings (EBITDA) minus interest expense and tax expense, all of the previous year, plus tangible investment and intangible investment of the current year. *Intangible Investment* is the annual change in total intangible other assets net plus the annual R&D expense plus thirty percent of the value of the annual SG&A expense subtracted by the annual R&D expense, everything divided by cashflows available to fund investment. *Total Investment* is the sum of *Tangible Investment* and *Intangible Investment. Interest Coverage Ratio* is operating earnings divided by the interest expense. The sample has 1,781 firms from all the different countries of the European Union and covers the years 2001 until 2022. Firms were excluded if they were from the financial and utilities sectors, had an average value of total assets during the entire sample period less than €5 million, or were not active until 2022. Firms from countries that joined the European Union during the 21st century are included in the sample starting from their nation's adhesion year. All dependent variables are lagged one year except the *Intangible Ratio*. The values that are in parentheses are t-statistics based on robust standard errors clustered at the firm level. ***, **, * are indicative of significance levels of 1%, 5%, and 10%, respectively.

Dependent Variable	*Cash Shortfalls 5yrs.*	*Interest Coverage Ratio*
Intangible Ratio	0.131***	2.768
	(3.86)	(0.69)
Ln Total Assets	0.038***	-0.799
	(4.96)	(0.91)
Net Leverage	0.165***	-30.067***
	(12.71)	(16.48)
Cashflow	-0.186***	10.063***
	(9.37)	(4.50)
Tobin's Q	-0.009***	4.385**
	(3.19)	(8.63)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	20,863	24,478
Adjusted R^2	0.07	0.11