
IPO Success of High-Technology Companies

Submitted 03/06/21, 1st revision 26/07/21, 2nd revision 13/08/21, accepted 30/9/21

Katarzyna Prędkiewicz¹, Marek Pauka², Paweł Prędkiewicz³

Abstract:

Purpose: The research aimed to verify whether high-technology companies are more successful during IPO than other low-technology peers.

Design/Methodology/Approach: We evaluated the IPO success using two measures: 1) relation of capital collected during IPO to the equity capital at the year-end of IPO, 2) underpricing. The analysis was based on the IPO of 334 companies on the Warsaw Stock Exchange in Poland from 2004 to 2018. According to Eurostat methodology, we measured technology level, and we divided companies into two groups, HT (high-tech) and LT (low-tech). Models were executed separately for the whole sample but also for each group. As control variables we have used, debt, profitability, size, and the bull market indicator.

Findings: Our empirical results confirmed that the more technologically advanced company (in terms of the sector in which the company operates), the lower success of IPO. The HT companies collect a relatively smaller amount of capital during IPO, and the underpricing is higher in the HT group. We link the results with a higher asymmetry of information.

Practical Implications: HT companies should pay special attention to lower the information asymmetry before the IPO by disclosing precise information about future development for better risk evaluation. HT should also raise a small amount of capital during the IPO and make secondary issues later when the company is more recognized in the market.

Originality/value: The previous research mainly focused on how going public impacts the innovation activities post-IPO. We did not find the previous literature studies on the IPO success of HT and LT firms. Some were related to underpricing, however, we extended measuring IPO success to additional indicator.

Keywords: Successful IPO, innovation, equity capital, underpricing.

JEL classification: G31, G10, D22.

Paper Type: Research study.

Acknowledgement: The project is financed by the Ministry of Science and Higher Education in Poland under the programme "Regional Initiative of Excellence" 2019 - 2022 project number 015/RID/2018/19 total funding amount 10 721 040,00 PLN.

¹Department of Finance, Wrocław University of Economics and Business, Poland, e-mail: katarzyna.predkiewicz@ue.wroc.pl

²Department of Finance, Wrocław University of Economics and Business, Poland, e-mail: marek.pauka@ue.wroc.pl

³Department of Finance, Wrocław University of Economics and Business, Poland, e-mail: pawel.predkiewicz@ue.wroc.pl

1. Introduction

Innovativeness as a competitive advantage attracts stock market investors, but at the same time, it may limit the possibilities of financing investments through traditional intermediaries such as banks. The reason, among other things, is the high asymmetry of information connected with more advanced technologically and innovative projects run by high-technology companies. Evaluation of such project is usually sophisticated, and the risk for a traditional capital provider is relatively higher. Then high technology firms are often forced to decide: to stay private or go public when additional equity capital is required. IPO then is the alternative to raising money from private investors (e.g., venture capital).

According to previous findings going public may have different impacts on companies' innovativeness. Bernstein (2015) finds that the quality of internal innovation declines post IPO. Aggarwal and Hsu (2013), claim that more extensive information disclosure may reduce the marginal benefit of introducing the innovation to the greatest extent, followed by another firm's acquisition, while remaining private involves the least information disclosure. However, on the other hand, the IPO of more technologically advanced companies may give the investors the chance to reach a higher rate of return. The investors on a stock exchange are dispersed which allows them to accept higher risk connected with the IPO of more technology-advanced companies. From the company's perspective, it potentially may allow conducting a more successful IPO and collect more capital.

Then, in this paper, we would like to answer the question, whether high-technology companies entering the stock market are more successful than low-technology peers. The previous research mainly focused on how going public impacts the innovation activities post-IPO. We did not find the previous literature studies on the IPO success of high and low-technology firms. Some research was related to underpricing; however, we extended measuring IPO success by introducing an additional indicator. The success for the company will be defined in the paper as raising as much capital as possible to the capital that the company already has at its disposal. Answering the research question will help take high-tech companies' decisions: whether to stay private or go public. Then we fill the gap in the research on IPO success of high-technology companies.

The rest of the paper is organized as follows. First, we review the previous studies, IPO and innovation, then IPO measures of success and IPO success factors. In the following third section, we describe data and methodology issues and show the characteristics of the sample companies. It is followed by the fourth section, where we report the empirical models, discuss results and present the robustness check section. Finally, in the last section, we conclude and discuss our results with previous findings. We also indicate the limitation of our research and outline the direction of future studies.

2. Literature Review

2.1 IPO and Innovation

Innovation appears one of the main driving forces of organizational success (Chatzoglou and Chatzoudes, 2017). However, introducing a new product or service is a long, complex process and requires capital. The nature of innovation may impact the probability of success when additional funds for financing innovation are raised. The returns on innovative activities are uncertain and make innovation much riskier to finance (Coad *et al.*, 2016; Hall, 2002; Mazzucato, 2013). Insider managers hold private information about the expected return and variance of returns on their firm's assets, while outside investors are less informed about the firm's value (Carpenter and Petersen, 2002; de Rassenfosse *et al.*, 2011; Stiglitz and Weiss, 1981). High asymmetry of information cause that investors or suppliers of external capital may have difficulty distinguishing good project from bad ones. For assessing a project in an early stage of technological development, skilled experts are necessary what can be problem for banks (Ueda, 2004).

Moreover, innovative projects are typically long-term running, have uncertain outcomes, and are challenging to predict future revenue (Brown *et al.*, 2012). Future cash flow is also hard to predict. Additionally, the knowledge asset created during the innovation process could not be used easily as collateral because they are intangible. Also, most R&D investments are personal expenses (Hall, 2010).

Based on the abovementioned reasons and the results of so far conducted studies, we can assume that more innovative and high-technology companies rely mainly on equity finance rather than debt compared to non-innovative, low-technology firms. For example, Aghion *et al.* (2004) and Casson (2008) observed that companies more intensively investing in R&D have a higher probability of issuing new equity, while the use of debt finance starts to decline as R&D intensity increases. Brown, Fazzari, and Petersen (2009) have proven that in the case of investment in innovation, an equally important source of financing as cash flow is external capital obtained from the issue of shares. Friend and Lang (1988) and Hall (2010) confirmed a clear negative correlation between the intensity of R&D expenditure and financial leverage in American enterprises. Similarly, Bah and Dumontier (2001) confirmed that a lower level of financial leverage characterizes enterprises in the USA, Great Britain, and Japan with high R&D spending. The same conclusions were made regarding European enterprises (Hall *et al.*, 2007).

In the light of reported studies, equity capital may be crucial for the development of innovative companies. However, when financing innovation, managers may consider two options: staying private or changing status to a public company and entering the stock exchange market. Going public may have a different impact on the innovativeness of companies. Firstly, it may generally reduce asymmetry of information – companies are obligated to provide financial statements and non-

financial information to lower general information asymmetry, before and after IPO, according to stock exchange requirements. Then companies are losing privacy and confidentiality. As claim Aggarwal and Hsu (2013), more extensive information disclosure may reduce the marginal benefit of introducing the innovation to the greatest extent, followed by another firm's acquisition, while remaining private involves the least information disclosure.

However, in relation to innovative firms, so-called accounting-related information asymmetry appears (Chin *et al.*, 2006) – many intangible assets are not presented in the balance sheet (e.g., patents, R&D expenditure). Moreover, there may be a problem with presenting R&D expenditure in the financial statement – they are treated as expenses (opposite to capital expenditure) that reduce operating income and company value. When the IPO initial price is based inter alia on accounting profit and value assets, high R&D expenditure may lead to a lower offering price. In addition, the value of patents is generally booked as the cost of legal and other fees to file the patent successfully. Regarding non-financial data disclosed before IPO in the offering prospectus, the companies may also inform about R&D expenditure and patent application. However, R&D expenditure with high certainty does not always promise a future positive cash flow for investors.

In contrast, patents granted suggest that firm may be innovative, but the investors cannot evaluate the likelihood of successful commercialization. Chin *et al.* (2006) confirmed that pre-IPO innovation information constitutes essential information for IPO investors and more innovative companies (measured by R&D expenditure and patent granted) are more likely to be underpriced. However, according to Heeley *et al.* (2007), an IPO firm's patents help reduce informational asymmetries, resulting in less IPO underpricing in industries, where the link between patents and inventive returns is transparent (e.g., when an individual patent confers monopoly rents as in the case of many pharmaceutical drugs). In contrast, patents are the reason of increased information asymmetries and underpricing in industries where the link is not transparent. Heeley *et al.* (2007) gave an example of complex technology products when a firm may need to license other patents protecting key components and then receiving a patent does not reduce information asymmetries. Investors still need firm-specific information to assess whether the firm will achieve high rent from its innovations.

Secondly, going public may impose short-term pressure on managers to focus more on quarterly profits rather than long-term earning potential, leading to the "managerial myopia" problem predicted by Stein (1988). Ferreira *et al.* (2014) confirmed that it is optimal to be a public company when exploiting existing ideas and staying private when exploring new ideas. The mechanism that explains their conclusions is the shorter investment horizon associated with the public equity market. Managers of public firms choose more conventional projects and care too much about current, short-term earnings. They find it challenging to pursue complex projects that the market does not appear to understand well.

Also, Bernstein (2015) finds that the quality of internal innovation declines post IPO (with no changes in the quantity of innovation), resulting from losing skilled inventors and a decrease in the productivity of inventors who do not leave. Meanwhile, public firms can attract new inventors and obtain patents from the acquisition of other companies. He concludes that going public changes firms strategies in pursuing innovation. Similarly, Aggarwal and Hsu (2013), examining patent activity as a measure of innovation, finds that innovation activity declines post-IPO.

There is also a relation between post-IPO innovation results and the cost of IPO. Justin Cox *et al.* (2020) showed that the direct (e.g., gross spreads, other expenses) and indirect costs of going public (underpricing) are negatively related to initial post-IPO firm innovation (measured by patents and patent citations).

However, Acharya and Xu (2017) investigated that there may be a different impact of going public for innovative activity in industries that are external finance-dependent (EFD) and internal finance-dependent (IFD). To measure whether the industry is EFD or IFD, authors followed Rajan and Zingales' (1998) methodology. Industries with internal cash flow lower than their investments were considered EFD, whereas internal cash flow was higher than an investment - the industry was classified as internal finance-dependent (IFD). The main findings were that the public firms in EFD industries invest more in R&D and have a better patent portfolio than private firms, which means that unlisted companies in EFD industries invest relatively less in innovation and have fewer subsequent innovation outputs than listed firms.

However, such effect was not observed for companies classified to IFD industries. Acharya and Xu (2017) indicate that public listing help to develop innovation of firms in EFD industries because the access to public equity helps to alleviate the financial constraints those firms face. Then, this may be the important conclusion, that the effect of IPO is different and strongly related to financial constraints of the companies. Also Hsu *et al.* (2014) based on cross-country analysis (32 developed and emerging countries) confirmed that “industries that are more dependent on external finance and that are more high-tech intensive exhibit a disproportionately higher innovation level in countries with better developed equity markets. However, the development of credit markets appears to discourage innovation in industries with these characteristics.”

To summarize, the key query for innovative companies is to stay private or go public when additional capital is required. The previous studies mainly focused on how going public impacts the innovation activities post-IPO. However, it is also an interesting and open question and not enough examined in the literature how innovativeness impacts the success of IPO. As indicated above, going public may reduce the general asymmetry of information. However, accounting-related information asymmetry (Chin *et al.*, 2006) linked with R&D and patent activity

disclosure may remain and influence the investors' decision. On the contrary, in industries where the link between patents and inventive returns is transparent, information asymmetry may be reduced and positively impacts the IPO success (Heeley *et al.*, 2007). Moreover, there may also be a difference between IFD and EFD industries. Then our research question is how the technology-level of companies impacts the success of IPO? Answering the question requires defining how the IPO success was measured so far based on the literature review.

2.2 IPO Success and its Factors

The IPO is the investment opportunity for companies (Brycz *et al.*, 2017) how do they raise their capital. It is one of the most important motives of IPO (Kim and Weisbach, 2008). Last research shows that it is important to realize the aims of original shareholders by the IPO (Skalická *et al.*, 2019). New equity capital raised is used not to finance subsequent investment and growth, but to reduce leverage and cost of bank credit and also associated by equity sales by controlling shareholders (Pagano *et al.*, 1995). Therefore the companies can lower their cost of equity capital and it also a motive to be more active on the capital market during so called hot periods, when prices are relatively high (Hanselaar *et al.*, 2019).

If the most important aim of IPO is to meet capital needs, Zingales (1995) and Brycz *et al.* (2017) justified that only companies which maximize the amount of capital raised by selling a limited number of shares during the IPO are able to raise large amounts of capital for new investments without losing control over the company, and this is why Brycz *et al.* (2017) measure IPO success in raising capital as a relation of the percentage increase in shareholders' equity to the percentage of firm ownership sold at the IPO. Alti (2006) measures the amount of equity issued at the IPO using two different variables. The first one is defined as the IPO proceeds from the sale of primary shares divided by IPO year-end total assets. This variable captures the amount of new equity capital the firm raises by going public. The second variable is defined as the total IPO proceeds divided by IPO year-end total assets. The second way was made to encompass cases where secondary shares are sold by insiders. Amini (2013) measures the influence of special factor on the money raised in IPO process, which was the sign of successful IPO and a short-term measure of the company's performance (Deeds *et al.*, 1997), while Dambra (2021) uses the inflation-adjusted dollar amount of IPO proceeds.

Helwege and Liang (2004) show that hot markets attract firms from a variety of industries with different characteristics. More important, the hot-market effect is almost completely orthogonal to other factors that are known to affect equity issues. The success of the IPO process seems to be negatively correlated with the underpricing phenomenon. The increase in prices on the first day means money left on the table for the company, because it reduces the amount of capital raised. Investors' behavior on the IPO market is often explained by the phenomenon of information asymmetry (Ljungqvist, 2007). As Lizińska and Czapiewski (2014)

write, market investors and security analysts usually try to decrease the uncertainty level by observing company financial situation. In order to do it, they analyze certain financial ratios with the assumption that reported financial relations are reliable and able to reveal some information about the company real situation and prospects for the future. One of the most investigated group of financial ratios are the profitability measures. Good companies can be expected to attract investors.

3. Data and Methodology

To answer our research question of whether high-technology companies entering the stock market are more successful than low-technology peers, we analyzed the IPO of 334 companies on the Warsaw Stock Exchange in Poland from 2004 to 2018. Financial reports were collected from the EMIS database, and the financial statement covered the period from the IPO year to 2018. The correctness of the dataset was verified based on their financial statements published on companies' websites or the National Court Register.

Based on the Eurostat indicators on High-tech industry and Knowledge-intensive services (Annex 3 – High-tech aggregation by NACE Rev. 2)⁴, the manufacturing companies were qualified on NACE code as high-technology, medium high-technology, medium-low-technology, and low-technology and others that have not been qualified for any groups. Then we aggregated them into two groups: high-tech (high-technology, medium high-technology, medium-low-technology companies) and low-tech (low-technology firms and not qualified to any group – not-technology). The sample structure is presented in Table 1.

Almost one-third of the research sample (37%) are HT companies, while the group was dominated by companies with a moderate technological level (19% of the sample). In turn, the LT group consists mainly of enterprises that do not belong to any group in terms of their technological level (65% of the sample).

Table 1. Sample structure

Groups	Eurostat methodology	Number of companies	Structure
1	High technology	14	6%
2	Medium-high tech technology	31	13%
3	Medium-low-technology	46	19%
	(1+2+3) High-tech (HT)	91	37%
4	Low- technology	26	8%
5	Others	218	65%
	(4+5) Low- technology (LT)	244	73%
	Total	335	100%

Source: Own study.

⁴ https://ec.europa.eu/eurostat/cache/metadata/en/htec_esms.htm

To measure the IPO success (IPO_SUCC), we used capital collected during IPO to the equity capital at the year-end of IPO. Alti (2006) divided the IPO proceeds from the sale of primary shares divided by IPO year-end total assets. However, in our opinion, it is better to measure the success to so far collected equity capital instead of all assets because it shows in percentage how much the equity capital increased.

Additionally equity from the end of the year in which the company carried out the IPO seems to be a better basis for assessing the amount of capital raised than the equity from the beginning of this year. In particular, some companies made losses or made more than one issue before the IPO. In particular, there were cases where the issue was not registered with the court at the moment of preparing the financial statements, so it was disclosed as a liability and not as equity.

The second measure of IPO success was based on inverse underpricing. High underpricing means that the closing price at the first date of the initial public offering is higher than the offering price. It is a loss in terms of a going public company because the offering price was fixed at a lower level. Consequently, a company collected through IPO a smaller amount of capital. Then high underpricing, means the failure of IPO. We measured underpricing as $UP_{it} = (P_t/P_{t0}) - 1$, where P_t is the closing price on the first day after the initial public offering, P_{t0} is the offering price.

The independent control variables included, leverage (DEBT), profitability (ROA), size (LOGMcap), and the bull market indicator (BULLit). In addition, we also used, yet described, the dummy variable for HT companies (EUROSTAT_HIGH). These are further described below:

Leverage (DEBT): Generally, a high degree of pre-IPO leverage serves as a positive signal of firm quality as it disciplines a firm's managers; however, there may be an opposite effect in the case of high-tech firms (Kim *et al.*, 2008). Then the HT companies may be less successful when the DEBT level is high. Therefore, we measured leverage as long and short-term interest debt to total assets.

Profitability (ROA): We measured as net profit to total assets as in previous studies of IPO success (Brycz *et al.*, 2017).

Size (LOGMcap): Previous research indicates that information asymmetry is less likely to exist for larger firms (Lizińska and Czapiewski, 2014). Then the log of the firm's market capitalization at the end-year IPO is used to control the size effect.

Bull market indicator (BULL): The magnitude of underpricing is relatively larger in bullish than in bearish markets (Chin *et al.*, 2006). Kim *et al.* (2008) found that hot-market IPOs were characterized by considerably higher underpricing.

Therefore, in our model, we use a bull market indicator to control the effect of bullish or bearish market conditions on IPO. $BULL_{it}$ is defined as the two-month construction buy-and-hold returns minus market returns (WIG). The operational definition of $BULL_{it}$ is defined below:

$$BULLit = (Iind0 - Iind-2) / Iind-2 - (Im0 - Im-2) / Im-2$$

where I_{ind0} denotes construction index at the end of day when firms go public (WIG-Construction), and I_{ind-2} two months before. I_{m0} and I_{m-2} denote the corresponding market index (WIG – the Warsaw Stock Exchange Index). Data were cleaned – the abnormal and outstanding data were excluded from the sample. Every observation which got variable outside the range: $Q1-3*(Q3-Q1)$; $Q3 + 3 * (Q3-Q1)$ was removed from the sample. All descriptive statistics are presented in Table 2.

Table 2. Descriptive statistics

		LT	HT	All
Mean	UNDER	0.0556	0.0963	0.0676
	IPO_SUCC	0.5280	0.3629	0.4795
	DEBT	0.5225	0.5123	0.5195
	LOGMcap	2.2344	2.2866	2.2497
	ROA	0.0969	0.0952	0.0964
	BULL	-0.0167	-0.0061	-0.0136
Max.	UNDER	0.5464	0.3890	0.5464
	IPO_SUCC	8.9652	0.8718	8.9652
	DEBT	0.8865	0.9094	0.9094
	LOGMcap	4.6272	3.4842	4.6272
	ROA	0.4055	0.3361	0.4055
	BULL	0.1891	0.1511	0.1891
Min.	UNDER	-0.3304	-0.1154	-0.3304
	IPO_SUCC	0.0205	0.0744	0.0205
	DEBT	0.0742	0.0983	0.0742
	LOGMcap	1.1139	1.1761	1.1139
	ROA	-0.2498	0.0762	-0.2498
	BULL	-0.2458	-0.3188	-0.3188
St.dev.	UNDER	0.1254	0.1173	0.1241
	IPO_SUCC	0.8178	0.1965	0.6986
	DEBT	0.1924	0.1862	0.1902
	LOGMcap	0.5963	0.5185	0.5736
	ROA	0.1088	0.0834	0.1018
	BULL	0.0866	0.0849	0.0860

Notes: HT – high technology companies, LT – low technology companies; UNDER – underpricing measured as the first-day closing price over offer price minus one, IPO_SUCC – IPO success measured as the amount of capital collected during IPO to the equity capital at the year-end of IPO; DEBT – long and short-term interest debt to total assets; LOGMcap – the measure of companies size – log of market capitalization; ROA – net profit to total assets; BULL – Bull market indicator - two-month WIG-Construction index return minus two months WIG index return.

Source: Own study.

When we compared the mean of IPO success measure, HT companies seem to collect less equity during IPO to equity capital at the end of the IPO year than LT firms. The mean for HT achieved 36% and for LT 53%, whereas for the whole sample 48%. The ANOVA analysis confirmed a statistically significant difference between the HT and LT companies when comparing the IPO success measure mean (p-value 0,0408).

The mean of underpricing for the whole sample is 6,8%, and the result is comparable to previous findings. For example, Gemzik-Salwach and Perz (2013) for 173 companies in the period 2007-2012 calculated underpricing on the Warsaw Stock Exchange at 9% (means), Perz (2017) in the period 2013-2015 for 81 companies – 3,5% and Langer, Langer and Roszkowska (2018) in years 2005-2017 for 387 companies – 10,73%.

The mean of underpricing in our research sample is higher at HT companies compared to peers. However, the ANOVA analysis has not confirmed the difference in the level of underpricing between the HT and LT firms. Also, when we compared other variables (ROA, DEBT, LOGMcap, BULL), there is no statistical difference between the HT and LT companies.

4. Empirical Results

4.1 Main Results

Firstly, we present the model results, where IPO success was a dependent variable (Table 3). The model shows that IPO success depends on two factors – the affiliation to HT group and leverage levels.

The success of IPO is negatively related to variable α EUROSTAT_HT. It means that HT firms are less successful than low technologies companies and collect a relatively smaller amount of capital during IPO. Then the asymmetry of information, also accounting-related information asymmetry, and higher risk accompanying high-technology companies is rather a factor that leads to the lower success of HT firms.

The leverage measured by debt ratio has a positive impact on IPO success rate, which is in line with conception, that generally, the debt level is a positive signal for investors about firm quality. Firstly, according to the agency theory formulated by Jensen and Meckling (1976), the debt discipline managers, a high level of debt may lead to the improvement of business management procedures in a situation of separation of ownership and management. Moreover, the high level of debt means that financial institutions (e.g., banks) monitor the company's financial situation. So then, it is not surprising that generally, in the whole sample, the higher the debt level impacts the success of IPO in terms of capital collected to equity at the end of the IPO year.

The other factors do not impact the IPO success based on model 1 (Table 3).

Table 3. Model 1 - the IPO Success

Variables	coefficient	std. error	t-ratio	p-value
const	0.0874976	0.373162	0.2345	0.8149
ROA	-0.0748545	0.326985	-0.2289	0.8192
DEBT	0.789513	0.395026	1.999	0.0471**
LOGMcap	0.0118449	0.103499	0.1144	0.9090
BULL	-0.5266666	0.434599	-1.212	0.2272
EUROSTAT_HT	-0.152197	0.0731412	-2.081	0.0389**
R-squared	0.060019	Adj. R-squared	0.034053	
F(5, 181)	3.801768	P-value(F)	0.002679	

Notes: OLS, using observations 1-335 ($n = 187$). Missing or incomplete observations dropped: 148; Heteroskedasticity-robust standard errors, variant HC1. Dependent variable: IPO_SUCC – IPO success measured as the amount of capital collected during IPO to the equity capital at the year-end of IPO; EUROSTAT_HT – dummy variable, reach 1 when company belongs to the high-tech group. Other control variables are described in Table 2.

Source: Own study.

We also executed models separately for HT and LT firms. The results for HT are presented in Table 4 (Model 2). As for the whole sample, also for HT firms, level of leverage is the factor that impacts the IPO success rate. Then, the debt level may inform the investors about the quality of firms. It is crucial for investors when the asymmetry of information connected with accounting and also other non-financial information as patents, R&D expenditure is high. Then debt level may reduce this asymmetry and help to succeed HT companies during the IPO.

The second important factor in model 2 is the size of companies measured by market capitalization at the end of the IPO year. The smaller firms gain relatively more capital in relation to equity capital. For LT firms, the model is not presented because all the variables were statistically unimportant.

Table 4. Model 2 - the IPO success in high-technology companies

Variables	coefficient	std. error	t-ratio	p-value
const	0.309903	0.120368	2.575	0.0130**
ROA	0.446612	0.316941	1.409	0.1650
DEBT	0.542322	0.122694	4.420	5.31e-05***
LOGMcap	-0.116364	0.0391841	-2.970	0.0046***
BULL	0.208100	0.295097	0.7052	0.4840
R-squared	0.365509	Adj. R-squared	0.314749	
F(4, 50)	7.185127	P-value(F)	0.000119	

Notes: OLS, using observations 1-335 ($n = 55$), Missing or incomplete observations dropped: 280; Heteroskedasticity-robust standard errors, variant HC1; Dependent variable: IPO_SUCC – IPO success measured as the amount of capital collected during IPO to the equity capital at the year-end of IPO; control variables are described in Table 2.

Source: Own study.

The findings that HT firm has lower success can also be connected with measuring IPO success. We calculated the capital gained during IPO in relation to end-year book equity. Previous findings confirmed that the innovative and HT firms mainly rely on the equity capital (Aghion *et al.*, 2004; Bah and Dumontier, 2001; Brown *et al.*, 2009; Casson *et al.*, 2008; Friend and Lang, 1988; Hall, 2010; Hall *et al.*, 2007). Then lower success rate of IPO may be related to a generally higher level of equity capital. Then, we employed in further research the second measure – underpricing.

Underpricing was treated in our studies as an inverse measure of IPO success. For IPO companies, the high underpricing is a failure because the company could fix the offering price at a higher level and collect more capital through IPO for further development. Underpricing was the dependent variable, and control variables were the same, as in the model of IPO success and described in the methodology section.

Model 3 (Table 5), confirmed that the underpricing is higher in the group of high-technology companies. It means that high-tech companies are less successful during the IPO and the relation of the first-day closing price over offer price is higher in the group of the high-tech firms, compared to peers – low-technology companies. These results are in line with our first measure of the IPO success and with previous findings (Chin *et al.*, 2006; Heeley *et al.*, 2007; Kim *et al.*, 2008). Then, the group of high-tech companies is at risk of failure because it gets less capital than it could.

The underpricing is surprisingly positively related to the size of the companies, opposite to our expectations and previous findings at other stocks exchange (Lizińska and Czapiewski, 2014). However, in our opinion, the local characteristics of the stock exchange may play a role. Investors may concentrate on more prominent companies, whereas the market capacity is limited. Therefore, the demand for new stocks of bigger companies may lead to higher underpricing. In addition, investors may perceive companies with a potential higher market capitalization as the more certain occasion to receive the higher rate of returns in the short period – the higher underpricing from the investors perspective is an opportunity for higher return received from the investment in the IPO company. Additionally, when the company is potentially more innovative, it also gives the investors occasion to the higher short-term rate of return.

Table 5. Model 3 – underpricing

Variables	Coefficient	std. error	t-ratio	p-value
const	-0.0782345	0.0447172	-1.750	0.0819*
ROA	0.0650665	0.0882626	0.7372	0.4620
DEBT	0.0584559	0.0473637	1.234	0.2187
LOGMcap	0.0441427	0.0156449	2.822	0.0053***
BULL	0.0993010	0.129883	0.7645	0.4455
EUROSTAT_HT	0.0380292	0.0198032	1.920	0.0564*
R-squared	0.076168	Adj.R-squared	0.050648	
F(5, 181)	3.240644	P-value(F)	0.007932	

Notes: OLS, using observations 1-335 ($n = 187$), Missing or incomplete observations dropped: 148, Heteroskedasticity-robust standard errors, variant HC1. Dependent variable: UNDER – underpricing measured as the first-day closing price over offer price minus one, control variables are described in Table 2.

Source: Own study.

When we executed models separately for HT and LT companies, it occurs that the size effect is only observable in LT companies, whereas for HT companies, it is not statistically important. It means also may confirm that investors may concentrate on more prominent (bigger) companies when they are low-technology entities. Whereas in the case of more innovative firms, the size of the company does not play any role – the fact that the company is perceived as belonging to HT sector attracts investors.

4.2 Robustness Check

According to the Eurostat classification, we assigned our research companies to 5 different groups based on NACE codes. We combined groups with higher intensity and low intensity for a more straightforward interpretation of the results (HT - high technology and LT - low technology). However, we had doubts whether the "middle" group of enterprises with a moderate level of technological advancement (medium-low-technology) should be included in HT or LT group. The "middle" group is quite significant in terms of share in the HT group (51%) and the whole sample (19%). Therefore, we thought that the "middle" group could distort results for HT group, but also, when we would classify the medium-low-technology to LT group (low-tech companies), the results from the model would be disturbed. Then, to check whether our basic models, when we qualified the „medium-low-tech“ firms to HT group, are stable, we run all models again for free groups, treating „middle group“ as a separate class. Then we received, the first group - high technology and medium-high tech technology, the second group - medium-low-technology companies, and the third group – low-technology and other firms.

Firstly we executed the model with a dependent variable – the IPO success. It is presented in Table 6. The statistically significant are still two variables as in Model 1 (Table 3) – debt level and the variable that refers to companies technology level. Then the results are in line with the previous – after excluding the group of „middle“ technology firms from HT group, the technology level still is a factor that impacts the IPO success in terms of capital proceeded during IPO to equity. The more technologically advanced companies, the lower this success is.

Table 6. Model 4 - the IPO Success - new division of companies' technology level

Variables	coefficient	std. error	t-ratio	p-value
const	0.0745703	0.378233	0.1972	0.8439
ROA	-0.0672896	0.327900	-0.2052	0.8376
DEBT	0.778878	0.391092	1.992	0.0479**
LOGMcap	0.0172101	0.105659	0.1629	0.8708
BULL	-0.505852	0.426546	-1.186	0.2372

EUROSTAT_L_M_H	-0.0854237	0.0424776	-2.011	0.0458**
R-squared	0.058553	Adj.R-squared	0.032546	
F(5, 181)	3.855608	P-value(F)	0.002413	

Notes: OLS, using observations 1-335 ($n = 187$). Missing or incomplete observations dropped: 148. Heteroskedasticity-robust standard errors, variant HCl. Dependent variable: IPO_SUCC – IPO success measured as the amount of capital collected during IPO to the equity capital at the year-end of IPO. EUROSTAT_L_M_H – dummy variable that reaches 0 for low-tech companies, 1 – medium-low-technology group, 2 – high-technology companies. The other control variables are described in Table 2.

Source: Own study.

We also executed the model for underpricing (Model 5 – Table 7) again. The results are also comparable with model 3 (Table 5). The more technologically advanced industry, the higher underpricing. Also, the size of a company is the factor that impacts underpricing. Then, the first way of dividing the companies into two groups did not disturb the results.

Table 7. *Model 5 - underpricing - a new division of companies technology level*

Variables	coefficient	std. error	t-ratio	p-value
const	-0.0745162	0.0447413	-1.665	0.0975*
ROA	0.0631946	0.0878088	0.7197	0.4726
DEBT	0.0606825	0.0474521	1.279	0.2026
LOGMcap	0.0429943	0.0157791	2.725	0.0071***
BULL	0.0953606	0.130702	0.7296	0.4666
IN_E_L_M_H	0.0198452	0.0110970	1.788	0.0754*
R-squared	0.071023	Adj. R-squared	0.045361	
F(5, 181)	3.088898	P-value(F)	0.010611	

Notes: OLS, using observations 1-335 ($n = 187$). Missing or incomplete observations dropped: 148. Heteroskedasticity-robust standard errors, variant HCl. Dependent variable: IPO_SUCC – IPO success measured as the amount of capital collected during IPO to the equity capital at the year-end of IPO. EUROSTAT_L_M_H – dummy variable that reaches 0 for low-tech companies, 1 – medium-low-technology group, 2 – high-technology companies. The other control variables are described in Table 2.

Source: Own study.

5. Discussion and Concluding Comments

The innovative, high-tech firms rely mainly on equity capital. Then managers looking for additional funds for development may consider two options: staying private or changing status to a public company and entering the stock exchange market.

We aimed to check whether high-technology, more innovative companies going public are more successful than non-innovative, low technology peers. The previous research mainly focused on how going public impacts the innovation activities post-IPO. Based on the literature review, we find different arguments – some may help to

succeed during IPO, others, on the contrary, may lead to failure. For example, going public may reduce the general asymmetry of information, but in the case of more innovative firms, remains accounting-related information asymmetry (Chin et al., 2006) linked with R&D and patent activity disclosure. The more innovative (high-tech firms) are also riskier, but it allows the investor to reach a higher rate of return, which may be a factor encouraging investors to buy shares of IPO company.

We evaluated the IPO success using two measures. The first: relation of capital collected during IPO to the equity capital at the year-end of IPO and the second: underpricing. We looked from the company's perspectives, then higher underpricing we treated as a failure of IPO because the offering price was fixed at a lower level, and consequently, the company proceeds from IPO, not optimal amount of capital.

Our empirical results confirmed that the more technologically advanced company (in terms of the sector in which the company operates), the lower success of IPO. The HT companies collect a relatively smaller amount of capital during IPO and the underpricing is higher in HT group. The results in terms of underpricing are in line with previous findings for other stock exchanges. For example, Chin (2006) found that more innovative firms are more likely to be underpriced. However, we have not confirmed the impact of debt on the level of underpricing. Kim, Pukthuanthong-Le, and Walker (2008) argued that generally, a high degree of pre-IPO leverage serves as a positive signal of firm quality as it disciplines a firm's managers, but in the case of high-tech companies, the effect of leverage during IPOs is opposite: higher leverage is associated with increased uncertainty and risk and reflected by higher price revisions and under-pricing. We have only found that debt level has a positive impact on the first measure of IPO success – for the whole sample, but also in the group of HT firm, what we interpret according to a theory formulated by Jensen and Meckling (1976), that a high level of debt may lead to the improvement of business management procedures in a situation of separation of ownership and management and is a positive signal for investors, also in the case of HT firms.

We think that the practical implication from our study is that HT companies should pay special attention to lower the asymmetry of information connected with accounting-related information asymmetry linked with R&D and patent activity disclosure. It could be done through disclosing precise information in prospects about a future project for better risk evaluation by potential investors. The results also indicate that high-tech companies should consider staying private and look for investors accepting higher risk (e.g., VC, PE). Another solution for HT firms is to raise a small amount of capital during the IPO and make secondary issues later when the company is more recognized in the market.

There are also limitations of our studies. Firstly, measuring the technology level of companies based on NACE codes, however, is commonly used in the literature, is still essential and imperfect. The best would be to evaluate each company separately, based on product portfolio, information on patents granted, R&D expenditure, etc.

However, it requires collecting additional, not always publicly available information. Secondly, the control variables in our models were limited to basic. For example, we could not control whether the company was backed by VC (*Heeley et al.*, 2007) or existing institutional holdings (Kim et al., 2008). However, in future studies, we will extend control variables and use other alternative IPO success indicators (*Brycz et al.*, 2017). Moreover, we also want to measure the level of company innovativeness and technology employing text-based analysis of companies reports (*Bellstam et al.*, 2020). Also, price variation is limited during a trading day on the Polish stock exchange because of the static and dynamic price collars, so we would like to extend our research on the longer period and take the volume-weighted average prices into account.

However, the initial studies confirm that the higher the technology level of companies, the lower IPO success.

References:

- Acharya, V., Xu, Z. 2017. Financial dependence and innovation: The case of public versus private firms. *Journal of Financial Economics*, 124, 223-243. <https://doi.org/10.1016/j.jfineco.2016.02.010>.
- Aggarwal, V.A., Hsu, D.H. 2013. Entrepreneurial Exits and Innovation. *Management Science*, 60, 867-887. <https://doi.org/10.1287/mnsc.2013.1801>.
- Aghion, P., Bond, S., Klemm, A., Marinescu, I. 2004. Technology and Financial Structure: Are Innovative Firms Different? *Journal of the European Economic Association*, 2, 277-288. <https://doi.org/10.1162/154247604323067989>.
- Alti, A. 2006. How persistent is the impact of market timing on capital structure? *The Journal of Finance*, 61, 1681-1710.
- Amini, S. 2013. The amount of raised capital by small IPOs : Spatial effect on the UK Alternative Investment Market. *International Journal of Entrepreneurial Behavior & Research*, 19, 344-358. <https://doi.org/10.1108/13552551311330219>.
- Bah, R., Dumontier, P. 2001. R&D Intensity and Corporate Financial Policy: Some International Evidence. *Journal of Business Finance & Accounting*, 28, 671-692. <https://doi.org/10.1111/1468-5957.00389>.
- Bellstam, G., Bhagat, S., Cookson, J.A. 2020. A Text-Based Analysis of Corporate Innovation. *Management Science*. <https://doi.org/10.1287/mnsc.2020.3682>.
- Brown, J.R., Fazzari, S.M., Petersen, B.C. 2009. Financing Innovation and Growth: Cash Flow, External Equity, and the 1990s R&D Boom. *The Journal of Finance*, 64, 151-185. <https://doi.org/10.1111/j.1540-6261.2008.01431.x>.
- Brown, J.R., Martinsson, G., Petersen, B.C. 2012. Do financing constraints matter for R&D? *European Economic Review*, 56, 1512-1529. <https://doi.org/10.1016/j.euroecorev.2012.07.007>.
- Brycz, B., Dudycz, T., Kowalski, M.J. 2017. Is the success of an issuer an investor success? Evidence from Polish IPOs. *Baltic Journal of Economics*, 17, 57-77. <https://doi.org/10.1080/1406099X.2017.1308781>.
- Carpenter, R.E., Petersen, B.C. 2002. Is the Growth of Small Firms Constrained by Internal Finance? *Review of Economics and Statistics*, 84, 298-309. <https://doi.org/10.1162/003465302317411541>.

- Casson, P.D., Martin, R., Nisar, T.M. 2008. The financing decisions of innovative firms. *Research in International Business and Finance*, 22, 208-221. <https://doi.org/10.1016/j.ribaf.2007.05.001>.
- Chatzoglou, P., Chatzoudes, D. 2017. The role of innovation in building competitive advantages: an empirical investigation. *European Journal of Innovation Management*, 21, 44-69. <https://doi.org/10.1108/EJIM-02-2017-0015>.
- Chin, C.L., Lee, P., Kleinman, G., Chen, P.Y. 2006. IPO anomalies and innovation capital. *Review of Quantitative Finance and Accounting*, 27, 67-91. <https://doi.org/10.1007/s11156-006-8543-7>.
- Coad, A., Segarra, A., Teruel, M. 2016. Innovation and firm growth: Does firm age play a role? *Research Policy*, 45, 387-400. <https://doi.org/10.1016/j.respol.2015.10.015>.
- Dambra, M., Gustafson, M.T., Pisciotta, K. 2021. What is the effect of an additional dollar of IPO proceeds? *Journal of Corporate Finance*, 66, 101795. <https://doi.org/10.1016/j.jcorpfin.2020.101795>.
- de Rassenfosse, G., Jensen, P., Webster, E. 2011. Understanding Innovation: The Role of Policy Intervention. A Report for Victorian Department of Treasury and Finance. WWW Document. URL <https://www.melbourneinstitute.com/downloads/industrial/Reports/Understanding%20innovation%202011.pdf>.
- Deeds, D.L., Decarolis, D., Coombs, J.E. 1997. The impact of firmspecific capabilities on the amount of capital raised in an initial public offering: Evidence from the biotechnology industry. *Journal of Business Venturing*, 12, 31-46. [https://doi.org/10.1016/S0883-9026\(97\)84970-1](https://doi.org/10.1016/S0883-9026(97)84970-1).
- Ferreira, D., Manso, G., Silva, A.C. 2014. Incentives to Innovate and the Decision to Go Public or Private. *The Review of Financial Studies*, 27, 256-300. <https://doi.org/10.1093/rfs/hhs070>.
- Friend, I., Lang, L.H.P. 1988. An Empirical Test of the Impact of Managerial Self-Interest on Corporate Capital Structure. *The Journal of Finance*, 43, 271-281. <https://doi.org/10.1111/j.1540-6261.1988.tb03938.x>.
- Gemzik-Salwach, A., Perz, P. 2013. Rynek pierwszych ofert sprzedaży akcji na NewConnect – wybrane zagadnienia. *Annales Universitatis Mariae Curie-Skłodowska. Sectio H Oeconomia*, 47, 177-185.
- Hall, B. 2010. The financing of innovative firms. *Review of Economics and Institutions*, 1.
- Hall, B. 2002. The Financing of Research and Development. *Oxford Review of Economic Policy*, 18, 35-51. <https://doi.org/10.1093/oxrep/18.1.35>.
- Hall, B., Thoma, G., Torrisi, S. 2007. The Market Value of Patents and R&D: Evidence From European Firms. *Academy of Management Proceedings*, 1-6. <https://doi.org/10.5465/AMBPP.2007.26530853>.
- Hanselaar, R.M., Stulz, R.M., van Dijk, M.A. 2019. Do firms issue more equity when markets become more liquid? *Journal of Financial Economics*, 133, 64-82. <https://doi.org/10.1016/j.jfineco.2018.12.004>.
- Heeley, M.B., Matusik, S.F., Jain, N. 2007. Innovation, Appropriability, and the Underpricing of Initial Public Offerings. *AMJ*, 50, 209-225. <https://doi.org/10.5465/amj.2007.24162388>.
- Helwege, J., Liang, N. 2004. Initial Public Offerings in Hot and Cold Markets. *Journal of Financial and Quantitative Analysis*, 39, 541-569. <https://doi.org/10.1017/S0022109000004026>.

- Hsu, P.H., Tian, X., Xu, Y., 2014. Financial development and innovation: Cross-country evidence. *Journal of Financial Economics*, 112, 116-135. <https://doi.org/10.1016/j.jfineco.2013.12.002>.
- Jensen, M.C., Meckling, W.H. 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3, 305-360. [https://doi.org/10.1016/0304-405X\(76\)90026-X](https://doi.org/10.1016/0304-405X(76)90026-X).
- Justin Cox, Kathleen P. Fuller, Zhilu Lin, Wentao Wu. 2020. Do IPO costs affect innovation? *Review of Financial Economics*. <https://doi.org/10.1002/rfe.1124>.
- Kim, J., Pukthuanthong-Le, K., Walker, T. 2008. Leverage and IPO underpricing: high-tech versus low-tech IPOs. *Management Decision*, 46, 106-130. <https://doi.org/10.1108/00251740810846770>.
- Kim, W., Weisbach, M.S. 2008. Motivations for public equity offers: An international perspective. *Journal of Financial Economics*, 87, 281-307. <https://doi.org/10.1016/j.jfineco.2006.09.010>.
- Langer, L., Langer, P., Roszkowska, P. 2018. Pension Funds and IPO Pricing. Evidence from a Quasi-Experiment. SSRN Scholarly Paper No. ID 3152562. Social Science Research Network, Rochester, NY. <https://doi.org/10.2139/ssrn.3152562>.
- Lizińska, J., Czapiewski, L. 2014. Performance of Polish IPO Firms: Size and Profitability Effect. *Gospodarka Narodowa. The Polish Journal of Economics*, 269, 53-71. <https://doi.org/10.33119/GN/100877>.
- Ljungqvist, A.P. 2007. IPO Underpricing. IN: *Handbook of Corporate Finance: Empirical Corporate Finance*, 1, ch. 7. Ed. BE. Eckbo. Elsevier.
- Mazzucato, M. 2013. Financing innovation: creative destruction vs. destructive creation. *Industrial and Corporate Change*, 22, 851-867. <https://doi.org/10.1093/icc/dtt025>.
- Pagano, M., Panetta, F., Zingales, L. 1995. Why Do Companies Go Public? An Empirical Investigation. NBER, Working Paper 5367.
- Perz, P. 2017. The Activity of Family Businesses and the Phenomenon of Underpricing of Their Shares in IPOs in Poland in the Years 2013-2015. *Studia i Materiały*, 153-161. <https://doi.org/10.7172/1733-9758.2017.23.14>.
- Rajan, R.G., Zingales, L. 1998. Financial Dependence and Growth. *American Economic Review*, 88, 559-586.
- Skalická, M., Zinecker, M., Balcerzak, A.P. Meluzín, T. 2019. Why do companies go public? Evidence from the Prague Stock Exchange. *Entrepreneurial Business and Economics Review*, 7, 181-199.
- Stein, J.C. 1988. Takeover Threats and Managerial Myopia. *Journal of Political Economy*, 96, 61-80. <https://doi.org/10.1086/261524>.
- Stiglitz, J.E., Weiss, A. 1981. Credit rationing in markets with imperfect information. *The American economic review*, 71, 393-410.
- Ueda, M. 2004. Banks versus Venture Capital: Project Evaluation, Screening, and Expropriation. *The Journal of Finance*, 59, 601-621. <https://doi.org/10.1111/j.1540-6261.2004.00643.x>.
- Zingales, L. 1995. Insider Ownership and the Decision to Go Public. *The Review of Economic Studies*, 62, 425-448. <https://doi.org/10.2307/2298036>.