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Relationship of the Market Value and Characteristics of Innovative Companies: Empirical Study

Master's Thesis by the 2nd year student,
Master in Corporate Finance
Gradyskaia Polina Vsevolodovna

Research advisor:
Berezinets Irina Vladimirovna,
Associate Professor,
Department of Finance and Accounting

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АННОТАЦИЯ

Автор	Градыская Полина Всеволодовна
Название ВКР	Взаимосвязь рыночной стоимости и характеристик инновационных компаний: эмпирическое исследование
Образовательная программа	080200 “Менеджмент”
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Научный руководитель	Березинец Ирина Владимировна, к. ф.-м. н., доцент, Кафедра финансов и учета
Описание цели, задач и основных результатов	Основной целью исследования является установление эффекта, который оказывают характеристики инновационных компаний, на оценку рынком их инновационной деятельности. Для достижения этой цели были исследованы теоретические концепции стоимости компании и инноваций, были рассмотрены исследования, анализирующие взаимосвязь между инновациями и рыночной стоимостью компаний, а также исследования, посвященные взаимосвязи характеристик инновационных компаний и рыночной оценки инновационной деятельности компаний. Исследование проводилось на выборке публичных компаний из Японии, Китая и Южной Кореи, которые инвестировали в НИОКР на постоянной основе в период с 2012 по 2019 год. Окончательная выборка включала 3 381 компанию (в общей сложности 21 444 наблюдения). Результатом эконометрического анализа стало установление статистически значимой положительной связи между высокими (выше среднеотраслевых) темпами роста инновационных компаний и рыночной оценкой инновационной деятельности компаний. Связь между размером инновационной компании и рыночной оценкой инновационной деятельности не была подтверждена. Кроме того, было установлено, что если инновационная компания имеет долю рынка выше, чем средняя доля рынка компаний в отрасли, то при прочих равных условиях ее инновационная деятельность будет оценена ниже, чем инновационная деятельность компаний с низкой долей рынка. Результаты этого исследования могут быть полезны как руководству компаний, целью которого является максимизация стоимости для акционеров, так и инвесторам, рассматривающим возможность включения инновационных азиатских компаний в свой портфель.
Ключевые слова	Оценка стоимости фирмы, рыночная стоимость, инновационные компании, инновации, характеристики компании, Китай, Япония, Южная Корея, Азия.

ABSTRACT

Master Student's Name	Gradyskaia Polina Vsevolodovna
Master Thesis Title	Relationship of the Market Value and Characteristics of Innovative Companies: Empirical Study
Educational Program	080200 “Management”
Main field of study	Master of Corporate Finance
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Academic Advisor’s Name	Irina V. Berezinets, PhD in Physico-mathematical sciences, Associate Professor, Finance and Accounting Department
Description of the goal, tasks and main results	The main purpose of the study is to establish the impact that the characteristics of innovative companies have on the market's value of the companies’ innovative activities. To achieve this goal, the theoretical concepts of company value and innovation were investigated, studies that analyze the relationship between innovation and the market value of companies, as well as studies on the relationship between the characteristics of innovative companies and the market valuation of innovative activities of companies, were analyzed. The study was conducted on a sample of public companies from Japan, China and South Korea that invested in R&D on a continuous basis between 2012 and 2019. The final sample included 3,381 companies (a total of 21,444 observations). The result of the econometric analysis is the establishment of a statistically significant positive relationship between the high (above the industry average) growth rates of innovative companies and the market valuation of innovative activities of companies. The relationship between the size of the innovative company and the market valuation of innovation activities has not been confirmed. In addition, it was found that if an innovative company has a market share higher than the average market share of companies in the industry, all other things being equal, its innovative activities will be evaluated by market lower than the innovative activities of companies with a market share lower than the industry average. The findings of this study can be useful both for management, whose goal is to maximize value for shareholders, and investors considering the inclusion of innovative Asian companies in their portfolio.
Keywords	Firm value, market value, innovative companies, innovations, characteristics of a company, China, Japan, South Korea, Asia.

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INTRODUCTION

In just a few months, the COVID-19 pandemic has forced millions of companies around the world to rethink how they do business and serve customers. According to the results of the global survey conducted by (McKinsey 2020), more than 90% of managers expect drastic changes in their business over the next 5 years due to COVID-19, and almost the same number claim that the crisis will have a long-term impact on the needs of their customers.

According to the authors of the study, the pandemic has affected the decline in attention to innovation in companies in almost all industries, the only exception being pharmaceuticals and medical products. In these companies, the number of managers who still see innovation as a top priority increased by almost 30 percentage points.

McKinsey experts believe that such a choice to abandon support for innovation-driven growth in the short term could have long-term implications for companies ' ability to grow in the coming years. The assumptions that supported years of stable, predictable growth may no longer be true. Thus, the role of innovation after the pandemic is likely to grow, which means that the importance of understanding the formation of market value for the innovation activities will only increase.

This paper is devoted to the study the impact of the characteristics of innovative companies on the relationship between innovative activities and the market value of these companies.

Innovation is essential for determining a company's economic potential. However, the future cash flows from these activities are often uncertain, and it is difficult to calculate in advance how the innovation activity will ultimately affect the value of the firm, so investors choose a strategy to respond to the company's innovation activity based on their assumptions, including ideas about how the characteristics of innovative companies are related to its market value.

The main question of the research is: "What characteristics of an innovative company are positively interrelated with the market estimates of the company’s innovations?" Accordingly, the purpose of this work is to determine the impact of innovative firm characteristics on the market value of firm innovation activities.

Since the 1990s, many studies have been conducted to check whether there is a relationship between the market value of a company and its innovation activities, and what characteristics of companies influence the market's assessment of these innovation activities. The majority of empirical research relates to the United States, as well as to the European economies and the United Kingdom.

According to the Global Innovation Index, in 2020, the top 20 innovative economies include not only the United States, the United Kingdom and European economies, but also the major economies of Asia, for which much less research has been conducted.

The investors' interest in Asian companies is high. According to (UNCTAD 2021), foreign direct investment in developing Asian countries in 2020 fell by only 4%, and investment in the Japanese economy increased, while on average during the pandemic, foreign direct investment decreased by 42%, which is why the object of scientific research is the innovative public companies of the top 4 innovative economies in Asia: Japan, China, South Korea and Singapore.

The subject of the study is the relationship between the characteristics of innovative companies and their market value.

The following tasks were identified as the tasks that to be solved in order to achieve this goal:

1. To analyze the value of the company and approaches to measure it.

2. To analyze the concept of innovation, approaches to measure it and justify the choice of the most appropriate approach for the purpose of the study.

3. To present an overview of current research on the analysis of the relationship between the characteristics of innovative companies and the market estimates of the companies' innovations.

4. To conduct an empirical study aimed at determining the effect of innovative firm characteristics on the relationship between innovation activities and the firm market value.

5. To analyze the results and draw conclusions on the work.

The structure of the work corresponds to the tasks set out above and includes an introduction, three chapters, conclusion, list of references and appendices.

The first chapter is devoted to approaches to assessing the value of the company. It examines the assessment of the internal value of the company using the discounted cash flow method and multipliers. In addition, this chapter analyzes the differences between internal and market value, as well as provides different views of investors on the functioning of the market.

In the second chapter of the work, the term of "innovation" is revealed, which is the key to defining an "innovative company", the analysis of various indicators of the company's innovation activities is carried out, the advantages, disadvantages and features of each of them are noted, and the indicator that best meets the purpose of this study is selected. It also provides an overview of current research on the relationship between the intensity of investment in R&D and the market value of the company. The chapter ends with an analysis of the works describing the relationship between market value of company innovations and the characteristics of innovative companies and the formulation of hypotheses of scientific research.

The third chapter is an empirical study. It includes a description of the methodology and the procedure for forming the sample. In addition, in this chapter descriptive statistics, the results of regression analysis are analyzed and decisions about the acceptance or rejection of hypotheses of scientific research are made. The relationship between the characteristics of companies and the market value of company innovation activities is established using econometric modeling; all calculations are performed using the econometric package "Stata 16". The study is conducted on a sample of public companies from Japan, China, and South Korea that invested in R&D on an ongoing basis between 2012 and 2019. The final sample included 3,381 companies, with a total of 21,444 observations. As a source of data collection, annual and quarterly reports of companies published in the Datastream database are used.

The result of the econometric analysis is the establishment of a statistically significant positive relationship between the high (above the industry average) growth rates of innovative companies and the market valuation of innovative activities of companies. The relationship between the size of the innovative company and the market valuation of innovation activities has not been confirmed. In addition, it was found that if an innovative company has a market share higher than the average market share of companies in the industry, all other things being equal, its innovative activities will be evaluated lower than the innovative activities of companies lower than the industry average.

The findings of this study can be useful both for management, whose goal is to maximize value for shareholder, s and investors considering the inclusion of innovative Asian companies in their portfolio.

CHAPTER 1. FIRM VALUATION. REVIEW OF APPROACHES

The evaluation of companies has different purposes, for example, determining the purchase/sale price of the company, evaluating the effectiveness of investments, as well as evaluating the effectiveness of the company's management. For the purposes of the study, we will consider the assessment of market value from the point of view of an investor who plans to include the company shares in his/her portfolio, and management, whose main goal is to maximize the value of the company for its investors.

In the first chapter, we will look at the basic concepts related to the company's value and approaches to evaluating public companies: their advantages and disadvantages.

There are two main approaches to company valuation. The first of them — the discounted cash flow (DCF) — relates the value of the company to the current value of the expected future cash flows. According to the second approach, defined as comparative valuation, the value of a company should be calculated by analyzing the pricing of similar companies, linking it to a variable (for example, revenue, cash flows, book value or sales volume).

1.1. Estimation of discounted cash flows

This approach, although not the most commonly used approach in evaluation, serves as the basis for other approaches. In addition, this approach is called fundamental, since it measures the value that a given asset is able to generate, adjusted for a risk. The foundation underlying this approach is the present value theory (PV), according to which the value of any asset corresponds to the present value of the expected cash flows attributable to that asset:

$$Company\ value = \sum_{t=1}^{t=n} \frac{CF_t}{(1+r)^t} \tag{1.1}$$

n = asset lifetime;
CF_t = cash flows for period t;
r = discount rate that reflects the risk of expected cash flows.

The discount rate is a function of the risk of expected cash flows. At the same time, higher rates are attributed to riskier assets, and lower rates are attributed to projects with greater security.

Cash flows differ depending on the type of asset. For the purposes of evaluating the company, this may include dividends, free cash flow, and residual earnings. Now let's look at each model in more detail.

1.1.1. Discounted free cash flow models

The discounted free cash flow model was first introduced (Williams 1938). The approach was later popularized among professionals and is currently described in a number of fundamental works (Damodaran 2007), (Brealey, Myers 2011). The main rationale for this model is that the firm's value is equal to its future cash flows, discounted by the degree of risk. The discounted free cash flow model in general form can be written as follows:

$$Company\ value = \sum_{t=1}^{t=n} \frac{FCFF_t}{(1+k_w)^t} \tag{1.2}$$

n = asset lifetime;
$FCFF_t$ = free cash flows for period t available to all capital providers of the company;
k_w= weighted average cost of capital, reflecting the risk of expected cash flows.

The value of the company reflects the free cash flow available to the owners and creditors of the company, in other words, the value of the company as a whole (Copeland, Koller, Murrin 1995).

If the analyst is only interested in the cost of equity, which is a more accurate estimate of the company's capitalization, then he can use two methods:

- To find equity value in case the company has only ordinary shares one should substract the book value of debt from the company value.

$$V_E^{\mathrm{FCF}} = \sum_{t=1}^{\infty} \frac{FCF_t}{(1+k_w)^t} - D_0 \tag{1.3}$$

V_E^{FCF} - fundamental value of equity;
FCF_j – free cash flows at the moment t;
k_w – weighted average cost of capital;
D_0 – book value of debt at the moment of valuation.

- The second method involves accounting for changes directly in free cash flows and in the discount rate. The free cash flow of the firm, which was used to calculate the value of the firm as a whole, is defined as the cash flow available to all suppliers of capital (both borrowed and own), and the free cash flow to equity is defined as the flow available only to the owners (shareholders) of the company.

$$V_E^{\mathrm{FCF}} = \sum_{t=1}^{\infty} \frac{FCFE_t}{(1+k_e)^t} \tag{1.4}$$

V_E^{FCF} - fundamental value of equity
$FCFE_t$- free cash flows for period t;
k_e- discount rate that reflects the required return of the owners.

Both formulas give the same result under the same assumptions about free cash flow and risk.

The cost of a company's equity can be used to estimate how much cash the firm can afford to return to the owners/holders of the shares. Using the cost of equity, you can estimate the internal value of a company and determine whether the market value is fair.

The discounted free cash flow model is best suited for analyzing companies that generate positive cash flow, which can be estimated with a sufficient degree of reliability for future periods, and it is also possible to approximate the risk required to determine the discount rate. The further we move away from these idealized conditions, the more difficult it becomes to estimate discounted cash flows. For example, firms that are in a state of crisis or cyclical firms that depend on the economic situation often have a negative cash flow and a high probability of bankruptcy. New companies can also have negative cash flow and are difficult for risk-assessment.

1.1.2. Dividend discount model

The dividend discount model is an alternative to the free cash flow to equity discount model. The free cash flow to equity discounting model assumes that all cash is available for distribution. The dividend discounting model is based on the assumption that the only type of cash flow received by the company's owners is dividends.

$$V_E^{\mathrm{DDM}} = \sum_{t=1}^{\infty} \frac{D_t}{(1+k_e)^t} \tag{1.5}$$

where V_E^{DDM} fundamental value of equity;
d_t – dividends at the moment t;
k_e – required return on equity;

The two models will result in different cost estimates in several cases. First, the value under the free cash flows to equity discount model will be greater than the value under the dividend discount model, in cases where the free cash flows to equity exceed the dividends, and the excess cash generates a percentage that is less than the market value; or if these funds are invested in projects with a negative net present value.

Second, the firm can pay more dividends than it can afford. When paying more dividends than the company can afford, the firm borrows money, increasing the debt load, which does not create an increase in cash flow in the future and negatively affects the decrease in free cash flow to capital.

The dividend discount model is suitable for evaluating companies whose dividend payments are constant and predictable or has the predictable growth rate. One of the varieties of the dividend discounting model is the Gordon model. The Gordon growth model can be used to evaluate a firm that is in a "steady state", paying dividends that are growing at a projected stable rate.

$$Company\ value = \frac{DPS_1}{k_e - g} \tag{1.6}$$

where DPS_1 = expected next year's dividend;
k_e = required return on equity;
g = *dividend growth rate over an infinite time horizon.*

(Damodaran 2007) notes that if there is a high probability of a takeover of a firm and a change in its management, then the best result will be an estimate of value using the free cash flow to equity discount model due to possible changes in the dividend policy after a change in the company's management, especially in the event of a hostile takeover. When changes in corporate control become more difficult due to the size of the firm and legal or market restrictions on acquisitions, the value of the discounted dividend model will provide a reference point for comparison.

1.1.3. Residual income models

Net income after deducting the income required by investors is called residual income or economic value added (EVA). Residual income model (RIM) assumes that the fundamental value of the company's equity depends on four factors: the amount of capital invested at the time of valuation; the actual return on capital; the required return on capital; and the stability of the results spread, i.e., the ability of the organization to generate a return on capital higher than the required one.

In this case, the time period during which a positive spread of results is provided is defined as the period of competitive advantage. According to the residual value model, fundamental value is created only during the period of competitive advantage; in other periods, the value is wasted.

Having restated the basic assumptions of the residual profit model, it can be argued that the fundamental cost of an organization's equity consists of the book value of equity at the time of valuation and the discounted flow of residual profits that provide an increase in the fundamental value over the book value of its own capital.

In general, the amount of residual profit can be expressed as follows:

$$RI_j = \pi_j - k * BV_{j-1} \quad (1.7)$$

where RI_j - the remaining profit of the reporting j-th year;

π_j - accounting profit for the reporting year;

k − required return on equity;

BV_{j-1} - the carrying amount of the investment at the beginning of the reporting (end of the previous reporting) year.

There are two main options for the residual income indicator: the residual operating profit and the residual net profit of the organization. The indicator of residual operating profit introduced (Penman, 2001) is essentially similar to the indicators of economic profit in (Copeland, Koller, Murrin, 1995) and economic value added (EVA) in (Stewart, 1999). The residual operating profit discounting model (ReOIM) assumes that the fundamental cost of an organization's equity consists of two elements: the book value of equity at the time of valuation and the amount of increase in the fundamental value over the book value, which is defined as an infinite stream of residual operating profits discounted at the rate of weighted average costs for all capital.

In general, the model of discounting residual operating profit can be written as follows:

$$V_E^{ReOIM} = E_0 + \sum_{t=1}^{\infty} \frac{ReOI_t}{(1+k_w)^t} - D_0 \quad (1.8)$$

V_E is the cost of equity;

E_0 - carrying amount of equity at the time of valuation;

$ReOI_t$ - residual operating profit;

k_w = weighted average cost of capital;

D_0 – book value of debt at the moment of valuation.

The residual earnings model (REM) assumes that the fundamental cost of an organization's equity consists of two elements: the book value of equity at the time of valuation and the amount of increase in the fundamental value over the book value, defined as an infinite stream of residual net profits discounted at the cost of equity rate. In the most general form, this model can be expressed as follows:

$$V_E^{\text{REM}} = E_0 + \sum_{t=1}^{\infty} \frac{RE_t}{(1 + k_e)^t} \quad (1.9)$$

where V_E-cost of equity;

E_0 – carrying amount of equity at the time of valuation;

RE_t - residual net profit;

k_e = required shareholder return;

These models are equivalent only if the weighted average cost of capital is calculated based on the fundamental (market) values of the sources of financing, rather than on the balance sheet. Proof of the equivalence of the discount models of residual operating and residual net profit is given in (Feltham, Ohlson, 1995).

The main advantage of residual income models is that the required input data is limited to accounting records. Unlike the models previously described, the results of the residual income models are not based on assumptions, since these models are based on the official data of the company presented in the reports. In addition, a number of authors (Pinto, Henry, Robinson, 2007) attribute the advantages of this model to the possibility of using it in conditions when companies do not pay dividends or have negative cash flows.

(Penman, Penman, 2007) believe that the residual net profit model provides more accurate results than other models. Comparing the forecast prices of securities on the NYSE, AMEX, and NASDAQ exchanges, the authors conclude that the residual net profit model is best suited for evaluation on short-term horizons (less than 6 months).

(Francis, Olsson, and Oswald, 2000) measure the accuracy of a company's intrinsic value using a sample of English companies. The analysis showed that the forecast error for the residual income model is 20% less than for the cash flow discounting model. The authors suggest that the reason for this is the need to make a large number of assumptions for the cash flow discounting model.

At the same time, the residual income model has one drawback. Since the model is based on accounting data, its quality largely depends on the quality and completeness of the information provided in the official reports. It is also not always possible to compare firms due to different accounting policies and reporting requirements.

1.1.4. Full formulation of discounted cash flow model

The models of discounted cash flows presented in general form are theoretically correct, but they are not directly applicable in practice, since it is impossible to predict all free cash flows over an infinite period.

To solve this problem, the entire time period, starting from the moment of estimation, is divided into two periods: a finite forecast period, called the forecast horizon, and an infinite post-forecast period. In accordance with this division, the fundamental value is also divided into two values: the fundamental value created during the forecast period, and the fundamental value created in the post-forecast period. The latter value is called the terminal value. According to the definition (R. Brayley and S. The Myers 2011) terminal cost is the cost of cash flow beyond the forecast horizon, reduced to the forecast period. In general, the model can be represented as follows:

$$Firm\ value\ = \sum_{t=1}^{t=n} \frac{CF_t}{(1+k_e)^t} + \frac{TV_n}{(1+k_e)^n} \quad (1.11)$$

According to (Damodaran 2007), terminal value is determined in three ways:

- at the liquidation value, when the project assets are divisible and their value can be determined in the market at the end of the project planning horizon;
- at the multiplicative cost, the cost of the project's cash flow after the forecast period (for example, 5-7 years);
- by Gordon's formula:

$$\text{TV} = \frac{FCF_t(1+q)}{(k_w - q)} \qquad (1.12)$$

TV-terminal value;
FCF_t - free cash flow of the last period;
q − constant steady growth rate;
k_w − weighted average cost of capital.

The fundamental value created during the forecast horizon is estimated based on the direct prediction of free cash flows. At the same time, a number of assumptions should be made to estimate the terminal value. It is assumed that net investment after the end of the forecast period gives a constant rate of return, and cash flow has a constant rate of growth.

1.2. Multiples approach

In practice, analysts most often use the multiplier method to evaluate companies, which is also called comparative valuation.

Comparative evaluation is more based on the market. In other words, we assume that the market correctly determines the prices of shares on average, but makes mistakes when forming the prices of individual shares. We also assume that comparing the multipliers will allow us to identify these errors, and they will be corrected over time.

The assumption that markets correct their mistakes over time is inherent in both discounted cash flow and comparative valuation. Nevertheless, proponents of comparative valuation argue with some degree of validity that errors made in the formation of prices for individual securities in a particular sector are more noticeable and therefore are likely to be corrected faster. For example, if a software company has a price/profit multiplier of 10, while the same multiplier of other companies in the sector is 25, then clearly the shares of this company are undervalued, so sooner or later there will be a correction towards the average indicator for the sector. At the same time, proponents of discounted cash flow estimates would take little comfort if the entire sector are overvalued by 50%.

(Damodaran 2012) notes that some analysts and managers of companies that use multipliers go back to discounted cash flow models to get them. Other analysts compare the multipliers of different firms or those that existed at different points in time, making explicit or implicit assumptions about how similar or different the fundamentals of the firms are.

In most cases, analysts set a price per share by comparing the multipliers that characterize a firm's trading activity with similar multipliers of other firms in the same business. However, in some cases, especially for mature firms with a long history, the comparison is based on historical data.

The main thing that attracts analysts to multipliers is their simplicity and ease of use. They can be quickly applied to the valuation of firms and assets, and they are particularly useful when the financial markets trade shares of a large number of comparable firms, and the markets, on average, correctly assign prices to these firms. It is more difficult to use market prices to evaluate single firms that have no analogues in the market, with small or zero revenues and negative profits. Similarly, multipliers are easy to manipulate, especially when comparable firms are used. Given that no two firms are exactly the same in terms of growth and risk, identifying comparable firms becomes a subjective process. Consequently, a biased analyst may choose a group of comparable firms to confirm their biases about the value of a particular firm.

Another problem with using a multiplier based on comparable firms is that it is prone to errors (overestimation or underestimation) that the market may have made when evaluating these firms. For example, if the market has overestimated all software firms, then usage of the average price / earnings multiplier to evaluate the initial stock offering will lead to a revaluation of this issue as well. In contrast, the valuation of discounted cash flows is based on the growth rate and cash flows of the firm, so this method is less likely to be affected by market errors in the valuation of the firm. Next, we'll look at the most commonly used multipliers.

1.2.1. Price multiples

The price-to-earnings multiple is calculated by dividing the market price per share by earnings per share.

$$\frac{P}{E_t} = \frac{MV_t}{EPS_t} \tag{1.13}$$

This coefficient was first introduced (Graham, Dodd, 1934) as an approach to finding undervalued companies. The beneficial aspect of the P/ E multiplier is the use of the most important characteristics of the company from the investor's point of view. However, it is not possible to estimate unprofitable companies by the P / E multiplier.

Another factor that is used to evaluate a company is the price-to-sales ratio, which is represented by the ratio of the market value of equityl to sales.

$$Price\ to\ Sales_t = \frac{MVE_t}{Sales_t} \tag{1.14}$$

(Pearl, Rosenbaum, 2013) emphasize that the P/S multiplier should be used with caution due to two facts. First, sales do not provide information about the actual marginality of the business. Second, sales can vary greatly depending on the industry.

The P / CF ratio is calculated as the division of the market value of equity by the company's cash flow. In this equation, cash flow is represented by the sum of net income and depreciation.

$$\frac{P}{CF_t} = \frac{MVE_t}{CF_t} \tag{1.15}$$

(Pinto, Robinson, Henry, Stowe, 2010) argue that by using cash flows, an investor or researcher can avoid possible inconsistencies when comparing different companies. First, the P / CF ratio is more stable than income-based multipliers because of its invulnerability to short-term industry shocks. Second, unlike P/E, this multiplier is difficult to manipulate.

Another approach to company valuation is the price for the dividend multiplier.

$$\frac{P}{Divt} = \frac{Share\ Price_t}{Div\ per\ share_t} \tag{1.16}$$

Despite the fact that this coefficient is rarely used in the initial assessment, it has a number of advantages. For example, (Weinstein, 1988) argues that unlike profit and revenue, dividends are not subject to large-scale manipulation, they are either paid or not. In addition, the author notes that the amount of dividends does not depend on short-term shocks that can cause a "write-off" of the company's profits.

The price-to-book value multiplier is expressed by dividing the market price by the book value of equity.

$$\frac{P}{Bt} = \frac{MV_t}{BV_t} \qquad (1.17)$$

On the one hand, the use of P/B provides the researcher with a fair estimate, since neither the market nor the book value can be manipulated. On the other hand, the P/B ratio does not make it possible to evaluate companies with a large share of intangible assets. Moreover, the company's debt is not taken into account when using P/B.

Another multiplier also compares the company's book value and market value. The market value to book value multiplier, represented as the ratio of the sum of the market value of equity and debt to the book value of equity and debt.

$$Market - to - Bookt = \frac{MVE_t + MVD_t}{BVE_t + BVD_t} \qquad (1.18)$$

The market-to-book ratio is an extended version of the P/B ratio, which additionally allows you to take debt into account when evaluating a firm. In addition, market-to-book ratio can be calculated for companies with a negative book value of capital, since it is offset by the cost of debt (Damodaran, 2007).

Innovations or breakthroughs in technological development can lead to an increase or decrease in the value of the company's assets. A company can be considered to create economic value for its investors if its additional income exceeds the difference between the market value of the assets and the cost of replacing them. Tobin's Q is the ratio between the market value of physical assets and the replacement cost.

This ratio is widely used as an indicator of efficiency or an indicator of the relative value of a firm. However, it was hardly possible to calculate the replacement cost of all assets. Thus, Tobin's Q is expressed in a similar ratio to the book value of assets instead of the cost of replacing the company's assets.

$$Tobin's\ Qt = \frac{MVE + BVD_t}{BVA_t} \qquad (1.19)$$

If Tobin's Q is equal to 1, the company is valued by the market at book value. A value of less than 1 signals that investors do not expect the company to create economic value. A Tobin's Q ratio of more than 1 indicates good investor expectations about the company's ability to create value with these assets.

1.2.2. Enterprise value multiplies

Enterprise multiplies are designed to measure how many units of operating income an investor can earn per dollar of ownership in a company.

The reason why the use of enterprise multipliers may be preferable to price multipliers is that they also take into account the company's cash flows, but are less sensitive to the effect of financial leverage. One of the problems associated with the use of price coefficients is the incorrect valuation of companies with a high leverage ratio. As a result, companies with the highest amount of debt can get a rating higher than a company with a "healthy" capital structure. Enterprise multipliers allows to avoid this problem. There are three corporate multipliers: EV/EBITDA, EV/EBIT, EV/Sales, where EV – is the enterprise value calculated as:

$$EV = MC + Total\ Debt - C \qquad (1.20)$$

MC- market capitalization;
Total debt – the book value of total debt;
C = cash and cash equivalents.

The EV / EBITDA indicator is used when capital expenditures and depreciation can be neglected. In studies with heterogeneous samples, EV / EBITDA helps minimize the impact of industry-specific factors (Copeland, 1983). Another positive effect of using this multiplier is the ability to compare companies with negative net income. However, the use of EBITDA may lead to an overestimation of the value of cash flows (Pinto, Robinson, Henry, Stowe, 2010).

The EV / EBIT indicator is useful when you need to take into account capital expenditures; it gives more accurate results when analyzing a sample of homogeneous companies.

The EV/Sales ratio is the least popular multiplier for businesses and can be used to evaluate and compare companies with the same type of activity or when differences in capital expenditures, depreciation, or tax features can be ignored.

1.3. The market value and efficient market

The market value of company equity (or market capitalization) is the total market value of its shares listed on the market. Market value reflects investors ' expectations about the profitability of investing in a company.

An efficient market is one in which the market price is determined by an unbiased assessment of the true value of the investment (Fama, 1971). The definition of an efficient market implies several key provisions:

Efficient market does not require that the market price be equal to the intrinsic value at any given time. It is only necessary that the errors in the market price are unbiased. Prices can be more or less than the intrinsic value, as long as the deviations are random. The internal (intrinsic) value is the value that reflects the real economic potential of the company.

The fact that prices deviate randomly from their intrinsic value implies that the probability of overvaluation is equal to the probability of undervaluation at any given time, and the observed deviations do not correlate with any observed variables.

If the deviations of the market price from the intrinsic value are random, then no group of investors is able to regularly find undervalued or overvalued shares.

Determining efficient market also involves making assumptions about the information that is available to investors and is reflected in the price. For example, a strict definition of efficient market, assuming that all information, both public and private, is reflected in the market price, would mean that even investors with reliable insider information would not be able to outperform the market. One of the earliest classifications of market efficiency levels was presented by (Fama, 1971), which proved that, according to the information reflected in prices, three levels of market efficiency are possible:

With low market efficiency, the current price takes into account the information contained in all past prices, meaning that price charts and technical analysis based only on historical data will not be useful in detecting undervalued stocks.

In the case of average performance, current prices reflect information contained in not only past prices, but also all open information (including financial statements and news). Thus, when searching for undervalued stocks, any approach based on this information will be useless.

In the case of high performance, the current price reflects all information, both public and private, so no investor will be able to detect undervalued shares, assuming to do so on a regular basis.

"Market efficiency" is one of the key attitudes of the investor, which largely determines his/her approach to investing. When evaluating an investment, the central questions are whether the markets are efficient and, if the answer is no, what does this inefficiency mean.

If the markets are efficient, then the market price provides the best estimate of value, and thus the valuation process becomes a way to justify the market price. If the markets are inefficient, then the market price may deviate from the intrinsic value, and the evaluation process in this case is aimed at obtaining a reasonable estimate of company value. Investors who evaluate correctly will be able to generate larger returns than other investors due to their ability to identify undervalued and overvalued firms.

However, in order for investors to have the opportunity to get a high return, the markets must correct their mistakes over time (i.e., become effective). The duration of these adjustments can have a serious impact on the investor's choice of approach to investing, as well as on the time horizon necessary for the successful implementation of the chosen investment strategy.

If the markets were efficient, then investors would stop looking for inefficiency, which would lead the markets to inefficiency again. It makes sense to talk about market efficiency as a self-correcting or self-regulating mechanism, where inefficiency regularly occurs, but almost instantly disappears when investors discover inefficiency and try to profit from it through trading transactions.

When evaluating a company, we try to determine the intrinsic value of the company. Although market prices may deviate from the intrinsic value, the two values are expected to converge sooner or later.

Summary

There are two main approaches to assess the value of a company: the method of discounted cash flow and the method of multiplers. The discounted cash flow valuation is based on an assumption about the future cash flows of the company, which allow one to compare the market value of the company with the value that the company is able to generate. The disadvantage of this approach is that for many companies, cash flows are difficult to predict.

Using multiples, we assume that the market correctly determines the prices of shares on average, but makes mistakes when forming the prices of individual shares. We also assume that comparing the multiples will allow us to identify these errors, and they will be corrected over time. This method is often used in practice because of its simplicity, but it is often difficult to select companies to compare multipliers due to the specifics of each company's business.

When evaluating a company, internal and external analysts try to determine the company's intrinsic value, which reflects the company's real economic potential. Although market prices may deviate from the intrinsic value, the two values are expected to converge sooner or later.

Chapter 2. The relationship between the characteristics of innovative companies and the market value of their innovative activities

In this chapter, we will look at the definition of innovation and choose a suitable proxy for measuring the company's innovation.

Next, we will analyze the research that studies the relationship between innovations and the market value of the company. After that, we will analyze the research on the relationship between the characteristics of an innovative company and the market value of firm innovation activities. Then we will formulate research hypotheses.

2.1. Definition of innovation and innovative company

J. Schumpeter in his book "The Theory of Economic Development" defined innovation as the commercialization of one or a combination of processes, such as:

1) new product or service creation;

2) new manufacturing way, which also involves new ways of products commercialization;

3) new materials and components usage;

4) new markets entering;

5) new organizational forms establishment (Backhaus and Schumpeter 2003).

Whereas (Backhaus and Schumpeter 2003) focused on commercialization as the result of innovation, (Callon et. Al. 1992) defined innovation as «all activity from the invention (discovery of a new device, product, process, or system) to the moment of first commercial or social use».

Thus, the term «innovation» includes two components: technological in the form of the invention of a new product or a new method of production and business in the form of the commercialization of the invention and can be defined as a process and result.

We discovered in every research or theoretical paper (Prazdnichnych 2013; Yudanov 2012) the author's own interpretation of this term. However, most of contemporary definitions of innovation are the slight variation of the term derived from Oslo manual.

In the Oslo manual, innovations are divided into four types, each of which has its own definition:

• Innovative product: a new or significantly improved product or service. For example, improvements can be made in product specifications, usability, or other functional characteristics.

• Technological innovation: a new or significantly improved method of production or delivery. For example, significant changes in production methods, delivery, equipment, and / or software that reduce the time from placing an order to receiving the finished product by the buyer.

• Marketing innovation: A new marketing method that involves significant changes in product design or packaging, product placement, product promotion, or pricing.

• Organizational innovation: a new method in business practice, workplace organization, or building relationships with counterparties (Mortensen et al. 2005).

Note that the last two types were added to the second edition of the manual, which reflected the perception of innovation not only as a technological invention.In addition, the definition of «innovation» includes not only products and processes that did not exist before (revolutionary innovations), but also improved products and processes (evolutionary innovations) developed on the basis of existing and used products and processes. Evolutionary and revolutionary innovations differ in the way they use organizational knowledge. Evolutionary innovation is the improvement of the potential of existing products/services (for example, by adding some features) and the use of existing knowledge and experience, while revolutionary innovation is defined as radical changes to existing products/services that often make them obsolete and are based on the transformed knowledge of the company (Subramaniam and Youndt, 2005; Wang et al., 2013; Menguc et al., 2014).

Oslo manual and other sources give freedom in defining "innovative company" according to the purpose of the research. Therefore, we stick to the point of view developed by (Yudanov 2012), who states, "Innovative companies vary from each other by the scale of innovation activities that should be measured with appropriate indicator".

2.2. Measuring company innovations

Empirical research often uses the number of confirmed patent applications to measure innovation (Barra & Zotti, 2016; Bottazzi & Peri, 2007). Although this indicator is usually used to measure innovation, in reality only a part of the innovation is enshrined in the patent. Many innovations are not patented due to imperfect patent laws, the economic impracticability of intellectual property protection funds, and other reasons (Voutsinas, Tsamadias, Carayannis, & Staikouras, 2018).

In addition, there are many studies proving that R&D investments can be used in modeling to reflect a company's innovation performance on a par with the number of patents.

Many studies have focused on the relationship between R&D investments and innovation, as well as on the impact of R&D investment on innovation. R&D costs are directly related to the research and development of the company's products or services and any intellectual property created in the process, which reflects innovation not only as a result, but also as a process.

According to research, investment in R&D has a positive impact on innovation. For example, Jaffe (1986), using a sample of 432 US firms, confirmed that if the business sector increased R&D spending by 10%, innovation, measured as the number of patents, would increase by 20%. (Porter and Stern 2000) also confirmed the relationship between innovation and investment in R&D using the example of OECD countries in 1973-1993.

(Furman and Hayes 2004) conducted a panel study on 23 countries between 1978 and 1999 and found that R&D investment in business and universities is positively and statistically significantly correlated with innovation, measured by the number of international patents.

(Panagiotis Pegkas, Christos Staikouras, and Constantinos Tsamadias 2019) investigated the relationship between innovations and R&D spending in the European Union over the period 1995-2014. The results of the empirical analysis show that there is a positive and significant relationship between investment in R&D and innovations. At the same time, the relationship between corporate R&D costs and innovation costs, measured as the number of patent applications, is the strongest.

The use of R&D investment to measure innovation is supported by the results of a study (Jesus Lopez-Rodriguez, Diego Martinez-Lopez 2016), which show that the impact of R&D investment on productivity growth (which is calculated as the amount of labor and capital required to produce products) is twice as large as the impact of non-R&D innovation. (Forbes 2018) sums it up by expressing the view that «successful innovation consists of R&D, customer values, and a business model. »

The Frascati manual (2002) points out the disadvantage of using R&D investment as a variable for measuring innovation: "R&D may or may not be part of innovation, as R&D is only one of many innovative activities. Innovation activities also include the acquisition of existing knowledge, machinery, equipment, and other capital goods, training, marketing, design, and software development. These innovative activities can be carried out in-house or purchased from third parties" (Frascati Manual, 2002).

However, despite the fact that investment in R&D is not the only factor that can be used to estimate a company's innovation activities, nevertheless, R&D has a greatest impact on the company's performance, and, consequently, on the evaluation, that is why we have chosen this indicator to measure innovative activities for our study.

2.3. Analysis of the relationship between innovation activities and company market value

(Schumpeter 2003) who is considered the founder of the theory of innovation proposed the idea of a special innovation rent that the owner of the innovation receives. He explained that as a result of the introduction of innovative processes, the company can produce products/provide services with less resources or, in other words, in a more economical way. Thus, the firm can set a lower price for the final product and get additional money from the increased demand at the expense of the cash flows of its competitors.

In addition, the innovation process can provide an increase in the number of consumers of the product/service without reducing the prices of the company's products/services, if the innovation process has managed to create or strengthen a competitive advantage. In the case of the development of an innovative product or process, the company becomes a monopolist who can set a higher price for the product/service based on exclusivity, and thus the company acquires the so-called "Schumpeter rent" or "innovator rent" (Backhaus and Schumpeter 2003). This means that companies invest in innovation activities in order to get innovative rents or at least keep up with competitors and maintain their current profits.

In recent years, the academic literature has provided ample evidence that investment in R&D affects economic growth (Jones, 1995; Arnold, 2006). As a result, scientists have come to view R&D costs more as a way to increase competitiveness and, consequently, increase the value of the company, rather than as a non-refundable cost. For example, back in 1981, Griliches pointed out that investments in R&D create intangible capital for the company, which should be taken into account when evaluating the company.

Although research and development activities are important for the future value of the firm, the future cash flows from these activities are quite uncertain, and it is difficult to calculate in advance how they will ultimately affect the value of the firm, so investors choose a strategy to respond to the volume of R&D investments based on their assumptions.

On the one hand, there is a perception that investors may overestimate the benefits of R&D or simply ignore the fact that many R&D investments are unprofitable (Jensen 1993), which leads to an overestimation of the value of R&D-intensive firms. This view is shared by (Lakonishok, Shleifer, and Vishny 1994), who found that growth stocks yield low future returns, while (Daniel and Titman 2006) show that this low return on growth stocks is concentrated in stocks with significant "intangible" information that is difficult to interpret.

On the other hand, there are studies on the activity of firms in the field of R&D, which suggest that the market, on the contrary, does not respond enough to information about investments in R&D. For example, (Chan, Lakonishok, and Sougiannis 2001) and (Lev and Sougiannis 1996) demonstrate that firms with a high R&D ratio relative to market capitalization earn high subsequent profits. (Eberhart, Maxwell, and Siddique 2004) found that a significant increase in R&D spending predicts higher operating profits in the future.

Since the 1990s, quite a lot of research has been conducted to test the existence of a relationship between the company's market value and the company's R&D investments. For example, Griliches (1981), using data of 457 companies from United States for the years 1968-1974, reports that an increase in R&D in dollars increases the market value of a firm by about $ 2 in the long run. Despite the fact that the majority of empirical studies were conducted on samples of American companies, at the same time, there are a number of studies conducted on samples of companies from the UK and European countries, such as the study of unbalanced panel of 2156 publicly traded US, EU and UK firms from 1989 to 1998 conducted by (e.g. Czarnitzki, Hall, and Oriani, 2006). They find that the value of R&D in France and Germany is remarkably similar both to each other and to that in the US or the UK during the same period.

In the last decade, the geography of innovation has been changing, as evidenced by the data of the Global Innovation Index1 rating . Over the years, China, Vietnam, India and the Philippines have become the countries that have made the most significant progress in the innovation ranking. All four countries are now in the top 50.

The top 20 of the ranking, along with the European economies, the United States, Canada, the United Kingdom, Australia and New Zealand, includes such Asian economies as Singapore

[1] The Global Innovation Index has been compiled since 2007 by a consortium of Cornell University (USA), INSEAD Business School (France) and the World Intellectual Property Organization. GII-2020 is formed on the basis of 80 indicators, combined in seven areas of analysis, for 131 countries. The final rating is calculated as the average of two sub — indices-innovation resources (institutions, human capital and science, infrastructure, level of market and business development) and innovation results (development of technologies and knowledge economy, results of creative activity). The innovation efficiency coefficient is defined as the ratio of two sub-indices, thus reflecting the aggregated effectiveness of innovation activity at a given innovation potential.

(8), South Korea (10), China (11,14), Japan (16), which indicates that these countries are comparable in terms of innovation infrastructure and innovation performance with EU, UK and USA. In the last decade, scientists have been actively engaged in research on the developed and developing markets of Asia, but the number of studies compared to the developed markets of the United States and Europe is still small. For example, (Sunil Kanwar, Bronwyn H. Hall, 2016) conducted a study on 380 Indian firms from 2001 through 2010. They found that financial markets value the R&D investment of Indian firms the same or higher than it values such investment in developed economies such as the US and European countries, suggesting some degree of underinvestment. (Sunarti Halid1, Amizahanum Adam1 Marina Ibrahim1, Masetah Ahmad Tarmizi, Prof. Dr. Muhd Kamil Ibrahim, 2017), having studied Malaysian companies, found a weak relationship between the value of the firm and investment in R&D, with a strong dependence of the value on the size of the company's tangible assets. Bae and Kim (2003) used the example of firms from the United States, Germany, and Japan to prove the relationship between R&D investment and firm value. The relationship was confirmed by Byung and Smyth (2016) using the example of 606 South Korean companies between 2007 and 2012.

2.4. Analysis of the firm characteristics impact on the relationship between firm innovative activities and its market value

In the early 1990s, scientists (for example, Jacobs, 1991; Porter, 1992), following popular publications in the business media, suggest that managers in the United States may systematically reduce investment in R&D in order to show high profits in the short term and thereby increase the value of the company in the market, instead of maximizing the value of the company through long-term growth. Although the evidence for "managerial myopia" is mixed (e.g., Bange and DeBondt, 1998; Lundstrum, 2002; Wahal and McConnell, 2000), the idea that American firms may systematically underinvest in R&D remains popular in the business media (e.g., Mandel, 2009). If the researchers were able to prove systematic "managerial myopia," it would mean that R&D investment is largely driven by managerial style, not working conditions.

However, there is strong evidence that firms choose the level of R&D investment to maximize value, taking into account the characteristics of the firm and the industry (Mark Hirschey, Hilla Skiba, M. Babajide Wintoki, 2012). (Mark Hirschey, Hilla Skiba, and M. Babajide Wintoki 2012) explore the determinants of intersectoral differences in R&D spending. Using aggregate data of the US firms, the authors find evidence that R&D investment is determined by the characteristics of the firm and the industry. According to their results, managers do not reduce the intensity of investment in R&D in response to a short-term decline in profitability, even during periods of economic downturn. The authors also find no evidence of managerial short sightedness, since total corporate R&D spending is growing faster than total profitability, and the number of US firms conducting R&D increased between 1976 and 2010. The authors also found that R&D spending continues to grow faster than advertising and capital expenditures.

A significant number of researchers have identified a positive relationship between the market value of innovative companies and the following characteristics of the firm: the size of the firm, the growth of the firm, and the market share.

(Pindado J., Chabela de la Torre 2010), in their study on the impact of company characteristics on the market valuation of R&D, conducted on a sample of 271 EU countries, based on assumptions about maximizing the value of the company as the main goal of management and market efficiency, suggest that these characteristics act not only as determinants of the size of R&D expenditures, but also play an important role in regulating the relationship between R&D expenditures and the value of the firm.

2.3.1. Company size

Both the academic literature (e.g., Eshima and Anderson, 2017) and the popular business media (e.g., Shaprio 2011) publish arguments that firms should invest resources more entrepreneurial. This view implies that small firms are more efficient at innovation (Acs and Audretsch 1990). This point of view is becoming more widespread. A growing belief among institutional investors and senior executives is that large corporations do not need to invest directly in R&D; instead, they should acquire small firms that have developed the necessary technologies.

However, if this widely held view is wrong, and if instead (Schumpeter 2003) rightly pointed out that large firms are the main engine of economic growth, then the increasing, academic recognition of the greater effectiveness of small firms in innovation is a danger to economic growth.

The literature on firm innovation includes both research supporting large firms as more effective innovators (e.g. Cohen and Klepper 1996a, b) and small firms (e.g. Acs and Audretsch 1990, Baumol 2002). To date, neither theory nor empirical research has provided an answer to the seemingly irrational investment behavior of large firms that continue to increase less productive R&D investments.

More interesting than the correlation between R&D investment and company size is how company size regulates the relationship between R&D and company value. (Cannolly and Hirschey 2005) find evidence supporting a size advantage for the estimated effect of R&D spending. This is consistent with the view (Chauvin and Hirschey, 1993), which concluded that the research activities of larger firms seem to be more efficient compared to small firms in terms of the market. (Pindado J., Chabela de la Torre, 2010) also confirmed a higher assessment of R&D investment for large firms in their study of EU firms. Moreover, benefits such as economies of scale and diversity in R&D and easier access to the capital market are usually attributed to large companies (Cohen and Klepper, 1996). Often, innovation success is achieved through greater persistence and consistency in innovation, and consistency, in turn, is usually characteristic of well-established mature or large firms (López-Salido, Stein, & Zakrajšek, 2017; Maslach, 2016).

Based on the above evidence, the first hypothesis of the study will be formulated as follows:

Hypothesis 1: The relationship between the innovative activities (R&D investments) and market value of a company is higher for the companies of high size.

2.3.2. Growth of the company

It has been argued that R&D spending contributes to a firm's success in the commodity market and that larger R&D investments result in higher growth rates. Ryan and Wiggins (2002) argue that a firm with high growth potential has more incentive to invest in R&D, since a significant percentage of its value is in assets that do not yet exist. Moreover, R&D spending has been proposed as an indicator of a firm's investment capacity (Becker-Blease and Paul, 2006; Billett, King, and Mauer, 2007) and growth (Yeh, Shu, and Guo, 2008; Poulsen and Stegemoller, 2008).

(Del Monte and Papagni 2003) summarize the results obtained by various studies over the past 20 years and conclude that a significant relationship between the share of R&D investment and the growth of the firm has not been confirmed. However, (Del Monte and Papagni 2003) provide evidence demonstrating a positive relationship between R&D intensity measured as the ratio of R&D investment to sales, and sales growth rates.

It can be assumed that firms that grow at a higher rate will maximize the excess profits generated from R&D projects. Consequently, the market will give them a higher rating than the rest of the firms.

Hypothesis 2: The relationship between the innovative activities (R&D investments) and market value of a company is higher for the companies with the high sales growth.

2.3.3. Market share

Blundell, Griffith, and Reenen (1999) investigate the relationship between innovation and market share and find that firms with a high market share innovate more; hence, their market valuation is higher. Given that, the R&D process is a source of innovation (Booth et al., 2006), these results demonstrate the importance of market share in regulating the relationship between

R&D and company value. In addition, Blundell, Griffith, and Reenen (1999) suggest that this positive influence plays a significant role in creating barriers to entry, the presence of which increases the value of the company. Moreover, a company with a larger market share will benefit more from applying R&D results due to a larger customer base.

In contrast, Chen, Ho, and Shih (2007) find no evidence to support the importance of market share for the market valuation of R&D investments.

Following the example of a study (Pindado J., Chabela de la Torre, 2010) that confirms the positive impact of market share on the evaluation of R&D, I will propose the following hypothesis:

Hypothesis 3: The relationship between the innovative activities (R&D investments) and market value of a company is higher for the companies with the high market share.

Summary

Innovation activity is the activity from the invention (the discovery of a new device, product, process or system) to the moment of the first commercial or social use. Innovations can be product, technological, marketing, and organizational. Also, innovations are divided into evolutionary innovations and revolutionary ones.

As a proxy for innovation, empirical research most often uses the indicator of confirmed patent applications and investment in R&D. For the purposes of our research, we selected the R&D investment indicator as the most appropriate proxy for measuring a company innovative activity, since it is more closely related to the company's performance, and, consequently, to the valuation.

Next, we analyzed studies that confirm a significant positive relationship between innovation and the company's market value. After analyzing articles and publications on the relationship between the characteristics of an innovative company and market value, we identified three characteristics that, according to previous studies, positively affect the value of an innovative company: company size, growth rate, and market share. Thus, we have formulated three hypotheses about the positive relationship between the characteristics of an innovative company and its market value.

CHAPTER 3. EMPIRICAL STUDY OF THE RELATIONSHIP BETWEEN THE CHARACTERISTICS OF COMPANIES AND MARKET VALUE OF FIRM INNOVATIVE ACTIVITIES

3.1. Methodology

The empirical study is based on the following model:

$$lnV_{it} = \beta_0 + \beta_1 lnBV_{it} + \beta_2 RI_{it} + (\beta_3 + \alpha_1 DV_{it})RD_{it} + \beta_4 NC_{it} + \beta_5 NSEC_{it} + u_{it} \quad (3.1)$$

The dependent variable V_{it} is a variable of the company market capitalization at company i at time t. The independent variables are variables from a basic model, dummy variables representing firm characteristics and dummy variables representing country and sector of the company i; u_{it} is a random variable. All the variables have the subscript "it", indicating that this information is measured for each company i at time t. The regression model also includes β_0 as an unknown scalar value and β_1 , β_2, β_3, β_4, β_5, α_1 as vectors of unknown coefficients. Note that this model is linear in terms of its parameters. Natural logarithm of firm value and book value of equity is introduced for normalizing data.

Table 1 describes the variables used in regression analysis.

Table 1. Variables' description

Variable	Definition
V	The market capitalization of a company
Basic model	
BV	The book value of a company
RI	Residual income of a company.
RD	Proxy variable for determining the innovativeness of a company (R&D expenses from the company's income statement).

Table 1. Variables' description (continued)

Variable	Definition
The company characteristics (dummy variables)	
DS	A binary variable that reflects the size of a company. It takes a value of 1 if the company size is larger than the national industry average, and 0 otherwise. Firm size is measured as the natural logarithm of the replacement value of total assets. If DS =1, the company size is considered large, and if DS=0, it is considered small.
DG	A binary variable that reflects the company's revenue growth. It takes a value equal to 1 if the company's revenue growth is higher than the average in the country's industry, and 0 otherwise. The firm growth is measured as a rate of sales growth. At DG =1, the company's growth rate is considered high, and at DG=0, it is considered low.
DMS	A binary variable that reflects the company's market share. It takes a value equal to 1 if the company's market share is higher than the average in the country's industry, and 0 otherwise. The firm market share is measured as a share of industry sales.[2] At DMS =1, the company's market share is considered high, and at DMS=0, it is considered low.
Country and sector variables	
NC	A binary variable that represent belonging to a particular country. It takes 1 when company is registered in certain country and 0 otherwise.
$NSEC$	A binary variable that represent belonging to a particular sector. It takes 1 when company is registered as operating mainly in certain sector and 0 otherwise. The Definitive Business Classification (TRBC) was used to classify companies by industry.

The residual value was calculated using the formula:

$$RI_{it} = \pi_{it} - rBV_{i,t-1} \quad (3.2)$$

RI_{it} – the residual income of company i at the moment t;

r_{it} – the required return of company's i equity at the moment t;

$BV_{i,t-1}$ – the book value of equity of company i at the moment t-1;

π_{it} – net income of company i at the moment t.

[2] For industry sales calculation the sample of 3,603 companies was used.

The majority of variables were taken from the companies' financial reports allocated in Datastream. Since the study is international, all variables were converted to the same currency. To do this, the indicators were multiplied by the exchange rate of the US dollar against the national currency at the end of the reporting year. The required yield was calculated according to the CAPM model, where the risk-free yield was taken as the yield of 10-year US bonds, and the market premium was calculated according to country's Moody's rating for each year, according to the Aswath Damodaran method.

The model used to study the relationship between R&D and firm value is based on the capital market arbitrage condition. According to this condition, the net profit after tax for the shareholders of company i during period t is formed in two ways: from current dividends and capital gains. Thus, the shareholders retain their shares as long as the resulting profit is equal to their required after-tax return. This equilibrium can be expressed by the following equation:

$$r_{it}V_{it}=(E_t V_{i,t+1} - V_{it}) + E_t D_{i,t+1} \quad (3.3)$$

or

$$V_{it}=E_t \sum_{j=1}^{\infty} \frac{D_{i.t+j}}{(1+r_{it})^j} \quad (3.4)$$

V_{it} *– the equity value of company i at the moment t;*

r_{it} *– required after-tax return of company i at the moment t;*

$D_{i,t+1,t+j}$ *–the dividends of company i at the moment t+1,t+j.*

The amount of the dividend can be calculated using the following net surplus ratio (CSR) from the accounting rules:

$$D_{it}= BV_{i,t-1}+\pi_{it} - BV_{it} \quad (3.5)$$

D_{it} *– the dividends of company i at the moment t;*

$BV_{it,\ t-1}$ *–the book value of company i equity at the moment t, t-1;*

π_{it} *– net income of company i at the moment t.*

Thus, we get the following equation:

$$V_{it} = E_t \sum_{j=1}^{\infty} \frac{BV_{i,t+j-1} + \pi_{it} - BV_{i,t+j}}{(1 + r_{it})^j} \quad (3.6)$$

or

$$V_{it} = BV_{it} + E_t \sum_{j=1}^{\infty} \frac{(\pi_{it} - rBV_{i,t+j-1})}{(1+r)^j} - E_t \frac{(BV_{i,t+\infty})}{(1+r)^{\infty}} \quad (3.7)$$

Following (Dechow, Hutton, Sloan, 1999; Myers, 1999), we can assume that the last term in equation (3.7) is zero.

Since the residual income is expressed as (3.2) the equation could be expressed as:

$$V_{it} = BV_{it} + E_t \sum_{j=1}^{\infty} \frac{(RI_{i,t+j-1})}{(1+r)^j} \quad (3.8)$$

(Sougiannis 1994) argues that the impact of R&D on market value can be indirectly reflected through profit. This is because the impact of past R&D expenditures on current market value can be reflected in investments that generate profits and, as a result, have an impact on current residual income. Therefore, past R&D expenditures probably play a role in explaining the residual income that depends on the information currently available.

According to (Sougiannis, 1994), the values of past R&D expenditures rarely convey additional information when explaining market value if the current residual income was included in the valuation model as an explanatory variable, that’s why only the company's current R&D investments were included in the econometric model.

Considering the two factors mentioned above, the model can be written as:

$$V_{it} = BV_{it} + \beta_1 RI_{it} + \beta_2 RD_{it} + u_{it} \quad (3.9)$$

V_{it} – the equity value of company i at the moment t;

BV_{it} – the book value of company i equity at the moment t;

RI_{it} – the residual income of company i at the moment t;

RD_{it} – the research and development investments of company i at the moment t;

The study sample was formed based on the following requirements:

1. Companies that are registered in China, South Korea, Japan, Singapore;

2. Public companies and ordinary shares only;

3. Companies that give information in their reports about innovation through R&D;

4. Only companies that regularly invested in R&D for at least 5 consecutive years and disclosed the amount of their investments in 2012-2017 were selected.

A total of 3,603 companies were found in Datastream.

3.2. Creating a sample

The companies are registered in China, South Korea, Japan, Singapore. The distribution of companies between countries is in Appendix 1.

There were 11 sectors presented in the primary sample: academic & educational services, basic materials, consumer cyclicals, consumer non-cyclicals, energy, financials, healthcare, industrials, real estate, technology and utilities. The more detailed description of each sector you can find in Appendix 3.

The initial sample was 3,603 companies, of which only 23 (less than 1.0%) were companies from Singapore. In addition, some industries were poorly represented, for example, academic & educational services were represented by only 7 companies, financials -8, real estate sector-16, utilities - 21, and energy - 47. The structure of the primary sample you can see in Appendix 2.

This low representation of some sectors may be due to the low level of R&D in these industries. For example, companies in the real estate industry do not necessarily need to invest large sums in the development of new products, since their competitiveness is based on talented specialists and a high-quality customer base. Also, the reason may be a small number of companies in the industry. For example, in all 4 countries, only 205 local companies from the utilities sector are registered on the exchanges. In addition, disclosure of the R&D investment indicator is not mandatory for companies: only 3,603 companies (23%) out from 15,339 local companies registered in China, Japan, South Korea and Singapore, whose shares are listed on local exchanges, disclosed the amount of R&D investment for at least one year in 2012-2019.

Since companies from Singapore accounted for less than 1.0% of the sample, it was decided not to include them in the final sample. A similar decision was made for industries with a small number of observations: energy, utilities, real estate, financials and academic & educational services.

After cleaning out the outliers, there were 3,381 companies from 3 countries and 6 industries in the sample (Table 2). The sample of innovative companies consists of 38% Japanese companies, 32% Chinese companies, and 30% South Korean companies. If we talk about the industry specifics of innovative companies, then the largest percentage of innovative companies was in the industrial sector. This can be explained by the high development of industrial production in Asia. The second place in the number of innovative companies is occupied by the technology industry.

Table 2. The structure of the final sample

	Basic Materials	Consumer Cyclicals	Consumer Non-Cyclicals	Healthcare	Industrials	Techno-logy	Total	%
China	202	183	57	111	311	216	**1,080**	**32%**
Japan	215	221	106	61	437	237	**1,277**	**38%**
South Korea	141	188	60	123	194	318	**1,024**	**30%**
Total	**558**	**592**	**223**	**295**	**942**	**771**	**3,381**	**100%**
%	**17%**	**18%**	**7%**	**9%**	**28%**	**23%**	**100%**	

In total, there are 21,411 observations in the sample. The number of observations is distributed almost evenly over the entire duration of the period of study.

Table 3. The time structure of observations

Year	Frequency	Percent
2012	1,759	8,2%
2013	2,538	11,9%
2014	2,893	13,5%
2014	2,960	13,8%
2016	2,948	13,8%
2017	2,750	12,8%
2018	2,748	12,8%
2019	2,815	13,2%
Total	**21,411**	**100%**

3.3. Descriptive statistics

The first stage of empirical analysis is the analysis of descriptive statistics. The descriptive statistics of the variables are presented in table 4.

Table 4. Descriptive statistics

$	MARKET VALUE	BV	RI	RD
mean	545,754,780	292,358,065	-7,438,742	10,323,774
std	834,293,566	369,239,654	39,204,279	19,194,347
min	3,661,006	150,812	-460,276,178	10
25%	71,232,058	68,107,231	-13,106,082	1,126,885
50%	220,122,503	162,876,751	-2,833,190	3,777,342
75%	685,684,562	368,061,007	2,797,707	10,899,844
max	7,625,266,566	3,703,619,672	400,807,510	194,534,161

In the sample, 48.1% of observations relate to companies with assets above the average among companies in the industry, 43.5% relate to companies whose revenue growth rates exceed the industry average, and 28.6% to companies whose market share is higher than the industry average.

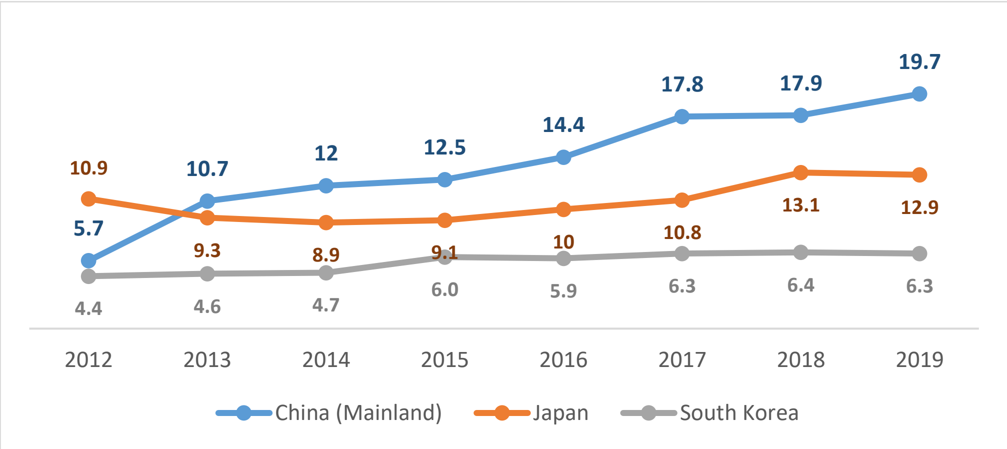
Table 4. Descriptive statistics (continued)

$	DS	DG	DMS
mean	0.480734	0.435103	0.285834
std	0.49964	0.495782	0.451821

The companies ' R&D investments vary significantly, from the $10 a year spent in 2013 by South Korea's Yulho Co Ltd, a technology company, to the record $195 million invested in 2019 by Japan's Furukawa Electric Co Ltd, a manufacturer of electrical and electronic equipment.

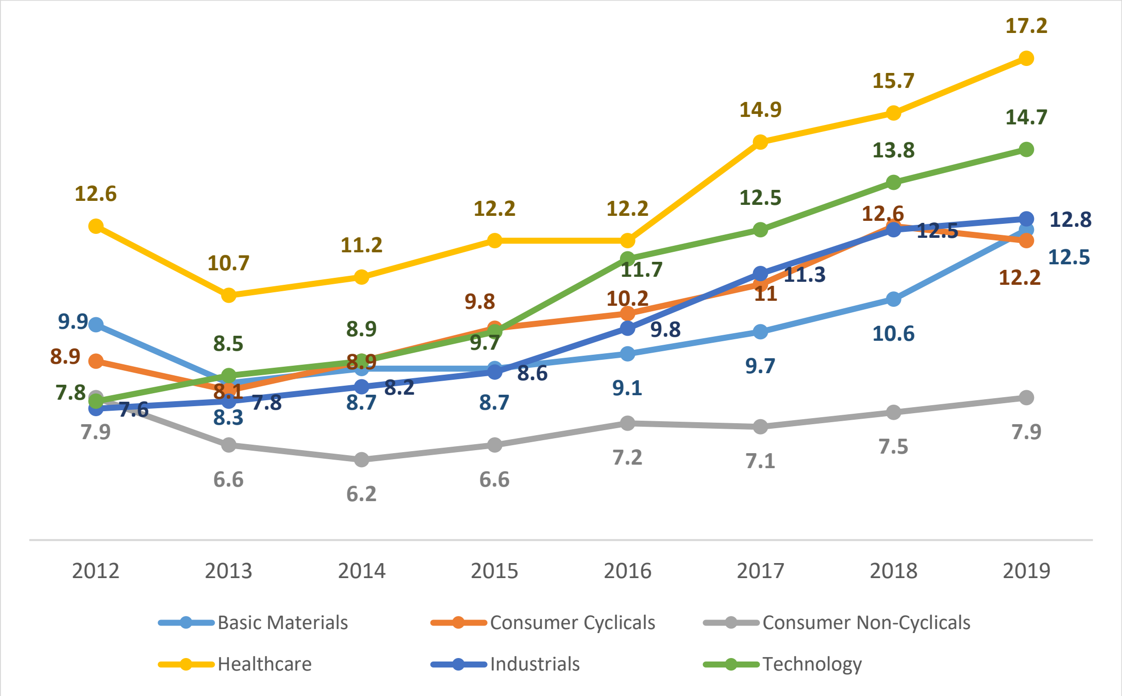
Picture 1 shows an upward trend in average R&D expenditures, which may indicate an increase in competition and the desire of companies to invest in future growth.

Picture 1. Dynamics of the mean of R&D values (country specifics), mln USD



In the industry structure of R&D investments, we see that means for R&D of companies from the Healthcare sector are located on the graph higher for each year than means of other sectors. This fact can be attributed to the high knowledge intensity of the industry. At the same time, companies in the Consumer Non-Cyclicals industry located lower than other industry for almost all years, which can be explained by the fact that when choosing essential goods, most consumers pay attention to the price, rather than to new products, brand and additional characteristics.

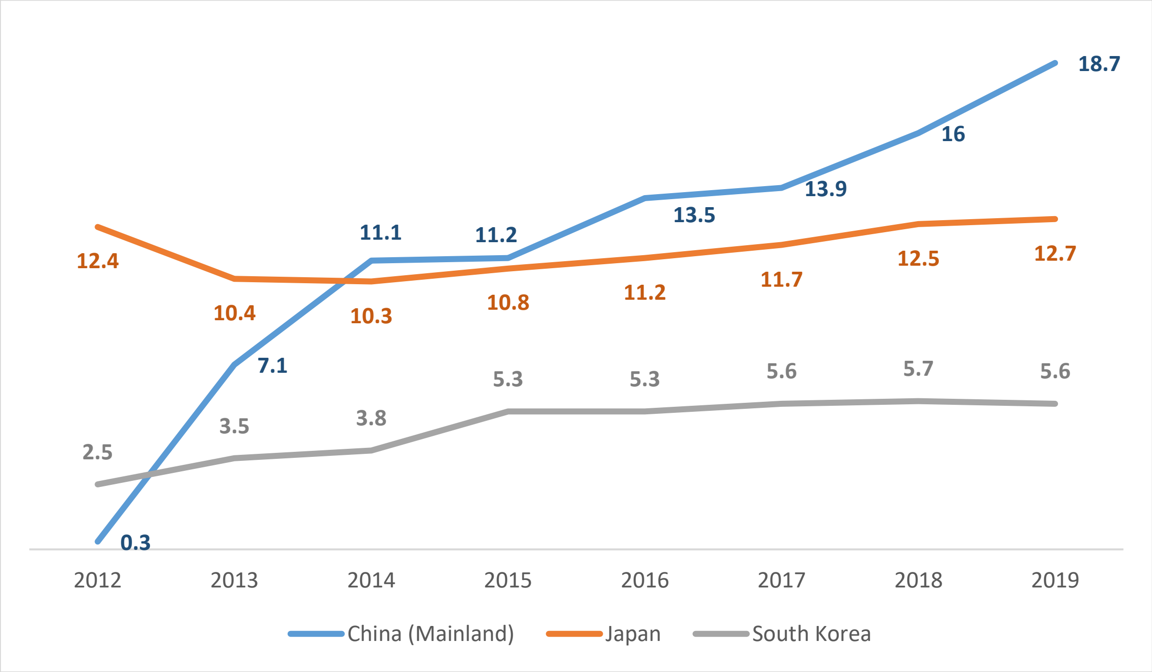
Picture 2. Dynamics of the mean of R&D values (sector specifics), mln USD



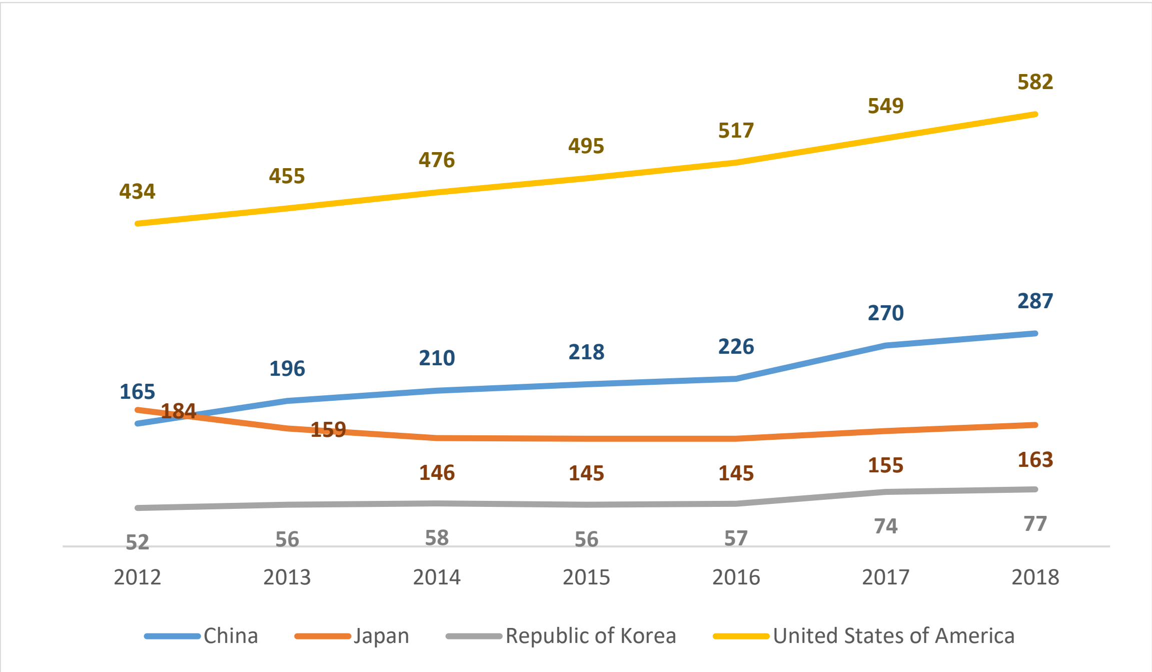
Picture 3 shows the total domestic R&D expenditures in each of the countries carried out during a particular reporting period and presented at current prices of billion USD. The picture 4 shows the same data from the UNESCO Institute Statistics. The dynamics of investments and the relative position of countries in the statistics of the UNESCO Institute for Statistics repeats the dynamics and the relative position of countries in the study sample. China also overtook Japan in R&D spending, while South Korean companies lag behind Japan and China in R&D spending. At the same time, we see that the US is still ahead of China in terms of R&D investment by more than 2 times.

The share of R&D investments of innovative and active local public companies from the sample is less than 10% of the country's domestic investment, since domestic investment includes the expenses of commercial enterprises operating in the country, the government, higher education institutions and private non-profit organizations, regardless of the source of funding.

Picture 3. Dynamics of the total R&D value (country specifics, sample data), bln USD



Picture 4. Dynamics of the total R&D value (UNESCO Institute Statistics), bln USD

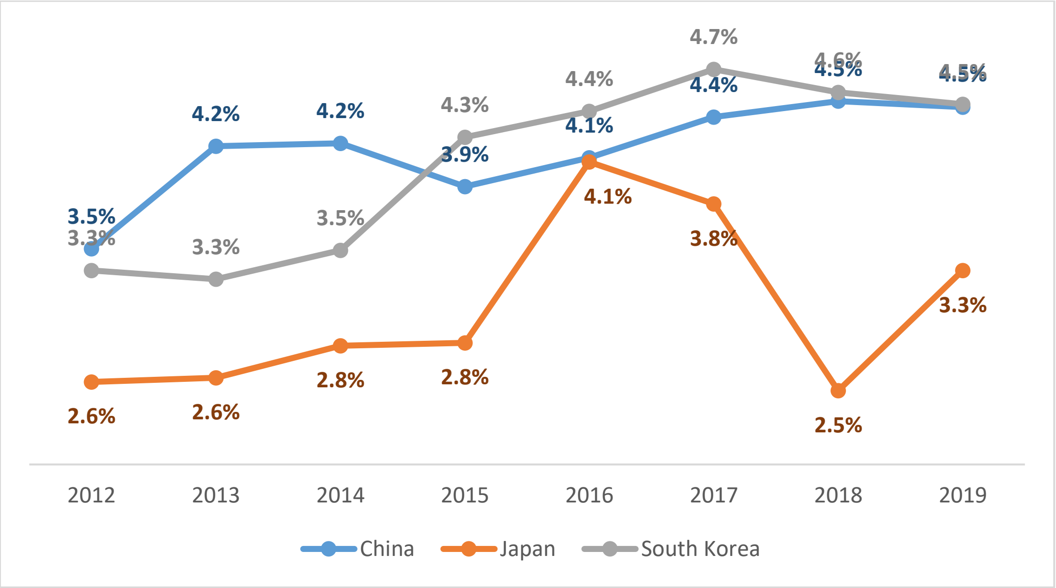


To measure a company's R&D investment, the most commonly used measure is the relative share of R&D investment in a company's revenue. This indicator allows you to reflect how much of the company's revenue is reinvested in R&D. Despite the lower investment in R&D in absolute terms, in relative terms, South Korea leads in the share of investment, according to the statistics for the countries of the UNESCO Institute for Statistics and the OECD. The indicator is calculated as the share of domestic investment in R&D in the country's GDP.

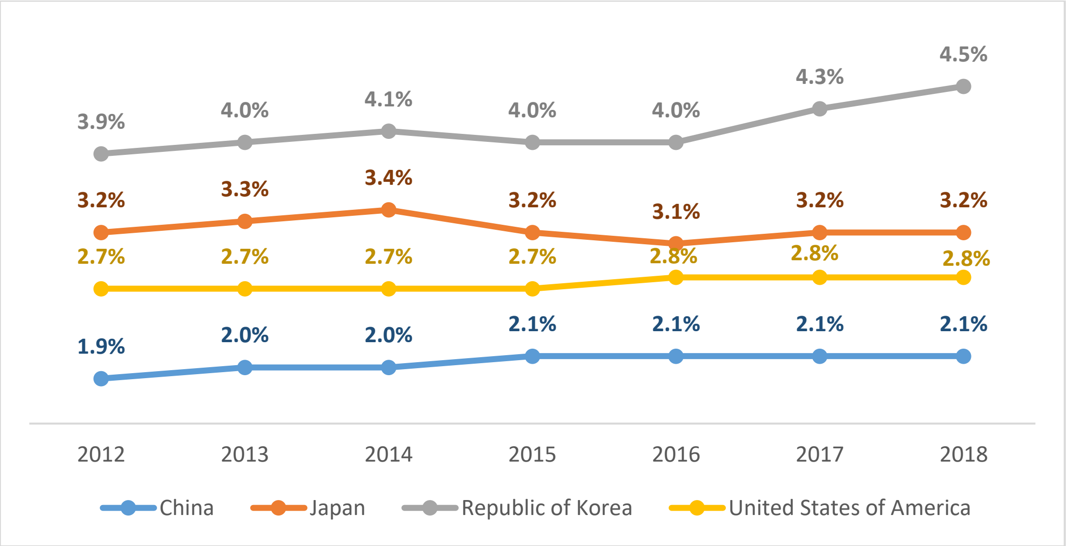
According to the sample, China's innovative companies invest a larger share of their revenue in R & D than the average government, commercial, and non-profit institutions across the country. On average, innovative companies in China, Japan, and South Korea invested more than 3.5% of their revenue in R & D in 2018, which is lower than the share of South Korean investment, but higher than the share of investment in China, Japan, and the United States.

Country-by-country statistics show that Japan and South Korea have overtaken the United States in terms of investment in the country's GDP, while China is slightly behind.

Picture 5. Dynamics of the R&D share in sales (country specifics, sample data)



Picture 6. Dynamics of the R&D share in GDP



3.4. Regression analysis and main results of the study

The regression analysis is carried out in two stages: the first stage is evaluation of the parameters of the baseline model, where the dependent variable is the market value of the company, and independent variables are the book value of capital, residual profit and investment in R&D. Further, we evaluate baseline model included binary variables that reflect the characteristics of companies: the size of companies, the rate of revenue growth and the market share.

At the second stage, binary variables were added to the baseline model, indicating the country and industry affiliation of the companies. After that, the significance of country and industry affiliation for determining the market value of companies and the stability of the parameters of independent variables that are evaluated at the first stage of the study is evaluated.

All the models in the study are built on panel data, so they are tested using the Wald, Breusch – Pagan, and Hausman tests for the preference of the pooled regression model, the model with fixed effects, and the model with random effects. As a result, a model with fixed effects is chosen for the equations without considering country and industry affiliation, and between-effect model was chosen for the model with industry and country affiliation. The results of the both stages of regression analysis of the models are presented below:

Table 5. Econometric analysis results

Variable	First stage				Second stage			
	Baseline model	Hyp. 1	Hyp. 2	Hyp. 3	Baseline model	Hyp. 1	Hyp. 2	Hyp. 3
Ln(BV)	0.691***	0.6913***	0.6891***	0.6912***	0.7918***	0.7916***	0.7895***	
RI	$6.82*10^{-10}$***	$6.82*10^{-10}$***	$5.81*10^{-10}$***	$6.93*10^{-10}$***	$2.67*10^{-9}$***	$2.68*10^{-9}$***	$2.36*10^{-9}$***	
RD	$4.04*10^{-9}$***	$4.4*10^{-9}$***	$3.3*10^{-9}$***	$5.6*10^{-9}$***	$6.02*10^{-9}$***	$5.7*10^{-9}$**	$2.35*10^{-9}$***	
RDDS		$-3.73*10^{-10}$				$3.18*10^{-10}$		
RDDG			$1.69*10^{-9}$***				$8.52*10^{-9}$***	
RDDMS				$-1.61*10^{-10}$**				$-3.8*10^{-9}$**
NC2					-1.3645***	-1.3654***	-1.3726***	-1.3544***
NC3					-1.1542***	-1.1552***	-1.1580***	-1.1402***
NSEC2					0.0592**	0.0591**	0.0600**	0.0605**
NSEC3					0.3228***	0.3225***	0.3240***	0.3252***
NSEC4					0.5411***	0.5411***	0.5495***	0.5388***
NSEC5					0.0967***	0.0966***	0.0994***	0.0969***
NSEC6					0.2873***	0.2873***	0.2883***	0.2834***
cons	6.1487****	6.1415***	6.1827***	6.1389***	4.9872***	4.9916***	5.0304***	4.9701***

Table 5. Econometric analysis results (continued)

R^2	0.6825	0.6828	0.6824	0.6841	0.8378	0.8378	0.8364	0.8380
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
N	21,411	21,411	21,411	21,411	21,411	21,411	21,411	21,411

Note: characters *, ** and *** denote variables significant at the 10%, 5% and 1% level respectively.

All the models presented are statistically significant. In the first baseline model all the independent variables that affect the market value of the company turned out to be significant. Thus, since the coefficient before the R&D investment variable turned out to be positive, our data are consistent with the conclusion of many scientific papers that the size of R&D investment positively affects the market value of the company. If current R&D investment increases by $100,000, all other things being equal, the company's market value will increase by 0.007%. At the same time, if the residual income increases by $100,000, all other things being equal, the market value will increase by 0.04%.

Based on the fact that the RDDS variable is insignificant, we conclude that hypothesis 1 is rejected. This means that there is no difference in the market value of innovative activities of companies, the size of which is greater than the average in the industry, and innovative companies, the size of which is lower or equal to the average size of companies in the industry. This result may be due to the fact that in Asia, young companies are rarely listed on the stock exchange, which is why the differences between the size of the companies in the sample are not very big. In addition, it is possible that the advantages that are available to larger companies are offset by the more flexible approach of small companies, so that significant differences between the assessment of their market value do not appear.

A positive sign of the coefficient and a low p-value for the RDDG variable indicates that innovation activities of companies whose sales are growing at a rate higher than the industry average are valued by the market higher than companies with lower growth rates. On average, companies with higher growth rates, with an increase in current R&D spending of $100,000, receive an additional 0.02% increase in market value. Thus, we accept the second hypothesis about the positive impact of high sales growth rates on the market's assessment of the value of an innovative and active company.

We reject our hypothesis about the positive impact of market share on the market value of innovation activities of a company. According to the results obtained from our model, a high market share negatively affects the company's innovations' market valuation. All other things being equal, companies with a higher market share are reduced in their market value by 0.02% when their R&D investments increase by $100,000. The possible explanation is that the shareholders of companies with a high market share may resist the additional costs of the company, since these costs do not go to the shareholders ' dividends.

All models that includes country and industry specificity also turned out to be significant. Based on the significance/insignificance of the coefficients before the variables and their sign, which is responsible for the relationship between the characteristics of the company and the market value, we can conclude that the coefficients before these variables are stable, which confirms the following relationships between the characteristics of companies and the market value:

(1) the size of the company does not affect the relationship between innovations and market value of companies,

(2) the growth rate of companies ' revenue positively affects the relationship between innovations and market value of companies,

(3) a high market share negatively affects the relationship between innovations and market value of companies.

At the same time, based on the results, for Japanese and South Korean companies, on average, the market value assessment is lower than for Chinese companies. This may be due to China's large GDP relative to Japan and South Korea, the country's high GDP growth rate, as well as the country's large domestic market, which allows investors to be confident in the future of Chinese companies.

In addition, we see that the market value of companies from consumer cyclicals, consumer non-cyclicals, healthcare, industrials, technology sectors is estimated by the market higher than the market value of companies from the basic materials industry. It can be assumed that since the resources used in this industry are non-renewable, investors assess the prospects of the industry worse than those of other industries where there are more business growth opportunities.

As a result of this analysis, a statistically significant positive relationship was established between the high growth rates of innovative companies and the market value of the firm innovative activities. This suggests that companies growing at a higher rate will make the most of the excess profits generated from R&D projects. Consequently, the market will give them a higher rating than the rest of the firms. This conclusion is consistent with the results obtained (Del Monte and Papagni 2003) and (Pindado J., Chabela de la Torre 2010).

The study also rejected the hypothesis of the relationship between the size of an innovative company and the market value of the firm innovations. It turned out that there is no difference in the market evaluation of innovative activities of companies, the size of which is larger than the average in the industry, and innovative companies, the size of which is lower or equal to the average size of companies in the industry. This may be due to the fact that the economies of scale, easier access to finance, and consistency of investment strategy that are more common in larger companies (Pindado J., Chabela de la Torre 2010; Cohen and Klepper 1996; López-Salido, Stein, & Zakrajšek, 2017; Maslach 2016; Chauvin and Hirschey 1993) are offset by a more entrepreneurial and flexible approach of small companies (Acs and Audretsch 1990; Eshima and Anderson 2017), which is why there are no significant differences between the assessment of their market value.

The study also produces unexpected results. We reject the hypothesis of a positive relationship between market share and the market value of an innovation activities of a company. According to the results obtained using the model, a high market share negatively affects the company's innovations' market valuation, which is at odds with the results of the cross-country study on the European Union (Pindado J., Chabela de la Torre 2010), where a positive relationship was found between an innovative company's high market share and the market value of firm innovations, as well as with the study (Chen, Ho, and Shih, 2007), where the relationship was not found. It can be assumed that the shareholders of the market-leading companies may resist the additional expenses of the company, since these expenses reduce the shareholders ' dividends.

Thus, based on the results of the study, we can recommend innovative companies, whose management is aimed at maximizing the value of the company for its shareholders, to increase the share of investments in R&D, given the fact that the assessment of their investments will be higher on average in the case of high growth rates of the company, and a high market share, other things being equal, can reduce the assessment of the market value of the company by investors. These results will also be useful for investors who are considering including innovative companies in their portfolio.

CONCLUSION

The purpose of this work is to establish the impact of innovative firm characteristics on the relationship between firm innovations and the market value.

In the course of achieving this goal, a number of tasks were consistently solved. The first chapter was an analysis of the concept of company value and approaches to value measurement. In the second chapter, the definition of "innovation" and "innovative companies" was given. In addition, this chapter analyzes various indicators of the company's innovation activity, on the basis of which the indicator of investment in R&D was selected as the corresponding to the goal of this work. In addition, this chapter provides an overview of research describing the relationship between the innovation activities of companies and market value, as well as publications and studies on the impact of frim characteristics on the relationship between companies' innovations and the market value of the companies. At the end of the chapter, the main hypotheses of the scientific research were formulated.

The third chapter presents the results of an empirical study aimed at establishing the impact of firm characteristics on the relationship between the companies' innovations and the market value of companies. The final sample consisted of 3,381 companies from 3 countries and 6 industries. The sample of innovative companies consists of 38% Japanese companies, 32% Chinese companies, and 30% South Korean companies.

The study was conducted using econometric modeling tools in two stages. At the first stage, establishing the impact of firm characteristics on the relationship between the companies' innovations and the market value of companies was revealed. It was found that the size of the company does not affect the relationship between innovations and market value of companies. Thus, the first hypothesis of a positive impact of the firm size on the relationship between of the company's innovations and the market value was rejected. The second hypothesis of a positive relationship between high revenue growth and market value of innovations was accepted with a level of significance of 1%. In the course of the study, it was revealed that a high market share negatively affects the market value of innovations in companies. Thus, the third hypothesis was rejected.

The second stage of the study was to analyze the model for stability by introducing additional binary variables that reflect the industry and country affiliation of the company.

According to the results of the calculations, the model was resistant to the introduction of new variables, since the direction of the relationship between the market value and the independent variables did not change.

At the same time, it turned out that for Japanese and South Korean companies, on average, the market value is lower than for Chinese companies. This may be due to China's large GDP relative to Japan and South Korea, the country's high GDP growth rate, as well as the country's large domestic market, which allows investors to be confident in the future of Chinese companies.

In addition, the market value of companies from Consumer Cyclicals, Consumer Non-Cyclicals, Healthcare, Industrials, Technology is estimated by the market higher than the market value of companies from the basic materials industry. It can be assumed that since the resources used in this industry are non-renewable, investors assess the prospects of the industry worse than those of other industries where there are more business growth opportunities.

Based on the results obtained, investors in innovative companies from China, Japan and South Korea are recommended to pay attention to the company's revenue growth rate compared to the industry average, as this indicator on average has a positive effect on the market valuation of innovation in the companies. In addition, all other things being equal, it is not worth investing in innovative companies with a high market share, since a high market share negatively affects the company's innovation activities valuation by the market. At the same time, the size of the company, all other things being equal, does not matter. These recommendations can also be useful for the management of Asian innovation-active companies, as they will get a better idea of what indicators should be improved by the company to increase shareholders' value.

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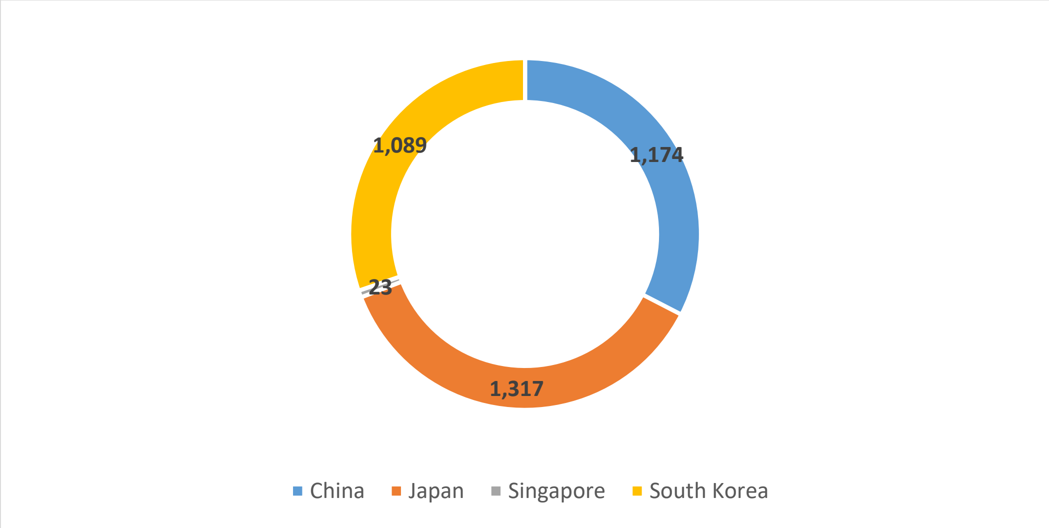
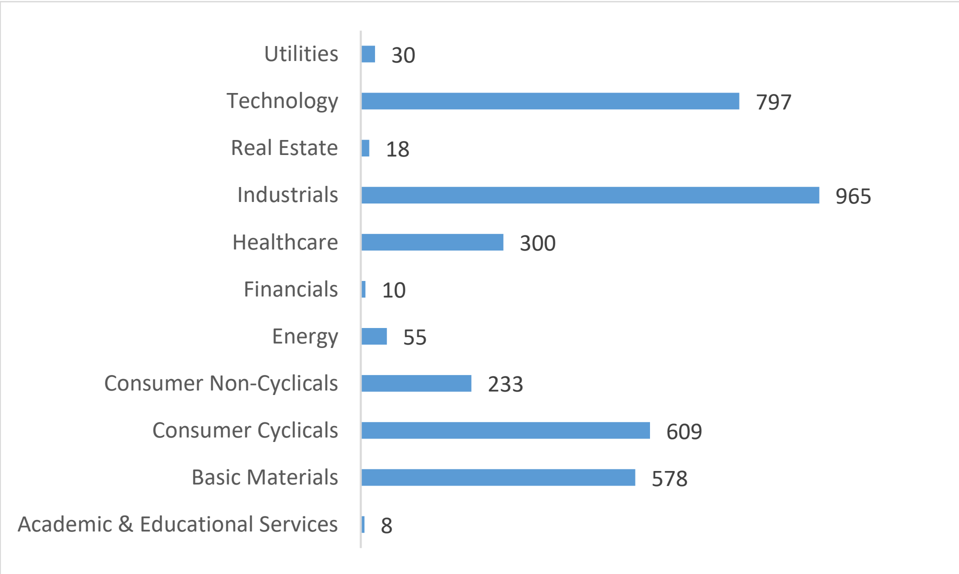
APPENDIXES

Appendix 1. The primary structure of the sample by country



Appendix 2. The structure of the primary sample by sector



Appendix 3. Sector description, TRBC classification

- Academic & Educational Services-an industry that includes institutions of preschool, primary, secondary, higher and additional education, as well as companies that provide professional and business education services.
- Basic Materials-an industry consisting of enterprises engaged in the search, development and processing of raw materials. This sector includes companies engaged in the extraction and processing of metals, chemical and forest products.

- Consumer Cyclicals is an industry consisting of businesses that sell consumer goods/services for which demand is elastic. For example, cars, clothing, passenger transportation services, and others.
- Consumer Non-Cyclicals is an industry consisting of businesses that sell consumer goods/essential services. For example, companies that sell food, medicines, and other goods.
- Energy-an industry consisting of companies engaged in the search, exploration and processing of energy resources such as oil, coal, and gas, as well as companies engaged in the generation of renewable energy.
- Financials-an industry consisting of businesses that provide banking, insurance, and investment services.
- Healthcare-an industry consisting of companies engaged in the supply of medical equipment, developing medical products and providing medical services.
- Industrials-the industry includes companies whose business is dominated by one of the following activities: production and marketing of capital goods, including aerospace and defense industries, construction, mechanical engineering and construction products, electrical equipment and industrial equipment.
- Real Estate-the industry includes companies that deal with residential and commercial real estate.
- Technology – an industry consists of businesses that sell goods and services in electronics, software, computers, artificial intelligence, and other companies associated with information technology.
- Utilities – public utilities industry includes companies that provide the basic amenities such as water supply, Sewerage, electricity, dams and natural gas.