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Analysis of the Effectiveness of Healthcare M&A Transactions in Developed Countries

Summary: The healthcare industry is a large and fast-growing segment of the corporate world, especially in developed countries. In the face of growing competition, healthcare companies inevitably resort to mergers and acquisitions (M&As) in order to accelerate their development. The objective of this study is to identify the creation of additional value for M&A deal participants in the healthcare industry in the United States and the European Union in 2008-2017. In this paper, we propose the following thesis statement: can healthcare companies expect excess returns from M&A deals? On average, M&A deals in the healthcare industry in developed countries create positive abnormal returns for acquiring companies and are efficient; a positive, significant impact on abnormal returns was found in the deal value of M&A deals, a negative significant impact was observed for deals conducted with the shares payment method and for acquiring companies with a larger number of employees.

Keywords: Merger and acquisition transactions, Strategy effectiveness, Average excess returns, Healthcare companies, Developed countries.

JEL: G30, L10.

This study was carried out within The National Research University Higher School of Economics (St. Petersburg School of Economics and Management, Department of Finance).

The objective of this study is to identify the creation of additional value for purchasers and other M&A deal participants by assessing the effectiveness of merger and acquisition (M&A) deals in the healthcare industry in the United States and the European Union in 2008-2017. The effectiveness of such M&A transactions is determined by analysing a sample of 204 transactions that occurred in 2008-2017. The study identifies factors that impact the effectiveness of transactions and create benefits for purchasers. The research thesis statement is the following: can healthcare companies expect excess returns from M&A deals?

The study of M&A efficiency is a key area in the field of corporate finance. In contrast to a large number of papers on this subject, we study the efficiency of M&A deals using the event method to calculate the cumulative abnormal return (CAR) based on the market return model, conduct an analysis of the significance of efficiency indicators of M&As based on parametric and non-parametric tests, and construct a regression model in order to identify significant factors. While analysing earlier studies, we have identified a relatively small number of papers on M&As in the medical services market, especially for developed countries. It can also be noted that there has been a lack of such studies in recent years. Most of the studies are aimed at determining the

final effect rather than identifying factors that predetermine the efficiency of a transaction or forecasting the trends and prospects of this market.

In contrast with other existing studies, using abnormal return as an indicator of efficient transactions allows us to make conclusions on the change in the value of European and American companies as a result of M&As in the long-term. In analysing one of the most recent time periods, 2008-2017, we prove that M&As facilitate efficiency growth in companies from developed countries.

The paper is structured as follows. The first section presents the theoretical framework and reviews the literature on which the study relies. The second section discusses and justifies the primary hypotheses of the study. The third section describes the data and methodology used in the analysis. In the fourth section, we analyse the results. Finally, the fifth section presents the conclusions.

1. Theoretical Framework and Review of the Literature

This study is based on works analysing the effectiveness of M&A transactions and contributing factors. This study considers papers that evaluate selected segments of the healthcare system (for example, the studies of Gregor Andrade, Mark Mitchell, and Erik Stafford 2001; Mae Hassan et al. 2007; Kazuharu Ohashi 2007; Seshadri 2016).

Methods of payment and their impact on the outcomes of deals are addressed by Sara Moeller, Frederik Schlingemann, and Rene Stulz (2004), Marina Martynova and Luc Renneboog (2009), Micah Officer (2014), Nickolaos Travlos (2015), Henri Servaes and Marc M. Zenner (2016).

The effect of cross-border transactions is studied in the works of Michael Aw and Robin Chatterjee (2004), Moeller and Schlingemann (2005) and Muhammad F. Malik (2014). The effect of transaction value on excess returns from M&A deals is examined by Richard Roll (1986) and Mathew Hayward and Donald Hambrick (1997) and the relationship between the success of a transaction and the size of the purchaser is analysed in the works of Espen Eckbo (2010) and Robert Verrecchia (2014).

The dependence of excess returns on the purchaser's origin in the US or the European Union is described in the works of Kadam Datta and George Puia (1995), Jose Campa and Ignasio Hernando (2004), Marc Goergen and Renneboog (2004) and Erik Devos, Palani-Rajan Kadapakkam, and Srinivasan Krishnamurthy (2014).

The model built by Hassan et al. (2007), which is based on data on 405 M&A transactions from 1981 to 2004 in the US pharmaceutical sector (which is a significant part of the healthcare industry), indicates that, on average, acquisitions in this area are efficient and increase firm value. The average CAR for mergers is 0.57%, which is not statistically significant; however, in cases of acquisitions, it reaches a statistically significant value of 4.17%, which is why acquisitions in the pharmaceutical sector are considered effective.

M&A transactions among companies that produce and sell medical technology are also characterised by positive excess returns (Ohashi 2007; Bain & Company 2016; The Pharma Letter 2016). In the study of 3-day CARs for a sample of 674 M&A deals in this segment of the healthcare industry, Ohashi (2007) finds that these transactions bring the purchaser an average of 0.4% excess returns.

The above information suggests that, on average, M&A transactions in the healthcare industry have historically had a positive average effect on excess returns for purchasers (Boston Consulting Group 2017).

Moeller, Schlingemann, and Stulz (2004) prove that M&A transactions among companies in the public sector have a significant positive impact on CAR when cash is the chosen method of payment. The same hypothesis is supported by a study conducted by Martynova and Renneboog (2009) with a sample of European M&A deals from 1993 to 2001; they prove that paying with stock produces worse results than cash purchases.

Based on the observations above, it can be concluded that the payment method is a significant factor in determining the effectiveness of M&A transactions, but its exact impact is ambiguous.

The nationality of companies that participate in M&A deals is deemed another factor that has an impact on the effectiveness of a transaction; it is important to consider whether the companies in question operate in the same country or whether they conduct a cross-border M&A transaction. Aw and Chatterjee (2004) support the idea that M&A transactions between companies from different countries result in increased value. In their article, they analyse the performance of companies from the UK after transactions with firms from the European Union and the US, and the study shows a significantly lower CARs after merging with companies from the same country. However, Moeller and Schlingemann (2005) prove that cross-border transactions may have a negative impact on M&A efficiency, while transactions between companies from the same country have the opposite effect. In their study, they reveal a negative impact on M&A transactions in the US across all industries.

In addition, a number of studies note that the aggregate value of M&A transactions is also a significant factor that affects M&A efficiency. Hayward and Hambrick (1997) state that high-value deals stimulate negative effects on a firm's value, as the purchaser pays the target company premiums that exceed its market value. Roll (1986) also advocates the positive effects of large transactions. He argues that large companies are more inclined to use stock as a method of payment, which allows paying lower premiums and leads to better returns.

Another contributing factor that researchers note is the purchaser's size and number of employees. In particular, Eckbo (2010) notes that larger firms are often willing to pay larger amounts of money than the actual value of a target company. Roll (1986) supports this observation with the fact that management in large companies is prone to arrogance, which entails mistakes and overpayments in transactions. Therefore, larger purchasers often obtain lower excess returns.

One cannot ignore the geographical aspect and its impact on the effectiveness of M&A transactions, despite the fact that the importance of this factor is rarely considered and most empirical studies do not take into account the nationality of buying companies. Datta and Puia (1995) examine cross-border transactions with US companies as purchasers. On average, they do not find either positive or negative significant CAR values for these firms. In their research on M&A transactions with purchasers from EU countries, Goergen and Renneboog (2004) identify small positive CARs for

purchasers, while Campa and Hernando (2004) do not find either an increase or a decrease in the value of EU companies after M&A deals.

The results of the studies are summarised in Table 1:

Table 1 Results of M&A Studies

Topic	Author(s) and date	Apparent effect on excess returns
Pharmaceutical industry	Hassan et al. (2007)	Positive
Pharmaceuticals and biotechnology	Andrade, Mitchell, and Stafford (2001)	Positive
Medical technology	Ohashi (2007)	Positive
Method of payment (stock)	Travlos (2015), Servaes and Zenner (2016)	Positive
Method of payment (stock)	Martynova and Renneboog (2009)	Negative
Method of payment	Officer (2014)	Negative
Method of payment (cash)	Moeller, Schlingemann, and Stulz (2004), Seshadri (2016)	Positive
Cross-border deals	Aw and Chatterjee (2004)	Positive
Cross-border deals	Moeller and Schlingemann (2005)	Negative
Transaction value	Hayward and Hambrick (1997)	Negative
Transaction value	Roll (1986)	Positive
Purchaser size	Eckbo (2010)	Negative
Purchaser size	Roll (1986)	Negative
US purchaser	Datta and Puia (1995)	Neutral
EU purchaser	Goergen and Renneboog (2004)	Positive
EU purchaser	Campa and Hernando (2004), Devos, Kadapakkam, and Krishnamurthy (2014)	Neutral

Source: Author's compilations.

2. Hypotheses Formulation

This section presents the hypotheses to be tested in the study, according to the arguments extracted from the theoretical framework and literature review. As previously stated, the objective of this paper is to identify the creation of additional value for M&A deal participants in the healthcare industry in the United States and the European Union in 2008-2017. According to the previous studies summarised in Table 1, it appears that different forces drive the efficiency of M&A deals in the healthcare sphere: the payment method, the country of the purchaser, the purchaser size, etc. Therefore, the hypotheses are in line with these arguments. We propose the following hypothesis:

Hypothesis 1: On average, healthcare M&A transactions in developed countries generate positive excess returns for purchasers.

Hypothesis 2: Cross-border healthcare M&A transactions in developed countries generate excess returns for purchasers.

Hypothesis 3: The use of cash as the payment method in M&A transactions in the healthcare industry in developed countries has an effect on excess returns for the purchaser.

Hypothesis 4: The use of stock as the method of payment in M&A transactions in the healthcare industry in developed countries has an effect on excess returns for the purchaser.

Hypothesis 5: The geographic affiliation of the purchaser with the United States or the European Union affects excess returns from M&A transactions in the healthcare industry in developed countries.

Hypothesis 6: The total value of an M&A transaction in the healthcare industry in developed countries affects excess returns for the purchaser.

Hypothesis 7: The purchaser's number of employees affects the purchaser's excess returns in M&A transactions in the healthcare industry in developed countries.

3. Data and Methodology

In this paper, we use an event study methodology. The method is based on assessing the extent to which a certain event affects company value (the value of its shares).

The event method is currently the most widespread and practical way to analyse the impact of an event on stock prices, which, in this case, allows us to apply it to assess the efficiency of M&A transactions. The advantages of this method include its convenience for comparing the efficiency of a large number of M&A transactions, as well as its accurate assessment of benefits that a company receives from transactions. For these reasons, the study will rely on this method (John Binder 1998; Tomaso Duso, Klaus Gugler, and Bursin Yurtoglu 2010; Morgan Stanley Capital International 2017).

The method is based on the efficient market hypothesis, which is the main assumption when applying the event method. The underlying idea of the theory is that prices completely reflect all information and events. A market in which prices do so is efficient. In the context of this study, this context means that all data on M&A transactions in the healthcare industry are instantly accounted for and reflected in a company's stock prices. The efficient market hypothesis is tested within the event method since M&A transactions must influence a company's stock prices. If this hypothesis is rejected, either the market is inefficient or there are errors in the abnormal return model.

The event method tests the efficient market hypothesis since M&A transactions are supposed to influence the value of the company's shares. If the hypothesis is rejected, either the market is inefficient or there are errors in the excess return model (Nida Mehros 2013).

For the purposes of this study, an event is an M&A deal made by a health care firm (point 0), an estimation window is not required due to the particular model chosen for the calculation of excess returns, and an event window is the period from the day before the transaction to the day after the transaction (T1-T2).

As an appropriate valuation model, we choose the market model to estimate excess returns, which produces more exact estimates and has less variation.

Excess returns are calculated on the basis of the market model and are based on a linear relationship between stock returns and market returns (Equation (1)); we use its variation, called the market return model, in which a_i equals zero, β_i is equal to one, and an estimation window is not required (A. Craig MacKinlay 1997):

$$R_{it} = a_i + \beta_i R_{mt} + \varepsilon_{it}, \quad (1)$$

where R_{it} - return on company stock at time *t*; R_{mt} - return on the equity market at time *t*; β_i - coefficient for R_{mt}; a_i - constant; ε_{it} - random error, given that:

$$E(\varepsilon_{it}) = 0,\ var(\varepsilon_{it}) = \sigma_{\varepsilon_i}^2. \quad (2)$$

Equation (2) indicates that the expected value of a random error in this model is 0, and its variation is $\sigma_{\varepsilon_i}^2$.

To calculate market returns, we use the MSCI ACWI Healthcare index, which includes data on securities in 23 developed and 23 developing countries for the healthcare industry, according to the GICS (Global Industry Classification Standard).

Excess returns are calculated using Equation (3):

$$AR_{it} = R_{it} - R_{mt}. \quad (3)$$

AR_{it} represents the excess returns on a company's stock at time *t*, which equals the difference between the actual returns on the stock and the market returns at time *t*.

To make conclusions about the effectiveness of an M&A transaction, the sum of excess returns during the event window is used as an indicator of cumulative excess returns which is to be considered a criterion for assessing the effectiveness of these transactions. CAR is considered the most objective indicator to estimate excess returns for short-term periods (MacKinlay 1997):

$$CAR_k = AR_{k,-1} + AR_{k.0} + AR_{k.+1}, \quad (4)$$

where $AR_{k,-1}$ characterises the excess revenue for stock k on the day before the transaction. $AR_{k.0}$ and $AR_{k.+1}$ represent excess returns on the day of the transaction and one day after the transaction, respectively.

Based on certain CARs, we conduct a number of parametric and non-parametric tests for the significance of their values. Parametric tests are based on the assumption of the normality of data distribution in the sample. Non-parametric tests do not make such assumptions. For this reason, we first conduct normality tests for CAR distribution in subsamples. If CAR is distributed normally, then all test results are evaluated equally. In cases with a non-normal distribution, parametric tests are conducted anyway, but the results of non-parametric tests have more weight when drawing conclusions.

The following tests are used to assess whether the data distribution is normal (Jeffrey Wooldridge 2014): a skewness and kurtosis test for normality; a Shapiro-Wilk normality test; and a Shapiro-Francia normality test.

When analysing the impact of M&As on excess returns, this indicator may be affected by a number of factors, which is why it is important to determine the degree of interconnection between CAR and characteristics related to the event.

When analysing the impact of M&As on abnormal return, a number of factors are proven to have an impact on this indicator. Therefore, it would be relevant to determine the extent of interconnection between CAR and characteristics that are related to this event. For this analysis, a suitable tool is the construction of a regression model based on the data collected. The most common and effective method for testing the significance of the impact of independent variables on dependent ones is ordinary least

squares (OLS). Since the data depend on stock prices, which change over time, all models are adjusted in accordance with White standard errors in order to avoid shifting the estimates of coefficients due to heteroscedasticity (Marno Verbeek 2012).

We use a regression model based on the collected data with CAR as the dependent variable:

$$CAR_k = \alpha + \beta_k X_k + \varepsilon_k, \quad (5)$$

where CAR_k - cumulative excess returns within the event window for stock k; α - constant; β_k - coefficient for the independent variable X_k, showing how much the value of CAR_k changes with a one-unit change in x; X_k - independent variable; ε_k - random error.

A more detailed description of all variables used to construct the model is given in Table 2 below. The choice of independent variables and the expediency of their use are based on an analysis of previous studies and identified market characteristics.

Table 2 Regression Variables

Variable	Definition
Dependent variable	
CAR (-1, +1)	Cumulative excess returns of a purchaser over a three-day period, where t=0 is the day of the corresponding M&A transaction.
Independent variables	
Inflation	Control variable. Average inflation rate during the event window for an M&A deal.
USDEUR_change	Control variable. Cumulative changes in the dollar-to-euro exchange rate during the event window.
Relative_size	Control variable. Transaction value divided by the purchaser's market capitalisation.
Initial_reaction	Control variable. Changes in the purchaser's stock the day after the transaction is announced.
Deal value	Total M&A deal value, in thousands EUR (Bureau van Dijk 2017)[1].
Cash	Dummy variable. Determines whether the method of payment is cash (1 – yes, 0 – no).
Shares	Dummy variable. Determines whether the method of payment is stock (1 – yes, 0 – no).
Cross-border	Dummy variable. Determines whether the participating companies are from the same country (1 – yes, 0 – no).
US	Dummy variable. Determines whether the purchaser is from the US (1 – yes, 0 – no).
Employees	Number of employees (in thousands) in the buying company at the time of the deal.

Source: Author's compilation.

Explanations of the model variables are presented below. We have used the following variables for the significance tests and the regression model:

- **CAR** is the dependent variable for the regression model. The principles of its calculation have been described earlier.
- The average inflation rate for the event window (**Inflation**) is a control variable used to increase the explanatory power of the model. M. S. Feldstein's

[1] **Bureau Van Dijk.** 2017. Zephyr - Company Information and Business Intelligence. www.bvdinfo.com/ru-ru/our-products/economic-and-m-a/m-a-data/zephyr (accessed June 10, 2017).

research shows that stock prices vary in proportion to inflation, and abnormal return depends on a company's stock prices. The variable is used only in the regression analysis.

- The cumulative change in the US dollar-to-euro exchange rate for the event window (**EUR/USD_change**) is a control variable. D. Dimitrova's research indicates a strong positive correlation between the national currency exchange rate and the company's stock prices. As the exchange rate stabilises, the stock market becomes more predictable for investors, and it becomes possible to predict an increasing interest in shares. The variable is used only in the regression analysis.
- The initial reaction to the announcement of a transaction (**Initial_reaction**) is a control variable that indicates a change in the acquiring company's share prices on the day after the announcement of an M&A transaction. Studies show that in most cases, the initial reaction to transactions predetermines future abnormal return after the transaction (M&As in the healthcare industry). Similarly to our expectation for initial public offerings, we can expect a very quick reaction from investors showing their interest in or distrust of a company's shares. The number of transactions with shares of the companies participating in an M&A transaction is an indicator of investor preferences.
- The relative size of a transaction (**Relative_size**) is a control variable calculated as the value of the transaction divided by the market capitalisation of the acquiring company. A number of studies have revealed a strong positive correlation between this indicator and abnormal return (K. J. Martin); this variable is used only for the regression analysis. We can assume that as the transaction becomes larger, the abnormal return it can guarantee increases. The value of a deal predetermines a range of investors, international investors' interest and the deal's prospects.
- The value of a deal (**Deal_Value**), expressed in thousands of euros. For the significance tests, this value is divided into three binary variables: up to 50 thousand euros, from 50 to 500 thousand euros, and over 500 thousand euros. For the regression analysis, the variable is measured in absolute value.
- The number of employees in the acquiring company (**Employees**) is expressed in thousands of employees. Similarly to deal value, for the significance tests, this value is divided into three binary variables: up to 100 employees, from 100 to 1000 employees, and over 1000 employees. In the regression analysis, this number is measured in absolute value. Like deal value, this variable accounts for the scale of a transaction and its possible impact on participants and potential revenue.
- Cross-border transactions (**Cross-border**) is a binary variable, where "1" indicates a deal between companies from different countries and "0" indicates a deal within one country. For the significance tests, we have also introduced the opposite variable, "Domestic", which indicates transactions between companies within the same country.
- Cash payment for a deal (**Cash**) is a binary variable, where "1" is cash payment and "0" is payment by another method. Payment of a transaction

involves paying in cash, which speeds up the transaction and provides some independence within it. When exchanging assets, participants acquire partial control and become completely dependent.

- Payment for a transaction with shares of the company (**Shares**) is a binary variable, where "1" is payment by shares and "0" means that the payment was made by another method.
- A US acquiring company (**US**) is a binary variable, where "1" stands for a company from the United States and "0" stands for one from the European Union. Since this paper focuses only on deals between companies from these two regions, this variable virtually compares abnormal returns in US companies and those in companies from the EU. For the significance tests, the opposite variable, EU, was created for an EU acquiring company. The study also aimed to determine the influence of a company's country of operation, which would identify the major countries with acquiring companies in the medical services market. The descriptive statistics for the variables used are shown in Table 3 below:

Table 3 Descriptive Statistics

Variables	N	Mean	s.d.	Min.	Max.
	(1)	(2)	(3)	(4)	(5)
CAR	204	0.00651	0.0319	-0.0802	0.138
Inflation	204	0.026458	0.00333	-0.0138	0.0356
USDEUR_change	204	0.030602	0.00376	-0.0108	0.0552
Relative_size	204	0.210	1.873	2.50e-06	26.69
Initial_reaction	204	-0.04223	0.106	-0.2314	0.2504
Employees	204	29.03	44.41	0.00900	300
Deal_Value	204	1,274	5,583	0.505	66,703
Cross-border	204	0.863	0.345	0	1
Cash	204	0.779	0.416	0	1
Shares	204	0.0441	0.206	0	1
US	204	0.309	0.463	0	1
EU	204	0.691	0.463	0	1

Source: Author's calculations.

The "variables" column contains variables included in the regression, which were described earlier. The "N" column is the number of elements in the sample; "mean" is the mean value of a variable; "s.d." is the standard deviation; "min" is the minimum value; and "max" is the maximum value of a variable.

Furthermore, we use a number of tests to assess the quality of the regression models: a skewness and kurtosis test for normality, a Shapiro-Wilk normality test, and a Shapiro-Francia normality test; we use the variance inflation factor (VIF) to test for a lack of multicollinearity, which assesses linear relationships between regressors, in a Ramsey RESET test.

All the tests listed above are used to ensure that the regression models can correctly measure the impact of regressors on CAR.

3.1 Sample Description

Information on M&A transactions is obtained using the Bureau van Dijk's Zephyr database (2017). The data on changes in stock prices are taken from Google Finance (2017)[2], and the data on market indices are obtained from the Investing.com website (2017)[3].

The initial sample consists of 553 M&A transactions in pharmaceuticals, biotechnology, and medical technologies and services, with companies from the United States and the European Union selected as representatives of developed countries. However, 327 transactions are excluded due to the lack of data on the purchasers' stock value. Of the remaining 226 transactions, 24 are not included in the final sample due to abnormally high CAR values (outliers). The final sample consists of 204 transactions. The strategy for choosing transactions for the final sample is presented in detail in Table 4 below:

Table 4 Choosing M&A Transactions for the Sample

	Step result (number of M&A deals)	Search result (number of M&A deals)
Methods of payment: cash, cash assumed, debt assumed, earn-out, other, shares	830 378	830 378
Time period: 2008 - current date (completed-confirmed, announced)	889 607	504 854
World regions: European Union enlarged (28) (acquirer OR target OR vendor), country (primary addresses): United States of America (US) (acquirer OR target OR vendor)	595 518	11 404
Current deal status: completed	1 321 555	9 526
UK SIC 2007 (primary codes): 21 - manufacture of basic pharmaceutical products and pharmaceutical preparations, 86 - human health activities (acquirer OR target OR vendor), US SIC (primary codes): 283 - drugs, 7352 - medical equipment rental and leasing, 80 - health services (acquirer OR target OR vendor), Zephus classification: biotechnology, pharmaceuticals, and life sciences (acquirer OR target OR vendor)	53 883	553
No data on stock prices	-	226
Outliers	-	204

Source: Author's calculations.

There are no mergers in the pure sense of the term (mergers of equals) in this sample. Most of the sample includes 100% acquisitions of target companies (126 out of 204 transactions), since the most common type of M&A transactions in healthcare is the purchase of a smaller company by a larger one in order to strengthen its market position. The remaining deals are incomplete acquisitions of 21 to 96 *per cent* of a target's shares.

[2] **Google Finance.** 2017. Stock Market Quotes, News, Currency Conversions and more. https://www.google.com/finance (accessed June 25, 2017).
[3] **Investing.com.** 2017. World Financial Markets. https://www.investing.com/markets/ (accessed June 25, 2017).

Regarding the distribution by healthcare industry segments, 163 transactions have purchasers from pharmaceuticals and biotechnology, 28 have purchasers from medical technology and services, and 13 purchasers have not been previously associated with the healthcare industry.

The sample includes transactions with various methods of payment. Most transactions are paid in cash (159 out of 204), 9 are paid in stock, and the method of payment for the remaining transactions is not disclosed.

4. Empirical Results

The table below shows the results of testing the hypothesis for the normality of CAR distribution in various subsamples. The Shapiro-Francia test was not used for the subsample in which shares were the method of payment, as the number of elements was less than ten. The *p*-value of less than 0.05 indicates the lack of normality in the distribution of the random value of CAR.

Table 5 Results of Tests for the Normality of a Random CAR Variable Distribution

CAR (-1; +1)	Shapiro-Wilk W test		Skewness/Kurtosis test		Shapiro-Francia W' test	
	p-value	Normal distribution	*p*-value	Normal distribution	*p*-value	Normal distribution
Whole sample	0.0015	No	0.0002	No	0.00102	No
Cross-border	0.0027	No	0.0006	No	0.00175	No
Domestic	0.4375	Yes	0.5198	Yes	0.44629	Yes
Cash	0.0124	No	0.0023	No	0.00577	No
Shares	0.0749	Yes	0.0477	No	-	-
US	0.0089	No	0.0013	No	0.00497	No
EU	0.0420	No	0.0072	No	0.01868	No
DV1	0.2225	Yes	0.0725	Yes	0.09539	Yes
DV2	0.6839	Yes	0.9287	Yes	0.78940	Yes
DV3	0.0024	No	0.0005	No	0.00186	No
Employees (1)	0.0042	No	0.0079	No	0.00504	No
Employees (2)	0.0152	No	0.0256	No	0.01840	No
Employees (3)	0.1673	Yes	0.0868	Yes	0.12781	Yes

Source: Author's calculations.

The final conclusions about the normality of the CAR distribution in each subsample are presented in Table 6 below:

Table 6 Normal CAR Distribution in Various Subsamples

Subsample	Normal distribution
Whole sample	No
Cross-border	No
Domestic	Yes
Cash	No
Shares	Yes
US	No
EU	No
DV1	Yes
DV2	Yes
DV3	No
Employees (1)	No
Employees (2)	No
Employees (3)	Yes

Source: Author's calculations.

Whole sample

Among all 204 transactions, the cumulative excess returns within the event window amount to 0.65%. The parametric *t*-test rejects the hypothesis about CAR values being statistically insignificant compared to zero at the 1% level. The non-parametric *t*-test also rejects this hypothesis at the 5% level; the value is very close to being significant at the 1% level. A *t*-value greater than zero indicates positive CAR in the sample. The significance tests for the whole sample are presented in Table 7.

Table 7 Results of the Significance Tests for the Whole Sample

***N* = 204** **CAR: 0.65%**	**Parametric tests**		**Non-parametric tests**	
	Test 1	**Test 2**	**Test 3**	**Test 4**
T/Z-value	2.9148	-	2.573	-
p-value	0.004***	-	0.0101**	-

Notes: *** relevant at the 1% significance level; ** relevant at the 5% significance level; * relevant at the 10% significance level.

Source: Author's calculations.

The results indicate that, in general, M&A deals in the healthcare industry in developed countries have significant positive CARs. Significant positive CARs correspond to the results obtained by Hassan et al. (1997). In other words, these transactions are efficient for the acquiring company in general, and one can expect positive excess returns at the time of their execution (Hassan et al. 1997).

The table below (Table 8) demonstrates summarised results of the study of CAR values as their difference from zero:

Table 8 Summarised Results of Parametric and Non-Parametric Tests

CAR (-1; +1)	Significant difference from zero (at the 10% level)	Significant difference from opposite samples (at the 10% level)
Whole sample	Positive	-
Cross-border	Positive	-
Domestic	-	-
Cash	Positive	-
Shares	-	Negative
US	-	-
EU	Positive	-
DV1	Positive	-
DV2	-	Negative
DV3	Positive	-
Employees (1)	-	-
Employees (2)	Positive	-
Employees (3)	-	-

Source: Author's calculations.

The null hypothesis of CAR being equal to zero is rejected overall, with a positive trend indicating the efficiency of M&A transactions in the healthcare industry in developed countries.

The null hypothesis was also rejected for cross-border transactions. These transactions show a significant positive CAR, which indicates a strong influence of this factor. At the same time, domestic transactions do not produce significant excess returns.

Among the methods of payment considered, cash payments prove to have a considerable positive impact on CAR, and stock payments result in significantly lower excess returns than other methods of payment.

Transactions with purchasers from the European Union also exhibit a positive effect on CAR, unlike those with US purchasers. Transaction value has a significant positive impact in categories under 50 thousand euros and over 500 thousand euros. The intermediate category does not provide non-zero results and produces a significantly worse CAR than others. The transactions are converted into categorical variables based on their value range. Transaction price is examined in more detail in absolute values in the regression analysis below.

The number of employees in buying companies shows a significant positive CAR only in the category of 100 to 1000 people. Similar to transaction value, this variable is converted into a categorical one and is analysed further in absolute values below.

At this stage, none of the hypotheses is rejected. Nevertheless, to confirm Hypotheses 2-7, it is necessary to analyse the cumulative influence of factors in the regression model.

Regression analysis results

Table 9 below shows the correlation matrix of the variables used in the regression model. There are no strong interrelations (more than 50%) between the independent variables; thus, it is possible to use them in one model.

Table 9 Correlation Matrix of the Variables

	Inflation	USDEUR_ change	dvcap	Initial_ reaction	Employees	Deal_Value	Crossborder	Cash	Shares	US
Inflation	1.00									
USDEUR_change	0.00	1.00								
dvcap	-0.01	0.28	1.00							
Initial_reaction	-0.02	-0.07	-0.06	1.00						
Employees	0.01	-0.09	-0.07	-0.0015	1.00					
Deal_Value	0.04	-0.01	0.03	-0.02	-0.08	1.00				
Crossborder	0.07	-0.01	0.02	0.08	0.00	0.03	1.00			
Cash	0.04	-0.06	-0.15	-0.09	0.16	-0.04	-0.11	1.00		
Shares	-0.03	0.08	0.36	0.07	-0.12	0.20	0.02	-0.40	1.00	
US	-0.03	-0.01	0.11	-0.08	0.07	-0.10	-0.44	-0.05	0.01	1.00

Source: Author's calculations.

Although the residuals are not normally distributed in the models (p-value < 0.05), according to the Central Limit Theorem, this condition is unimportant in sufficiently large samples (more than 200 elements), as the sum of a sufficiently large number of weakly dependent, approximately equal random variables has a distribution that is close to normal. In this study, the sample corresponds to this criterion. The Ramsey test proves the correct choice of the functional form in all models (p-value > 0.05), which indicates that the models provide reliable estimates of variable coefficients, as the models have all the significant regressors and the functional form is selected correctly. The multicollinearity test showed its absence in all 4 models (VIF < 5), which indicates that the coefficients in the models are assessed correctly. The results of the regression analysis are presented in Table 10 below.

The values opposite the variables are coefficients of the dependence of CAR on the given variable (how much CAR changes when a variable increases by one or, for binary variables, how much CAR changes if the category changes from "0" to "1"). The values in parentheses under the coefficients indicate the standard variance in the variables. R-squared and R-squared adj. are indicators of the explanatory power of the model: the percentage of the variance in the CAR dependent variable that it can explain. In this case, all models can explain approximately 58% of the variance, which is a relatively good indicator of the quality of models. F-statistics for all four models are significant at the 5% level, as indicated by their p-value, which is below 0.05; thus, coefficients for the variables in the models are not zero, and the models can explain the influence of the factors on the CAR value.

Table 10 Multiple Regression Analysis

Variables	Model 1	Model 2	Model 3	Model 4
	(1)	(2)	(3)	(4)
Inflation	0.0607***	0.0605***	0.0605***	0.0602***
	(0.00657)	(0.00642)	(0.00666)	(0.00653)
USD/EUR_change	0.0553***	0.0547***	0.0555***	0.0550***
	(0.00509)	(0.00516)	(0.00509)	(0.00514)
Relative_size	0.00222***	0.00224***	0.00216***	0.00214***
	(0.000352)	(0.000349)	(0.000362)	(0.000359)
Initial_reaction	0.0512***	0.0519***	0.0510***	0.0521***
	(0.0145)	(0.0140)	(0.0151)	(0.0146)
Cash	0.000265	0.000992	0.000737	0.00164
	(0.00360)	(0.00365)	(0.00368)	(0.00374)
Shares	-0.0142**	-0.0166***	-0.0138**	-0.0161**
	(0.00643)	(0.00639)	(0.00663)	(0.00660)
Employees		-5.96e-05**		-6.23e-05**
		(2.79e-05)		(2.76e-05)
Deal_Value		2.58e-07***		2.69e-07***
		(8.18e-08)		(8.69e-08)
Cross-border			0.00369	0.00433
			(0.00500)	(0.00496)
US			0.00139	0.00243
			(0.00321)	(0.00329)
Constant	0.00533*	0.00633*	0.00134	0.00140
	(0.00311)	(0.00325)	(0.00618)	(0.00625)
Observations	204	204	204	204
R-squared	0.594	0.603	0.596	0.605
R-squared adj.	0.582	0.587	0.579	0.585
F-statistic	234.61	167.02	251.05	193.24
p-value	0.000***	0.000***	0.000***	0.000***

Notes: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Author's calculations.

To verify the accuracy of determining important factors, we build four models with different specifications, which always include 4 control variables – the inflation rate, the dollar-to-euro exchange rate, the relative transaction value, and the initial change in the price of the purchaser's shares after the announcement of the transaction. As expected, these variables have a considerable positive effect on CAR, are significant at the 1% level, and increase the explanatory power of the models under each specification.

The results indicate that the payment method has a significant influence on CAR, stock payments in particular. This variable is significant at the 5% level in models 1, 3 and 4 and at the 1% level in model 2. The models show that, on average, transactions paid for with stock have a 1.38-1.66% lower excess profit than transactions with a different payment method, which was expected in accordance with the results of previous studies. The negative effect of this method of payment has to do

with the fact that the payment is often made by issuing additional shares, which lowers the overall value of the purchaser's shares. An example of such a transaction is the takeover of a pharmaceutical services provider PharmaKodex LTD by Swedish pharmaceutical company Orexo AB in 2009, which resulted in a 2.53% decrease in the purchaser's share value (Martynova and Renneboog 2009; Officer 2014).

Transaction value in thousands of EUR, included as an independent variable in models 2 and 4, has a significant positive impact on CAR at the 5% level. With an increase in deal value by 1000 euros, excess returns grow by 0.000000258-0.000000269. The results of previous studies vary in terms of the effect of transaction value on excess returns. This study suggests that for the healthcare industry, larger transactions generate larger CARs, which is consistent with Roll's conclusions. The positive effect stems from the fact that in large-scale transactions, companies are more careful about estimating fair values, which leads to greater positive returns through savings. For example, the 2015 deal between the two largest pharmaceutical companies, Actavis PLC and Allergan INC., for a total of $70.5 billion, was announced six months before the purchase, and the transaction value was calculated for several months prior in order to achieve a fair estimate. According to the estimates in this study, the CAR in this transaction was 2.87% (Roll 1986).

The number of a purchaser's employees in models 2 and 4 shows a significant negative impact on CAR at the 5% level. Every 1000 additional employees reduce excess returns by 0.0000596-0.0000623. This finding is consistent with the observations of other authors that larger companies tend to overpay for M&A transactions, which negatively affects excess returns. For example, GlaxoSmithKline PLC, a pharmaceutical giant, purchased Human Genome Sciences INC. in 2012. Human Genome Sciences was a small biotechnology corporation that long insisted on large amounts for the deal, to which GlaxoSmithKline eventually agreed. However, GlaxoSmithKline did not receive the expected results from the acquired assets after the transaction. According to our estimates, the CAR on this transaction is -8.4%. Company size does not have a strong correlation with the scale of a transaction (a correlation of 8%), since large companies often enter into smaller transactions, acquiring small firms. Therefore, there is no logical contradiction in the fact that company size and transaction value have opposite influences on CAR (Roll 1986; Eckbo 2010).

The method of payment in cash does not show either positive or negative impacts on CAR that are significant at the 10% level. In addition, there was no difference in the influence of cross-border and domestic transactions, transactions with US companies or those with companies from the European Union.

The regression analysis supports Hypotheses 4, 6, and 7. Hypotheses 2, 3 and 5 are rejected. Hypothesis 1 is not tested in this case.

The results of the study show that, on average, M&A deals in the healthcare industry in developed countries bring positive abnormal returns of 0.6% to the acquiring company. Deal value has a positive effect on CAR: larger M&As bring in larger CAR. A negative impact has been identified in transactions when shares are used as payment and when the size of the acquiring company increases.

The Bureau Von Dijk's Zephyr database has been used to select 204 M&A transactions in the healthcare industry in the US and the European Union. These data

have been used in parametric and non-parametric tests for the significance of transaction performance indicators, as well as in the regression analysis. As a measure of the efficiency of M&A transactions, we have chosen CAR for a three-day period, which includes the day before the transaction, the day of the transaction, and the day after the transaction. CAR has been calculated based on the market return model, taking into account the MSCI ACWI Healthcare index, which includes data on securities in the healthcare industry in 23 developed and 23 developing countries.

To test the proposed hypotheses, we conducted tests for the significance of CAR, as well as a regression analysis to identify important factors affecting CAR.

Hypothesis 1: As a rule, M&A transactions in the healthcare industry in developed countries bring positive abnormal returns to acquiring companies.

This hypothesis is supported by both parametric and non-parametric *t*-tests at the 5% significance level. On average, companies can expect a positive CAR of 0.6% from M&A transactions in the healthcare industry in developed countries. This finding allows us to state that, in general, these transactions are efficient. The hypothesis is confirmed.

Hypothesis 2: Cross-border M&A deals in the healthcare industry in developed countries bring abnormal returns to acquiring companies.

The *y*-tests for significance show that cross-border transactions bring a significant positive CAR of 0.74% to acquiring companies. Nevertheless, the regression analysis and Wilcoxon tests do not indicate a significant difference in CAR between domestic and cross-border transactions. Thus, the hypothesis is rejected in view of limited arguments in its favour, and this factor is not deemed significant.

Hypothesis 3: Cash payment for an M&A transaction in the healthcare industry in developed countries affects the abnormal return for the acquiring company.

The *T*-tests show significant non-zero CAR in the subsample in which this payment method is used, which indicates limited abnormal returns when using cash payment. However, CAR that is significantly different from those of other payment methods is found in this subsample, and in the regression analysis, this factor produces mixed results, showing both positive and negative effects on CAR, depending on the model specification. Nevertheless, in each model, this factor is insignificant at the 10% level, so the hypothesis is rejected.

Hypothesis 4: Payment by shares for M&A deals in the healthcare industry in developed countries affects abnormal returns for acquiring companies.

Tests for non-zero CAR do not show significant results. However, all four models in the regression analysis show that this payment method negatively affects the CAR indicator, in contrast to other payment methods. Payment by company shares leads to the results, which are 1.38-1.66% worse than those in a situation if another method is used. In addition, Wilcoxon tests show that on average, this payment method yields lower abnormal return than others. Therefore, this factor is significant, and the hypothesis is confirmed. The negative impact of payment by shares is caused by the issue of additional shares by the company during the transaction, which reduces abnormal return.

Hypothesis 5: The geographical affiliation of acquiring companies with the US or the European Union affects the abnormal return from M&A transactions in the healthcare industry in developed countries.

Non-zero positive CAR is identified only in the subsample for companies from the EU, indicating that there is limited abnormal return. Wilcoxon tests and regression models do not find any differences between abnormal return for companies from the US and the EU, proving the insignificance of this factor and resulting in the rejection of the hypothesis.

Hypothesis 6: The total value of an M&A deal in the healthcare industry in developed countries has an impact on the abnormal return for acquiring companies.

Positive significant CAR is discovered for categories of transactions with values up to 50 thousand euros and more than 500 thousand euros, while the middle category, with a value from 50 to 500 thousand euros, shows significantly worse CAR. The regression analysis shows that with an increase in deal value, CAR improves at the 5% significance level. All these findings suggest that this factor positively affects CAR, and the hypothesis is confirmed. In large transactions, companies are more careful when determining a fair price for the transaction, which allows them to spend resources more effectively and obtain more return from the acquisition.

Hypothesis 7: The number of employees at the acquiring company affects the abnormal return of an M&A transaction for acquiring companies in the healthcare industry in developed countries.

The category of purchasers with a staff of 100 to 1000 employees has shown positive, significant CAR, and the regression has demonstrated that at the 5% significance level, as the number of employees grows, CAR decreases because of managers' overconfidence in large corporations, which leads to negative effects from the transaction. The hypothesis is confirmed.

Therefore, on average, M&A transactions in the healthcare industry in developed countries result in positive CAR, with the greatest success for buyers with 100 to 1000 employees, those trading in values between 50 and 500 thousand euros, and those that pay for transactions with methods other than their own shares. Domestic transactions and transactions with US buyers do not result in excessive returns. Limited excess returns are observed in cross-border transactions, in transactions with EU buyers, and in cases when cash is the chosen method of payment.

The research has proven that acquiring companies can expect limited abnormal returns in M&A transactions in the healthcare industry in developed countries.

The results of this study may be useful for companies from the United States and the European Union that plan to conduct M&A transactions in the healthcare industry. According to the results of the analysis, on average, such companies may expect positive excess returns from M&A deals, which makes this industry potentially attractive for such transactions. Companies should avoid using their own shares as a method of payment, and they need to be mindful of the fact that large-value transactions normally lead to high excess returns. In addition, larger firms should be careful when negotiating transaction values because managers tend to overpay when buying other companies, which results in losses. By making decisions based on the results of

this study, purchasers may be able to receive large excess returns from M&A transactions in the healthcare industry.

5. Conclusion

The study analyses the market for M&A transactions in the healthcare industry in developed countries in recent years. It becomes evident that the number of transactions and their values grow significantly every year.

To test the proposed hypotheses, we use CAR significance tests, as well as regression analysis, to identify important contributing factors that affect CAR.

According to the main findings of the study, on average, healthcare M&A transactions in developed countries generate positive excess returns for purchasers. On average, a company may expect a positive CAR of 0.6% from M&A in the healthcare industry in developed countries. There is no significant correlation between cross-border transactions in developed countries and excess returns for purchasers. Cash as the method of payment in M&A transactions in the healthcare industry in developed countries has no effect on excess returns for the purchaser. This factor is not significant at the 10% lever in any model. The use of stock as the payment method in M&A transactions in the healthcare industry in developed countries decreases excess returns for the purchaser. The negative impact of payment with stock is associated with issuing additional shares in the course of a transaction, which reduces excess returns. The geographical affiliation of purchasers with the USA or the European Union proves to be insignificant. The study shows no effect on excess returns from M&A transactions in healthcare in developed countries. The total value of an M&A transaction in the healthcare industry in developed countries has an impact on excess returns for the purchaser. The number of employees of the purchaser has an influence on excess returns for the purchaser in M&A transactions in the healthcare industry in developed countries.

The relevance of the study is based on the fact that it identifies key factors of efficient acquisitions of companies in developed markets, taking into account the specifics of the medical services market. The positive effect of deals on acquiring companies, which is proven in the article; the multi-directional impact of deal value, the method of payment, and the size of a company on abnormal return ensure a higher-quality financial justification for diversification strategies and the formation of an optimal business portfolio for medical companies, which will generally improve the quality of management and corporate governance in the company.

The results of the research can be used by management to improve management processes in international companies, including solutions to problems such as the following:

(1) Determining the degree of international diversification that contributes to the achievement of strategic goals (growth in the company's size, increase in the company's value, increase in return on capital, and a reduction in capital costs);

(2) Predicting the impact of international diversification on company performance, taking into account the stage of international diversification of the company and representation in different countries;

(3) Evaluating the impact of the M&A strategy on company performance in the short- and long-terms.

In future development of the topic, we plan to compile a more complete sample of M&A transactions in the healthcare industry, consider a longer period for calculating excess returns, and analyse the impact of additional factors on CAR, such as consultations with leading consulting industry companies and the market values of target companies.

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