INTANGIBLE DETERMINANTS OF FIRM PERFORMANCE: EVIDENCE FROM WESTERN AND NORTHEN EUROPE

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ABSTRACT

This paper empirically analyses selected intangible determinants of firm performance in firms of Western and Northern Europe. The main objective of this paper is to analyze the contribution of intangible assets, which became important competitive advantage and source of economic growth for the firms. We use three intangible determinants – the sum of intangible assets and goodwill from a balance sheet and R&D expenses, both scaled by total assets, and ROTA Rank Measure. We proved the statistically significant positive effect of R&D intensity on firm performance. We conclude that this indicator approximates intangible intensity in the best possible way.

KEY WORDS

Intangible assets. R&D expenses. ROTA Rank Measure. Instrumental variable approach. Endogeneity.

JEL CLASSIFICATION

O300.

INTRODUCTION

Knowledge-based economics is based on monetization of knowledge assets into activities that generate profit, provide the competitive advantage and sustain stable economic growth. The capital structure of the firm determines its overall business performance. Expansion of knowledge-based industries changed the nature of economics and switched the focus from tangible to intangible assets. This, however, results in many problems related to the intangible nature, such as inability of specific intangible assets to meet the criterions for being disclosed in financial statements (e.g. Sedláček, 2010), tax-driven profit shifting and transfer price manipulation via royalty payments to subsidiaries usually located in tax havens (e.g. Weichenrieder, 2009, Dharmapala and Riedel, 2013, Belz et al., 2017) or disunity within

capitalization and expensing of R&D investments (e.g. Wang et al., 2016). In empirical analyses, different variables are used as proxy variables for intangible intensity.

The objective of this paper is to investigate the effect of three variables that are frequently used as proxies for intangible assets. We use the indirect measure of intangible intensity ROTA Rank Measure (Clausen and Hirth, 2017) and intangible intensity from a balance sheet and R&D expenses, both scaled by total assets. In our analysis we also try to account for the endogeneity of variable R&D expenses/total assets.

1 THEORETICAL OVERVIEW

Intangible assets as a determinant of corporate performance were extensively analyzed by Clausen and Hirth (2017). In their paper, authors propose the new indicator of intangible intensity ROTA Rank Measure and analyze an influence of this measure on market capitalization, liquidation value, M&A transaction value, and market leverage of selected US companies. In their models, they additionally test the applicability of usual intangible intensity proxies, such as R&D expenses, intangible assets from a balance sheet or the number of patents and trademarks. They prove the validity of ROTA Rank Measure as a measure of intangible-driven earnings and confirm the significance of intangible assets for market value and M&A transaction value.

R&D intensity as left-hand side and right-hand side variable was analyzed by Min and Smyth (2016) on a sample of firms from South Korea. They chose South Korea as this is one of the countries with the highest corporate-funded R&D intensity in the world. In their analysis, instrumental variables are used to determine an effect on firm value. Moreover, Min and Smyth (2016) also examine the non-linear effect of leverage on R&D intensity considering different quantiles of the leverage variable. The leverage effect on R&D intensity is positive, however, in extremely high quantiles of leverage, it turns to be negative. Endogeneity of R&D expenses was also treated by Xue (2007) and Ciftci and Darrough (2015).

2 OBJECTIVES AND METHODOLOGY

We used the data of Western and Northern European public listed companies in a time frame 2013 – 2017. Our data sample came from Thomson Reuters Datastream Database. We were interested only in intangible intensive companies and thus, availability of R&D expenses and ROTA Rank measure were the main criterions limiting our data sample. The initial sample consisted of 7676 firm observations, we excluded all observations with not available or zero

value of R&D expenses. Calculation of ROTA Rank Measure applies only for profit companies, therefore we additionally excluded loss firms with the negative value of EBITDA. Our final sample consisted of 1599 firm-year observations with 338 firm observations for 5 time periods. Thus, our data were assembled in a long balanced panel.

Similarly to Clausen and Hirth (2017), we assume that R&D expenses influence market value expressed as a market-to-book value ratio. In contrast to them, we deal with a variable RDAS as with an endogenous variable and apply an instrumental variable approach to account for it. Consistent with Xue (2007) and Ciftci and Darrough (2015), we use average industry R&D expenses scaled by total assets as an exogenous determinant of R&D expenses. We choose property, plant, and equipment scaled by total assets as the second exogenous variable. Both exogenous variables have the statistically significant positive effect on variable RDAS and no significant effect on variable MTB. In the second stage, dependent variable MTB is regressed by instrumented variable RDAS, Rota Rank Measure, IntAS, InventAS, Lev, CashAS, ProfitAS, and lMCap. Definition of all variables is presented in Table 1.

Table 1 Definition of variables

Variable	Calculation
MTB	Market-to-book value ratio calculated as the closing share price multiplied by the number of assets outstanding plus the sum of the current portion of debt in liabilities, deferred tax, preferred stock, and long-term debt and scaled by total assets (Clausen and Hirth (2015).
RDAS	R&D expenses scaled by total assets.
AvgRDAS	Average industry R&D expenses scaled by total assets (industry averages calculated based on Thomson Reuters Industry Sector classification).
RotaRM	An indirect measure of intangible intensity calculated as return on tangible assets reduced by industry and year median and standardized by the standard deviation (Clausen and Hirth, 2015).
PPEAS	The net value of property, plant and equipment expenses scaled by total assets.
IntAS	The intensity of balance sheet intangible assets calculated as the sum of intangible assets from a balance sheet and goodwill scaled by total assets.
InventAS	Total inventory scaled by total assets.
Lev	Leverage calculated as a ratio of total liabilities - represented by the sum of total current liabilities, total long-term debt, deferred income tax, minority interest and other liabilities - and total assets.
CashAS	Cash and short-term investments scaled by total assets.
ProfitAS	Positive values of EBITDA scaled by total assets.
lMCap	Control variable, size of the firm expressed as the logarithm of market capitalization

Source: Own editing.

We tested the hypotheses that the is a positive relationship between intangible intensity indicators and the firm value measured by variable MTB. Our three hypotheses were following:

H1: There is a positive relationship between R&D intensity and firm value.

H2: There is a positive relationship between ROTA Rank Measure and firm value.

H3: There is a positive relationship between the intensity of intangible assets from a balance sheet and firm value.

We use fixed effects instrumental variable approach for panel data. Our analysis was performed in statistical software Stata. To deal with the potential serial correlation, we clustered the standard errors at the company level. In a first stage, we estimate the following model:

$$RDAS_{it} = \beta_0 + \beta_1 AvgRDAS_{it} + \beta_2 PPEAS_{it} + c_i + u_{it}, \text{ for } t=1, 2, 3, 4, 5. \quad (1)$$

In a second stage, estimated values of variable RDAS from equation (1) are used as the independent variable:

$$MTB_{it} = \beta_0 + \beta_1 \widehat{RDAS}_{it} + \beta_2 RotaRM_{it} + \beta_3 IntAS_{it} + \beta_4 InventAS_{it} + \beta_5 Lev_{it} + \beta_6 CashAS_{it} + \beta_7 ProfitAS_{it} + \beta_8 lMCap_{it} + c_i + u_{it}, \text{ for } t=1, 2, 3, 4, 5, \quad (2)$$

where c_i is an unobserved firm heterogeneity constant over time, and u_{it} is the idiosyncratic error.

3 RESULTS AND DISCUSSION

In this paper, we focused on the relationship between intangible assets and other capital structure items and market-to-book value ratio, as an indicator of firm performance. Table 2 displays macroeconomic indicators and average values of intangible indicators of countries of our data sample.

Table 2 Intangible intensity of analyzed countries

	R&D (% GDP)	R&D per capita	Avg RDAS	Avg RotaRM	Avg IntAS	Obs.
Switzerland	2.40[1]	1780.2[1]	0.0553	0.0825	0.1972	36
Sweden	2.26	1069.5	0.0384	0.4076	0.3376	42
Denmark	1.89	918.8	0.0668	0.3292	0.2900	12
Austria	2.20	896.3	0.0348	-0.0703	0.1937	7
Germany	2.00	764.5	0.0417	0.0433	0.2243	64
Iceland	1.31	722.4	0.0294	0.1012	0.4405	2
Finland	1.81	711.0	0.0362	0.0119	0.2054	15
Norway	1.08	697	0.0124	0.0052	0.1396	4
Belgium	1.73	648.2	0.0641	-0.0026	0.1373	14
Luxembourg	0.64	588.8	0.0103	0.1674	0.2262	5
Ireland	0.83	485.3	0.0286	0.1266	0.4732	15
Netherlands	1.16	478.9	0.0425	0.0070	0.2951	21
France	1.43	477.3	0.0368	0.1994	0.2516	35
UK	1.13	414.8	0.0403	0.2315	0.3516	67
Latvia	0.11	13.7	0.0035	-0.0069	0.0389	1

Note: fulfilling colour indicates intangibility level within the corresponding cathegory (from green for the highest values till red for the lowest values)

Source: Own editing.

Based on macroeconomic indicators, Switzerland, Denmark, Sweden, Austria and Germany belong to the countries with highest R&D intensity. In our data sample, average value of R&D expenses divided by total assets is highest in firms from Switzerland, Denmark or Belgium. Indirect ROTA Rank Measure recognize the highest average value for firms in Sweden and Denmark. The sum of balance sheet intangible assets and goodwill scaled by total assets was highest in sample firms from Iceland, Ireland, Sweden and the UK. The lowest intangible intensity is shown in Latvia.

Applying Hadri test, we confirmed the stationarity of our panel data sample (z-statistics = 9.8673). We ran an instrumental variable regression for panel data. The main results are presented in Table 3.

[1] Value for the year 2016 was not available, therefore the value for the year 2015 was used.

Table 3 Instrumental variable regression results

Variable	Regression Estimate	Robust Standard Errors
cons	-19.8372***	3.0416
$\widehat{RDAS}$	20.2698*	9.3002
Rota Rank Measure	-0.0043	0.2164
InventAS	1.5587	1.3363
IntAS	-1.7081***	0.4764
Lev	0.9563*	0.3899
CashAS	0.0197	0.6071
ProfitAS	3.9177***	1.0432
lMCap	0.9370***	0.1361
R-Squared	0.0673	
rho	0.9330	

*Note: Figures in parenthesis are p-values. *** (**) (*) denotes significance at 1 (5) (10) per cent.*

Source: Own calculation.

Application of instrumental variables slightly increased the R-Squared of the model. The regression coefficient of variable RDAS changed significantly, while regression coefficients of other statistically significant variables stayed almost unchanged. High value of intraclass correlation coefficient indicates that the most of the variability in the model is due to fixed effects and comes from differences between the groups

Results indicate that R&D intensity, leverage, profit intensity and size of the firm have a positive effect on market-to-book value ratio. We confirmed the first and the third hypothesis and conclude that the effect of R&D expenses on firm value is positive, while the effect of balance sheet intangible assets is negative. When variable RDAS increases about 1 unit, variable MTB increases in average about more than 20 units. Effect of variable RDAS is the highest compared to all other variables. For example, an increase of profit to total assets ratio about 1 unit will cause an increase of variable MTB in average about 3.9 units. Our analysis surprisingly shown negative effect of intangible intensity on market-to-book value ratio. We failed to confirm the hypothesis about positive effect of ROTA Rank Measure on firm performance.

CONCLUSION

Our analysis applied three different variables frequently used as proxies for intangible assets and estimated an effect of each of these variables on firm performance measured by market-to-book value. Application of instrumental variable approach helped us to account for the endogeneity of the variable RDAS, while panel structure of data addressed bias associated

with omitted time constant variables. We have confirmed the hypothesis about the statistically significant positive effect of R&D intensity on firm performance. On a sample of European companies, the effect of balance sheet intangible assets was negative. This indicates that each additional unit of intangible assets recognized in the balance sheet is represented by the decrease of market value scaled by total assets. Indicator ROTA Rank Measure introduced by Clausen and Hirth (2017) was not statistically significant. We have empirically proved that R&D expenses scaled by total assets are the essential indicator of firms' intangibility and that endogeneity of this variable might be addressed by RDAS industry average and variable PPEAS.

Based on our assumptions and previous empirical studies (e.g. Ciftci and Darrough, 2015, Clausen and Hirth, 2016), we assumed statistically significant and positive effect of intangible intensity indicators on firm value. We identified R&D expenses as the most suitable indicator and considering its endogenous nature, we confirmed the hypothesis about its statistically significant effect on firm value. Partial objective of our analysis was the further investigation of the variable ROTA rank measure. Clausen and Hirth (2016) assumed that highly profitable firms with relatively small proportion of tangible assets must be intangible intensive. Their assumption was confirmed on a sample of US data, however, in our European data sample it turned out to be statistically insignificant. Therefore, we could not confirm that ROTA rank measure might be used instead of direct intangible indicators.

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