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Company-Size Effect on the Polish Stock Market

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Because of higher financial and operating risks small firms are considered to carry higher investment risks than larger ones. Plenty of empirical research found that relatively small / large companies are characterized by relatively high / low long-term average returns as well as relatively high / low variability of these returns. However, findings of different studies are far from being unequivocal as regards statistical significance, scope, stability and even direction of the relationship between firm-size and long-term risks and returns. In this paper we examine the size-effect on the Polish stock market in 1999-2011 years, using four alternative company-size measures. Our research confirmed the existence of statistically significant and strong negative relationships between long-term stock returns and company-size (with all four company-size variables statistically significant). However, our findings as regards analogous relationships between portfolios' Betas and company-size turned out to be much more mixed.

JEL Codes: G11 and C21

1. Introduction

Small firms are deemed to be riskier investments than bigger ones (Berk, 1995). There are many potential factors staying behind their relatively high investment risk. Among them are relatively low diversification of operations (e.g., high concentration on single markets or customers), limited access to capital markets (especially in periods such as stock market crashes or credit crunches), low liquidity of shares, limited bargaining power against suppliers and customers, relatively low corporate governance standards, dependence on key-persons (e.g., owners) or competitive disadvantages stemming from inability to benefit from economies of scale.

Those risks, specific for small firms, are reflected in higher variability of their stock prices (as compared to bigger companies). However, a plethora of empirical research (Annin, 1995; Crain, 2010) also found that relatively high riskiness of small stocks is more than compensated for by their abnormal long-term realized returns as compared to the theoretical returns justified by the Capital Asset Pricing Model (so-called "small-cap anomaly").

We study the relationships between company-size (measured by four variables) on one side and long-term returns as well as long-term relative variability of returns on the other side. We hypothesize that relatively small / large public companies are associated with above-average / below-average long-term stock returns as well as with relatively high / low variability of these returns. We quantify the size-effects for the Polish stock market in the period between February 1999 and February 2011. Specifically, we test:

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- whether in Poland there are statistically significant relationships between firm-size on one side and long-term returns and investment risks on the other side,
- whether these relationships are negative,
- what is the strength of the size-effect.

Although there exists abundant research literature related to those relationships in the case of developed markets, the empirical evidence for Poland (which is now the leading emerging market in the European Union) is lacking. Even though there is rather low probability for rejecting the negative direction of linkages between firm-size and long-term risk as well as between firm-size and long-term returns, the statistical significance as well as the strength of the size-effect in Poland can differ from other markets (especially developed ones). It is important for practitioners valuing Polish small enterprises (especially private ones), because uncritical application of small-company discounts quantified for other markets might result in significant over-valuation or under-valuation of those firms.

The remainder of the paper is organized as follows. In the next section we discuss the relevant literature. Next, the data and methodology used in the study are described. Then the section that presents the empirical results follows. The paper closes with concluding comments.

2. Literature Review

The body of literature points to the existence of the so-called size-effect or small-firm effect (sometimes calling it a “puzzle” or “anomaly”). Most of the studies were conducted for U.S. markets but there is also plenty of research available for other mature markets. However, the research for emerging markets, although existing, is much more limited and in many cases rather preliminary (mainly because of the shortage of data series long enough to enable capturing several business cycles). The research for Poland was lacking so far.

Size-effect is usually measured in two ways. The first approach is based on the comparison of long-run average returns of portfolios formed on the basis of company-size criterion and long-run returns of the market as a whole. Because the differences between returns of portfolios composed of small stocks and returns of the whole market are usually positive, it is assumed that these positive differences (called “small-size premiums”) constitute the manifestation of the positive risk-return relationship. Accordingly, because the differences between returns of portfolios composed of large stocks and returns of the whole market are usually negative, it is assumed that these negative differences reflect below-average risk of big companies (consistently with the theory of the positive risk-return relationship).

The studies carried out on the data from U.S. markets consistently confirm the negative correlation between company-size (as measured by market capitalization) and long-term average returns. Many researchers found that small U.S. public companies earn higher risk-adjusted returns than the stocks of large corporations (Banz, 1981; Reinganum, 1981; Penman, 2007). Between 1927 and 2001 the equally-weighted portfolio of 10% smallest stocks (including micro-firms) earned about 28% per annum on average, compared to little more than 10% per annum in the case of 10% biggest companies (Damodaran, 2004). Comparable results were

obtained in another study (based on U.S. data from 1951-2003 years), where the difference between average returns of micro-capitalization stocks and large stocks was estimated at about 16 percentage points (O'Shaughnessy, 2005). However, when micro-capitalization stocks (i.e., stocks with market values below 25 million U.S. dollars), that can be practically uninvestable (because of very low liquidity), were excluded from the sample, the size-effect has shrunk dramatically to only about 4 percentage points. This seems consistent with other findings, according to which between 1926 and 1996 the compound return of the smallest companies (which, however, excluded micro-caps) exceeded the compound return of the largest companies by mere 1,9 percentage points (Jones, 1998) and between 1926 and 2006 this difference equalled 4,4 percentage points (Siegel, 2008). It suggests that the size-effect is mainly visible in the case of very small enterprises.

The results of all the studies cited above refer to the size-effect where size is measured by market capitalization. However, there are also other measures of company-size that are much more useful in valuations of private companies (due to lack of observable market values). These measures are based on accounting or operating data, such as net sales, book value of equity, book value of total assets or number of employees. One study covering U.S. markets and period between 1963 and 1999 found that the difference between average returns of the smallest 4% companies and largest 4% companies was 8,7 percentage points when companies were sorted by market capitalization, 7,2 percentage points when companies were sorted by book value of equity, 7,9 percentage points when companies were sorted by book value of total assets and 6,6 percentage points when companies were sorted by annual net sales (Grabowski, King, 2001). It seems therefore that the strongest measure of firm-size is market capitalization. However, the results obtained for accounting-based variables are rather consistent with the results for market values and can constitute reasonable starting point for valuations of small non-public entities (Pratt, 2002).

The research produced more mixed results as regards the existence of the size-effect in other developed markets. The estimated scope as well as the statistical significance of this effect varies substantially between different studies. The small-size premium has been estimated to equal about 7% in United Kingdom (Dimson, Marsh, 1986), 5,1% in Japan (Chan, Hamao, Lakonishok, 1991) and 8,8% in France (Bergstrom, Frashure, Chisholm, 1991). Other research studies confirmed the existence of significant size-effect in the case of U.K. stocks and corroborated that the size-effect of U.K stocks is visible not only when companies are sorted by market capitalization but also when they are classified with the use of accounting-based measures (London Economics, 2010). However, the study by Heston, Rouwenhorts and Wessels (1999), based on 1980-1995 data for twelve European markets, found that the size-effect in that period was statistically significant and had positive direction only in five cases (Austria, France, Spain, Sweden and United Kingdom) and was insignificant in the case of the remaining seven countries (Belgium, Denmark, Germany, Italy, Netherlands, Norway and Switzerland). While Corhay and Rad (1993) found statistically significant (although weak) size-effect in the case of Dutch companies, Doeswijk (1997) obtained the contradictory results (i.e., lack of any size-effect). Contrary to the earlier evidence the study by Amel-Zadeh (2010) found the presence of size-effect in the case of German companies. A recent study by Van Dijk (2011), based on international data from 1970s, 1980s and 1990s, corroborates

the presence of the size-effect in Australia, Belgium, Canada, Finland, France, Germany, Ireland, Japan, New Zealand, Spain, Switzerland and United Kingdom.

To summarize, the research studies for developed markets other than U.S. are pretty mixed as regards the existence of the size-effect. Furthermore, the scope of this effect seems to show significant inter-temporal and cross-sectional variation and is at least partly related to macro-economic drivers such as interest rates and industrial production (Jacobs, Levy, 1989). There are also many critics of the general idea about the existence of any size-effect in long-term stock returns (Paschall, Hawkins, 1999). Their main arguments are focused around potential deficiencies of the research methodologies used in the size-effect studies, including calendar effects (excess returns for small publicly traded stocks tend to occur in the first few trading days in January), non-allowance for high transaction costs and poor liquidity of small stocks, absence of actual real-time (not *ex post*) evidence and the repeated occurrence of prolonged periods with large-stocks supremacy over small-stocks. Demirtas and Guner (2008) found that within the firms that have low market capitalization, stocks with low past profitability ("laggers") bring returns significantly higher than those of stocks with high past profitability ("leaders") and therefore size-effect is generated largely by small "laggers". Lu (2009) argues that adding small-size premium to the cost of capital of small enterprises is unjustified in the long-run (and can result in significant under-valuation) because firm size is a changing characteristic and the size premium wears off just after two years.

The evidence obtained for less developed markets is even much more mixed. Fama and French, using databases for 1987-1995 years, found that the empirical size-premium in this period was positive and equalled 71% in Nigeria, 62% in Zimbabwe, 28% in Malaysia, 24,2% in Venezuela, 12,9% in Taiwan, 12% in Brazil, 8,7% in Chile, 6,2% in Korea, 4% in Argentina, 2,7% in Mexico and 1,2% in Jordan, but was negative and equalled -20,5% in Colombia, -11,6% in Greece, -11% in Pakistan, -5,9% in Philippines and -0,2% in India (Fama, French, 1998). Other research found limited evidence of any small-size effect in 19 emerging markets (Claressens, Dasgupta, Glen, 1995). Herrera and Lockwood (1994) found statistically significant size-effect in the case of Mexican companies. The study of Chui and Wei (1998) stated that the size-effect is statistically significant in Hong Kong, Korea and Malaysia, but is insignificant in Taiwan. In other studies the statistically significant size-effect was also evidenced for Singapore (Wong, 1989), Turkey (Aksu, Onder, 2003), Malaysia (Pandey, 2001) and India (Sehgal, Tripathi, 2005). Recent research by Van Dijk (2011), based on international data from 1970s, 1980s and 1990s, generally corroborates the presence of size-effect in emerging markets.

Another popular measure of the size-effect is the difference between Beta coefficients of portfolios composed of stocks of different sizes (and the higher the Beta the smaller the firm-size). However, empirical results related to the impact of firm-size on Betas are very mixed. The research conducted by Handa, Kothari and Wasley (1989) found that the relationship between market Betas and firm-size is statistically significant only for Betas calculated on the basis of return intervals shorter than annual (and relationship between annual Betas and firm-size is insignificant). Other research found that the relationship between market Betas and company size is significant only for Betas estimated on the time-series embracing no more than five years (Chan, Chen, 1988). Furthermore, one research found a negative relationship between firm-size and 70-year Betas but a positive relationship

between firm-size and 60-month Betas (Annin, 1997). A recent study by Van Dijk (2011) found substantial differences between small-stock Betas and large-stock Betas in Australia, Japan and Mexico but lack of expected significant differences in Belgium, Canada, Finland, Germany, New Zealand and Taiwan.

There exists at least one more measure of the size-effect but this is relatively rarely used in empirical studies. This measure is based on direct comparisons of average valuation multiples of large and small companies. Findings of the research using this approach are generally consistent in stating that the relationship between company-size and its investment risk is negative (and this is reflected in relatively low / high valuation multiples of relatively small / large enterprises). Pratt (2001) corroborates this on the basis of private as well as public U.S. company data, stating that in both cases the average multiples rise with the increase of the firm-size. Using similar methodology other studies also found general support for the argument that firm-size is positively related to firm value (Adams, Thornton, 2009; Chen, Jindra, 2001).

The importance of the size-effect for professional business valuations cannot be neglected. As most of the cited studies indicate that small enterprises are associated with relatively high investment risks and long-term returns, applying some firm-size adjustment when valuing businesses (especially small and private ones) should always be considered. This statement seems to be justified in light of abundant valuation literature which advises adding some (even subjective if necessary) small-size premium in cost of capital estimated for valuing relatively small enterprises (Damodaran, 1996; Evans, Bishop, 2001; Butler, Pinkerton, 2007; DePamphilis, 2010).

3. Methodology

Our research embraced the twelve-year period between February 1999 and February 2011. Although the Warsaw Stock Exchange has operated since the beginning of the 1990s we omitted all the years before 1999 due to the small number of then-listed companies. The stock prices data were obtained from *money.pl* and historical financial results were obtained from *Notoria Serwis* database. In our analysis we included all the companies for which all the necessary data were available. However, due to significant accounting differences, we omitted all the financial companies as well as The National Investment Funds.

In the research we used four alternative measures of company size. The first one was the market capitalization. This is the most popular measure of company size and is used in most research studies on the company size-effect. However, this measure has at least one significant drawback: it is not observable in the case of private companies. It makes all the research findings related to the relationships between company capitalization and size-effect less useful for valuations of non-public businesses (and overwhelming majority of small firms in Poland is non-public). Therefore, we also applied three alternative company-size measures, based on financial statement data: annual net sales, book value of shareholder's equity and book value of total assets.

Medians of four measures of company size are presented in Table 1.

Table 1: Medians of four measures of company size (in thousands of PLN*).

Data for the end of:	Number of companies	Median market capitalization	Median last-year net sales	Median last-year book value of equity	Median last-year book value of total assets
Feb 1999	128	34.613	137.756	51.256	103.841
Feb 2000	141	41.807	137.021	50.450	108.407
Feb 2001	138	37.211	156.224	50.303	135.229
Feb 2002	133	35.700	177.614	56.276	148.018
Feb 2003	134	27.315	153.805	43.640	136.509
Feb 2004	134	70.487	178.036	46.694	132.451
Feb 2005	137	104.923	199.270	71.477	168.054
Feb 2006	185	168.210	179.852	72.679	166.886
Feb 2007	179	236.010	187.032	90.772	197.598
Feb 2008	259	171.420	172.635	93.655	177.376
Feb 2009	295	63.000	184.300	92.600	202.600
Feb 2010	291	117.464	162.833	95.600	186.600

** all the data presented in the table are denominated in polish currency (PLN) and unadjusted for inflation*
Source: money.pl; Notoria Serwis; author's calculations.

Coefficients of variation of four measures of company size are presented in Table 2.

Table 2: Coefficients of variation (CoV)* of four measures of company size.

Data for the end of:	Number of companies	CoV of market capitalization	CoV of last-year net sales	CoV of last-year book value of equity	CoV of last-year book value of total assets
Feb 1999	128	656,7%	265,8%	450,9%	467,3%
Feb 2000	141	606,6%	330,3%	399,1%	427,0%
Feb 2001	138	579,5%	359,6%	414,1%	410,6%
Feb 2002	133	491,9%	354,1%	431,0%	423,2%
Feb 2003	134	427,8%	368,1%	424,0%	433,4%
Feb 2004	134	385,2%	400,3%	445,0%	449,4%
Feb 2005	137	431,2%	373,8%	434,8%	419,0%
Feb 2006	185	368,7%	393,7%	460,3%	423,8%
Feb 2007	179	310,2%	405,4%	437,5%	428,3%
Feb 2008	259	309,4%	449,9%	426,1%	410,1%
Feb 2009	295	416,9%	478,0%	393,7%	375,6%
Feb 2010	291	761,8%	432,8%	421,2%	406,2%

** standard deviation divided by arithmetic average*
Source: money.pl; Notoria Serwis; author's calculations.

As the data show, in all the analyzed years there was considerable inter-temporal as well as inter-company differentiation in terms of values of all four firm-size measures. Throughout the twelve-year period under investigation the medians of all four measures showed significant upward trends (with the fastest average pace of growth in the case of median market capitalization). This nominal growth is partially attributable to inflation in the period (which remained, however, under 5% y/y on average) but the main reason seems to be positive and relatively fast growth experienced by the Polish economy (without any single year with decline of real gross domestic product), especially after joining the European Union in 2004.

From Table 2 we can see that in all the years under investigation there was substantial inter-company variation of all four company-size measures. All computed coefficients of variation are three-digit and the smallest value equals 265,8% (which still points to rather high differentiation). All this suggests that companies listed on the Warsaw Stock Exchange are highly differentiated in terms of their sizes (as measured by all four criteria).

In accordance to the practice used in most other empirical research related to the stock returns, we based our analysis on the portfolio returns (and not the individual stock returns) and we constructed all the alternative portfolios with the objective criterion (by dividing the whole samples into ten equally-numbered deciles). In our research we used two alternative measures of company size-effect. The first measure was the difference between the average annual nominal return of a given portfolio formed with the criterion of company size and the average annual nominal return of the market as a whole. The second measure was Beta coefficient computed for the different portfolios formed with the criterion of company size.

In order to estimate the average annual nominal returns of different portfolios formed on the basis of company size, at the end of February of each year we sorted all the companies in order of decreasing values of a given measure of company size and then we divided the stocks into ten portfolios so that the first portfolio embraced 10% biggest companies and the tenth portfolio comprised 10% smallest companies. We made these classifications at the end of February in order to allow for the time lag between the end of the previous year and the time when all the quarterly reports concerning that year are available.

In order to estimate the relationships between company-size on one side and stocks' returns and risks on the other side, we treated all ten portfolios as alternative investment strategies. We assumed that buying stocks from the first portfolio is equivalent to the strategy of investing in 10% biggest companies and buying stocks from the tenth portfolio is equivalent to the strategy of investing in 10% smallest stocks. Because in most cases the sample did not divide equally by ten we adjusted the number of stocks in the last portfolio. Within all the portfolios the equal weights for all stocks were applied.

For all the portfolios we computed annual nominal returns (between the end of February of a given year and the end of February of the next year). Next**,** we calculated the geometric average annual returns in the period between the end of February 1999 and the end of February 2011. We applied geometric average because it represents the constant return an investor must earn every year to arrive at the same final value that would be produced by a series of variable returns

(Cornell, 1999). The dividends and transaction costs were disregarded due to the lack of any database regarding them. As the benchmark for the portfolios the returns of indexing strategy (based on the Warsaw Stock Exchange WIG Index) were used. Finally, the size-effect of all the individual portfolios was measured as the difference between the average annual return of a given portfolio and the average annual return of the market as a whole.

The second measure of the size-effect was the Beta coefficient of the individual portfolios. In order to evaluate the relative riskiness of all the portfolios we computed their Betas as slope coefficients of simple linear regressions with the given portfolio annual returns as the dependent variable and WIG Index (the broadest Warsaw Stock Exchange index) as the explanatory variable.

In order to validate our findings we supplemented the visual observation of stock returns and stock Betas with the simple regressions. In the case of all four firm-size measures we regressed both the portfolios' returns as well as portfolios' Betas against the numbers of portfolios. However, because it is sometimes argued that these relationships can be characterized by significant non-linearities (Horowitz, Loughran, Savin, 2000), in each case we estimated two types of regressions: linear (with the original values of dependent and independent variable) as well as log-linear (with logarithms of all the original observations). To mitigate the risk of inference errors stemming from the potentially high heteroscedasticity of residuals, we estimated all the regressions with weighted least squares method (where weights for individual observations were derived from the inverses of residuals' absolute values obtained from ordinary least squares estimation).

4. Findings

The average nominal returns of the alternative portfolios (formed on the basis of four company-size measures) are presented in Table 3.

Table 3: The actual* and fitted average returns of the alternative portfolios.**

Deciles	Market capitalization		Net sales		Book value of equity		Book value of total assets	
	Actual returns*	Fitted returns**	Actual returns*	Fitted returns**	Actual returns*	Fitted returns**	Actual returns*	Fitted returns**
Dec. 1***	0,8%	1,9%	8,7%	7,3%	3,4%	4,0%	7,5%	6,3%
Dec. 2	10,6%	4,2%	6,4%	9,7%	8,7%	6,8%	4,9%	8,8%
Dec. 3	11,6%	6,7%	11,8%	11,5%	10,9%	9,3%	12,4%	10,7%
Dec. 4	14,4%	9,3%	19,1%	12,9%	7,7%	11,6%	18,4%	12,2%
Dec. 5	7,0%	12,1%	10,3%	14,1%	16,8%	13,7%	16,1%	13,6%
Dec. 6	14,9%	14,9%	16,6%	15,2%	15,4%	15,8%	13,2%	14,9%
Dec. 7	13,0%	17,8%	19,7%	16,2%	18,1%	17,8%	13,7%	16,0%
Dec. 8	18,4%	20,7%	16,2%	17,1%	20,2%	19,8%	19,0%	17,0%
Dec. 9	17,1%	23,7%	16,0%	18,0%	18,6%	21,6%	12,5%	18,0%
Dec. 10****	34,8%	26,7%	19,2%	18,7%	25,4%	23,5%	23,4%	19,0%
Statistics of the linear regression of actual returns:								
	Original values	Logged values	Original values	Logged values	Original values	Logged values	Original values	Logged values
Slope (*t-Stat.*)	0,024 (*5,34*)	1,147 (*4,28*)	0,012 (*17,30*)	0,409 (*12,47*)	0,021 (*13,84*)	0,773 (*14,04*)	0,013 (*6,97*)	0,478 (*4,67*)
R-squared	0,65	0,70	0,55	0,61	0,89	0,89	0,51	0,58
F-stat. (*signific. level*)	15,00 (*0,0047*)	19,08 (*0,0024*)	9,61 (*0,0147*)	12,28 (*0,0080*)	62,32 (*0,0000*)	65,77 (*0,0000*)	8,45 (*0,0197*)	10,94 (*0,0107*)

** average annual returns in the period between February 1999 and February 2011*
*** because in all four cases the log-linear regressions have higher F-statistics (than linear ones), in the table we included only fitted values from log-linear regressions*
**** 10% companies with the highest values of a given firm-size measure*
***** 10% companies with the lowest values of a given firm-size measure*
Source: money.pl; Notoria Serwis; author's calculations.

The Beta coefficients of the alternative portfolios (formed on the basis of four company-size measures) are presented in Table 4.

Table 4: The actual* and fitted Beta coefficients of the alternative portfolios.**

Deciles	Market capitalization		Net sales		Book value of equity		Book value of total assets	
	Actual Betas*	Fitted Betas**	Actual Betas*	Fitted Betas**	Actual Betas*	Fitted Betas**	Actual Betas*	Fitted Betas**
Dec. 1***	0,85	0,84	0,98	1,09	1,00	1,09	0,99	1,07
Dec. 2	1,09	1,04	1,03	1,19	1,11	1,19	1,05	1,18
Dec. 3	1,04	1,17	1,58	1,25	1,42	1,25	1,49	1,25
Dec. 4	1,37	1,27	1,66	1,30	1,71	1,30	1,45	1,31
Dec. 5	1,37	1,36	1,28	1,34	1,35	1,34	1,57	1,35
Dec. 6	1,37	1,43	1,64	1,37	1,21	1,37	1,49	1,39
Dec. 7	1,50	1,50	1,15	1,39	1,19	1,40	1,28	1,42
Dec. 8	1,56	1,56	1,30	1,42	1,60	1,42	1,30	1,44
Dec. 9	1,51	1,61	1,45	1,44	1,54	1,45	1,33	1,47
Dec. 10****	1,81	1,66	1,32	1,46	1,28	1,47	1,50	1,49
Statistics of the linear regression of actual Betas:								
	Original values	Logged values	Original values	Logged values	Original values	Logged values	Original values	Logged values
Slope (*t-Stat.*)	0,089 (*15,36*)	0,295 (*121,22*)	0,021 (*2,51*)	0,125 (4,88)	0,029 (*2,18*)	0,129 (*4,76*)	0,030 (*2,79*)	0,145 (*5,50*)
R-squared	0,90	0,92	0,07	0,24	0,15	0,31	0,22	0,45
F-stat. (*signific. level*)	68,80 (*0,0000*)	96,27 (*0,0000*)	0,58 (*0,4664*)	2,55 (*0,1489*)	1,43 (*0,2656*)	3,63 (*0,0930*)	2,21 (*0,1753*)	6,60 (*0,0332*)

** actual Betas were calculated as the slope coefficients of the linear regression between annual returns of the given portfolio in the period between February 1999 and February 2011 and annual returns of the WIG Index*

*** because in all four cases the log-linear regressions have higher F-statistics (than linear ones), in the table we included only fitted values from log-linear regressions*

**** 10% companies with the highest values of a given firm-size measure*

***** 10% companies with the lowest values of a given firm-size measure*

Source: money.pl; Notoria Serwis; author's calculations.

As the data in Table 3 show, in the twelve-year period under investigation strong negative relationships between stock returns and all four measures of firm-size were observed. The relatively big / small companies (regardless of the firm-size measure) are usually characterized by relatively low / high long-term average returns. The difference between fitted returns of tenth and first decile vary from 11,4 percentage points (in the case of net sales criterion) to 24,8 points (in the case of market value criterion). All regressions (linear as well as log-linear) with returns as dependent variable and numbers of deciles as explanatory variable are statistically significant (below 2% significance level) and have coefficients of determination (R-squared) exceeding 0,50. In all four cases the log-linear regressions have higher F-statistics than linear ones. It suggests that the quantified relationships are indeed non-linear. Furthermore, in all four cases the fitted value for the tenth decile is smaller than the actual value, which suggests that the log-linear functions are not able fully to capture the real nonlinearities (and probably much of the size-effect is concentrated around

the smallest companies). The strongest relationships are observed in the case of market value of equity (i.e. market capitalization) and book value of equity. To summarize, the above data confirm the existence of statistically significant (and probably heavily non-linear) relationships between long-term stock returns and firm-size.

As can be seen in Table 4, the results are much more mixed than in the case of long-term average returns. Although there is a statistically significant and strong negative relationship between Betas and corporate market capitalization, the relationships between Betas and all three accounting-based firm-size measures are much weaker (and insignificant at 5% significance level). It should be noted also that the only portfolios with actual and fitted Betas below unity are the portfolios of the biggest corporations (Siegel, 2008). However, the distance between Betas of the extremes portfolios (equalling 0,96 in terms of actual returns) is much larger than in the case of U.S. stocks (where this difference in 1926-2006 equalled 0,50).

5. Conclusions

In the paper we explored the so-called size-effect, which is the long-term relationship between stock returns and stock Betas on one side and company-size on the other side. The empirical examination embraced the Warsaw Stock Exchange data in the twelve-year period between February 1999 and February 2011. Although the size-effect is well documented for developed markets (as well as for some emerging-markets), the research for the Warsaw Stock Exchange (which is currently the largest and the fastest developing stock market in Central-Eastern Europe) was lacking so far.

Our research generally confirmed the existence of statistically significant and quite strong negative relationships between long-term stock returns on one side and company-size on the other side (with all four company-size variables statistically significant). However, our findings as regards analogous relationships between portfolios' Betas and company-size turned out to be much more mixed. It seems that out of four firm-size measures market capitalization is the only one statistically correlated with companies' Betas. Conversely, accounting measures (corporate sales, book value of equity and book value of total assets) are statistically significant drivers of stock returns (especially so in the case of book value of equity) but they present much weaker relationships with stock Betas. However, our research seems to constitute another confirmation of the relatively higher / lower investment risk associated with the relatively small / big companies. Nevertheless, given our mixed results obtained for all three accounting measures, the problem of allowing for the small-size effect in valuations of small private companies (that are lacking observable market values) remains unresolved.

This study has some relevant limitations. First of all, the twelve-year period covered by the research is pretty short and embraces only several stock market cycles. Moreover, during the years under investigation the Polish economy did not experience any single year of recession (i.e., decline of gross domestic product). This means that the results can be somewhat biased. In particular, it is likely that our estimates overstate the true scope of the relationships between stock returns and firm-size, especially in the case of the smallest enterprises. It is an important qualification because in the case of recession (especially the deep and unforeseen

one) the higher share of small companies (as compared to bigger ones) could go bankrupt and that would significantly depress the long-term returns of the smallest-stocks portfolios.

The above-mentioned limitations of the study justify inclusion of longer samples (covering, e.g., twenty or thirty years of stock market data). Regrettably, extending our sample years further into the past (i.e., before 1999) is not viable owing to the small number of then-listed companies. Also the double-digit inflation environment in which the Polish economy functioned in the early and mid-1990s could probably distort the results.

Last but not least, our findings can be distorted by the survivorship bias. During the years under investigation some companies listed on the Warsaw Stock Exchange did go bankrupt and most of them were relatively small. Due to the lack of relevant data we were unable to allow properly for their negative impact on the returns and Betas of small-stocks portfolios. However, these bankruptcies often meant the loss of almost all shareholders' value.

In further research we would like to refine (as far as possible) our findings by allowing for the shortcomings described above. We would also like to apply different tools of measuring the size-effect. Specifically, we will explore the extent to which the firm-size affects the relative values of companies' valuation multiples.

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