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The Polish stock market: risk and risk premia

Abstract. This paper analyzes issues related to the pricing of equity in an Eastern European emerging capital market, the Warsaw Stock Exchange (WSE), with the purpose of estimating the CAPM, and the return-risk relationship, using the domestic and the international asset-pricing model. The empirical evidence from a sample of 221 Polish firms listed on the Warsaw Stock Exchange indicates that there exists a (sign-) conditional relationship between beta and return when the domestic CAPM is tested. The international CAPM did not perform well in the early days of the transition but since 2000 the Polish stock market seems well integrated. Most likely the local market has been segmented during the early period. The cross-sectional stock returns are positively related to the downside risk variable measured by the semi-deviation from the mean, and the total risk. However, the cross-sectional stock returns are also positively related to the unsystematic risk, and negatively related to other downside risk measures. In addition, firm size is found to be positively related to the cross-sectional stock returns, while the book-to-market ratio is found to have no explanatory power as regards the returns.
Keywords: asset pricing, risk premium, cost of capital.
JEL codes: G12, G15.

1. Introduction

The Capital Asset Pricing Model (CAPM) developed by Sharpe (1964), Lintner (1965) and Mossin (1966) has been widely used to estimate the firm's cost of equity capital, to measure the performance of funds, to help investors make their portfolio allocation decisions, etc. The CAPM states that there is a positive, linear relationship between the stock's expected returns and its systematic risk, beta, and that beta is a sufficient variable to explain cross sectional stock returns.

However, whether the CAPM is an appropriate model to the asset pricing is controversial. First, the beta used as the signal measure of the systematic risk has been challenged by the alternative equilibrium asset-pricing model, the Arbitrage Pricing Theory (APT). Second, the empirical evidences from the developed equity market has shown a weak relationship between the beta and returns (Fama and French 1992).

Pettengill et al. (1995) propose a new methodology to estimate the relationship between the beta and returns. Their argument is that since the CAPM deals with the expected returns, while the realized returns are used as proxies, negative realized risk premia could be observed in some periods. The model of Pettengill et al. is conditional on the sign of the realized risk premium, whether it is positive or negative. When the realized risk premium is positive, there should be a positive relationship between the beta and return, and when the premium is negative, the beta and return should be negatively related. The reason is that high beta stocks will be more sensitive to the negative realized risk premium and have a lower return than low beta stocks. Their empirical results based on estimation conditional on the signs of the market excess returns indicate that betas and returns are positively related in the US capital market. This conditional positive relationship is observed in the UK (Fletcher, 1997), Germany (Elasa, 2000), and Brussels (Crombez and Bennet, 1997) as well.

There are recent studies asking whether the standard CAPM can be applied to emerging capital markets in order to estimate the cost of equity capital in these markets. Since the individual emerging market has its unique market structure, institutional background, history, level of the market integration, local risk-free return, etc, the answer may differ across countries. Karacabey (2001) studies the beta-return relationship in the Istanbul Stock Exchange and shows that only the conditional relationship exists. Thus, beta is still a useful risk measure in this emerging market.

Estrada (2001) gives evidence that the cross section of returns in emerging markets can be explained by "downside risk" measures as the semideviation of the means. The semideviation method uses only negative deviations from a benchmark return such as the mean return of the asset or a specified target mean. Thus, downside risk defines risk as volatility below the benchmark (Nawrocki, 1999; Sortino and Meer, 1991). Estrada (2001) points out that for skewed distributions, the semi-deviation is a more appropriate risk measure. One of the advantages of the downside risk approach is that a desired benchmark return can be chosen, and the investors care about more downside than upside risk.

This paper focuses on the pricing of equity in one Eastern European emerging capital market, the Warsaw Stock Exchange (WSE), with the purpose of estimating the CAPM, and the return-risk relationship for different risk measures, such as unconditional and (sign-) conditional beta, downside risk, total risk, idiosyncratic risk, and accounting ratios. We also ask whether the domestic asset-pricing model associated with segmented capital markets, or the international asset-pricing model associated with integrated world markets is best able to explain the risk and return relationship. We analyze the risk-return relationship using cross section data for all traded firms in an emerging market, while most previous studies used index data for a number of countries or cross industry data. Thus, the range of different risk measures has not been compared systematically.

Emerging equity makers usually exhibit high expected returns, high volatility, and low correlation with the developed countries' equity markets (Harvey 1995, Goetzmann and Jorion 1999). Here we find that, in the period March 1992 – January 2002, the real average monthly return on the Warsaw Stock Exchange index in zlotys is 1.91% with a standard deviation of 15.61%, which gives a variance ratio of 8.18, while the real average monthly return on the Morgan Stanley world index in dollars is 0.60% with a standard deviation of 3.88%, which gives a variance ratio of 6.74. The correlation coefficient between the two indices is only 0.04. The nominal monthly average return on Poland Treasury Bill is 1.73%, while that on the U.S. Treasury Bill is 0.37%. Yet, in real terms, the difference between the local and US risk-free rates is not that large, the real rates being 0.19% in Poland and 0.15% in the US. Thus, negative excess returns on the market portfolio or realized risk premia are more likely to be observed in this volatile local equity market with a high nominal risk-free rate. During the period, 53.34% of the realized local market risk premium in zlotys is found to be negative, while the realized global market risk premium in dollars is found to be negative in 38.89% of the months. The average monthly local market risk premium is 1.72%, which implies 22.71% per annum, while the corresponding figures in the world market are 0.45% per month, or 5.54% per annum.

We expect that the conditional rather than the unconditional relationship between beta and return should exist in the emerging domestic capital market. Moreover, according to Pettengill et al (1995), in order to guarantee a positive risk-return tradeoff from the (sign-) conditional CAPM, the distribution of the up market period (positive risk premia) and down market period (negative risk premia) should be symmetric. This symmetric distribution seems to exist in the WSE. However, if the realized negative risk premium periods are observed too often, neither the conditional nor the unconditional CAPM is likely to work. If so, an alternative risk measure such as downside risk, total risk, etc. may explain returns better.

The international version of CAPM is most appropriate when countries' equity markets are integrated with the world markets, and when purchasing power parity can be expected to hold (Stulz, 1995). Bekaert (1995) argues that the emerging markets are not fully integrated with the world markets because of investment barriers set by national governments. Like Harvey (1995) we find that the correlation coefficient between the returns on the Warsaw Stock Exchange and the emerging equity markets is low, and that the Warsaw Stock Exchange is even less correlated with an index for the global equity markets. Thus, we hypothesize that the national CAPM will perform better than the international CAPM in the emerging WSE.

The rest of the paper will be organized as follows. Section 2 provides background for the Warsaw Stock Exchange. Section 3 presents the methodologies for the empirical tests. Section 4 discusses the dataset. Section 5 reports the empirical results, and finally, Section 6 summarizes the findings.

2. The Warsaw Stock Exchange

The Warsaw Stock Exchange (WSE), a joint-stock company, was established by Poland's State Treasury in April 1991. During the last decade, the exchange along with Poland's financial markets were developing rapidly. Now, the WSE is one of the most important exchanges in the region of Central and Eastern Europe with 230 listed securities, a total market capitalization of 103,370m zloty (29,366m Euro), and a total yearly turnover value of 80,443m zloty (22,853m Euro) at the end of 2001. Equity trading on the Warsaw Stock Exchange takes place in four market segments: 1) the main market, 2) the parallel market, 3) the free market, and 4) the SiTech segment. To be admitted to trading on a particular market, a firm must meet the requirements of the Exchange Rules. Securities listed on the main market are those with the highest liquidity. The issuers on the main market generally have larger capital and longer histories. The parallel market lists securities with lower liquidity; issuers on this market usually have less capital and shorter histories than the firms on the main market. The shares listed on the free market are those being admitted for public trading, while not meeting the requirements for listing on the WSE main or parallel markets. In addition, SiTech is the segment for innovative technologies related to IT and telecommunication stocks.

The Warsaw Stock Exchange Index (WIG), which was launched in April 1991, is the most important market indicator. WIG is calculated as the value-weighted geometric mean of the securities listed on the main market. WIG20 comprises the twenty firms with the greatest market capitalization. WIRR, which was launched in March 1995, comprises those firms listed on the parallel market, while TECHWIG comprises the firms listed on the SiTech market.

The WSE started as a periodic call market with a single price auction (par casier). Trading sessions were held at weekly intervals initially. The WSE gradually increased the number of trading sessions per week. In October 1994 the fifth trading session per week was introduced. Since then the WSE has been functioning on a daily basis. Securities on the WSE are quoted in one of the three systems: *a*) single price auction system with one auction, *b*) single price auction system with two auctions, and *c*) continuous trading. Since November 17, 2000, all quotations on the Warsaw Stock Exchange have been taking place in a new system called WARSET (WARsaw Stock Exchange Trading system). Such a system is also used in Paris, Brussels, Amsterdam, Chicago, and Singapore. WARSET provides full automation of order transfer and transaction execution, efficient access to the trading system for market participants, and a wide range of means to obtain information about the market situation.

3. Methodology

The main empirical approaches to analyzing the risk-return relationship are: *a*) the unconditional and conditional CAPM, *b*) the downside risk, *c*) total individual firm variance, and d) accounting ratio based risk measures.

3.1. The unconditional and conditional CAPM

The CAPM predicts a positive linear relation between risk and the expected return of a risky asset of the form

$$E\{R_i\} = R_f + \beta_i \left(E\{R_m\} - R_f \right) \tag{1}$$

where $E\{R_i\}$ is the expected return of asset *i*, $E\{R_m\}$ is the expected return on the market portfolio, R_f is return on the riskfree asset, and $\beta_i = \sigma_{i,m} / \sigma_m^2$ is the systematic risk of asset *i*. In order to guarantee a positive risk-return tradeoff, the expected return on the market must be greater than the risk-free return. Otherwise, no one would want to hold the risky asset.

Empirical tests of Eq. (1) usually follow the Fama and MacBeth (1973) two-pass regression method. In the first step, beta is estimated by

$$R_{it} - R_{ft} = \hat{\alpha}_i + \hat{\beta}_i \left(R_{mt} - R_{ft} \right) + \varepsilon_{it} \tag{2}$$

where R_{it} is the realized return of asset *i* in period *t*, R_{mt} is the realized return on the market portfolio in period *t*; ε_{it} is an *iid* random error term, and $\hat{\beta}_i$ is the estimated beta of asset *i*.

In the second step, the unconditional relationship between the beta and return is estimated as

$$R_{it} - R_{ft} = \hat{\gamma}_{0t} + \hat{\gamma}_{1t} \hat{\beta}_i + u_{it} \tag{3}$$

where $\hat{\beta}_i$ is estimated from Eq. (2). In Eq. (3), $\hat{\gamma}_{0t}$ and $\hat{\gamma}_{1t}$ are first estimated by OLS for each period. Then, they are averaged over the *t* periods. The average value, $\overline{\gamma}_0$ or $\overline{\gamma}_1$ is tested whether they are significantly different from zero using the *t*-test of Fama and MacBeth (1973). Based on Eq. (2), should be equal to zero and should be significantly positive for a positive risk premium. Most empirical tests have found only a weak relation between the risk and return in Eq. (3).

Pettengill et al. (1995) argue that the CAPM models the expected returns, yet, in empirical research the realized returns are used as proxies for the expected ones. The realised returns on the market portfolio often fall below the returns of the risk-free asset so that negative ex post risk premia are observed in some periods. If the realized market portfolio returns were always above the risk-free returns, no one would be willing to hold the risk-free asset. They propose an alternative methodology to estimate the relationship between betas and returns. Their model is conditional on whether the realised risk premium is positive or negative. When the realised risk premium is positive, there should be a positive relationship between the beta and return, while when the premium is negative, the beta and return should be negatively related, since high beta stocks will be more sensitive to the negative risk premium and have a lower return than low beta stocks.

According to the methodology of Pettengill et al., the conditional relationship between the beta and return is estimated as

$$R_{it} - R_{ft} = \hat{\gamma}_{0t} + \hat{\gamma}_{2t} D\hat{\beta}_{i,u} + \hat{\gamma}_{3t}(1-D)\hat{\beta}_{i,d} + e_{it} \tag{4}$$

where *D* is the dummy variable that equals one if the realised premium is positive and zero if it is negative, $\hat{\gamma}_{2t}$ is the estimated risk premium in the up market period (with positive risk premia) and $\hat{\gamma}_{3t}$ is the estimated risk premium in the down market period (with negative risk premia). The average values, $\overline{\gamma}_0$, $\overline{\gamma}_2$, or $\overline{\gamma}_3$ are tested for whether they are significantly different from zero using the same *t*-test of Fama and MacBeth (1973). Thus, the null hypotheses can be tested $\overline{\gamma}_0 = 0, \overline{\gamma}_2 = 0, \overline{\gamma}_3 = 0$ against $\overline{\gamma}_0 \neq 0, \overline{\gamma}_2 > 0, \overline{\gamma}_3 < 0$. In Eq. (4), either γ_{2t} or γ_{3t} will be estimated in a given time period depending on the sign of the risk premium. Pettengill et al. (1995) point out that in order to guarantee a positive risk and return tradeoff, two conditions should be met: *i*) the average risk premium should be positive, and *ii*) the distribution of the up market periods and down market periods should be symmetric. The second condition can be tested by a two-population *t* test but the sign of $\hat{\gamma}_{3t}$ coefficient needs to be reversed and the average value recalculated. The null hypothesis can be tested $\overline{\gamma}_2 - \overline{\gamma}_3 = 0$ against $\overline{\gamma}_2 - \overline{\gamma}_3 \neq 0$.

3.2. Downside risk

Estrada (2001) argues that betas and returns seem to be unrelated in the emerging markets, and thus some measures of downside risk, total risk, and idiosyncratic risk are significantly related to the returns based on a sample of 28 emerging markets.

The downside risk or "semideviation" method gives a positive weight only for the deviations below the benchmark, for example, the mean. If so, downside risk defines risk as volatility below the benchmark (Nawrocki, 1999; Sortino and Meer, 1991).

Three steps are involved in the computation. In the first step, the mean return of asset *i*, $\bar{R}_i$, is calculated. In the second step, the semi-standard deviation of the return of asset *i* is calculated as

$$\Sigma_B = \sqrt{(1/T)\times\sum_{t=1}^{T}\left(R_{it}-\bar{R}_i\right)^2} \text{ for all } R_{it} < \bar{R} \quad (5)$$

where R_{it} is the return on asset *i* in period *t* and $\bar{R}_i$ is the average return of asset *i*, which is the benchmark in this case. Several other average returns will be used as the benchmark below, i.e. the average return on the local market portfolio $\bar{R}_L$, the average return on the global market portfolio $\bar{R}_G$, the average return on the risk free asset $\bar{R}_f$, and zero.

The third step consists of the regression analysis of the relationship between the return and risk as

$$\bar{R}_i = \alpha_0 + \alpha_1 \Sigma_{B,i} + u_i \quad (6)$$

where $\Sigma_{B,\,i}$ is the downside risk estimated from Eq. (5). $\bar{R}_i$ is the average return of asset *i*. In Eq. (6), α_0 and α_1 are estimated by OLS. Both are expected to be greater than zero.

3.3. Total risk and accounting based risk measures

Several risk measures that often appear in empirical studies will be tested as follows.

$$\bar{R}_i = \alpha_0 + \alpha_1 RV_{j,i} + u_i \quad (7)$$

where $RV_{j,\,i}$ is the risk factor *j* for firms *i*. These risk factors will be *a*) total risk (the standard deviation of returns), *b*) idiosyncratic risk (the variability of the returns that is not explained by beta), *c*) size of the firm, and *d*) book-to-market value of the equity.

Size is often presumed to be negatively related to risk, thus, the coefficient for size in Eq. (7) is expected to be negative. The book-to-market ratio is expected to be high for low growth, low-risk firms, thus, the coefficient before this variable is expected to be negative. The book-to-market ratio is only indirectly related to risk (if related at all), however. Thus it should be complemented with other ratios that control various sources of differences in the book-to-market value ratio.

4. Data

The dataset used in this study consists of monthly time series for a ten-year period from March 1992 to January 2002. The dataset comes from three databases, DataStream, IMF Statistics, and EcoWin. From DataStream, we collect a sample of the share prices of 221 Polish firms listed on the Warsaw Stock Exchange. In order to avoid survivorship bias, non-survival shares are included in the tests as well. In EcoWin, we obtain the market indices and the US risk free rate series, while from IMF Statistics, we collect the consumer price indices and Poland's risk free rate se-

Table 1. Descriptive statistics of the return series

The following Table reports the descriptive statistics for the returns series in the study from March 1992 – January 2002. The variables are: PTB: Poland T-bill rate; USTB: US 3-month T-bill rate; RWIG: returns on the Warsaw stock exchange index in zlotys; RMSWID: returns on the Morgan Stanley world index in dollars; RMSWIPZ: returns on the Morgan Stanley world index in zlotys; RMSEMID: returns on the Morgan Stanley emerging market index in dollars, and RMSEMIPZ: returns on the Morgan Stanley emerging market index in zlotys. The "RL_" before a variable indicates that the variable is in real terms.

Variable	Obs.	Monthly Mean (%)	Monthly Standard Deviation (%)	Variance Ratio
PTB	118	1.73	0.58	0.34
RL_PTB	118	0.19	0.39	2.05
USTB	118	0.37	0.09	0.24
RL_USTB	118	0.15	0.09	0.60
RWIG	118	3.49	16.10	4.61
RL_RWIG	118	1.91	15.62	8.18
RMSWID	118	0.82	3.88	4.73
RL_RMSWID	118	0.60	3.88	6.47
RMSWIPZ	118	1.85	4.87	2.63
RMSEMID	118	0.38	6.99	18.39
RL_RMSEMID	118	0.16	6.98	43.63
RMSEMIPZ	118	1.41	7.61	5.40

ries. The series of the returns on the Warsaw main market index, the Warsaw stock exchange index in zlotys (RWIG) is used as a proxy for the returns on the local market portfolio. Poland's Treasure Bill rate in zlotys (PTB) is used as a proxy for the domestic riskfree rate. The difference between RWIG and PTB is used as the excess returns in the local market, or the realized local risk premium (LRP). Two world market excess return series for the realised global risk premia (GRP and GLRP) are constructed on the basis of different assumptions. GRP is calculated by taking the difference between the returns on the Morgan Stanley world index in dollars (RMSWID) and the 3-month US Treasury Bill rates (USTB), while GLRP is obtained by taking the difference between the returns on the Morgan Stanley world index in zlotys (RMSWIPZ) and Poland's Treasury Bill rates (PTB). In addition, an emerging market excess return series, or the realized emerging market risk premium in zlotys (ERP) is constructed by using the difference between the returns on the Morgan Stanley emerging market index in zlotys (RMSEMIPZ) and Poland's Treasury Bill rates (PTB). Using consumer price indices for the US and Poland all the return series are converted into real terms as well. The descriptive statistics for them can be found in Table 1.

5. Empirical results

5.1. Descriptive statistics

In Table 1 we can see that the average nominal monthly risk free rate in Poland (1.73%) is much higher than the average nominal monthly US risk free rate (0.37%). However, in real terms, the difference is small; the rates are 0.19% in Poland and 0.15% in the US, which reflects very high inflation rates in Poland during this period. In nominal terms, and all in zlotys, the average monthly return of the local market portfolio is 3.49% with the standard deviation of 16.10%. The return and risk on the local market both seem higher than those on the global market in zloty (return 1.85%, and risk 4.87%) and the emerging market in zloty (return 1.41, and risk 7.61). If we look in real terms, the average monthly return and risk for the domestic market in real zlotys are 1.91% and 15.62%, while those for the global market in real dollars are 0.60% and 3.88%. The variance ratio for the local market is 8.18, while that for the global is 6.47. Thus, the local market actually seems more risky than the world markets. Also, the local market seems less risky than the emerging markets. The variance ratio for the emerging markets is very high, 43.63. In Table 2 we can find that, all in local currencies, the returns on the local market index are less correlated with those on the global markets (0.040), yet they are more correlated with the emerging market returns (0.214). These results are consistent with most findings in the emerging mar-

Table 2. Correlations of the series of market returns and adjusted excess market returns (adjusted realized risk premia)

The following Table reports the correlation coefficients for the return and excess return series from March 1992 – January 2002. The variables are: RWIG: returns on the Warsaw stock exchange index in zlotys; RMSWIPZ: returns on the Morgan Stanley world index in zlotys; RMSEMIPZ: returns on the Morgan Stanley emerging market index in zlotys; ALRP: adjusted excess returns on the local market portfolio, which is: (returns on the Warsaw stock exchange index in zlotys – Poland T-bill rates)/(1+ Poland T-bill rates); AGRP: adjusted returns on the global market portfolio in dollars over the US risk free rate, which is: (returns on the Morgan Stanley world index in dollars – US 3-month T-bill rates)/(1+ US 3-month T-bill rates); AGLRP: returns on the global market portfolio in zlotys over the Poland risk free rates, which is (returns on the Morgan Stanley world index in zlotys – Poland T-bill rates)/(1+ Poland T-bill rates); AERP: adjusted excess returns on the emerging market portfolio, which is: (returns on the Morgan Stanley emerging market index in zlotys – Poland T-bill rates)/(1+ Poland T-bill rates).

	RWIG	RMSWIPZ	REMIPZ	ALRP	AGRP	AGLRP	AERP
RWIG	1						
RMSWIPZ	0.040	1					
	(0.668)						
RMSEMIPZ	0.214	0.712	1				
	(0.020)	(0.000)					
ALRP	0.999	0.033	0.213	1			
	(0.000)	(0.720)	(0.02)				
AGRP	0.018	0.797	0.593	0.015	1		
	(0.850)	(0.000)	(0.000)	(0.868)			
AGLRP	0.020	0.993	0.714	0.018	0.801	1	
	(0.827)	(0.000)	(0.000)	(0.847)	(0.000)		
AERP	0.201	0.701	0.997	(0.203)	0.591	0.712	1
	(0.029)	(0.000)	(0.000)	(0.028)	(0.000)	(0.000)	

The probability values are in parentheses.

kets: high-expected returns, high volatility, and low corrections with the developed countries' equity markets (Harvey 1995, Goetzmann and Jorion 1999).

Before testing the unconditional and conditional CAPM, the domestic CAPM will be compared with the international CAPM. The international CAPM would be preferred under specific assumptions. The critical ones are: the domestic capital market should be integrated and purchasing power parity should hold. Bekaert (1995) argues that the emerging markets are not fully integrated with the world markets because of investment barriers set by the local government. Stulz (1995) argues that the local CAPM should be used when the market is segmented and the international CAPM should be used when the market is integrated. Segmentation of the Polish capital market from the world market may explain the low correlations in Table 2. However, still both domestic and international versions of CAPM are going to be tested in the following sections.

5.2. Analysis of the excess returns on the market portfolio (realised risk premia)

Four excess market returns series, or realised market risk premia, are going to be examined in the CAPM; 1) returns on the local market over the local risk free rate in zlotys (LRP), 2) returns on the global market over the local risk free rate in zlotys (GLRP), 3) returns on the global market over the US risk free rate in dollars (GRP), and 4) returns on the emerging market and the local risk free rate in zlotys (ERP). The excess return series here is calculated as a difference between the average market return and the risk-free rate. Since the levels in zlotys and dollars are so different, and the simple difference between interest rates is really only appropriate when interest rates are low, an adjustment is made by dividing this difference by (1 + risk free rate). In Table 3 and Figures 1-4, we can see that the series of the adjusted local market excess returns in zlotys (ALRP) has both higher return and risk in comparison with the series of the global market excess returns in either zlotys (AGLRP), or in dollars (AGRP). The average monthly return of ALRP is 1.72%, implying 22.71% per annum, while the average return of AGLRP is 0.12%, or 1.45 per annum, and that of AGRP is 0.45%, or 5.54% per annum. The local market seems more risky than the global markets defined as the difference between the adjusted average global market return and the US risk free rate in dollars (GRP) based on the variance ratios, which are 9.12 for the local market and 8.60 for the global market. However, the Sharpe ratios are almost identical; 0.11 and 0.12 for the local and global market, respectively. In Table 3, we can see that the variance ratio and the Sharpe ratio for AGLRP are extremely high (around 40). The reason is that the nominal domestic returns and rates are used here. In other words, dollar returns have been translated into zloty returns for the global market. Exchange rate variability may account for the high variance in zloty terms.

Table 3. Descriptive statistics of the series of excess market returns (realized risk premia)

The following Table reports the excess returns on the markets or the realized risk premia from March 1992 – January 2002. The variables are: ALRP: adjusted excess returns on the local market portfolio, which is: (returns on the Warsaw stock exchange index in zlotys – Poland T-bill rates)/(1+ Poland T-bill rates); AGRP: adjusted returns on the global market portfolio in dollars over the US risk free rates, which is: (returns on the Morgan Stanley world index in dollars – US 3-month T-bill rates)/(1+ US 3-month T-bill rates); AGLRP: adjusted returns on the global market portfolio in zlotys over the Poland risk free rates, which is (returns on the Morgan Stanley world index in zlotys – Poland T-bill rates)/(1+ Poland T-bill rates); AERP: adjusted excess returns on the emerging market portfolio, which is: (returns on the Morgan Stanley emerging market index in zlotys – Poland T-bill rates)/(1+ Poland T-bill rates).

Variable	Observations			Monthly mean	Monthly standard deviation	Sharpe ratio	Variance ratio
	Total	Pos./Nag.	% of Neg.				
ALRP	118	55/63	53.34%	1.72% (1.190)	15.69	0.107	9.12
AGRP	118	72/46	38.89%	0.45% (1.256)	3.87	0.116	8.60
AGLRP	118	63/55	38.89%	0.12% (0.279)	4.72	40.58	39.33
AERP	118	46/77	65.25%	–2.23% (–3.242)**	7.50	0.296	-3.36

The *t*-values are in parentheses, which test the null hypothesis that the mean is zero.
* Significant at the 0.05 level;
** Significant at the 0.01 level or better.

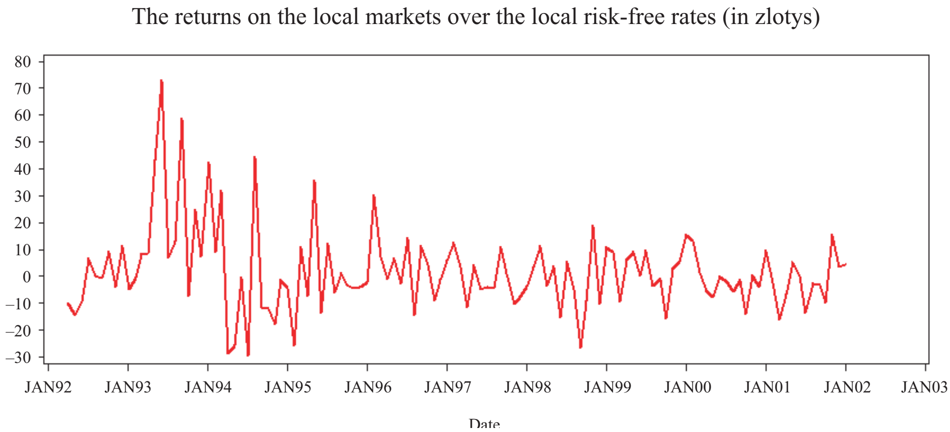

Figure 1. Local market excess returns

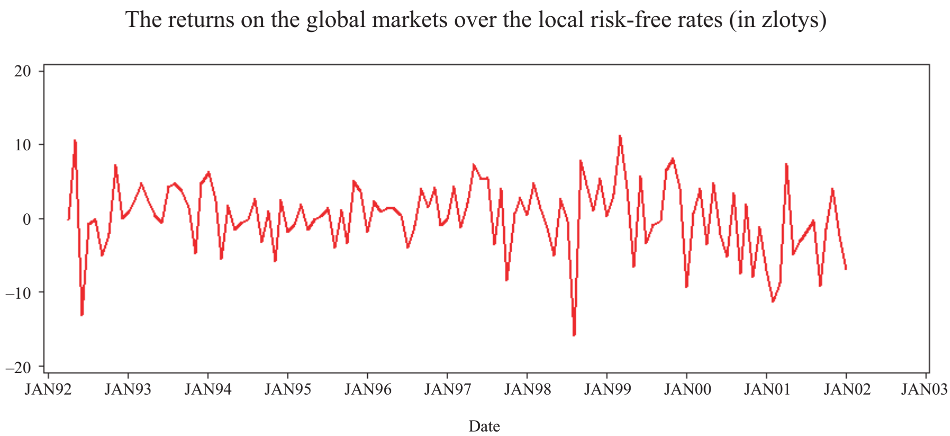

Figure 2. Global market excess returns (a)

Both local excess returns in zlotys (LRP) and global excess returns in zlotys (GLRP) and dollars (GRP) will be tested in the CAPM based on different assumptions. If the local market is segmented, taking the perspective of a local investor, the LRP is an appropriate measure of the realised domestic risk premium. Yet, if taking the perspective of a US-based, internationally diversified investor, the difference between the returns on the Morgan Stanley world index in dollars and the US Treasury Bill rates (GRP) should be used, since the risk free rate should compensate the investor for the expected loss of purchasing power, and the risk premium should compensate for the risk of investing in the market portfolio. Then, if the Polish domestic equity market is assumed to be fully integrated with the world

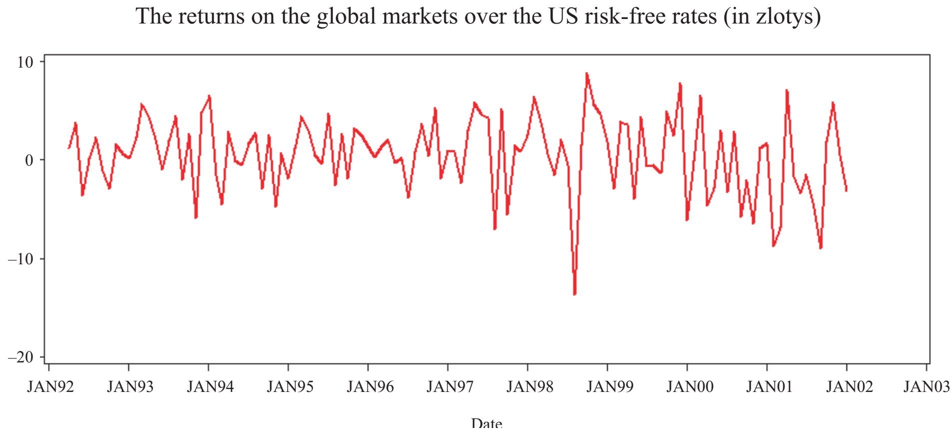

Figure 3. Global market excess returns (b)

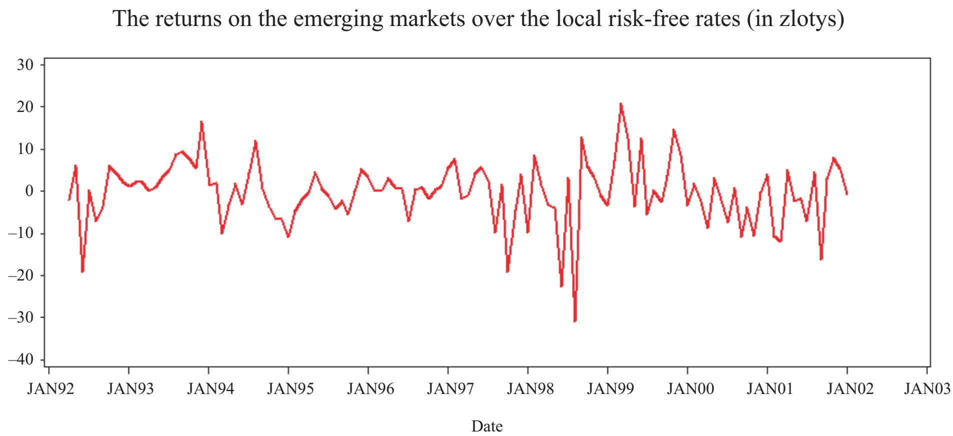

Figure 4. Emerging market excess returns

market, and if a local investor is able to invest in a world market portfolio without any investment restrictions imposed by the local government, the difference between the returns on the Morgan Stanley world index in zlotys and Poland's Treasury Bill rates (GLRP) should be used in the CAPM.

The returns on the emerging markets over the local risk free rates ERP could be an alternative for the excess returns on the market portfolio in the CAPM. However, in Table 3, we find that the monthly mean return (AERP) is –2.23%, which is negative and with a *t*-value of –3.242 that is significant at the 5% level. According to the CAPM, on average the realized market excess return should be positive, although in some periods it can be negative. Thus, it is excluded as a measure for the realized risk premium in the following study.

The reason for us to observe the average negative realized market excess return is that the nominal Polish risk free rate has been extremely high in comparison with the other countries because of the expected high inflation rate in Poland. In Table 1, the nominal average monthly T-bill rate in Poland is 1.73%, or 22.85% per annum, while in the US, the nominal average monthly T-bill rate is 0.37%, or 4.53% per annum in the same period. The Polish T-bill rate is more volatile in comparison with the US one as well. The coefficient of variation is 0.34 for the Polish T-bill rate and 0.24 for the US one. A higher risk free return will result in a lower or even negative market excess return if the returns on the market portfolio are either low or volatile.

5.3. Unconditional and (sign-) conditional beta and returns

Table 4 shows the two-step parameter estimates of the unconditional CAPM of Eqs. (2) and (3), and Table 5 shows the two-step parameter estimates of the (sign-) conditional CAPM of Eqs. (2) and (4). In the first step of the analysis, the coefficients of are estimated. In the second step, the monthly cross-sectional regression is conducted. The estimated coefficients of are then averaged. We test whether the mean of the coefficients is significantly different from zero using a *t*-test.

Three excess return series are tested under different assumptions: 1) the local market excess return, or the realized local market risk premium, LRP (for local investors in a segmented domestic market), 2) the global market excess return, or the realised global market risk premium in local currency, GLRP (for local investors in an integrated market), and 3) the global market excess return in dollars, GRP (for US-based international investors). We test the overall sample period between March 1992 and January 2002, and two sub-periods, between March 1992 – November 2000, and December 2000 – January 2002. The reason for us to split the sample in this way is that since November 17, 2000, quotations on the Warsaw Stock Exchange have been taking place in a new system called WARSET (WARsaw Stock Exchange Trading system). Thus, the market microstructure has changed and the technical efficiency has increased in the WSE since then[1]. Also, we may detect if there has been an increase in the degree of integration of the Polish stock market.

The results in Table 4 indicate either a flat or no relationship between beta and returns, which is consistent with Fama and French (1992) and most of the studies. According to the CAPM, the γ_0 coefficients should be zero and the γ_1 coefficients are expected to be significantly positive. The average excess return on the market

[1] However, this splitting way gives us only 14 monthly observations in the second period.

Table 4. Test of unconditional CAPM

This Table contains the parameter estimates of the following unconditional CAPM model.

$$R_{it} - R_{ft} = \hat{\alpha}_i + \hat{\beta}_i \left(R_{mt} - R_{ft} \right) + \varepsilon_{it}$$

$$R_{it} - R_{ft} = \hat{\gamma}_{0t} + \hat{\gamma}_{1t} \hat{\beta}_i + u_{it}$$

	$\overline{\gamma}_0$	$\overline{\gamma}_1$
Panel A: Local excess returns = $R_{\text{WIG in zlotys}} - R_{f\,\text{Poland}}$		
Total period (1992.03–2002.01)	2.910 (1.473)	–2.393 (–0.763)
Period 1 (1992.03–2000.11)	4.018 (1.850)	–2.938 (0.872)
Period 2 (2000.12–2002.01)	–2.510 (–4.542)**	–1.334 (–0.479)
Panel B: Global excess returns = $R_{\text{MSWI in zlotys}} - R_{f\,\text{Poland}}$		
Total period (1992.03–2002.01)	1.876 (1.626)	1.918 (0.642)
1st Period (1992.03–2000.11)	3.093 (2.322)*	0.839 (0.307)
2nd Period (2000.12–2002.01)	–3.129 (–2.638)*	0.192 (0.132)
Panel C: Global excess returns = $R_{\text{MSWI in dollars}} - R_{f\,\text{US}}$		
Total period (1992.03–2002.01)	2.110 (1.570)	1.001 (0.470)
1st Period (1992.03–2000.11)	2.637 (1.894)*	–0.851 (–0.417)
2nd Period (2000.12–2002.01)	–1.195 (–0.787)	0.185 (0.126)

WIG: Warsaw Stock Exchange index; MSWI: Morgan Stanley world index.
In panel C, the assets' returns are in dollars, while in the panels A and B, they are in zlotys.
The *t*-values are in parentheses;
* Significant at the 0.05 level;
** Significant at the 0.01 level or better.

portfolio is expected to be positive since investors are assumed to be risk averse, thus, they should be rewarded for taking risk. In Table 4, we can see that for the overall period and two sub-periods, none of the coefficients for γ_1 are significant no matter whether the realized local market risk premium or either of the two realized global market risk premium series is used. All the coefficients for γ_1 associated with the local market portfolio have negative signs.

Now, let us examine the (sign-) conditional relation. The results in Panel A of Table 5 indicate a strong relation between beta and return for the total period and the first period. The signs of the coefficients are in line with what can be expected and are highly significant. Shares with higher betas have higher returns when the local market excess return is positive and lower returns when the local market excess return is negative. Yet, this relation is weak for the second period, since the coefficient for the positive market excess return period is not significant, although the coefficient for the negative market excess return period is still highly significant. The reason could be that the observations in this period are quite few. In Panel B and C, where global market returns are used, we can see that the relation between beta and return does not seem to exist for the whole period. Both $\overline{\gamma}_2$ and $\overline{\gamma}_3$ are insignificant for the full period and the first sub-periods. However, we observe that after 2000 the coefficients are significant. Although we must be careful with so few observations, the results could mean that segmentation has decreased substantially.

The third column in Table 5 indicates that the symmetrical distribution can only be rejected after 2000 in Panel B. In other cases, the distribution of the up market period and down market period is symmetric. A positive risk and return tradeoff can be guaranteed here (Pettengill et al., 1995).

According to the above results, there is a positive relationship between beta and return in the Warsaw Stock Exchange when the domestic conditional capital asset pricing model is applied. The international capital asset pricing model does not perform well for the whole period because of the segmentation of the local market. As noted, there are indications that the Polish market has become more integrated after 2000.

The results also indicate that beta is a useful measure for investors and portfolio managers to make investment decisions as the tests for the conditional CAPM show. When the realized market excess return is positive, investors could increase their investment performance if they had been investing in high beta shares. When the realized market excess return is negative, investors would have been better protected if they held low beta shares. The CAPM is still one of the useful methods for estimating the cost of equity capital in this emerging market.

Table 5. Test of conditional CAPM

This Table contains the parameter estimates of the following conditional CAPM model.

$$R_{it} - R_{ft} = \hat{\alpha}_i + \hat{\beta}_i \left(R_{mt} - R_{ft} \right) + \varepsilon_{it}$$

$$R_{it} - R_{ft} = \hat{\gamma}_{0t} + \hat{\gamma}_{2t} D\hat{\beta}_{i,u} + \hat{\gamma}_{3t} (1-D)\hat{\beta}_{i,d} + e_{it}$$

	$\overline{\gamma}_2$	$\overline{\gamma}_3$	$\overline{\gamma}_2 - \overline{\gamma}_3 = 0$
Panel A: Local excess returns = $R_{\text{WIG in zlotys}} - R_{f\,\text{Poland}}$			
Total period	12.923	–15.764	(–0.50)
(1992.03–2002.01)	(4.340)**	(–3.374)**	
1st Period	12.879	–17.031	(–0.68)
(1992.03–2000.11)	(4.180)**	(–3.363)**	
2nd Period	5.657	–6.226	(–0.16)
(2000.12–2002.01)	(1.618)	(–3.601)**	
Panel B: Global excess returns = $R_{\text{MSWI in zlotys}} - R_{f\,\text{Poland}}$			
Total period	4.417	–4.332	(0.54)
(1992.03–2002.01)	(1.984)*	(–1.042)	
1st Period	5.017	–5.089	(–0.01)
(1992.03–2000.11)	(1.730)	(–1.00)	
2nd Period	11.641	–1.716	(5.21)**
(2000.12–2002.01)	(28.624)*	(–2.288)*	
Panel C: Global excess returns = $R_{\text{MSWI in dollars}} - R_{f\,\text{US}}$			
Total period	4.307	–3.974	(0.02)
(1992.03–2002.01)	(1.960)	(–0.920)	
1st Period	2.541	–6.744	(–1.01)
(1992.03–2000.11)	(1.197)	(–1.664)	
2nd Period	4.515	–3.063	(0.67)
(2000.12–2002.01)	(1.979)	(–3.796)**	

WIG: Warsaw Stock Exchange index; MSWI: Morgan Stanley world index.
In panel C, the assets' returns are in dollars, while in the panels A and B, they are in zlotys.
The *t*-values are in parentheses;
* Significant at the 0.05 level;
** Significant at the 0.01 level or better.

5.4. Downside risk

Table 6 shows the cross sectional regressions of Eq. (6). We can see a positive relation between the downside risk variable measured by the semi-deviation from the mean, , and the average return, which is consistent with the studies of Estrada (2001) in which country and industry level data were used.

Table 6. Test of downside risk

This Table contains the parameter estimates of the following cross section regression model.

$$\bar{R}_i = \alpha_0 + \alpha_1 \Sigma_{B,i} + u_i$$

where $\Sigma_{B,i}$ is the benchmark, *B*, for firm *i*. *B* takes the form of Σ_μ, the semideviation from the mean of firm *i*; Σ_L, the semideviation from the average return on the local market portfolio; Σ_G, the semideviation from the average return on the global market portfolio; Σ_f, the semideviation from the average return on the risk free asset, and Σ_0, the semideviation from zero.

Variable	α_0	α_1	R^2	$Adj - R^2$
Σ_μ	–3.725	0.378	0.133	0.128
	(–5.71)**	(5.79)**		
Σ_L	2.997	–0.327	0.083	0.079
	(3.96)**	(–4.46)**		
Σ_G	2.586	–0.298	0.074	0.070
	(3.65)**	(–4.19)**		
Σ_f	3.275	–0.343	0.099	0.095
	(4.37)**	(–4.90)**		
Σ_0	2.996	–0.340	0.095	0.092
	(4.24)**	(–4.28)**		

The *t*-values are in parentheses;
* Significant at the 0.05 level;
** Significant at the 0.01 level or better.

The coefficients for the other downside risk measures, i.e. the semi-deviation from the average return on the local market portfolio, Σ_L, the semi-deviation from the average return on the global market portfolio, Σ_G, the semi-deviation from the average return on the riskfree asset, Σ_f, and the semi-deviation from zero, Σ_0 are all significant and negatively related to the average returns. These measures are also more ad hoc than the semi-deviation around the mean, since this measure primarily corrects for skewness.

5.5. Other measures of risk

Table 7 reports the parameter estimates for Eq. (7). We can see that the total risk variable, TR, measured by the standard deviation and the average return are positively and significantly related. An efficient portfolio frontier or an upward sloped capital market line can be guaranteed here. However, we also find a highly significant positive sign for the coefficient before the variable that measures the idiosyncratic risk, IR, if the domestic capital market is able to provide substantial diversification opportunities to investors, this coefficient should be insignificant. It is not surprising that the Polish stock market does not seem to have offered such opportunities. The result is consistent with the indication of market segmentation above.

Table 7. Cross Sectional Regression

This Table contains the parameter estimates of the following cross section regression model.

$$\bar{R}_i = \alpha_0 + \alpha_1 RV_{j,i} + u_i$$

where $RV_{j,i}$ is the risk factor *j* for firm *i*. The risk factor takes the form of TR: total risk; IR: idiosyncratic risk; MCAP: logarithm of the market capitalization; BE/ME: logarithm of the book-to-market value of the equity.

	α_0	α_1	R^2	$Adj - R^2$
TR	–2.767 (–9.86)**	0.156 (12.58)**	0.419	0.417
IR	–6.488 (–8.77)**	1.702 (8.91)**	0.268	0.265
MCAP	–1.508 (–2.58)**	0.296 (2.35)*	0.025	0.020
BV/MV	0.672 (1.93)	–0.468 (–1.28)	0.023	0.009

The *t*-values are in parentheses;
* Significant at the 0.05 level;
** Significant at the 0.01 level or better.

In Table 7 we can see that one of the proxies for risk: firm size, MCAP, measured by taking the logarithm of the total market capitalization of the firm is significant and positively related to returns rather than negatively as was expected. This result indicates that large firms produce higher returns in contrast to most of the evidence from the developed markets.

The result is inconsistent with that of Clasessens, Dasgupta and Glen (1995), however. According to them the positive relation could be explained by volatility in the size-return relation. In some periods, there could be a size premium, and in the other periods there could be a discount. Other explanations are specific to the emerging markets in the process of opening up to foreign investors. These investors may be first interested in large (blue chip) shares. Thus, the turnover of the large firms' shares could be larger than this of the small firms. Moreover, in some countries, larger firms may have had easier access to cheaper capital, either through government-subsidized credits or through lower-cost international financing. The evidence in Poland shows that the domestic banks usually give a discounted lending rate to the larger firms and their well-established customers. Furthermore, since the real and nominal interest rates have been high in Poland, it is possible that firms preferred to borrow internationally in order to get cheaper credits. Large firms have better access to the international financial markets than small firms which are usually perceived to be more risky by the foreign financial institutions. Finally, it is possible that reforms and privatisation could benefit large firms rather than the small ones at the early stages of transition.

In Table 7 we can see that the other proxy for risk: the logarithm of the book-to-market ratio, BV/MV, has no power to explain the cross-sectional returns in the Warsaw Stock Exchange. This result seems contradictory to the studies by Fama and French (1998) and Rouwenhorst (1998), and Clasessens, Dasgupta and Glen (1995), in which all of them show that the book-to-market ratio is one of the factors that drive cross-sectional differences in the expected returns in the emerging markets. Fame and French (1998) and Rouwenhorst (1998) report a positive relationship, while Clasessens, Dasgupta and Glen (1995) show a negative relationship. In Table 7, the sign of the coefficient for book-to-market ratio is consistent with that of Clasessens, Dasgupta and Glen (1995), although it is insignificant in this study.

6. Conclusions

This paper addresses the questions of how risky assets are priced, and it estimates the influence of risk factors on cost of capital in an emerging capital market, the Warsaw Stock Exchange (WSE). The monthly cross section of stock returns and risks are investigated for different risk measures; unconditional and conditional beta, downside risk, total risk, idiosyncratic risk, and accounting ratios. We also ask whether the domestic version of the asset-pricing model associated with segmented capital markets, or the international asset-pricing model associated with integrated world markets is best able to explain the risk and return relationship in the WSE.

Our empirical results from 221 Polish firms listed on the Warsaw Stock Exchange indicate that the CAPM is still one of the useful methods for pricing the assets and estimating the cost of capital in this emerging market. There exists a (sign-) conditional relationship between beta and return when the domestic asset-pricing model is used. The international version of the asset-pricing model does not perform well before 2000 because of the segmentation of the local market, and the high nominal domestic risk free rate. However, we found indications that the degree of segmentation has decreased, and that risk premia have declined. As expected, the empirical evidence also indicates that the cross-sectional stock returns are positively related to the downside risk variable measured by the semi-deviation from the mean, and the total risk measured by the standard deviation. In addition, one risk proxy, firm size, is found to be positively related to the cross-sectional stock returns, while another proxy, the book-to-market ratio, does not seem to have explanatory power for the returns on the shares listed on the Warsaw Stock Exchange.

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