Testing Feasibility of Measuring Market Risk by Predicted Beta with Liquidity Adjustment[1]

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Abstract

The present paper assesses the CAPM *predicted* beta coefficient which is employed by a number of Russian investment companies in the calculation of a discount rate for future cash flows valuation. It is common practice to estimate the target stock price within the DCF method using the single-factor CAPM where the beta coefficient is the only measure of investment risk. A shift from the historical to the predicted beta coefficient is due to low liquidity of the majority of Russian stocks which results in rather low historical beta coefficients obtained by regressing on historical data. The paper assesses a new method of calculating the beta coefficient introduced by Aton Investment Company which dismisses company's industry-specific characteristics while accentuating company's size (measured by market capitalization) and liquidity (measured by the free-float coefficient). The sample size is 72 Russian stocks traded on the Russian Trading System (RTS) Stock Exchange. The sample period is from 2007 to the first half of 2008.

Key words: CAPM, historical beta, free-float, adjusted beta, predicted beta adjusted for liquidity.

[1] A working paper version.

Problems in application of CAPM in emerging capital markets

The single-factor equilibrium Capital Asset Pricing Model (CAPM) of the rate of return on equity and equity risk premium (ERP) remains the most popular one for setting a discount rate which is further used in calculating the equity (company) fair price within the Discounted Cash Flow method (DCF). CAPM implies that the required rate of return on equity and ERP can be thought of as depending upon 3 parameters: the risk-free rate, the market risk premium (MRP), and the beta coefficient representing equity systematic risk. The first two parameters are shared by the whole market; the third one is an equity-specific parameter. Most historical beta coefficients range globally from 0.4 to 1.8, with the lowest values attributed to the power and food industries and the largest values attributed to high-tech companies. Empirical data suggests that a company's beta tends to 1 over time since, with grow and diversification, many of the company's corporate governance, operational and financial risks decrease. This fact substantiates the use of an adjusted beta. Practitioners frequently use Blume-adjusted beta

$$\beta adj = 0.67 \cdot \beta raw + 0.33 \cdot 1,$$

where βraw and 1 are the raw (historical) and predicted beta coefficients respectively, 0.67 and 0.33 are their weighs.

The majority of Russian investment companies and investment departments of banks employ DCF in the computation of a target price[2] and refer to CAPM when setting the required rate of return on equity. "Evaluating a company on the basis of Discounted Cash Flow is our preferable method of estimating a target price of all Russian companies."[3]

Some modifications into the computation of the required rate of return on equity and ERP have been suggested in order to protect interests of foreign investors. They primarily take account of the existence of barriers to the free movement of capital which results in the segmentation of local markets, impossibility of portfolio's regional diversification, and brings about a compensational claim by

[2]There have been studied and compared reports (research notes on computing the fundamental equity price) of 27 analytical teams, including those from Russian banks (the Bank of Moscow, Gazprombank, VTB Bank, Uralsib), investment companies (Troika Dialog, Veles Capital, Renaissance Capital, Aton, Zerich Capital Management), financial boutiques (RMG Securities) as well as from Russian branches of global investment companies (UBS, CitiGroup, Merrill Lynch, Deutsche Bank).

[3] Analytical note by Aton, Oct. 10, 2002.

foreign investors in the form of a country-specific risk premium[4]. As a rule, this premium adjustment to global CAPM is introduced in the market parameters: risk-free rate or ERP. A.Damodaran's model suggests considering company's different extent of vulnerability to the country risk through a special lambda coefficient; the beta coefficient remains a measure of equity systematic risk in the model. It should be noted that even in the absence of capital markets segmentation (the country risk premium equals zero) there still remain problems in using CAPM parameters in their originally defined terms.

The first problem is that of a mismatch of the actual distribution of stock returns to the normal distribution. Research conducted in many markets reveals that the actual distribution is featured with skewness and kurtosis. Also, investor's expectations drift away from the established view on the behavior of stock returns. Analysts suggest solving the problem either by using a one-sided beta coefficient or by using multy-factor models containing parameters to reflect skewness (gamma coefficient) and kurtosis (delta coefficient). In some cases this innovation does help to increase the explanatory power of the asset pricing models[5].

The second problem relates to insufficient liquidity of stocks in emerging markets which makes unfeasible using the beta coefficient obtained by regressing on historical data. The historical betas for low liquidity stocks prove to be considerably less than 1 (that can be seen in Table 7). A solution to this problem frequently employed in practice consists in replacing such beta with a more reliable beta of a similar but highly liquid company. This is a so called "increasing beta" method that takes account of a difference in financial leverage between the company considered and a similar but highly liquid company. Financial leverage adjustment implies that ceteris paribus highly leveraged companies are supposed to have betas of higher magnitude. It comes from the fact that in the process of composing asset portfolio to diversify capital the remaining systematic risk comprises both operational and financial non-diversifiable components. That is, financial risk can not be fully diversified.

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[4] A review of most commonly used ways of setting the country risk premium is given in chapter III of T.Teplova's monograph "Investment Mechanisms of Enterprise Value Maximization", http://www.cfin.ru/management/strategy/classic/investment_risks.shtml.

[5] The results of testing models with a one-sided systematic risk parameter as well as with skewness and kurtosis parameters on a sample of Russian stocks were reported by T.Teplova at the 11th International Conference of The State University – Higher School of Economics held on April 6-8, 2010.

However, the method contains a serious limitation. It does not take into account liquidity risk of an asset. It actually implies that the required rate of return on investment into highly liquid and low liquid companies from the same industry and with the same financial leverage will be similar. Common sense suggests that this simplification is too strong and the investor's acceptance of liquidity risk must be counterbalanced by an additional premium. This hypothesis has been tested in a number of developed and emerging markets and has proved to be feasible. In these studies the liquidity premium was introduced into the asset pricing model in the form of an additional parameter[6]. For instance, the Amihud & Mendelson paper (1986)[7] confirms statistically significant positive correlation between the expected return and the relative bid-ask spread.

A complicated aspect, when accounting for liquidity, is to determine the level of stock liquidity. As a rule an investor is able to obtain information about the liquidity level of one or another stock (for instance, differentiation of stocks traded on an exchange on the basis liquidity). In empirical research the liquidity level is measured by one of the four following ways (in a descending order of preference): 1) relative bid-ask spread[8], 2) stock turnover, 3) stock free float, 4) number of days with zero trading volume and exchange turnover[9]. Empirical research gives evidence that companies, whose liquidity measured by one of the four abovementioned ways is low, have higher expected rate of return, that is, the hypothesis of the liquidity risk premium holds. At the same time illiquid companies have a discount in multipliers (for example, EV/EBITDA, reported by the Valmetrics analytical group[10]).

According to the relative bid-ask spread measure of liquidity in the Russian market there are both highly liquid companies (1% for Lukoil and Tatneft, 1.5% for

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[6] See for example Stoll, Hans R., Whaley, Robert E. "Transaction Costs and the Small Firm Effect." Journal of Financial Economics 12 (1983), 57-59.

[7] Amihud, Y., Mendelson, H. "Asset Pricing and Bid-Ask Spread." Journal of Financial Economics 17 (1986), 223-249.

[8] Data on the relative bid-ask spread is available from some financial databases. Alternatively, the daily relative bid-ask spread can be computed by subtracting the (closing) bid from the (closing) ask and dividing by the bid and ask average. The relative bid-ask spreads for other time intervals are computed in a similar way. Increasingly lower values of the relative bid-ask spread indicate increasingly higher levels of liquidity.

[9] Along with other measures of liquidity this one is used in the Hearn & Piesse study "Sector Level Cost of Equity in African Financial Markets" (2009). It is an indicator of the "price empty dynamics" and is computed by dividing the accumulated daily price change (summing up the absolute values of all positive and negative price changes) by the corresponding daily trading volume. The higher the indicator is the lower the liquidity level is. Thus, if a considerable price movement of a stock is not accompanied by a sufficient trading volume (that is, it results mostly from speculative activity) such asset is not liquid.

[10] Industry Illiquidity Discount Report (IIDR), 2006.

Sberbank and Rostelecom in 2002) and rather illiquid companies (8% for Severstal, 4.4% for Avtovaz, 4% for Baltika).

A number of Russian investment banks employ an alternative approach to accounting for low stock liquidity when setting a discount rate in the calculation of the fundamental price. The approach is described in Aton's analytical note of 10 October, 2002. Its application is also mentioned in some analytical reports in 2008-2010[11]. An analytical group headed by T.Teplova and V.Rodina[12] has tested on a sample of Russian companies the feasibility of the given approach with respect to its predictive power and its goodness of fit to the actual stock returns behavior and has conducted a comparative analysis of the given approach and models with historical and adjusted beta coefficients available from some popular financial databases (Bloomberg, Reuters).

Aton's approach to the calculation of the predicted beta coefficient for Russian companies

In order to calculate the cost of equity k_e Aton employs the traditional CAPM specification with some modifications described below:

$$k_e = r_f + \beta (r_m - r_f),$$

where r_f is the risk-free rate, (Aton suggests using Russia's 2030 Eurobond offer quote), β is the beta coefficient, $r_m - r_f$ is the market risk premium. "For estimating the market risk premium for the Russian market in April 2002 we devised the following methodology. We suggested that the standard market risk premium in developed markets amounted to 3.5%. That corresponds to various estimates for the positive spread between the returns on the US' main market indices (including dividends) and the returns on the Treasury Bonds for period 1927-2002… We compared the average volatility of the RTSI index with the average volatility of the S&P 500 index which, broadly speaking, represents all developed markets… We define volatility to be the standard deviation of the daily RTSI changes for any 12-month period… The volatility in the Russian market is 1.45-fold greater than the volatility in developed markets. Hence, the market risk premium for the Russian market amounts to 5.08%."

[11] For example, the Bank of Moscow report on WBD of 1 April, 2010 or on ferrous metallurgy of 5 April, 2010.

[12] The test has been conducted by A.Busarov, A.Masyutin, K.Efimov, R.Kuznetsov, E.Platonov, A.Smolina, O.Shatvoryan as a part of a research project at the Research & Training Laboratory of Financial Markets Analysis of the Faculty of Economics of the State University – Higher School of Economics.

Further on the analytical note considers two problems of calculating the historical beta coefficient for the Russian market. First, such beta does not take into account the existence of financial leverage. This problem is illustrated by the comparison of two Russian companies, Surgutneftegas and Lukoil, which have similar shares in RTSI (about 17%) and similar trading volumes in 2001-2002 ($20-30 millions) but differ considerably in the magnitude of financial leverage, which in case of Surgutneftegas is nearly zero. Second, due to low liquidity of the majority of Russian companies there is a mismatch between the historical beta coefficients and the actual risk level. For instance, the Avtovaz beta at the end of September 2002 amounted to 0.52 (for a one-year sample period) which can hardly be explained by the Avtovaz low operational risk (betas for similar foreign companies exceed one) and is more likely due to its low liquidity.

However, it is hard to admit that the beta coefficient obtained by regressing on historical data does not fully reflect financial risk. Since the regression is performed on stock returns the obtained beta coefficient is supposed to reflect corporate governance, operational, and financial risks. Thus, it is not quite correct to compare Surgutneftegas and Lukoil; they have different operational risks (that can be seen in their cost/income structure) and different corporate governance risks, that being reflected in both stock volatility and stock beta.

In Aton's view one of the key considerations in the determination of the predicted beta coefficient is company's size. Aton's analysts refer to the research conducted by Barra Investment Risk Management Company which review estimates for the size premium on a yearly basis. Its change ranges from 0 to 5% in the developed markets. Empirical research reveals that betas of large diversified companies tend to 1. That is Aton's suggested benchmark for large and highly diversified Russian companies. Aton's approach implies considering two factors: liquidity measured by the free float coefficient (FF) and company's size measures by the market capitalization (both common and preferred stock). The values of the beta coefficients thus defined range between 1 and 2 (see Table 1).

Table 1. Aton's intermediate predicted beta coefficients accounting for liquidity and company's size	
Average yearly market capitalization in the US dollars (common and preferred stock)	**β_U**
> 500	**1**
250-500	**1,25**
100-250	**1,5**
50-100	**1,75**
< 50	**2**

By this approach the beta coefficients of most Russian blue chips and highly liquid second-tier companies (not yet adjusted for the financial leverage) are either 1 or 1.25 while the beta coefficients of less liquid companies assume larger values (see Table 2).

Table 2. Historical betas and Aton's predicted beta as of 30 September, 2002		
Companies	**Blume-adjusted historical betas computed from the daily closing quotes for the last 12 months available from Bloomberg**	**Aton's intermediate predicted beta (β_U)**
Lukoil	**1,05**	**1**
Gazprom	**0,87**	**1**
Surgutneftegas	**1,14**	**1**
Sberbank	**0,82**	**1**
Baltika	**0,11**	**1,5**
Avtovaz	**0,72**	**1,5**
MGTS	**0,53**	**1,75**
Aeroflot	**0,66**	**1,75**

To account for the financial leverage the following formula is applied:

$$\beta_L = \beta_U\left(1 + \frac{D}{E}\right).$$

For example, the predicted beta coefficient adjusted for the financial leverage for Gazprom in 2002 equaled 1 * (1 + 0.91) = 1.91 since its debt-to-asset ratio

amounted then to 47.7%. With the risk-free rate equaling to 10.2%, the market risk premium in the developed markets equaling to 3.5%, and the volatility of the Russian market relative to that of the developed markets equaling to 1.45 the required rate of return on Gazprom's equity is

$$k_e = 10.2\% + 1.91(3.5\% \cdot 1.45) = 19.9\%.$$

Aton's approach to calculating the beta coefficient is far from being unambiguous. In addition, the formula for calculating the required rate of return on equity suffers from a double-counting trap: the country risk premium is counted for in both the risk-free rate and in the market risk premium. Empirical studies of emerging markets (for example, by Godfrey & Espinosa (1996)) confirm the infeasibility of this calculation. To avoid double counting requires the introduction of a correction coefficient which can be specified as $(1 - R^2)$, where R^2 is the coefficient of determination in a regression equation of the rate of return on the local market and the country default spread which is calculated as a difference in the rate of returns on the local market government securities and on the global market.

Testing several beta specifications in the Russian market

The test of feasibility and the comparative analysis of 3 beta specifications have been done for Russian stocks listed on RTS for year 2007 which is regarded as a rather stable and low volatile period of the Russian stock market development. The 3 beta specifications considered comprise the raw (historical) beta obtained by regressing on weekly data for a one-year period, Blume-adjusted beta, and Aton's beta adjusted for liquidity and financial leverage risks. Also, a test on the predictive power of the 3 approaches to calculating the cost of equity has been performed for year 2008 on the whole and the first (pre-crisis) quarter separately. The research is done in 10 steps.

Step 1

The 2007 dollar market capitalization was calculated for companies enlisted on RTS (both common and preferred stock) by averaging dollar market capitalization available on the last trading day of each quarter (see Table 3). The price of each stock was calculated either as the average of the maximum and minimum traded prices or (in case of no trading on that day) as the average of the bid and ask.

Table 3. The 2007 market capitalization (common and preferred stock)

Code	Name	Market Cap, USD (30/03/2007)	Market Cap, USD (29/06/2007)	Market Cap, USD (28/09/2007)	Market Cap, USD (28/12/2007)	2007 Average Market Cap
AFKS	Sistema, cs	11531750000	11580000000	13124000000	16004139000	13059972250
AFLT	Aeroflot, cs	3146742478	3131937963	3331848897	4109280306	3429952411
AKRN	Akron, cs	1120658600	1120658600	1144502400	2392328092	1444536923
ARHE	Arkhener-go, cs	87472490	94333077	85757343	103080326	92660809
ARHEP	Arkhener-go, ps	21107232	18292934	15865603	19383475	18662311

Step 2

The free float coefficients (FF) were obtained for each sample company from RTS. One of the difficulties in the practical implementation of Aton's approach consists in discrepancy in the FF estimates by various analysts. As seen in Table 2 of the Appendix the RTS and the MICEX 2007 free float estimates differ to a large extent.

Step 3

The 2007 average free float market capitalization (common and preferred stock) was obtained by multiplying the 2007 average market capitalization of a stock by its free float coefficient (see Table 1 of the Appendix, Column 3).

Step 4

The 2007 average financial leverage was computed for each sample company (see an example in Table 4). A simplification was made to the computation by applying the book value of equity (the RAS Statement 1, raw 490 "Capital & Reserves") and by adding up long-term and short-term debts. For a more correct debt specification one should have determined regularly employed short-term debt with paid interest; however that kind of data was unavailable.

Table 4. An example of the financial leverage computation (debt/equity ratio) for a number the sample companies for 2007					
Code	**Name**	**Equity Capital**	**Long-term Debt**	**Short-term Debt**	**Financial Leverage**
AFKS	Sistema	482092399	9982187	22149833	0,07
AFLT	Aeroflot	30441623	88758	14341176	0,47
AKRN	Akron	22648657	6158993	1678608	0,35
AVAZ	Avtovaz	57421	18746	54528	1,28
BANE	Bashneft	76348745	86346	7173178	0,10
BEGY	Bashkirenergo	34754297	1535454	4900323	0,19
BLNG	Belon	5691127	5162280	5919217	1,95
CHMF	Severstal	305972432	25065977	24809446	0,16
CMST	Komstar	74008026	27193794	1013602	0,38
CNTL	Central Telegraph	1253462	1968548	1063402	2,42

Step 5

RTSI weekly returns were computed as the normalized difference between the average of the maximum and minimum quotes on the fixed days separated by a weekly interval (see Table 5). Stock weekly returns were computed in a similar way with the average of the maximum and minimum traded price or (in case of no trading on that day) with the average of the bid and ask prices.

Table 5. An extract from the RTSI weekly returns time series					
DATE	**RTSI HIGH**	**RTSI LOW**	**RTSI MEAN**	**RTSI RETURN**	**RTSI RETURN %**
15.01.2007	1879,86	1798,45	1839,16		
22.01.2007	1886,76	1819,93	1853,35	0,0077	0,77
29.01.2007	1904,67	1800,59	1852,63	-0,0004	-0,04
05.02.2007	1927,06	1878,86	1902,96	0,0272	2,72
12.02.2007	1905,30	1827,05	1866,18	-0,0193	-1,93
19.02.2007	1934,99	1893,20	1914,10	0,0257	2,57
26.02.2007	1971,35	1772,92	1872,14	-0,0219	-2,19
05.03.2007	1818,28	1701,80	1760,04	-0,0599	-5,99
12.03.2007	1829,77	1750,06	1789,92	0,0170	1,70
19.03.2007	1915,42	1825,80	1870,61	0,0451	4,51
26.03.2007	1953,56	1907,59	1930,58	0,0321	3,21
02.04.2007	1947,97	1914,85	1931,41	0,0004	0,04
09.04.2007	2001,59	1946,95	1974,27	0,0222	2,22
16.04.2007	2008,71	1915,36	1962,04	-0,0062	-0,62

A book of beta was composed of the alpha, beta, and R^2 coefficients obtained by regressing the stock weekly returns on the RTSI weekly returns as well as of Blume-adjusted betas (see Table 6).

Table 6. An Extract from the Book of Beta					
Code	**Name**	**Raw Beta**	**Alpha**	**R^2**	**Blume's Beta**
AFLT	Aeroflot	0,639497475	0,776278203	0,099331873	0,747648
AKRN	Akron	0,54785797	0,89632682	0,12424556	0,683501
BANE	Bashneft	0,426475374	-0,092110143	0,099693243	0,598533
BLNG	Belon	0,796150319	1,445016401	0,123202711	0,857305
CHMF	Severstal	1,638555824	0,851097871	0,554861078	1,446989
ENCO	Sibir Telekom	0,99628917	-0,134569446	0,196064348	0,997402
FESH	DVMP	0,389021136	1,634443711	0,037241893	0,572315
GAZP	Gazprom	1,352983836	-0,038793971	0,587423113	1,247089
GMKN	Nornikel	2,501088065	1,254421663	0,104429554	2,050762

Step 6

The feasibility of the three approaches was tested with respect to the accuracy of the description of the mean returns of the sample companies for 2007. The better the quality of the regression was, the higher the beta coefficient was ranked. Below is given the outcome of the test for raw (historical) beta (***B***) and Aton's beta (***B****). The general test formula is

$$EMR_i = \alpha_1 + a_2\beta_i + u_i,$$

where EMR_i denotes equity mean weekly return for 2007, β_i denotes either raw (historical) beta ***B*** or Aton's beta ***B****, α_1 and α_2 denote the intercept and slope coefficients respectively, i indexes the company (there are overall 72 companies in the sample).

Model 1: OLS; number of observations: 72; regressand: **EMR**

	Coefficient	Standard Error	t-statistics	p-value	
const	0,322615	0,173249	1,862	0,0668	*
B	**0,531949**	0,186213	2,857	0,0056	***

R^2 0,104408
adjusted R^2 0,091613

The slope coefficient in Model 1 is positive and statistically significant at any reasonable level of significance. The coefficient of determination is not large (about 10%); however that is in compliance with other such estimates for emerging markets.

Model 2: OLS; number of observations: 72; regressand: **EMR**

	Coefficient	Standard Error	t-statistics	p-value	
const	1,06306	0,191911	5,539	4,99e-07	***
B*	**-0,141277**	0,0728646	-1,939	0,0565	*

R^2 0,050967
adjusted R^2 0,037409

The comparison of the regression results makes it obvious that the approximation of the mean weekly returns for 2007 using Aton's beta is much poorer. The coefficient of determination in Model 2 is about 5%, nearly twice less than that in the model with the traditional beta specification. The slope coefficient in Model 2 turns out negative, implying decreased mean return for increased beta which clearly confronts with the established notion of the beta coefficient. A conclusion made at this stage of the research is that Aton's approach to computing the beta coefficient based on the 2007 data is inferior to the traditional approach widely used for developed markets.

Step 7

Testing the predictive power of the three beta coefficients for 2008 based on the data for 2007. Expected weekly stock returns were computed on the basis of CAPM where the risk-free rate was approximated by Russia's 2018 Eurobond. This Eurobond is quoted in dollars as are the RTS stock prices employed for the analysis. That helped avoiding the exchange rate risk problem. The 2008 RTSI weekly returns were computed twice: 1) as the normalized difference between each Friday's and Monday's price; 2) as the difference in the price logarithms (ln(*Friday's closing price*) - ln(*Monday's opening price*)).

Table 7. The two ways of the RTSI weekly returns computation		
Date	Weekly returns as the difference in the price logarithms	Weekly returns as the normalized difference
04.01.2008	0,568187041	0,569804285
11.01.2008	-6,924294443	-6,69000389
18.01.2008	-6,013466498	-5,836228058
25.01.2008	-3,140169276	-3,091378004
01.02.2008	-5,17197293	-5,04050268
08.02.2008	6,132204983	6,324127573
15.02.2008	4,406345527	4,504866663
22.02.2008	-0,802992357	-0,799776985
29.02.2008	-0,239198947	-0,238913094
07.03.2008	2,660527708	2,696235717
14.03.2008	-4,880349494	-4,763174351

Next, each company's weekly observed return was compared to the expected weekly return implied by CAPM with three beta specifications. Table 8 provides an example for Aeroflot. The last column contains the standard deviation of the realized return from the expected return for 2008. Table 9 provides the sample's overall results for 2008.

Table 8. A comparison of the Aeroflot's weekly observed and implied returns (in the percentage term) for each week (an extract of three weeks of January)					
		18.01.2008	25.01.2008	01.02.2008	SD for 2008
RTSI		-6,69	-5,84	-3,09	
risk-free		5,34	5,31	5,22	
AFLT	observed	-2,97	-1,07	3,94	
	raw	1,06	1,58	3,24	
	Blume's	0,33	0,94	2,90	
	Aton's	-1,36	-0,53	2,12	
	SD(raw)	16,18	6,98	0,49	4619,86
	SD(Blume's)	10,88	4,05	1,07	4974,27
	SD(Aton's)	2,59	0,29	3,30	6279,76

Table 9. The standard deviation of the 2008 observed return from the CAPM implied return for three beta specifications (the sample's overall results)		
raw beta	Blume-adjusted beta	Aton's beta
703828,11	692120,36	894167,09

Table 10 reveals that the largest difference between the observed and implied returns for the whole sample of 72 companies for 2008 comes with the application of Aton's beta. The best approximation for the observed returns is given by CAPM-implied returns when applying Blume-adjusted beta.

Step 8

The accuracy of the 2008 expected returns was assessed by the regression through the origin of the form

$$r_{obs_i} = \alpha \cdot r_{exp_i} + e_i.$$

The slope coefficient being statistically equal to one implies a very close approximation for the observed returns by the implied ones (by CAPM with three beta specifications). Thus, each company's returns were regressed trice (see Table 10).

Table 10. Number of the sample companies for which the hypothesis of the unit slope coefficient is not rejected						
	at 5% level of significance			at 1% level of significance		
	Raw	Blume's	Aton's	Raw	Blume's	Aton's
-	65	64	68	58	58	63
+	7	8	4	14	14	9

Step 9

A comparison of the required returns implied by Aton and the required returns implied by CAPM to the observed returns was performed for the first quarter of 2008. Aton's required return is given by the formula

$$k_e = r_f + \beta_u\left(1 + \frac{D}{E}\right) \cdot MRP \cdot \left(\frac{SDL}{SDG}\right),$$

where k_e denotes the cost of equity, r_f denotes the risk-free rate (Russia's 2030 Eurobond return for a one-quarter period); $\beta_u(1+D/E)$ denotes Aton's levered

beta; MRP denotes the global market risk premium of 3.5% converted to the one-quarter period premium of 0.86%; SDL/SDG denotes the RTSI volatility in the first quarter of 2008 relative to the corresponding S&P 500 volatility.

Table 11 provides data for comparing the observed rate of return and the two implied required rates of return. The last two columns contain the difference in absolute terms between the observed and implied required returns.

Table 11. A comparison of Aton's implied and CAPM-implied required rate of return with the observed rate of return for the first quarter of 2008 (extract)

Code	Observed return	CAPM-implied return	Aton's implied return	Observed - CAPM	Observed - Aton's
AFLT	11,05	-6,50	3,25	17,55	7,80
AKRN	38,60	-5,38	3,53	43,97	35,07
AMEZ	-14,97	-8,56	4,16	6,42	19,14
BANE	-20,87	-3,89	2,75	16,98	23,63
BLNG	35,00	-8,41	8,09	43,41	26,91
CHEP	-6,57	-3,87	4,76	2,70	11,32
CHMF	4,04	-18,70	2,84	22,74	1,20
DGBZ	116,22	-5,04	4,96	121,26	111,25
EESR	-19,85	-11,42	2,70	8,43	22,55
ENCO	-17,31	-10,86	4,69	6,45	21,99
ESMO	-17,03	-2,76	4,39	14,26	21,42
FESH	-8,22	-3,44	3,01	4,78	11,23
GAZP	-11,99	-15,21	3,05	3,23	15,04
GMKN	7,65	-29,24	3,53	36,89	4,12
GRAZ	23,70	-1,91	6,36	25,62	17,34
GUMM	16,67	-2,06	4,28	18,73	12,39
IRGZ	-22,80	-7,51	2,80	15,29	25,60

IRKT	-1,49	-2,49	8,93	0,99	10,42
KHEL	-12,33	-0,36	11,26	11,98	23,59
KIRZ	-10,19	-1,62	4,96	8,57	15,14
KLNA	-19,13	-6,09	4,71	13,04	23,84
KMAZ	4,11	-1,31	3,24	5,42	0,87
KUBN	-15,54	-3,55	5,94	11,99	21,48
LEKZ	-4,23	-2,47	4,73	1,76	8,95
LKOH	-0,87	-16,21	4,08	15,33	4,95
			min dif	**0,65**	**0,29**
			max dif	**121,26**	**111,25**
			mean dif	**16,31**	**17,51**
			sum of dif	**1174,26**	**1260,93**

Table 11 reveals that Aton's approach to computing the required rate of return on a stock is inferior to CAPM with beta obtained by regressing on historical data.

Step 10

Aton's intermediate beta (set on the basis of the free-float market capitalization of common and preferred stock) was tested on how well it indicates differences in companies by liquidity and volatility for 2007. Liquidity was measured by the average 2007 relative bid-ask spread according to the formula

$$\sum \frac{(ask - bid)}{(ask + bid)/2} / N,$$

where N denotes the number of trading days in 2007. For example, on 29 January 2009 Aeroflot's closing bid and ask amounted to $2.7 and $2.83 respectively. Then the absolute spread equals $0.13 and the relative spread equals (0.13/2.765) = 0.047 = 4.7%. Aeroflot's average relative bid-ask spread equaled 6.9% for 2007.

Table 12 displays three possible liquidity risk measures, Aton's intermediate beta, relative bid-ask spread, and average daily volatility, which enables to conduct a comparative analysis of the sample companies. As seen in the Table, Akron is less risky than Aeroflot or Kamaz when measured by the relative bid-ask spread or average daily volatility; however it is more risky by Aton's approach (Aton's beta for Akron is larger). The group of stocks which are highly liquid according to Aton's approach (Aton's beta for such stocks proves to be 1) is in fact very diverse when compared by the relative bid-ask spread. For example, it includes both UES of Russia's stock with the relative bid-ask spread of 6.4% and MGTS' stock with the relative bid-ask spread of 11.57%.

Table 12. A comparison of the sample companies by three possible liquidity risk measures: Aton's intermediate beta, relative bid-ask spread, and daily volatility

Code	Company's name	Aton's intermediate beta	Bid-ask spread (%)	Daily volatility (%)
AFLT	Aeroflot	1	6,09	2,64
AKRN	Akron	1,25	5,34	1,88
AMEZ	Ashinskiy Metallurgical Works	1,75	4,18	1,86
BANE	Bashneft	1	4,39	1,37
BLNG	Belon	1,75	6,99	2,24
CHEP	CHTPZ Group	1,25	1,75	1,10
CHMF	Severstal	1	1,70	2,18
DGBZ	Dorogobuzh	2	15,50	2,02
EESR	UES of Russia	1	0,64	2,02
ENCO	SibirTelekom	1	2,46	2,20
ESMO	TsentrTelekom	1	2,97	1,41
FESH	DVMP	1,25	4,35	1,92
GAZP	Gazprom	1	0,90	1,83
GMKN	Nornikel	1	1,18	2,65
GRAZ	Razgulay Group	1,5	2,81	1,54
GUMM	GUM	2	7,93	1,82
IRGZ	Irkutskenergo	1	3,62	1,76
IRKT	Irkut Corporation	1,25	3,80	0,96
KHEL	Kazan Helicopters	1,75	6,36	1,38
KIRZ	Kirovskiy Factory	1,5	7,82	2,28
KLNA	Kalina Concern	1,5	2,98	1,45
KMAZ	Kamaz	1	9,94	3,38
KUBN	YUTK	1,25	4,09	1,50
LEKZ	Lebedyansky	1,25	2,81	1,42
LKOH	Lukoil	1	0,79	1,83
MAGN	MMK	1	3,41	2,05
MASZ	Elemash	1,5	5,52	1,38
MGNT	Magnit	1	1,51	1,33
MGTS	MGTS	1	11,57	1,79

MSNG	Mosenergo	1,25	6,41	2,72
MSRS	MOESK	1,25	4,44	1,99
MSSB	Mosenergosbyt	1,75	31,90	4,33
MSSV	MTK	1,25	9,33	3,67
MTLR	Mechel	1	7,22	2,61
MTSS	MTS	1	1,20	2,21
NLMK	NLMK	1	4,13	2,66
NNSI	VolgaTelekom	1	2,20	1,87
NVTK	NOVATEK	1	6,47	2,03
OGKB	OGK-2	1	3,09	2,32
OGKC	OGK-3	1	4,43	1,86
OGKD	OGK-4	1	3,47	2,10
OGKE	OGK-5	1	1,71	1,54
PHST	Pharmstandard	1,25	1,24	2,62
PKBA	Baltika	1	3,88	1,13
PLZL	Polyus Gold	1	2,90	1,87
PMTL	Polymetal	1	2,85	1,96
PNTZ	Yraltrubostal	1,75	6,93	1,26
RASP	Raspadskaya	1	2,79	2,23
ROSN	Rosneft	1	0,80	1,66
RTKM	RosTelekom	1	1,28	1,51
SCON	The Seventh Continent	1,25	1,63	1,31
SIBN	Gazprom Neft	1	8,62	3,08
SILM	Power Machines	1,25	1,84	1,02
SILV	Silvinit	1	6,13	1,94
SNGS	Surgutneftegaz	1	1,48	2,03
SNOZ	Salavatnefteorgsintez	1,25	2,20	0,97
SNTZ	Sinarsky Pipe Works	1,75	4,94	0,99
SPTL	North-West Telekom	1	2,58	1,39
SVAV	Severstal-auto	1,25	2,69	1,71
TATN	Tatneft	1	2,55	2,64
TGKA	TGK-1	1,25	6,13	2,87
TGKE	TGK-5	1,25	7,19	2,43
TGKF	TGK-6	1,5	8,00	2,37
TGKI	TGK-9	1,5	10,77	3,52
TRMK	TMK	1	2,43	2,02
TRNFP	Transneft	1	1,94	2,26
UFMO	Ufa Engine Industrial Association	1,5	7,97	0,99
URKA	Uralkali	1	3,23	2,55
URSI	Uralsvyazinform	1	2,78	1,98
VRPH	Veropharm	1,5	3,41	1,79
VSMO	VSMPO-AVISMA Corporation	1	2,57	1,05
WBDF	WBD	1,25	2,66	2,08

The sample companies were assorted into groups ranked by the size of their 2007 average bid-ask spread (S). The first group comprises companies whose spread S ranges 0% to 1% ($0 < S < 1$), the second group comprises companies whose spread

ranges 1% to 2% (1 < S < 2) and so on. The last group contains an outlier company Mosenergosbyt whose average bid-ask spread in 2007 was computed to be 31.9%. Next, it was indicated for each group how many companies are attributed with Aton's intermediate beta of 1, 1.25, 1.5, 1.72 or 2. For example, in the first group of companies (whose bid-ask spread does not exceed 1%) there are 4 companies in total; one company is attributed with Aton's beta of 1, two companies are attributed with Aton's beta of 1.25, and yet one more company is attributed with Aton's beta of 1.5. Since Aton's beta coefficients measure liquidity alongside the bid-ask spread measure, this data provides a good source for comparative analysis (see Table 13).

Table 13. The allocation of the companies according to the bid-ask spread (S) and to Aton's beta

Bid-ask spread		Aton's beta				
		1	1,25	1,5	1,75	2
0<S<1	**4**	1	2	1	x	x
1<S<2	**12**	8	4	x	x	x
2<S<3	**17**	11	4	2	x	x
3<S<4	**8**	6	1	1	x	x
4<S<5	**8**	3	3	x	2	x
5<S<6	**2**	x	1	1	x	x
6<S<7	**8**	3	2	x	3	x
7<S<8	**5**	1	1	2	x	1
8<S<9	**2**	1	x	1	x	x
9<S<10	**2**	1	1	x	x	x
10<S<11	**1**	x	x	1	x	x
11<S<12	**1**	1	x	x	x	x
12<S<13	**x**	x	x	x	x	x
13<S<14	**x**	x	x	x	x	x
14<S<15	**x**	x	x	x	x	x
15<S<16	**1**	x	x	x	x	1
S=31,90	**1**	x	x	x	1	x

There are two things to be pointed out upon studying Table 12 and Table 13.

1) The companies having the same bid-ask spread may quite differ by Aton's beta. For example, a moderately liquid group with the bid-ask spread ranging 8 to 9% ($8 < S < 9$) contains one company which is moderately liquid by Aton's measure of liquidity and one company which is highly liquid by the same measure.
2) The companies attributed with the same Aton's beta may quite differ by the bid-ask spread. Particularly diverse are companies having Aton's beta of 1 and 1.25.

Therefore, Aton's beta is likely to overestimate or underestimate liquidity risk for companies falling into the same category under the free-float market capitalization (common and preferred stock).

Conclusion

Although CAPM is not much accurate in describing and predicting stock returns for the Russian market, it is nevertheless superior to the alternative approach in which the beta coefficient is dependent upon company's size and liquidity. Using the free-float coefficient as a liquidity measure is associated with some difficulties. First, free-float estimates are far from being unambiguous (see Table 2 of the Appendix). Second, the free-float market capitalization is nearly uncorrelated with widely accepted liquidity measures such as the bid-ask spread or trading volume. Third, modifying CAPM by introducing country risk as the relative market volatility into the CAPM formula may generate a double-counting problem since country risk is already counted for in the risk-free rate which according to Aton is set by a local government debt instrument.

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Appendix

Table 1. A comparison of Aton's betas and historical betas for 2007

Code	Company's name	RTS free-float market capitalization, $	Aton's intermediate beta	FL	Aton's beta	Historical beta
AFLT	Aeroflot	685990482,20	1	0,47	1,47	0,64
AKRN	Akron	288907384,60	1,25	0,35	1,68	0,55
AMEZ	Ashinskiy Metallurgical Works	69811837,75	1,75	0,24	2,17	0,81
BANE	Bashneft	796134520,60	1	0,10	1,10	0,43
BLNG	Belon	91856250,00	1,75	1,95	5,16	0,80
CHEP	CHTPZ Group	392786364,75	1,25	1,10	2,62	0,42
CHMF	Severstal	2692118760,68	1	0,16	1,16	1,64
DGBZ	Dorogobuzh	48838611,85	2	0,39	2,78	0,52
EESR	UES of Russia	10158229999,35	1	0,05	1,05	1,04
ENCO	SibirTelekom	850708571,10	1	1,57	2,57	1,00
ESMO	TsentrTelekom	789274320,05	1	1,34	2,34	0,33
FESH	DVMP	273764482,69	1,25	0,03	1,29	0,39
GAZP	Gazprom	108885138908,00	1	0,32	1,32	1,35
GMKN	Nornikel	8715716574,10	1	0,69	1,69	2,50
GRAZ	Razgulay Group	103226620,00	1,5	1,56	3,84	0,26
GUMM	GUM	19350000,00	2	0,13	2,26	0,28
IRGZ	Irkutskenergo	504344938,48	1	0,13	1,13	0,72
IRKT	Irkut Corporation	322233233,00	1,25	3,64	5,80	0,31
KHEL	Kazan Helicopters	68589039,68	1,75	3,33	7,57	0,14
KIRZ	Kirovskiy Factory	116327046,38	1,5	0,85	2,77	0,24
KLNA	Kalina Concern	150983533,30	1,5	0,72	2,58	0,61
KMAZ	Kamaz	44008575622,50	1	0,47	1,47	0,21
KUBN	YUTK	352279823,75	1,25	1,82	3,52	0,40
LEKZ	Lebedyansky	346016439,85	1,25	1,08	2,60	0,31
LKOH	Lukoil	42416251590,90	1	1,10	2,10	1,43
MAGN	MMK	1267937594,25	1	0,21	1,21	1,29
MASZ	Elemash	111745322,30	1,5	0,31	1,96	0,29
MGNT	Magnit	645094296,00	1	0,21	1,21	0,48
MGTS	MGTS	551021323,75	1	0,16	1,16	0,19
MSNG	Mosenergo	410411034,39	1,25	0,25	1,56	1,58
MSRS	MOESK	301420668,00	1,25	0,94	2,42	0,97
MSSB	Mosenergosbyt	86160547,10	1,75	2,24	5,67	0,57
MSSV	MTK	413768371,60	1,25	0,44	1,79	0,62
MTLR	Mechel	1038855678,00	1	0,33	1,33	1,50
MTSS	MTS	1154607255,54	1	1,06	2,06	1,46
NLMK	NLMK	2957147469,45	1	0,23	1,23	1,78
NNSI	VolgaTelekom	867340930,05	1	0,96	1,96	0,84
NVTK	NOVATEK	4382717941,88	1	0,16	1,16	1,35
OGKB	OGK-2	1547481051,20	1	0,26	1,26	0,94
OGKC	OGK-3	1010978766,34	1	0,02	1,02	0,57
OGKD	OGK-4	650479278,30	1	0,03	1,03	1,20

OGKE	OGK-5	1104429690,15	1	0,21	1,21	0,57
PHST	Pharmstandard	418349957,18	1,25	1,17	2,71	1,04
PKBA	Baltika	1189936143,70	1	0,62	1,62	0,30
PLZL	Polyus Gold	2987660974,20	1	0,07	1,07	1,14
PMTL	Polymetal	529649465,63	1	0,05	1,05	1,22
PNTZ	Yraltrubostal	75393416,38	1,75	1,14	3,75	0,27
RASP	Raspadskaya	596626130,05	1	0,56	1,56	1,25
ROSN	Rosneft	13604550995,40	1	1,44	2,44	0,99
RTKM	RosTelekom	2137349492,60	1	0,32	1,32	0,84
SCON	The Seventh Continent	496993968,75	1,25	1,00	2,50	0,36
SIBN	Gazprom Neft	1101166841,16	1	1,71	2,71	1,91
SILM	Power Machines	295642133,45	1,25	2,66	4,57	0,40
SILV	Silvinit	550835682,00	1	0,52	1,52	0,49
SNGS	Surgutneftegaz	14808990037,61	1	0,07	1,07	1,21
SNOZ	Salavatnefteorgsintez	353335740,13	1,25	1,79	3,49	0,23
SNTZ	Sinarsky Pipe Works	72548401,95	1,75	0,72	3,01	0,05
SPTL	North-West Telekom	857598712,45	1	0,65	1,65	0,55
SVAV	Severstal-auto	499431197,21	1,25	0,46	1,82	0,53
TATN	Tatneft	3849719693,20	1	0,15	1,15	1,43
TGKA	TGK-1	427567130,40	1,25	0,21	1,51	0,74
TGKE	TGK-5	269344943,75	1,25	0,09	1,36	0,24
TGKF	TGK-6	139776994,58	1,5	0,47	2,21	0,85
TGKI	TGK-9	161535404,59	1,5	0,68	2,52	1,03
TRMK	TMK	1674707063,85	1	0,85	1,85	1,16
TRNFP	Transneft	2914742763,25	1	3,60	4,60	1,18
UFMO	Ufa Engine Industrial Association	113926640,63	1,5	1,80	4,19	0,24
URKA	Uralkali	1620812910,25	1	0,77	1,77	1,18
URSI	Uralsvyazinform	1026331142,89	1	1,42	2,42	0,99
VRPH	Veropharm	216958337,50	1,5	1,64	3,96	0,11
VSMO	VSMPO-AVISMA Corporation	875657443,63	1	0,62	1,62	0,40
WBDF	WBD	340743337,00	1,25	2,31	4,13	0,69

Table 2. A discrepancy in the RTS & MICEX free-float estimates

Code	Company's name	RTS FF	MICEX FF
AFLT	Aeroflot	0,20	0,12
AKRN	Akron	0,20	0,12
BLNG	Belon	0,15	0,13
CHMF	Severstal	0,15	0,24
EESR	UES of Russia	0,15	0,20

ENCO	SibirTelekom	0,40	0,40
ESMO	TsentrTelekom	0,35	0,34
GAZP	Gazprom	0,40	0,31
GMKN	Nornikel	0,20	0,29
IRGZ	Irkutskenergo	0,10	0,08
IRKT	Irkut Corporation	0,35	0,35
KLNA	Kalina Concern	0,40	0,14
KMAZ	Kamaz	0,15	0,28
LKOH	Lukoil	0,60	0,50
LSNG	Lenenergo	0,08	0,05
MAGN	MMK	0,10	0,10
MGNT	Magnit	0,20	0,08
MGTS	ОАО МГТС, ао	0,05	0,09
MSNG	Mosenergo	0,05	0,13
MSSB	Mosenergosbyt	0,20	0,20
MTSS	MTS	0,05	0,43
NLMK	NLMK	0,15	0,08
NNSI	VolgaTelekom	0,40	0,38
NVTK	Novatek	0,25	0,25
OGKB	OGK-2	0,35	0,10
OGKC	OGK-3	0,15	0,27
OGKD	OGK-4	0,10	0,10
OGKE	OGK-5	0,20	0,12
PKBA	Baltika	0,10	0,09
PLZL	Polyus Gold	0,35	0,37
PMTL	Polymetal	0,25	0,25
RITK	RITEK	0,25	0,34
ROSN	Rosneft	0,15	0,12
RTKM	RosTelekom	0,20	0,40
SBER	Sberbank	0,40	0,34
SCON	The Seventh Continent	0,25	0,25
SPTL	North-West Telekom	0,40	0,38
TATN	Tatneft	0,30	0,39
TGKA	TGK-1	0,10	0,10
TGKD	TGK-4	0,20	0,43
TGKE	TGK-5	0,20	0,16
TGKF	TGK-6	0,10	0,16
TGKI	TGK-9	0,09	0,09
VRPH	Veropharm	0,50	0,41