A SIMPLE CORELATIONAL ANALYSIS Overnight Interbank Rates and Istanbul Stock Exchange

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1- Introduction

The impact of economy wide liquidity shortages on the stock markets is a well documented economic phenomenon. It is intuitive to think that this impact is further augmented in thin equity markets. ISE can safely be considered such a thin market and therefore it is claimed that liquidity shortages in the economy causes frequent fluctuations in the stock market.

The overnight interbank interest rates in Turkish financial markets represent the interest on the shortest maturity claims and considered to be a sound measure of the short swings in the liquidity need of the economy. Although overnight interbank rates are to some extent affected by the longer term interest rates, they more accurately reflect the short term flactuations of the liquidity need in the economy. Instances such as corporate tax payments, replenishment of the disponibility reserves of the major banks create sharp fluctuations in the interbank rates which are independent of the longer term interest rates.

Also it was considered to be an indictor of then (during the study period) illegel repurchase (repo) market rates. Although regulations in the fi-

nancial markets (Decree by Law 35, Article 29) prohibited repurchase agreements between financial institutions and financial institutions and third parties, there was a very active repurcahse market for the short term treasury bills and other government bonds. It is claimed that almost 60% of the transactions involving government issued securities are repurchase agreements (Altay, Beyazitoglu and Ersel, 1988). Repos can be used as profitable substitutes for the time deposits since repos do not require any reserve posting in the Central Bank. This reduces the cost of the short term funds for the banks and practically leads to higher short term interst rates than the time deposits. Since corporations can derive higher interest rates on their short term investments, they prefer repos over time deposits. Although there is no documentation, it is claimed that the average maturity in the repo market ranges from 2-3 days to six weeks. The most active partcipants of the repo market are commercial banks and brokerage firms who hold large inventories of t-bills and government bonds since their returns are tax exempt. On the other hand all the corporations, who desire to obtain higher returns on their excess cash than the time deposits, constitute the demand side.

2- Hypotheses

The claimed correlation between interbank rates and the stock market lies in the link between interbank market and the repo market. It is a frequently phrased claim that the major source of financing for the brokers is the repurchase (repo) market. Therefore the brokers are expected to finance their purchases through the repo market when the rates are low. This induces an indirect negative correlation between the stock market and the overnight interbank interest rates. The proposition that the stock market is adversely affected by the liquidity shortages will be tested through the following null hypothesis:

H_{01}: The stock market returns are not correlated to the overnight interbank interest rates.

If the claim that brokers finance their purchases through repos when the short term interest rates are down is true, the volume in ISE should increase during the periods in which short term interest rates are low. This link suggests that overnight rates should be negatively correlated with the trading volume in ISE. This proposition can be tested through the following null hypothesis:

H_{02}: The trading volume in ISE is not correlated to the overnight interbank interest rates.

3- Data and Methodology

The sample data includes daily ISE-Index returns, daily returns on four volume portfolio and four size portfolio, and annualized overnight interbank interest rates for the period January 1988 through January 1, 1992. Overnight interbank interest rates were obtained from Central Bank of Turkey.

In order to explore the significance of the link between stock market returns and the liquidity shortages in the Turkish context the correlations between daily ISE-Index returns, daily volume and size portfolio returns and the overnight interest rates were analyzed. The use of the volume and size portfolios creates the opportunity to explore if the underlying relationship varies depending on the liquidity and the size of the assets. In other words the liquidity and size effects are to some extent controlled in the analysis. The correlations were calculated between contemporaneous interbank rates and the daily returns, since overnight market starts to operate at 9:00 am, an hour before the stock market starts to operate.

The correlations between two sets of rates were calculated by using two measures: The parametric Pearson correlation coefficient and the non-parametric Spearman correlation. CORR procedure of SAS software calculates both correlation coefficients. The output produces correlation coefficients and the p-values. The Pearson correlation coefficient is calculated with the assumption that the relationship is linear and two series are bivariate normally distributed. The Spearman correlation coefficient is constructed by relaxing the distributional assumption.

The Pearson correlation coefficient is calculated as:

$\rho=\sum_{i}^{n}\frac{(x_i-\bar{x})(y_i-\bar{y})}{(n-1)s_x s_y}$ where $(x_i-\bar{x})$ and $(y_i-\bar{y})$ are the deviations from means of the variables and s_x, s_y are the sample standard deviations. The critical values for n>120 (number observations) the critical value of the test statistic is given as $t\sqrt{t^2_c+n-2}$, where t_c is the critical t value associated with a given significance level and has df=n-2. The Spearman rank correlation coefficient is calculated as:

$$\varphi=\frac{\Sigma(R_i-\bar{R})(S_i-\bar{S})}{\sqrt{\Sigma(R_i-\bar{R})^2\Sigma(S_i-\bar{S})^2}}$$

where R_i is the rank of the ith value of x and S_i is the rank of the ith value of y. $\bar{R}$ and $\bar{S}$ are the average values of R_i and S_i, The critical value described above is approximately true for Spearman correlation as well for n>10.

The hypothesis that the correlation between stock market returns and overnight returns is zero were tested at 5 % significance level by using both methods.

4- The Empirical Results:

The null hypothesis that the interbank rates are not correlated to the ISE-Index can not be rejected at the 5 % significance level when the Pearson correlation coefficient used as measure of correlation. The null hypothesis is rejected at the 10 % significance level and indicates a positive correlation (see table-1). On the other hand the Spearman rank correlation coefficient indicates that the correlation is positive and significant at the 5 % significance level. This result contradicts with the proposed relationship that the stock returns are negatively correlated to the interbank rates.

The results for volume based portfolios are qualitatively different than the ISE-Index results. The volume portfolio-1; consisting of the most actively traded securities; exhibits significant negative correlation to the interbank interest rates. The results are consistent for both measures of correlation. Correlation coefficients are -0.1061 and -0.1117 for Pearson and Spearman correlation coefficients respectively (see table-1). The Pearson correlation coefficients are -0.1116, -0.1032 and -0.0981 for volume portfolio-2, volume portfolio-3 and volume portfolio-4 respectively. The Spearman correlation coefficients are consistent with the Pearson correlation coefficients and are reported in table-1. Ali the correlation coefficients are significant at the 5% significance level.

The results for the size based portfolios indicate that the correlation coefficients are ali negative and significant as expected. The Pearson and Spearman correlation coefficients are -0.0951 and -0.0837 for the size portfolio-1 respectively. The Pearson coefficients are -0.1103, -0.1059 and -0.1134 for the size portfolio-2, size portfolio-3 and size portfolio-4 respec-

tively. The coefficient for the Spearman correlations were reported in table-1 and are consistent with the Pearson correlations.

Overall results of the correlation between selected return series and the interbank rates yield consistent results with the a priori expectations except for the ISE-index returns. The Pearson correlation coefficient was found to be insignificant at the 5% significant level. The discrepancy between index results and the portfolio results can be attributed to the poor representation of the index as documented in an earlier study (Aybar, 1994). In summary the correlation analysis indicates that the null hypothesis that the stock market returns is not related to the overnight interbank interest rates in rejected in 8 ofthe 9 return series analyzed.

The correlation between transaction volume and the interbank rates were also analyzed. The results are in conflict with the proposition that the low interbank rates trigger volume in the market. Ali the correlation coefficients including the aggregate market volume is positively and significantly (at the 5% significance level) correlated to the interbank market rates. The Pearson and Spearman correlation coefficients are identical for the market (0.2010). The correlation coefficients for the volume portfolios are 0.1876, 0.2072, 0.1749 and 0.2316 for the volume portfolios 1, 2, 3 and 4 respectiveiy. The correlation coefficients do not follow a pattern as in the case of return-interbank correlation (higher for more active portfolios and lower for less active portfolios).

The correlation coefficients between size portfolios and the interbank rates are not qualitatively different than the results of the volume portfolios. Positive and significant correlation coefficients do not exhibit any consistent size related pattern. The Pearson correlation coefficients are 0.2262, 0.1182, 0.1413 and 0.2791 for the size portfolios 1, 2, 3 and 4 respectively. The Speraman correlation coefficients are presented in the table-2.

In summary the null hypothesis that the volume is not correlated to the interbank rates was rejected at the 5% significance level, but the proposed direction of the correlation were not verified.

5- Discussion and Conclusions

The results of the correlation analysis indicate that the stock market returns are negatively correlated to the interbank rates. This result is consistent with the claim that the interbank rates disguise the illegal re-

po market rates and the brokers in ISE extensively use the repo market to finance their purchases. Intuitively, when the rates in the repo market are low, brokers are expected to tap the repo market to raise cash and invest into stocks. The demand fueled by the cheap cash is likely to increase the prices. This scenario is particularly realistic in a thin market such as ISE. When the liquidity is scarce and the rates in the interbank market are high, the brokers and particularly banks who own brokerage branches and manage mutual funds tend to sell and increase the supply in the market. When the short term profit opportunities arise, banks are expected to disload equity in their mutual funds. The flexibility of the banks; a rather rare privilege in more developed capital markets; to adjust their mutual fund returns through direct transactions between bank itself and the mutual fund, increases stock sales to statisfy the cash need in the market elsewhere. On the other hand the finding that the volume increases as the interbank rates increase is in conflict with the proposed relationship that volume increases as interbank rates decline. This means that as interbank rates increase, the stock market trading volume increases. If the assumptions that the brokers finance their purchases through the cash raised in the repo market and the interbank market is an indicator of the rates in the repo market are true, this empirical result in conjunction with the documented correlation between stock market returns and the interbank rates implies that the transaction volume increases more when the market declines then when it increases. In order to verify this inference a dummy regression were run and the validity of the proposition that the volume increases more when the prices decline in ISE. The model $(\log V_t)_d = \alpha + \gamma D_1 + \beta R_t + \Phi D_1 R_t + e_t$ (where D_1 is 1 if $R_t<0$ and D_0 is 0 if $R_t>0$) were used to test the proposition. If the proposition is true, γ is expected to be positive and Φ is expected to be negative. The regression results (see table 3 and 4) indicate that while for all the portfolios the first coefficient is insignificant, the second coefficient is negative and significant in six of the eight cases. In other words the dummy regression lends support to the proposition that the volume increases more when the prices decline than when the prices increase.

Table-1: Correlations Between Interbank Rates and Selected Returns[1]

	Interbank Rate (Pearson Corr.)[2]	Interbank Rate (Spearman Corr.)[2]
ISE-Index	0.0689* (0.0597)	0.1103 (0.0025)
Volume Portfolio-1	-0.1061 (0.0008)	0.1117 (0.0004)
Volume Portfolio-2	-0.1116 (0.0004)	-0.1118 (0.0004)
Volume Portfolio-3	-0.10321 (0.0011)	-0.0970 (0.0021)
Volume Portfolio-4	-0.09806 (0.0019)	-0.1063 (0.0008)
Size Portfolio-1	-0.0951 (0.0026)	-0.0837 (0.0081)
Size Portfolio-2	-0.1103 (0.0005)	-0.1190 (0.0002)
Size Portfolio-3	-0.1059 (0.0008)	-0.1128 (0.0004)
Size Portfolio-4	-0.1134 (0.0003)	-0.1412 (0.0001)

(1) The values in parantheses are p-values. P-values indicate the probability of obtaining the observed correlation coefficient when the null hypothesis that the correlation coefficent is zero true. P-values less than 5% indicate significant correlations at 5% significance level.

(*) The correlation coefficient is significant at 10% level of significance.

(2) The pearson product moment correlation assumes bivariate normality.

(3) The Spearman rank correlation is a non-parametric method without any distributional assumptions.

Table-2: Correlations Between Interbank Rates and Volume[1]

	Interbank Rate (Pearson Corr.)[2]	Interbank Rate (Spearman Corr.)[3]
ISE-Index	0.2010 (0.0001)	0.2010 (0.0001)
Volume Portfolio-1	0.1876 (0.0001)	0.1762 (0.0001)
Volume Portfolio-2	0.2072 (0.0001)	0.2075 (0.0001)
Volume Portfolio-3	0.1749 (0.0001)	0.1579 (0.0001)
Volume Portfolio-4	0.2316 (0.0001)	0.1539 (0.0001)
Size Portfolio-1	0.2262 (0.0001)	0.2236 (0.0001)
Size Portfolio-2	0.1182 (0.0002)	0.1210 (0.0001)
Size Portfolio-3	0.1413 (0.0001)	0.1511 (0.0001)
Size Portfolio-4	0.2791 (0.0001)	0.1681 (0.0001)

(1) The values in parantheses are p-vahies. P-values indicate the probability of obtaining the observed correlation coefficient when the null hypothesis that the correlation coefficent is zero true. P-values less than 5% indicate significant correlations at 5% significance level.

(*) The correlation coefficient is significant at 10% level of significance.

(2) The pearson product moment correlation assumes bivariate normality.

(3) The Spearman rank correlation is a non-parametric method without any distributional assumptions.

Table-3: Volume-Return Regressions: Volume Portfolios

The Model: $(\log V_t)_d = \alpha + \gamma D_1 + \beta R_t + \Phi D_1 R_t + \varepsilon_t$ [1]

	PV1	PV2	PV3	PV4
α	-0.0216 (0.4536)	-0.0349 (0.02417)	-0.0705 (0.0407)	0.0093 (0.8382)
γ	-0.0131 (0.7463)	-0.0005 (0.9903)	0.0473 (0.3501)	-0.0541 (0.4293)
β	3.7579* (0.0001)	4.6674* (0.0001)	6.7403* (0.0001)	5.6656* (0.0001)
Φ	-2.2700 (0.0812)	-3.2325* (0.0234)	-3.9747* (0.0133)	-2.9050* (0.2488)
R-Square	0.0479	0.0499	0.0725	0.0359
F-Value	16.676 (0.0001)	17.353 (0.0001)	25.753 (0.0001)	12.265 (0.0001)

(*) The coefficent is significant at the 5% level of significance.
(1) The logarithm of the volume was differenced once to detrend the volume series.

Table-4: Volume-Return Regressions: Size Portfolios

The Model: $(\log V_t)_d = \alpha + \gamma D_1 + \beta R_t + \Phi D_1 R_t + \varepsilon_t$ [1]

Coefficients	PC1	PC2	PC3	PC4
α	-0.0339 (0.3185)	-0.0245 (0.6255)	-0.0114 (0.6730)	-0.0017 (0.9754)
γ	-0.0338 (0.4798)	-0.0579 (0.1230)	-0.0864 (0.2385)	-0.0245 (0.7603)
β	4.0673* (0.0001)	3.9704* (0.0001)	4.4781* (0.0027)	3.1964 (0.0644)
Φ	-3.9713* (0.0077)	-0.3.5358* (0.0053)	-5.7976* (0.0131)	-1.4039 (0.6198)
R-Square	0.0381	0.0598	0.02	0.009
F-Value	13.123 (0.0001)	21.088 (0.0001)	6.772 (0.0002)	2.945 (0.0321)

(*) The coefficent is significant at the 5% level of significance.
(1) The logarithm of the volume was differenced once to detrend the volume series.

REFERENCES

1- C. Bülent Aybar, "The Relationship Between Volume and Price Changes in İstanbul Stock Exchange", İstanbul University 1994, (Manuscript under review).
2- Altay, Beyazıoğhı, H, Ersel, Repo Pazarı Merkez Bankası 1988, Ankara, (yayınlanmamış çalışma).