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# THE DYNAMICS OFMARGIN BORROWING, HOLDING PERIOD AND NASDAQINDEX: LESSONS FROM THE 1990'S

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**Abstract**

*The paper explore long run equilibrium relation among the series: borrowing on margin to finance investment in equity market (margin borrowing), period of time over which stocks are held by the investors (holding period), and the NASDAQ index for the US within a dynamic setting. The statistical methodology of cointegration is applied to the monthly data for 1983.01-2003.04 to examine the relation. Our findings suggest that the long-run causality flow from NASDAQ index to margin borrowing which is positive and that to the holding period is negative. Also, the relationship between margin borrowing and holding period is negative and but bidirectional. Furthermore, tests confirm short-run interactive feedback relationships among these series with the expected signs. The results are intuitive and consistent with investor behavior — maximize investment income using available opportunities.*

***JEL Classification:*** *G1, G2, G10, G12, G19*

***Key Words:*** *Margin Borrowing, NASDAQ, Holding Period, Granger Causation, Feedback Relationship, Cointegration*

## I. INTRODUCTION

The objective of the paper is to empirically explore: (a) a long run relationship among borrowing on the margin to finance investment in the equity market (margin borrowing), period of time over which stocks are held by the investors (holding period), and the NASDAQ index[1]; and (b) the direction of causality among these series to understand the dynamic interaction during the decade of the 1990's. The paper implements the Johansen Juselius maximum likelihood method and the Granger causality procedure to the data for the period 1983.1–2003.04.

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The decade is of particular interest because it captures the features of the new economy which had ushered major changes in the equity markets across the globe. The changes in the equity trading had become dependent on advanced communication technology. The structure of investment in equity markets has changed from its traditional very-long-run decision to a much shorter one. Lower transaction cost, the tide of globalization, and the move towards broader economic and financial deregulation across the world have added to the value and volume of trade. This has reduced the average holding period for stocks and contributed to the observed increase in volume. Froot *et al.* (1991) noted that the average holding period has fallen from ten to two years over the past several decades. Such changes have made it harder for the fund managers to evaluate the horizons for investment opportunities and created enhance volatility in the market. Investors saw real opportunity to boost return by transferring resources from a low return yielding asset to high yielding one and thus create room for extra fund for reinvestment. The higher the frequency of such trade more is the opportunity to gain. This action had the effect of increasing the turnover of the assets and thus holding period. Second, extend the budget line to fund to investment in the equity market by taking additional advantage from leveraged margin borrowing. The possibility of changing some of the current assets holding to another more profitable one, as a way to make more cash available to invest was a new idea which had enormous impact on the holding periods of equities. Both these changes in investor behavior were made possible by online and day trading. As a consequence, many investors were able to add sizeable investment resources which may be considered novel in features of the market of the 1990's. The stock brokers also made every effort to make online trading simple and easy. All these taken together unleashed dynamic motion in the market.

The margin requirement for equity investors is meant to help stabilize stock prices by discouraging redirection of credit from business uses to speculative activity, and also to protect the investors and the brokers from the risks generated by excessive leverage. However, pyramiding and de-pyramiding processes (Bogen and Krooss, 1960) tend to unleash destabilizing effects of margin borrowing on stock prices (Fortune, 2001). Pyramiding pushes stock prices above their intrinsic values. This makes it easy for investors to borrow excessive amounts from brokers. Galbraith (1954) blamed the behavior of heavy borrowing from stock brokers for the soaring U.S. stock market in the 1920s and the subsequent crash of 1929. The Presidential Task Force on Market Mechanism (the Brady Report 1988, named after its chairman) held the low margin requirements responsible for the 1987 stock market crash. Shiller (2000) advocated a more proactive margin policy by the Fed to insure stock market stability. Excessive borrowing to fund investment in equity aggravates the situation. Subsequent margin calls by the brokers following price reversals only force the investors to sell stocks Carlson (2007), further pushing prices below their intrinsic values, leading to a cyclical negative-feedback loop. The growth in leveraged margin borrowing helped create a bubble in equity markets which was partly responsible for equity markets' increased volatility. Perhaps this was further

exacerbated by the changes in investors' behavior acting in conjunction with the heavy borrowing as appears to be case (Appendix B). The annual compound growth in margin borrowing between the years 1986-91 was 3.9% - increasing to 13.4% in 1992-2002. Ricke (2004) used the theoretical framework of principal-agent model to demonstrate how availability of margin loan can produce a stock market bubble by inducing investors to pay more for a stock than their fundamentals would warrant. In a situation where a large part of investment is built on margin debt, investors become increasingly vulnerable to margin calls, and more so, if inexperienced investors are the principal accumulators of the debt. The greater the margin, the more likely the investor is subject to forced selling in a downdraft scenario in stock prices. When the bubble bursts, the burden rests solely on the investor alone. This is because the lenders sell stock quickly to recover their money, regardless of its potential. The enhanced volatility through the creation of bubble in the equity market creates a negative effect on average returns. The fund managers also tend to respond by selling short which decrease holding period.

A good number of papers have focused on exploring the relationship between stock prices and leveraged margin borrowing, mostly in the context of volatility[2]. Noting that changes in each of the equity price reflect their underlying value and that differences thereat opens up opportunity for large profits, the prudent investor can transfer assets by following the market signals and transfer assets from one to the other. This short run investor behavior ushered a new dynamic in the market. As the investors take advantage of the price dynamic generated from the changing asset prices, one obvious implication is a lowering of the period of stock-holding. When the stock market is rising, the latter action can be highly lucrative in gaining access to extra funds above and beyond what can be obtained from margin borrowing. However, the potential for exploiting changes in the holding period as a meaningful way to generate additional cash for further reinvestment has so far failed to draw serious academic attention, if any. Specifically, the price dynamics, given its possible simultaneous interaction with leveraged margin borrowing as well as changes in the holding period should of be of interest to those involved in the equity market. The prospect of reinvestment by frequent transfer of funds from low to high return assets (due to lower holding period) and thus generate further changes in stock prices has not been explicitly addressed in the contemporary research.

A careful look at the three series (Appendix B) suggests margin borrowing and holding period may have been at play in the stock market dynamics. The figures suggest that the NASDAQ index and the Margin Borrowing series moved in tandem as the holding period went the other way. The fall in the holding period, concomitant with a rise both in the leveraged margin borrowing and the NASDAQ index, is unlikely to be independent of each other.

The remainder of the paper is structured as follows. Section II reviews the relevant literature. Section III outlines the empirical design. Section IV reports empirical findings and offers conclusions.

## II. SURVEY OF THE RELEVANT LITERATURE

In this section we provide a brief review of the relevant prior literature surrounding stock prices in the context of volatility and the underlying market dynamics. Scott (1991) and Timmermann (1993) studied this issue through the concept of learning effects on stock price dynamics. Zhang *et al.* (2005) used "margin credit balance as a measure of leverage to examine the time series relation among margin borrowing, stock returns, and market volatility" (p. 273).

Prior to the 1987 crash, limiting margin credit was rarely advocated. Many considered that margin requirements did not have any effect on stock price volatility (Kupiec, 1997). But Hardouvelis (1990) argued that margin requirements were useful in controlling stock volatility. Hsieh and Miller (1990) examined price volatility before and after changes in margin requirement and dispute the findings of Hardouvelis (1990).

While an inverse relationship has been found to exist between margin requirement and volatility, the causal connection has not be clearly established since volatility is known to be serially correlated and is mean reverting. So, the relationship appears spurious (Kim and Oppenheimer, 2002). Moore (1966) and Officer (1973) were among the earlier researchers to provide empirical evidence that margin requirement did not moderate volatility. Hardouvelis (1988) contradicted this finding which rekindled the volatility-margin debate. In a subsequent paper, Hardouvelis and Peristiani (1992) reconfirmed Hardouveli's (1988) earlier findings, using Japanese stock market data. On issues of methodology, the above findings have been contested (Kupiec, 1989, Salinger, 1989, Hsieh and Miller, 1990, Kumar *et al.*, 1991). Hardouvelis (1988) also noted that margins are typically used for speculative trading. Kyle (1988) and Treynor (1981) argued that risk-prone impatient traders tend to make short-term gains by responding quickly to changes in situations and thus are more influenced by margin requirements. Because individuals tend to be more capital-constrained compared to institutions, the former are likely to be more affected by the changes in margin requirement [Prowse (1992), Hsieh and Miller (1990), Schaede (1991)]. They contended that virtually no institutional investor buys on margin.

Galbraith (1954) placed margin loans at the center of the 1929 crash. He argued that heavy borrowing from brokers exacerbated the rise in stock prices in the late 1920s which subsequently led to stock price declines ultimately ending with the Crash. The mechanism by which margin loans increase stock price variability producing upside as well as downside risks was described by Bogen and Krooss (1960) as "pyramiding and de-pyramiding".

## III. EMPIRICAL DESIGN

### (a) Data

All data for the paper are in monthly frequency, covering the period 1983.1 – 2003.04. Since stock market went through fundamental changes such as invention of online

trading, globalization, deregulations, etc during 1990's, we like to study the dynamic relationship between stock returns, margin borrowing and holding period for this period. Besides, NASDAQ was reformed in 1997 and AMEX merged with NASDAQ. Thus, our sample period would be able to capture the dynamic relation given these fundamental changes. They are collected from different sources. The monthly average of NASDAQ series was computed from daily data obtained from the web site, *www.nasdaq.com*. The construction of holding period series involved substantial computations to come up with monthly averages. First, we computed monthly turnover rate, which is the share volume for the month divided by the shares outstanding. This shows what fraction of the outstanding stocks turned over during that month. The inverse of the average turnover rate for a month gives us monthly holding period. The margin borrowing series was collected from the New York Stock Exchange.

**(b) Statistical Methodology**

The procedure begins with implementing the following cointegration regressions to look for possible bidirectional long term causality between variables (x and y):

$$y_t = a + bx_t + e_t \tag{1}$$

$$x_t = a' + b'y_t + u_t \tag{2}$$

where, regression (2) is the reverse specification of regression (1). Both $e_t$ and $u_t$ are the stochastic error terms.

To investigate the hypothesized long-run equilibrium relation among NASDAQ index, margin borrowing and holding period, a pairwise bivariate cointegration methodology is implemented among the three variables of interest. The time series property of each variable in levels, and the orders of integration have been ascertained by applying both the Phillips-Perron (PP) (1988) and the Kwiatkowski, Phillips, Schmidt, and Shin (1992) (KPSS) tests.

To establish the existence of a long-run relationship between the two I(1) series, it is necessary to estimate the cointegrating regression. All such relationships between the variables in this paper are established by the VAR approach following Johansen (1988, 1991), and Johansen and Juselius (1990, 1992). The determination of the appropriate lag-length (p), needed to induce white noise property in the error term, is done by applying the final prediction error (FPE) criterion (Akaike, 1969). The Johansen-Juselius test statistics ($\lambda_{max}$ and $\lambda_{trace}$) are derived from the sample canonical correlations between $\Delta X_t$ and $X_{t-p}$, after adjusting for all intervening lags. The procedure is based on the following regression:

$$\Delta X_t = \mu + \sum_{i=1}^{p-1} \pi_i \Delta X_{t-i} + \pi X_{t-p} + \varepsilon_t \tag{3}$$

where, $\mu$ is a (nx1) vector of constants, and $\varepsilon_t$ is stationary error term. The rank r, pertaining to the long-run matrix $\pi$, determines how many linear combinations of

$X_t$ are stationary. Furthermore, given $\mu = \alpha\beta'$, the short-run relationship is represented by $\alpha$, and the long-run relationship by $\beta$. The parameter $\alpha$ is the speed of adjustment vector. This measures the rapidity with which the variables respond to the disequilibrium in the system. The parameter $\beta$ is the coefficient vector and refers to the long-run equilibrium relationships between/ among variables.

Next we test for the Granger causality between/ among the variables. If the test confirms the existence of a cointegrating relationship, the relevant error-correction terms (ECT), obtained from the cointegrating regressions, must then be included in the standard causality test. This step is useful and helps avoid the potential problem of misspecification caused by the omission of important constraints. Because of the advantage of combining the long-run relationship with the short-run dynamics of the model, it is preferable to use the Granger causality test within the Error-Correction Model (ECM) environment. Further, the existence of cointegration implies that either unidirectional or bi-directional (or both) Granger causality must exist. The usual t-test is applied to the coefficient of the error-correction terms, lagged by one period ($ECT_{t-1}$). A significant t-statistic indicates long-run relationships, and a significant F-statistic for the join test suggests short-run causality with interactive feedback relationship.

If the series are cointegrated there must be an error-correction representation (Engle and Granger (1987)). The error-correction model may take the following bivariate form:

$$\Delta x_t = \beta_1 e_{t-1} + \sum_{i=1}^{k} \phi_i \Delta x_{t-i} + \sum_{j=1}^{k} \delta_j \Delta y_{t-j} + u_{1t} \tag{4}$$

$$\Delta y_t = \beta_2 u_{t-1} + \sum_{i=1}^{k} \pi_i \Delta x_{t-i} + \sum_{j=1}^{k} \gamma_j \Delta y_{t-j} + u_{2t} \tag{5}$$

The reverse specification is considered due to plausible bidirectional causality. In these two equations, the series $x_t$ and $y_t$ are cointegrated when at least one of the coefficients $\beta_1$ or $\beta_2$ is not zero. If $\beta_1 \neq 0$ and $\beta_2 = 0$, then $y_t$ will lead $x_t$ in the long run. Further, if $\beta_2 \neq 0$ and $\beta_1 = 0$, then $x_t$ will lead $y_t$ in the long run. If $\delta_j$'s are not all zero, movements in $y_t$ will lead those in $x_t$ in the short run. If $\pi_i$'s are not all zero, movements in $x_t$ will lead movements in $y_t$ in the short run.

## IV. EMPIRICAL RESULTS

Table 1 reveals that the PP test fails to reject the null hypothesis of unit root (non-stationarity) while the KPSS test rejects the null hypothesis of no unit root (stationarity) of each series at the 1% level. Both tests affirm level-nonstationarity, but are first-difference stationary. In other words, each series is integrated of order I(1). Since both the series are nonstationary are of the same order of integration I(1), we examine pairwise cointegrating relationship among the three variables by implementing the Johansen-Juselius procedure as reported in Table 2.

**Table 1**
**Results of PP and KPSS Tests**

| *Variable* | *PP Test Level* | *First Difference* | *KPSS Test Level* | *First Difference* |
|---|---|---|---|---|
| NASDAQ Index | -1.029 | -13.112** | 1.74** | .163 |
| Margin Borrowing | -1.036 | -10.843** | 1.77** | .193 |
| Holding Period | -1.30 | -9.129** | 1.86** | .067 |

*The Phillips-Perron test is not sensitive to the number of lags in the autocorrelation function. The reported statistics are obtained using 9 lags. **Denotes the rejection of null hypothesis at the 1% significance level. PP tests the null hypothesis of existence of unit root and the KPSS test the null hypothesis of no unit root.

Table 2 suggests clear rejection of the null hypothesis of no cointegration ($H_0$: r = 0) by the $\lambda_{max}$ and the $\lambda_{trace}$ tests at the 5% level. This establishes the presence of one cointegrating relationship among the NASDAQ index, margin borrowing, and holding period series. This result implies the presence of one common factor is the driving force in the system of the three variables mentioned above.

**Table 2**
**Johansen-Juselius Cointegration Tests**

| *Null & Alternative Hypotheses* | *Max-Eigen Statistic ($\lambda_{max}$)* | *Trace ($\lambda_{trace}$)* |
|---|---|---|
| $H_0$: r = 0 | 23.636* | 39.376* |
| $H_A$: r ≤ 1 | | |
| $H_0$:r ≤ 1 | 12.315 | 15.739 |
| $H_A$:r = 2 | | |

*Note:* r indicates the number of cointegrating vectors. The (*) indicates rejection of the null hypothesis of no-cointegration at the 5% level of significance.

Finally, the estimates of the bivariate error-correction Equation (8) with its reverse specification (9) for long-run causal relationship and short-run feedbacks are reported in Table 3. Based on the associated t-value of the relevant error-correction term, we find evidences of positive long-run unidirectional causality flow from NASDAQ index to margin borrowing (Specification iii in Table 3), and negative long-run causal flow from NASDAQ to holding period (Specification iv). There are evidences of negative bidirectional long-run causal flows between holding period and margin borrowing (Specification v and vi).

The results imply that rising NASDAQ levels lead investors to higher margin borrowing and at the same time to reduce holding period. This suggests more active trading over time. The holding period and the margin borrowing influence each other inversely, over time. The F-statistics also reveal short-run bidirectional causality and feedback relationships between variables (Specification ii, iv, v, and vi).

**Table 3**
**Granger-Causality Test from ECM**

| *Specification* | *Dep. Variable* | *Ind. Variable* | *F-Statistics* | *t-Stat. on* $ECT_{t-1}$ |
|---|---|---|---|---|
| (i) | NASDAQ Index | Margin Borrowing | 0.750 | .003 |
| (ii) | Margin Borrowing | NASDAQ index | 15.346** | 2.655** |
| (iii) | NASDAQ index | Holding Period | 0.712 | 0.15 |
| (iv) | Holding Period | NASDAQ index | 10.019** | -3.467** |
| (v) | Margin Borrowing | Holding Period | 5.218** | -2.290* |
| (vi) | Holding Period | Margin Borrowing | 6.577** | -3.224** |

*Note:* The optimal lag length is 2, determined by FPE criterion (Akaike, 1969).
**Significant at 1%, *Significant at 10%

## V. CONCLUSION

The findings imply that investors respond to increases in the return opportunities by borrowing on the margin to reap extra benefit of rising stock prices. Once the limit to borrowing is reached, they reduce the holding period for stocks to release further funds. This allows them to expand the budget set granting additional access to resources. The result is true both in the long and the short run. In an environment when opportunities exist, it natural for investor to be able to expand their resource base.

Margin borrowing and holding period do not influence NASDAQ index either in the long or the short run. In terms of effects of these variables on the investor behavior, an increase in margin borrowing exerts very similar impact of a decrease in holding period – both of them allows the budget constraint to be expanded. The negative relation between margin borrowing and holding period (both ways) captures this relation and thus reflects investors' response, as the index may warrant. These finding are consistent with the predictions of investors' behavior where individuals aim is to maximize wealth using access to all the resources and opportunities.

This dynamic feedback among NASDAQ Price, holding period, and margin borrowing can explain the surge in market volatility and contribute to the creation of a bubble. Growth in margin borrowing due to easy margin requirement created bubble and enhanced volatilities in the equities market. Enhanced volatility in the stock market increased risk premium. The fund managers respond through short selling which in fact decreases the holding period. Besides, online trading due to technological advancement were on the rise which reduced the transaction costs of substantially and further reduced the average holding period of stocks.

### *Notes*

1. The NASDAQ index is chosen in this paper for several reasons. The series with its tech bias was more vulnerable and at the same time a relatively stronger target for speculation. Information Tech (IT) stocks were overvalued far beyond the historical average of price-to-earnings (P/E) ratio in the range of 15-22 times. The series was more volatile which provided

a good case to link with the pyramiding story, compared to the S&P 500 during 1980s and 1990s. The growth of the U.S. financial market was led by tech-dominated stocks listed in the NASDAQ market.

2. Please see Zhang et al (2005), Hsieh and Miller (1990), Kim and Oppenheimer (2002), and Hardouvelis (1988).

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**Appendix A: Descriptive Statistics**

| | *Holding Period* | *Margin Borrowing* | *NASDAQ Index* |
|---|---|---|---|
| Mean | 0.761510 | 84850.83 | 1130.994 |
| Median | 0.654462 | 60070.00 | 751.1400 |
| Maximum | 1.721091 | 278530.0 | 4696.688 |
| Minimum | 0.270790 | 22090.00 | 278.7000 |
| Std. Dev. | 0.367154 | 63359.23 | 941.8397 |
| Skewness | 0.514828 | 1.062307 | 1.609227 |
| Kurtosis | 1.971495 | 3.174925 | 5.354866 |
| Jarque-Bera | 19.41513 | 41.65864 | 145.7852 |
| Observations | 220 | 220 | 220 |

**Appendix B: Figures**