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Analyzing the relationship between Tobin's Q and stock performance of selected U.S. firms

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Abstract

The aim of this study is to analyze the dynamic impact of changes in Tobin's Q on stock prices for a selected group of 249 publicly traded U.S. companies across various industries. To achieve this, panel unit root tests and cointegration tests are conducted, followed by estimations using DOLS and GMM models. The study utilizes annual data spanning from 2004 to 2012 for the chosen companies. Results from the panel unit root tests indicate mixed evidence regarding the non-stationarity of both variables, while cointegration between them is clearly observed. The negative coefficient of the error-correction term suggests a slow adjustment toward long-run equilibrium. Additionally, the findings highlight short-run positive feedback interactions between the variables. Both DOLS and GMM estimations consistently indicate stock overvaluation, as reflected in the upward shift of Tobin's Q beyond the typical 0-to-1 range. For much of the sample period, the U.S. stock market experienced a downturn, largely influenced by heightened economic uncertainties during and after the Great Recession. Enhancing Tobin's Q could contribute to increasing stock prices, though this effect is more evident in the long run, whereas short-term dynamics show mutual reinforcement. This study addresses a relatively underexplored topic, applying advanced econometric techniques using panel data. The insights derived from the results add valuable contributions to the existing literature.

Keywords: Tobin's Q, Stock Performance, Panel Cointegration, Panel ECM, GMM, DOLS.

INTRODUCTION

This study examines the impact of changes in Tobin’s Q on the stock prices of 249 selected U.S. companies from various industry sectors. The analysis covers the period from 2004 to 2012 and employs advanced econometric techniques, including heterogeneous panel cointegration, heterogeneous panel dynamic OLS, and dynamic GMM (Generalized Method of Moments) models. Data for the study is sourced from the Federal Reserve’s "Flow of Funds Accounts of the United States Z1."

Tobin’s Q, initially introduced by Tobin (1969), is a financial metric calculated as the ratio of a company's market value of installed capital to its replacement cost. If the ratio falls between 0 and 1, it suggests that the company’s market value is lower than the recorded value of its assets, indicating potential undervaluation. Conversely, a Tobin’s Q greater than 1 implies overvaluation of the firm's stock. A high Tobin’s Q often incentivizes companies to increase capital investments, as their market worth exceeds the cost of capital. This ratio is a key component of Tobin’s investment model and plays a crucial role in understanding financial markets and guiding investment decisions. It is also widely used for estimating consumption and investment based on stock price fluctuations.

Traditionally, stock prices are predicted using variables such as dividend yield and the price-to-earnings ratio. However, Tobin’s Q also serves as a significant predictor of these variables, often demonstrating superior predictive power in forecasting stock returns or percentage changes in stock prices. According to Lang and Stulz (1994), firms that are more diversified across products and markets tend to exhibit lower Tobin’s Q values due to reduced asset valuations.

LITERATURE REVIEW

Financial economists and macroeconomists have shown increasing interest in understanding price behavior in asset markets by examining various financial and macroeconomic variables used to predict stock returns (e.g., Cochrane, 1991b; Cooper & Priestley, 2005; Lamont, 2000; Lettau & Ludvigson, 2001a; Menzly, Santos & Veronesi, 2004). Gaining insight into how these macroeconomic factors influence investment returns can help investors and portfolio managers make more informed decisions. Among these predictors, Tobin’s Q has been found to have strong predictive power in estimating the dividend yield ratio and the stock price-to-earnings ratio, making it a valuable indicator for forecasting stock returns.

While Black and Scholes (1974) and Miller and Scholes (1982) argued that dividend yield and stock returns are unrelated, several empirical studies have supported the existence of such a relationship. For instance, Blume (1980) identified a significant positive correlation between dividend yields and stock returns. Similarly, research by Litzenberger & Ramaswamy (1982) and Morgan (1982) confirmed a positive, albeit nonlinear, relationship between these variables. Kiem (1985) further demonstrated that stock returns positively influence dividend yield, while Fama & French (1988) provided strong empirical evidence linking stock returns and dividend yields. Additionally, Hodrick (1992) found a robust connection between these two financial indicators, and Naranjo, Nimalendran & Ryngaert (1998) corroborated these findings. Some studies, however, suggest a negative relationship between stock returns and the price-to-earnings (P/E) ratio. For example, Basu (1977) found that portfolios containing low P/E ratio stocks generated higher risk-adjusted returns compared to portfolios of high P/E ratio stocks. Peavy & Goodman (1983) reached similar conclusions. Research by Campbell & Shiller (1988) indicated that an increase in the P/E ratio often leads to slower growth in equity prices. Additionally, Harney & Tower (2003) found that Tobin’s Q serves as a superior predictor of the price-to-earnings ratio when forecasting stock returns.

Jiang & Lee (2007) observed that excess equity risk premiums can be explained through a linear combination of dividends and the book-to-market ratio. Sum (2013a) established that movements in stock market returns are influenced by Granger causality from both the dividend yield and the P/E ratio. Sum (2013b) further demonstrated that variations in Tobin's Q can predict approximately 67.53% to 67.78% of the P/E ratio fluctuations within a two- to eight-quarter time frame. In another study, Sum (2013c) found that changes in aggregate Tobin's Q forecast around 6.43% of the S&P 500 dividend yield at a three-quarter horizon and 11.22% at an eight-quarter horizon. Numerous other studies have employed Tobin's Q as a measure for assessing company valuations, including research by Cho (1998), Lang & Stulz (1994), McConnell & Servaes (1990), and Morck et al. (1998). These findings reinforce the significance of Tobin's Q as a fundamental tool in financial analysis and investment decision-making.

RESEARCH METHODOLOGY

This study utilizes both time series observations and cross-sectional panel data. This type of dataset is particularly useful when an adequate number of cross-sectional or longitudinal observations are unavailable. The decision to employ panel data is justified, as it provides a sufficient number of observations spanning multiple time periods. Additionally, given that the time series length is relatively short compared to the number of cross-sectional units, the impact of autocorrelation is minimal, if not negligible.

Panel data estimation methods include the constant coefficient (pooled), fixed effects, and random effects regression models. To examine the long-run equilibrium relationship between the specified variables, we propose the following econometric model.

$$y_i = \alpha_i + \beta_{ii} + \gamma_i D_i + e_i \ldots(1)$$

Where:

- y represents the logarithm of stock price (STR)
- x represents the logarithm of Tobin's Q (TBQ)
- i=1,…,N (cross-sectional units)
- t=1,…,T (time periods)

As a result, the panel dataset consists of a total of N×T observations.

In Model (1), α_i accounts for the potential presence of company-specific fixed effects, while βi allows for heterogeneous cointegrating vectors. The term γi captures time-dependent common shocks, which are represented by common-time dummies (Di) and may simultaneously impact all 249 U.S. companies included in the study. Model (1) is estimated using the panel Fully Modified Ordinary Least Squares (FMOLS) cointegration technique proposed by Pedroni (2000, 2001). This method corrects for endogeneity and serial correlation, making it well-suited for cases where endogenous macroeconomic factors may drive co-movements between the specified variables.

Before estimating Model (1), it is essential to determine the order of integration of the variables using four panel unit root tests. If all variables are found to be integrated of order one, I(1), then Pedroni's panel cointegration tests (1999, 2000, 2001) are applied to assess whether they exhibit a long-run equilibrium relationship. These tests and techniques are selected to ensure that the estimation of βi is not affected by spurious regression. To examine the presence of a unit root in the panel data, unit root tests proposed by Im, Pesaran, and Shin (2003); Hadri (1999); Levin, Lin, and Chu (2002); and Breitung (2000) are employed. In these tests, the null hypothesis assumes the stationarity of variables. Once a cointegrating relationship among the variables is established, the following panel vector error-correction model, based on the approach of Engle and Granger (1987), is estimated.

$$\Delta yi = \alpha + \sum kq{=}1 \beta \Delta yi{-}q + \sum lq{=}1 \phi \beta \Delta xi{-}q + \pi ei{-}1 + \mu i \ldots.(2)$$

To clarify:

- y represents the logarithm of stock price (STR).
- x represents the logarithm of Tobin's Q (TBQ).

If the estimated coefficient of the error correction term is negative, it indicates long-run convergence and the presence of a causal relationship. The estimated βi\beta_iβi coefficients capture short-run interactive feedback effects. The optimal lag lengths are selected using the Akaike Information Criterion (Akaike, 1969).

Additionally, Stock and Watson (1993) demonstrate that Dynamic Ordinary Least Squares (DOLS) is particularly advantageous in small samples compared to other estimators of long-run parameters, such as those introduced by Engle and Granger (1987) and Phillips and Hansen (1990). Moreover, short-run elasticity estimates are derived using robust dynamic error-correction models (ECMs).

For panel data, the estimating base equation is specified as follows:

$$Yit = \alpha0 + \alpha1Xit + eit \ldots\ldots(3)$$

Before conducting panel cointegration analysis, four panel unit root tests are applied: Levin, Lin, and Chu (LLC, 2002); Breitung (2000); Im, Pesaran, and Shin (IPS, 2003); and Hadri (1999). These tests help determine the stationarity properties of the variables.

Following Pedroni's (2000) guidelines, the cointegration relationship between the variables is estimated using the Dynamic Ordinary Least Squares (DOLS) method with the following model:

$$Yit = \alpha i + \beta iXit + \gamma tDit + \mu it \ldots\ldots..(4)$$

In the pooled data model, Y_{it} serves as the dependent variable, while X_{it} acts as the explanatory variable.

The term α_i accounts for potential company-specific fixed effects, β_i while allows for heterogeneous cointegrating vectors. Additionally, γ_t captures time-dependent common shocks, represented by common-time dummies (D_{it}).

The Dynamic Ordinary Least Squares (DOLS) procedure involves regressing any I(1) variables on other I(1) variables, any I(0) variables, as well as the leads and lags of the first differences of I(1) variables.

However, since examining short-run dynamics is also a key aspect of this analysis, the panel bi-variate error correction model (ECM) is formulated as follows to draw inferences about both long-run and short-run relationships:

$$\Delta Y_{it} = \sum_{j=1}^{k} \emptyset_{ij}\, \Delta y_{t-j} + \sum mj{=}0\ nj\ \Delta xi{-}j + ECit{-}1 + \epsilon t \ldots\ldots (5)$$

When variables are cointegrated, short-term deviations from the long-run equilibrium will influence changes in the dependent variable, guiding it back toward equilibrium. If the dependent variable directly reacts to this long-term disequilibrium, it indicates a feedback mechanism. Otherwise, its movement is driven solely by short-term shocks within the stochastic environment.

The significance of the differenced explanatory variables provides insight into short-term effects, while the long-term causal relationship is inferred from the significance of the ttt-test on the lagged error-correction term. This term encapsulates long-term information, as it is derived from the cointegrating relationship. The coefficient of the lagged error-correction term serves as the short-term adjustment coefficient, representing the fraction of long-term disequilibrium corrected in each period. If this coefficient is statistically insignificant or omitted, it may undermine the validity of the implied long-term relationship, potentially conflicting with the underlying theoretical framework.

This study also employs the Generalized Method of Moments (GMM), introduced by Hansen (1982), to obtain robust and efficient estimates. GMM is a widely used econometric tool in finance, leveraging a set of moment conditions to estimate model parameters. Typically, the number of moment conditions exceeds the number of parameters to be estimated. Model misspecification related to over-identifying restrictions can be assessed using the GMM J-statistic. Notably, GMM does not require strong distributional assumptions, making it well-suited for financial applications.

Given the use of panel data in this study, dynamic GMM panel estimation is preferred over traditional GMM estimation. Differencing the regression equation helps mitigate unobserved company-specific effects, while the inclusion of differenced lagged regressors addresses parameter inconsistency caused by simultaneity bias (Arellano and Bond, 1991). Monte Carlo simulations further demonstrate that this approach enhances both efficiency and consistency (Blundell and Bond, 1997).

RESULTS

Stock prices and Tobin's Q based panel unit root test is provided in the following table.

Table1

Panel Unit Root Tests

METHOD				
Variable (level)	**LLC**	**Breitung**	**IPS**	**Hadri**
TBQ	73.8554 (0.0000)	-53.0329 (0.0000)	57.1334 (0.0000)	5.51852 (0.0000)
STR	5.85354 (0.0000)	-0.77534 (0.3333)	18.8786 (0.000)	0.8782 (0.0000)
VARIABLE (DIFFERENCES)	LLC	Breitung	IPS	Hadri
Δ (TBQ)	38.1552 (1.0000)	-13.8537* (0.0000)	37.3132 (0.0000)*	0.57732* (0.3818)
Δ (STR)	37.8786 (1.0000)	-3.70082* (0.0003)	35.8772* (0.0000)	3.01716* (0.0318)

Where:

- TBQ = Log of Tobin's Q
- STR = Log of stock price
- Total observations (NT) = 249 × 9 = 2,241

Note:

- LLC = Levin, Lin, and Chu (2002)
- IPS = Im, Pesaran, and Shin (2003)

The statistical tests are asymptotically distributed as standard normal, with a left-tailed rejection area for all tests except the Hadri test, which follows a right-tailed rejection criterion. An asterisk (*) denotes the rejection of the null hypothesis—indicating nonstationarity for LLC, Breitung, and IPS tests, or stationarity for the Hadri test—at the 1% and 5% significance levels.

Data from Table 1 indicates that the LLC, Breitung, and IPS tests suggest that the log of Tobin's Q (TBQ) and the log of stock prices (STR) are nonstationary at the 1% significance level. However, the Hadri test provides contrasting results at the same significance level. Additionally, the Breitung test presents evidence of stationarity in the log of stock prices, leading to mixed results for both variables. Given these findings, further tests are conducted to examine panel cointegration between TBQ and STR. The results of seven panel cointegration tests are reported as follows:

Table 2
Pedroni Panel Co-integration Tests

Test	Constant trend	Constant + Trend
Panel v-Statistic	-0.84419 (0.1700)	-1. 26882 (+ 0.8144)
Panel rho-Statistic	-126.8847 (0.0000)*	-112.2201 (0.0000)*
Panel PP-Statistic	-46.42821 (0.0000)*	-41.42246 (0.0000)*
Panel ADF-Statistic	-28.82781 (0.0000)*	-22..4416 (0.0000)*
Group rho-Statistic	-124.866 (0.0000)*	-87.17823 (0.0000)*
Group PP-Statistic	-44.0886 (0.0000)*	-44.80719 (0.0000)*
Group ADF-Statistic	-24.4887 (0.0000) *	-24.27045 (0.0000)*

*indicates significance at 1 % level.

These tests were conducted under the null hypothesis of no cointegration. The results indicate that six out of seven tests confirm a cointegrating relationship between STR and TBQ at the 1% significance level. Additionally, all tests, except for the panel V statistic with a constant trend, exhibited signs supporting cointegration. Therefore, the overall evidence strongly suggests the presence of a long-run convergence relationship between these two variables.

Table 3
Panel Dynamic Least Squares (DOLS) Estimates. Dependent Variable: STR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
STR(-1)	0.89777	0.7787	4.5552	0.0000
TBQ(-1)	-1.98988	0.2220	-5.5493	0.0060

Based on the information in the table, it can be inferred that changes in Tobin's Q (TBQ) have short-run negative effects on stock prices (STR), with a one-year lag also observed in stock price adjustments. These results suggest that when a company's TBQ exceeds 1, indicating overvaluation, stock prices tend to decline. This aligns with the broader trend observed during most of the sample period, where the stock market experienced a downturn. Consequently, overvaluation may further discourage investment, exacerbating the decline in stock prices.

Table 4
Panel Generalized Method of Moments (GMM) Estimates
Dependent Variable: STR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
STR	- 0.538782	0.018354	- 28.18734	0 .0000
TBQ	0.137332	0.012536	10.85374	0 .0000
TBQ(-1)	0.083777	0.012814	5.555021	0 .0000

J-statistic 36.44975
Prob (J-statistic)0.000000

Based on the GMM estimates, there are evident short-run dynamic effects of past stock prices (STR) on current STR. These net effects are negative, indicating stock overvaluation when Tobin's Q (TBQ) exceeds 1. Furthermore, the GMM statistic of 36.44975 confirms that the model is correctly specified. Both GMM and DOLS estimates present a consistent picture of stock overvaluation for the majority of the 249 U.S. companies, particularly since 2008 during the sample period. However, some differences exist in the magnitude of the coefficients and their associated t-values.

Finally, the estimates of the VECM are reported as follows:

$\Delta STR_i = -0.0074 + 0.4925\Delta S_{it-1} + 0.2805\Delta STR_{it-2} - 0.19742\Delta STR_{it-3}$
(-0.5600) (14.3745) (8.9978) (-8.8978)
$- 0.1974\Delta TBQ_{it-1} - 0.2446\Delta TBQ_{it-2} + 0.0825\Delta TBQ_{it-3}$
(-9.7408) (-9.7573) (6. 1393)
$- 0.3938EC_{it-1}$ … …. (5)'
(-10.6637)
$S^2 = 0.4435$, F = 251.9438

The estimated equation (5)' corresponds to equation (5) in the third section. The error-correction term (ECit-1) exhibits the expected negative sign, indicating long-run convergence, with strong statistical significance (t-value = -10.6637). The short-run interactive net feedback effect of lagged changes in Tobin's Q (TBQ) is negative, suggesting that stock prices decline when TBQ exceeds one, signaling stock overvaluation. These findings suggest that most of the stocks included in this study were overvalued during the sample period, likely influenced by the global financial crisis of 2008.

CONCLUSION

Our findings present mixed evidence regarding the nonstationarity of Tobin's Q and stock prices. However, the results confirm a strong cointegration relationship between these variables. The DOLS estimates indicate stock overvaluation, leading to a subsequent decline in stock prices as TBQ rises above unity. Similarly, the GMM estimates depict short-run effects consistent with overvaluation, though with some variations in the computed coefficients and associated t-values. The vector error-correction model estimates suggest a statistically significant, albeit slow, convergence toward long-run equilibrium. The observed net negative effect further reinforces the link between stock overvaluation and elevated TBQ levels. In conclusion, changes in Tobin's Q significantly impact stock valuation, often resulting in price declines. Investors should closely track TBQ fluctuations to refine their investment strategies accordingly.

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