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Is the Yardstick ratio "a good yardstick" for stock market valuations?

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Abstract

This note empirically examines whether there is a long-run relation between a country's Yardstick ratio—i.e., stock-market capitalization divided by GDP—and total stock-market values. Using U.S. data, we show that this relation does not exist. However, after including the VIX index, our model successfully identifies a stable long-run relation among the three variables. We argue that, possibly, the Yardstick ratio reflects firms' dividend payments, and VIX represents market discount rates. Our novel results indicate that the rule of thumb among practitioners of using the Yardstick ratio as "the best single measure" of stock-market valuations is not well grounded.

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1. Introduction

This note presents the preliminary results of examining the extent to which a country's stock market capitalization divided by GDP, which is known as the Yardstick ratio, can explain the movements of the country's total stock-market values. Despite its popularity among practitioners, there has been little discussion in the academic literature about this "Yardstick hypothesis." Using U.S. data, we first show that the Yardstick ratio is non-stationary. This empirical evidence indicates that the common rule of thumb that the stock market will go down if the Yardstick ratio is greater than a threshold (and vice versa) is not necessarily valid. Furthermore, our results suggest that a stable relation does not exist between total stock-market values and the Yardstick ratio. Therefore, the Yardstick ratio alone cannot explain long-run stock market movements. However, by including the VIX index in the model, we find a significant long-run relation among the three variables. To the best of our knowledge, we are the first to document these empirical facts.

The Yardstick ratio, originally proposed by Warren Buffett, is popular among practitioners as a barometer of stock market valuations. Its underlying logic relies on a simple intuition that the stock market cannot deviate too far from the real economy. Thus, when the total capitalization of stocks exceeds GDP by an overly large amount, which is reflected in a too high Yardstick ratio, such as over 136%, investors would typically expect the stock market to decrease, and vice versa.[1] This intuition has been supported by some stylized facts in the data. For example, right before the Dot.com Bubble collapsed, the total U.S. market capitalization (cap) stood at 146% of the GDP. Prior to the Great Recession, the U.S. market cap was 137% of the GDP.

However, from an academic point of view, is this "unwritten rule" among practitioners well grounded? Specifically, is the time series of the Yardstick ratio stationary and frequently mean reverting to a constant so that investors can make a judgement about future stock-market movements based on the current value of this ratio? We examine U.S. quarterly data from 1951 to 2020 and find that the answer is "No." The results obtained from common unit root tests clearly show that the Yardstick ratio is non-stationary and is not mean reverting but integrated of order one. Therefore, the trading rules based on expecting the stock market to plummet when the current Yardstick ratio is high, and to soar when the ratio is low, are not well founded.

Notwithstanding, the non-stationarity does not necessarily jeopardize the role of the Yardstick ratio as a stock market indicator. Through an autoregressive distributed lag (ARDL) approach and a bounds testing procedure developed in Pesaran et al. (2001), we demonstrate that a stable long-run relation exists among the total stock-market cap, Yardstick ratio, and VIX index. This result suggests that the three variables co-move in the long run. Consequently, the Yardstick ratio and VIX together can explain stock-market values. However, we further find that such a stable relation does *not* exist if VIX is removed from the model. That is, the Yardstick ratio itself cannot explain the movements of the stock market. This empirical evidence contrasts with a usual notion among practitioners that "[the Yardstick ratio is] the best *single* measure of where valuations stand at any given moment," as quoted by Warren Buffett. A possible explanation for this result is that, as in the textbook model, stock-market valuations simultaneously rely on dividends and market discount rates. The literature has documented that the Yardstick ratio characterizes the ratio of listed firms' dividends to GDP (Kuvshinov and Zimmermann 2020). We argue that in addition, VIX might capture market discount rates by reflecting uncertainty, risk premiums, and investor sentiment.

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[1] Moreover, typically, if the ratio is below 73%, the stock market is considered to be "significantly undervalued," and investors would expect the stock market to increase, according to Gurufocus.com, a leading investor website.

There has been little academic research on the relation between the Yardstick ratio and stock market movements. Kuvshinov and Zimmermann (2020) and Umlauft (2020) have found that there exists a negative correlation between the Yardstick ratio and future stock market *returns*. We instead demonstrate a cointegrating relation among the Yardstick ratio, VIX, and stock market *levels*. As discussed later (in equation 2 and footnote 6), it is straightforward to obtain the negative Yardstick-return relation from the level relation we find but not the other way around. We are also the first to show that the Yardstick ratio follows a unit-root process (thus warranting the use of cointegration analysis) and that VIX plays a crucial role in linking the Yardstick ratio and stock market movements together.

The rest of the paper is organized as follows. Section 2 presents our data and unit root test results. Section 3 records the ARDL bounds testing results. Section 4 concludes.

2. Data and unit root testing

We collect quarterly data on GDP and total stock market capitalization (cap) in the U.S. between 1951Q4 and 2020Q1 from the St. Louis Federal Reserve Economic Data. The Yardstick ratio is calculated as the ratio of the total market cap to GDP. Moreover, the quarterly data for VIX are from the Chicago Board Options Exchange between 1990Q1 and 2020Q1, since earlier data are not available. Table I shows the summary statistics of the key variables.[2]

Table I. Summary statistics.

	Obs.	Mean	Std. Dev.	10th-percentile	Median	90th-percentile
Yardstick ratio	274	0.76	0.32	0.39	0.69	1.27
Total market cap	274	6.66	8.30	0.31	1.97	18.9
VIX	121	19.14	7.41	11.87	17.40	26.25

Total market cap is in trillions of U.S. dollars.

We start our analysis by testing for unit roots with three different methods: (i) the Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (1979); (ii) the Phillips-Perron (PP) test proposed by Phillips and Perron (1988); and (iii) the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test proposed by Kwiatkowski et al. (1992). The ADF and PP tests have a null hypothesis of unit roots, while the KPSS test has a null of stationarity. The test statistics are summarized in Table II, where column 1 is for the full sample, column 2 is for 1951-1989, and column 3 is for 1990-2020. We split the sample period in the year 1990 because Kuvshinov and Zimmermann (2020) argue that there might be a structural break around this time, which may lead to spurious non-stationarity.

Our results show that both in the full sample and within each subsample, the Yardstick ratio is unit rooted.[3] Due to this non-stationarity, the Yardstick ratio can display different means across time. The same result applies to the total stock market cap. Consequently, one should not judge whether the Yardstick ratio—and the total stock-market values—will increase or decrease depending on whether the current ratio is lower or higher than a threshold. In contrast, the test

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[2] In Table I, the values are presented in the untransformed form; however, in the tests and estimation, we use all variables in the logarithm form.

[3] The numbers of lags for these tests are chosen following the convention in the *Stata* program as an increasing function of the sample size, i.e., the integer part of $4(T/100)^{(2/9)}$—for the full sample, the number of lags is 5; and for each subsample, the number of lags is 4. The results are robust to using the same number of lags, either 4 or 5, for all the sample periods. Our results are also robust to including a trend term in the tests.

results for VIX are mixed: the ADF test cannot reject the existence of unit roots; however, both the PP test and the KPSS test show evidence that VIX can be stationary.

3. ARDL bounds testing

Next, we examine whether there is a stable long-run relation between the total stock-market cap and the Yardstick ratio. If such a relation exists, the Yardstick ratio would be useful to explain long-run stock market movements. Given that both variables are unit rooted, the long-run relation that we refer to is essentially a cointegrating relation. We rely on an autoregressive distributed lag (ARDL) model and a bounds testing procedure, which was developed in Pesaran et al. (2001), to estimate this relation and test for its existence. This approach has many advantages. For instance, it allows for regressor endogeneity in that the Yardstick ratio and the stock-market cap can follow a vector-autoregression process, with both variables endogenously determined. Moreover, it can account for both stationary and unit root processes, which is crucial for our estimation given that VIX is possibly stationary.

Table II. Unit root tests.

	1951Q4-2020Q1	1951Q4-1989Q4	1990Q1-2020Q1
		Yardstick ratio	
ADF test	-1.54	-1.96	-1.92
PP test	-1.57	-2.12	-2.02
KPSS test	2.41*	1.01*	1.34*
		Total market cap	
ADF test	-1.00	-0.70	-1.57
PP test	-0.85	-0.57	-1.59
KPSS test	4.62*	2.93*	2.18*
		VIX	
ADF test			-2.45
PP test			-4.17*
KPSS test			0.21

*Test statistics are shown in the table; † indicates 5% significance; * indicates 1% significance.*

Specifically, we employ the following conditional ARDL error-correction model:

$$\Delta(TMC)_t = c_0 - \alpha[(TMC)_{t-1} - \theta(YR)_{t-1}] + \sum_{i=1}^{p-1} \gamma_i \Delta(TMC)_{t-i} + \sum_{j=0}^{q-1} \delta_j \Delta(YR)_{t-j} + \varepsilon_t, \qquad (1)$$

where TMC stands for the total stock-market cap, and YR represents the Yardstick ratio; $(TMC)_{t-1} - \theta(YR)_{t-1}$ is the error-correction term that characterizes a potential long-run relation. Pesaran et al. (2001) design a bounds testing procedure to evaluate whether the long-run relation exists and is stable. The testing procedure consists of an F-test for the joint significance of α and θ for $H_0^F: \alpha = \theta = 0$ and a t-test for $H_0^t: \alpha = 0$. Each test has two critical value bounds: one derived assuming that the regressors are stationary, i.e., I(0), and the other one derived assuming that the regressors are unit rooted, i.e., I(1). Both tests accept their nulls when the test statistics are closer to zero than the I(0) bounds; and reject the nulls when the test statistics are more extreme than the I(1) bounds; if instead the test statistics are between the I(0) and I(1) bounds, then the test results are inconclusive. We need to reject H_0^F and H_0^t simultaneously to proceed to the next step, in which a standard *t*-test can be further applied to test for the significance of θ, as the "long-run coefficient." To conclude that a long-run relation exists, all the three tests need to reject the null.

The results of the ARDL bounds test are reported in Table III.[4] The first two columns show the test results for model (1). We observe that the *F*-statistic is always insignificant, and the *t*-statistic is significant only for the second subsample. Thus, a long-run relation does not exist between the total stock-market cap and the Yardstick ratio for the sample periods under consideration.

Table III. ARDL bounds test results.

	Without VIX		With VIX	
	F-statistic	*t*-statistic	*F*-statistic	*t*-statistic
1951Q4-2020Q1	5.28	-1.07		
1951Q4-1989Q4	2.06	2.02		
1990Q1-2020Q1	5.67	-3.35†	18.44*	-5.88*

*† indicates 5% significance; * indicates 1% significance.*

Next, we extend model (1) by adding the VIX index. Because the data for VIX starts in 1990, we conduct the bounds test only for the subsample period of 1990-2020. The test results are summarized in the last two columns of Table III. We find that after adding VIX to our model, both the *F*- and *t*-statistics are highly significant. The estimated ARDL model is presented in equation (2), with the *t*-statistics under the estimates of each coefficient († and * indicate 5% and 1% significance, respectively).[5] The test results indicate that there is a stable long-run relation among the three variables.

$$\Delta(TMC)_t = \underbrace{0.21}_{6.79*} - \underbrace{0.01}_{-5.88*}\left((TMC)_{t-1} + \underbrace{2.02}_{12.51*}(YR)_{t-1} - \underbrace{0.61}_{-3.71*}(VIX)_{t-1}\right) + \underbrace{1.02}_{162.52*}\Delta(YR)_t - \underbrace{0.01}_{-4.68*}\Delta(VIX)_t + \varepsilon_t. \quad (2)$$

The estimated long-run relation is characterized by the following error-correction term:

$$(TMC)_{t-1} + \underbrace{2.02}_{12.51*}(YR)_{t-1} - \underbrace{0.61}_{-3.71*}(VIX)_{t-1},$$

where the long-run coefficient for the Yardstick ratio is 2.02, and that for VIX is -0.61, which are both highly significant. In equation (2), the parameter before this error-correction term is -0.01, which is also highly significant and often referred to as the speed of adjustment. To interpret this estimation result, consider the following: at time $t-1$, (i) if in equilibrium, the error-correction term equals zero and does not contribute to the stock-market movement $\Delta(TMC)_t$; (ii) if the error-correction term is positive, which can be caused by an overly high Yardstick ratio compared to

[4] The numbers of lags *p* and *q* are optimally chosen through the Bayesian information criteria (BIC).

[5] Note that in this estimation, minimizing the BIC method gives p=1 and q=1. Thus, the term with coefficient γ is dropped from equation (2).

TMC and VIX, the negative speed-of-adjustment parameter will lead to a decrease in the stock market—that is, the contribution of the error-correction term to $\Delta(TMC)_t$ is negative; and (iii) if the error-correction term is negative, which may be due to a Yardstick ratio that is too low compared to TMC and VIX, the stock market will incline to increase.[6]

Accordingly, our empirical analyses demonstrate that the long-run stock-market values rely simultaneously on the Yardstick ratio and VIX. Thus, the Yardstick ratio can explain stock-market movements but not solely by itself.[7]

4. Concluding remarks

Using U.S. aggregate data, this note investigates the long-run relation between the total stock-market cap and the Yardstick ratio. We present three preliminary empirical results that have not been previously documented. (i) The Yardstick ratio is unit rooted. (ii) A long-run relation does not exist between the total stock-market cap and the Yardstick ratio—that is, these two variables are not cointegrated. (iii) After including VIX, a long-run relation exists among the three variables.

The Yardstick ratio has been commonly regarded by practitioners as a barometer of stock-market valuations, which is where the name "Yardstick" comes from. The logic is straightforward and can be described by, for example, an analogy from Andre Kostolany, a great German investor: "The relation between stock market and economy is like someone walking a dog. The person (the economy) walks slowly, and the dog (the stock market) runs back and forth." Following this simple intuition, investors are inclined to believe that, at each moment, the ratio between the total stock-market value and GDP—i.e., the Yardstick ratio—should be within a reasonable range, just as the dog cannot be too far away from the dog walker.

We demonstrate, through formal empirical analyses, that this view is only partially correct at best. In fact, the above result (i) shows that a "reasonable range" may not be found because, due to non-stationarity, the Yardstick ratio can have different means at different moments. A same "low" ratio associated with a rise in the stock market at this moment can instead be followed by a decline in stock prices next time. Result (ii) further indicates that the dynamics of the Yardstick ratio alone cannot explain stock-market movements, as the two are not closely connected in the long run. Moreover, result (iii) illustrates that the reason for this "disconnection" is that VIX plays an important role in determining stock-market values in addition to the Yardstick ratio. Therefore, the Yardstick ratio itself is not "a good yardstick" for judging whether the stock market is over- or under-valued. It needs to be used together with other tools, and we find that VIX is a candidate.

Why does VIX play such a role? A plausible conjecture is that it captures market discount rates. According to the textbook dividend discount model, total stock-market values depend on the expected dividend payments by listed firms and the rates at which investors discount such payments. Previously, the literature has shown that the Yardstick ratio reflects the dividend

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[6] Put differently, holding $(TMC)_{t-1}$ and $(VIX)_{t-1}$ constant, an overly high $(YR)_{t-1}$ will result in a low stock market return in the following quarter, i.e., small $\Delta(TMC)_t$, and vice versa.

[7] Schlingemann and Stulz (2021) find that listed firms contribute less to the real economy over the past 10 years. Following this logic, it is reasonable to conjecture that the relation between the Yardstick ratio and stock market values is weaker in 2011-2020. To see this, we repeat our analysis for this recent period, finding that the bounds testing results are insignificant (in contrast, results remain significant for the period 1990-2010). The insignificance can be caused by two possible reasons. First, there are only 37 observations in this period (2011Q1-2020Q1). Thus, even if the long-run relation existed, it would be difficult for the testing procedure to obtain a reliable result. Second, the long-run relation might not exist in this period due to reasons such as the disconnection between the stock market and real economy documented by Schlingemann and Stulz (2021). Given the shortness of the period, it is difficult to distinguish these two possibilities. We thus leave further investigation to future research.

payments. The VIX, in contrast, is a usual measure of uncertainty, risk premiums, and investor sentiment—all of which play a large part in influencing market discount rates. Therefore, it is reasonable to hypothesize that VIX contributes to stock-market values through its effects on the discount rates. Future works may include formally exploring this hypothesis, scrutinizing the role that VIX can play, and developing a trading strategy given the estimated long-run relation.

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