Measuring Corporate Dividend Risk Using a Monte Carlo Simulation Model

Salwa Ammar
Manhattan College

Amira Annabi
Manhattan College

Thaddeus Sim
Central New York Innovation Center
Bank of New York Melon

Ronald Wright
Le Moyne College

Investors have long used historical stock prices to evaluate future returns, as well as the risk associated with the estimated returns. In this paper, we propose a method for evaluating risk based on historical dividend payments. We develop a Monte Carlo simulation to generate future dividends and calculate the mean internal rate of return. We apply data analytical techniques to model estimates and use them to define a dividend risk ratio. We conclude that the newly defined dividend risk ratio provides essential information to dividend investors and is a useful tool in portfolio management.

Keywords: risk assessment, simulation, stock dividends, data analytics, portfolio management, dividend investors

INTRODUCTION

Inherent in stock portfolio management is the process of employing available tools that measure the return and risk associated with the growth in the value of the stock. Those measures often assume reinvestment of stock dividends into additional stock purchases and that these dividends are consequently an indistinguishable component of the return on the investment. This treatment is consistent with the argument that in perfect capital markets, dividend payments are irrelevant (see Miller and Modigliani, 1961). Consequently, it would follow that there is no need for any separate tools to measure risk and return on dividend payments. However, the assumptions of Miller and Modigliani (1961) are not universally accepted.

Over the past five decades, scholars have debated the fundamental questions of why corporations pay dividends and why investors pay attention to dividends. Three distinct streams tackling the determinants of corporate dividend policy have emerged. The first focuses on theoretical frameworks that account for market frictions and imperfections such as taxes, agency costs, and information asymmetry (see, e.g., Black, 1976; Bhattacharya, 1979; Easterbrook, 1984). The second empirically identifies the cross-sectional and time-series determinants of dividends (see, e.g., Fama and French, 2001; Frankfurter and Wood, 2002; DeAngelo, DeAngelo, and Skinner, 2004). Finally, the third approach uses results from corporate treasurers and CFO surveys to document the drivers of corporate dividend policy (see, e.g., Baker, Farrelly, and Edelman, 1985; Baker and Powell, 2000).

In our paper, we conjecture that dividend history provides insights into the company's performance in the stock market and is a valuable component in assessing the value of a corporation. As argued by Baker et al. (1985) and Baker and Powell (2000), dividend payments reflect, to some extent, managers' belief that dividend policy affects the firm's value and hence shareholders' wealth. Further, given the information asymmetry between managers and investors, dividend payments also send a positive signal about future cash flows (see, e.g., Bhattacharya, 1979; Myers and Majluf, 1984). There is documentation that investors more highly reward companies with a history of consistent and increasing dividend payments relative to those with a stagnant and inconsistent dividend history. Several studies also show adverse market reactions to dividend decreases or cuts (see, e.g., Handjinicolaou and Kalay, 1984; Denis, Denis, and Sarin, 1994). It is interesting to note that the dividend yield on the overall S&P 500 index has been trending lower in recent decades (Siegel, 2014). However, under the surface, stocks that have not reduced their dividend payments have had an average yield of over 2%, with some as high as 5%.

Beyond this variety of assessments of the importance of dividends, there is evidence that not all investors treat all forms of payout equally (DeAngelo and DeAngelo, 2007). Mutual fund providers still offer funds that focus on dividend-paying stocks, and the dividend yield is a popular investment metric for mutual funds and investment advisors. As interest rates remain low, investors looking for income might consider high-quality dividend-paying stocks as a relatively low-risk alternative to bonds while maintaining the potential to benefit from the gains in stock values. Furthermore, beyond the potential of focus on dividend payments as a source of income, Conover, Jensen, and Simpson (2016) claim that high-dividend payers tend to have higher total returns and lower risk than non-dividend payers. Whatever the reason, if some investors intend to pay attention to dividend payout in their portfolio, and if part of their rationale for investing in dividend-paying stocks is to reduce risk, it seems reasonable that they should consider measures that address the risk specifically associated with the dividend payouts, and not rely exclusively on measures of risk for total return. In this paper, we apply data analytics techniques to develop a dividend discount model that will allow us to investigate the contribution of dividend payments in the evaluation of a stock's value as well as the associated risk. Our analysis leads to a discussion of the interplay between dividend payments and stock market performance. Through this discussion, we acknowledge the complementary role historical dividends play in estimating stock value and risk.

In the following section, we describe the model in three parts. First, we present the theoretical framework; second, we describe the simulation, and third we discuss the knowledge discovery process for data selection and assumptions. After describing the model, we introduce measures that capture both the valuation and risk from historical dividends, mainly the internal rate of return produced by the dividend discount model and a newly introduced dividend risk ratio. We also highlight the results of specific stocks to motivate the relevance of the model findings. In the next section, we present a comparison between the dividend risk ratio and the beta value of the analyzed stocks. We provide insights into similarities and differences and conclude that together the two measures provide investors with complementary tools for portfolio management.

MODEL DESCRIPTION

Theoretical Framework

In contrast to Miller and Modigliani (1961) argument of the irrelevance of dividend's, Williams (1938) argued that the real value of an investment should precisely be the net present value of all future cash flows and that dividends would make up the most significant part of that income stream. Of course, this approach made more sense when the yield on corporate dividends was much higher. William's discounted cash flow model still provides a theoretical model of the value of stock under the assumption that an investor will hold a share in perpetuity and that the future dividends represent the entire return on the investment. Under this assumption the intrinsic value of the stock, v_0, is

$$v_0 = \sum_{t=1}^{\infty} \frac{d_t}{(1+r_t)^t} \tag{1}$$

where d_t is the cash dividend paid in year t and r_t is the discount rate in year t. Some simplifying approaches include the constant growth model of Gordon and Shapiro (1956), where dividends grow at a steady rate g, and the net present value is calculated using a constant discount rate r, resulting in the following model.

$$v_0 = \sum_{t=1}^{\infty} \frac{(1+g)*d_{t-1}}{(1+r)^t} \tag{2}$$

Scholars have also proposed multi-stage versions of the constant growth models. For example, a two-stage version splits the future into two periods, with each period having its constant growth rate for the dividends.

The dividend discount model offers little practical application for determining the value of a stock. These models were popular when dividends represented a much higher percentage of the total return. Furthermore, the value v_0 is highly dependent on the identification of future dividends and the choice of the discount rate. However, the model can offer a means of measuring the relative contribution of dividends to the total return as well as the risk associated with the return based on dividends.

Sim and Wright (2017) proposed an approach based on the dividend discount model to calculate a return and, eventually, a measure of the risk associated with the return. Future dividends, d_t, are randomly generated based on past dividends. Specifically, for each stock, the growth in the annual dividends is calculated over a specified period, and each future rate of growth in dividends, g_t, is randomly selected from the distribution of the historical growth rates. In addition, a single discount rate is assumed, resulting in the following model.

$$v_0 = \sum_{t=1}^{\infty} \frac{(1+g_t)*d_{t-1}}{(1+r)^t} \tag{3}$$

Next, instead of selecting a discount rate to determine the intrinsic value of the stock, the model determines the discount rate that will result in the sum of future discounted dividends equaling the current price of the stock, P_0. Under the assumption that $g_t >= 0$, Sim and Wright (2017) proved that there is a unique rate, r, that solves the above equation for $v_0 = P_0$. This rate, r, represents the internal rate of return for the investment cash flow.

In the next section, we describe the above simulation model and the calculation of the internal rate of return of an investment in a stock purchased at the current price and held in perpetuity, assuming the randomly generated dividends. Initially, we have limited our analysis to all of the S&P 500 stocks that have had a history of consistent non-decreasing dividend payments from 1999 to 2017. In addition to meeting the criteria established by Sim and Wright (2017), these 96 stocks represent a group of stocks likely to be of most interest to dividend investors.

Simulating Internal Rate of Return

We illustrate the potential for measuring and comparing rates of return by applying the dividend discount model to the 96 stocks. We apply a two-step Monte Carlo simulation model. First, we approximate the infinite sum with a 500-year partial sum, randomly generate growth rates using a prescribed distribution for each stock, and use Excel's internal rate of return function to calculate the internal rate of return. This step is one trial in the simulation of the projected future dividend-based internal rates of return for each stock. In the second step, we repeat the process for five thousand simulation trials and calculate a mean internal rate of return as well as a standard deviation of the internal rate of return. Together, these calculations provide the basis for assessing the risk associated with future dividend payouts.

After several attempts of fitting a continuous distribution that we could use to generate random, periodic growth rates of dividends, we decided to use the historical growth as a discrete distribution of potential future growth. Specifically, for any stock under consideration, we recorded the total annual dividends (the sum of the previous four quarterly dividends) from October 31, 1999, to October 31, 2017, and calculated the eighteen annual rates of increase over that period.

FIGURE 1
ANNUAL DIVIDEND PAYMENTS FOR TJX COMPANIES

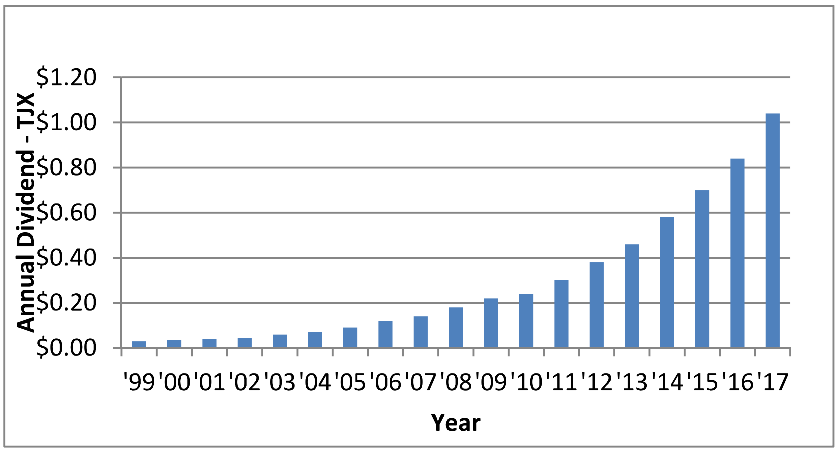
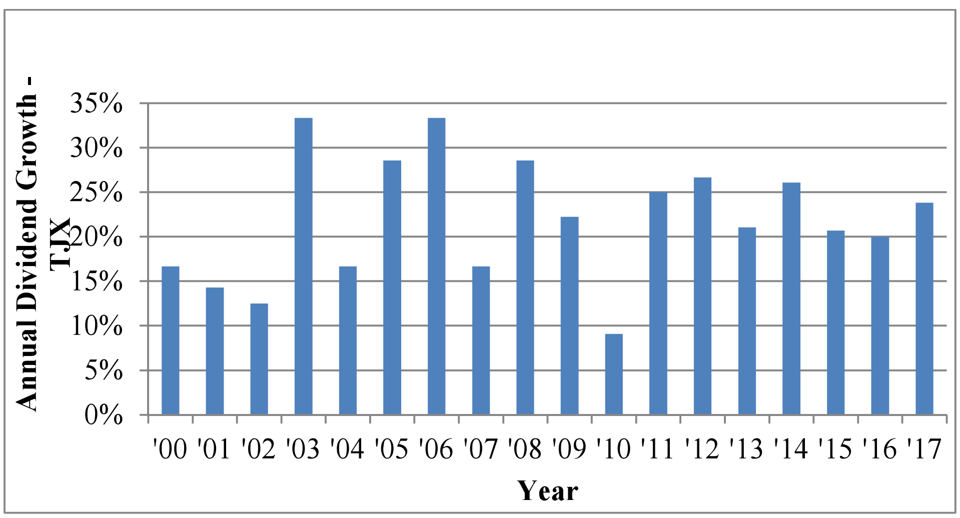


FIGURE 2
ANNUAL PERCENTAGE INCREASE IN DIVIDEND PAYMENTS FOR TJX COMPANIES



As an illustration, Figure 1 shows the annual dividend payments for TJX Companies with consistently increasing dividends, and Figure 2 shows the annual rates of increase in those payments.

TJX Companies' dividend policy is consistent with the dividend life cycle theory that the optimal dividend policy of a corporation depends on its stage in its life cycle. As summarized by Lease, Kose, and Kalay (2000), a company should be paying low, growing, and generous dividends only if it is at the rapid growth, maturity, or decline stages, respectively. Since its inception in 1956, TJX Companies sustained dividend payments seem to fit into this description of dividend policy. In the TJX case, it is easy to recognize that there is no evidence that the rates of increase are dependent on a time-series, nor that the rates increase or decrease in any pattern over time. Similar looks at other stocks result in the same, and not surprising, conclusion. Therefore, we elected to simulate future random rates of increase in annual dividends using a discrete distribution comprised of the eighteen values weighted equally. Hence, for each year in the 500-year simulated trial, the model randomly selects a rate of increase from the eighteen historical values. See Table 1 for an illustration of this simulation.

TABLE 1
ILLUSTRATION OF THE EXCEL SIMULATION MODEL

Stock TJX			
Year	Dividend Payment	Annual Change	g% (Growth)
1999	$ 0.03		
2000	$ 0.04	$ 0.01	17%
2001	$ 0.04	$ 0.01	14%
2002	$ 0.05	$ 0.01	13%
2003	$ 0.06	$ 0.02	33%
2004	$ 0.07	$ 0.01	17%
2005	$ 0.09	$ 0.02	29%
2006	$ 0.12	$ 0.03	33%
2007	$ 0.14	$ 0.02	17%
2008	$ 0.18	$ 0.04	29%
2009	$ 0.22	$ 0.04	22%
2010	$ 0.24	$ 0.02	9%
2011	$ 0.30	$ 0.06	25%
2012	$ 0.38	$ 0.08	27%
2013	$ 0.46	$ 0.08	21%
2014	$ 0.58	$ 0.12	26%
2015	$ 0.70	$ 0.12	21%
2016	$ 0.84	$ 0.14	20%
2017	$ 1.04	$ 0.20	24%

Simulation		5000 trials	
Future Year	500-year Cash Flow	Mean IRR	23.50%
		Stdev IRR	0.56%
0	$ 76.46		
1	$ 1.34	Trial #	IRR
2	$ 1.53	0	23.3%
3	$ 1.75	1	23.5%
4	$ 2.04	2	23.4%
5	$ 2.72	3	23.0%
6	$ 3.62	4	23.0%
7	$ 4.35	5	24.7%
8	$ 5.31	6	24.2%
9	$ 6.43	7	24.1%
10	$ 8.11	8	24.2%
11	$ 10.81	9	24.2%
12	$ 13.90	10	23.5%
13	$ 15.89	11	23.2%
14	$ 17.33	12	24.5%
15	$ 22.28	13	23.8%
16	$ 26.89	14	24.0%
17	$ 31.38	15	23.3%
18	$ 35.30	16	23.7%
19	$ 44.71	…	…
20	$ 55.89	5000	24.0%

Note. In the left panel, *Stock TJX*, we use a discrete distribution with 18 equally likely dividend growth rates. In the right panel, *simulation*, in trial #0, we simulate future dividends for 500 years starting from 2017, using randomly generated annual growth rates.

Data Selection

As stated above, Sim and Wright (2017) proved that there is a unique rate of return that solves the equation for the dividend discount model described above. The underlying assumption of their theorem took into account only nonnegative rates of change in dividends. However, since we are approximating the infinite series with a finite sum of 500 years, we can conclude that an internal rate of return does indeed exist for any combination of positive and negative rates of dividend change. However, from a data analysis perspective, a single large dividend decrease or several small dividend decreases can occasionally result in future dividends becoming virtually zero and create conditions under which the Excel internal rate of return algorithm results in division by zero.

Furthermore, without the certainty of convergence in the infinite series, we cannot be confident that a 500-year sum is a valid approximation of the infinite series. Hence, in this initial investigation of stock assessment using dividends, we elected to restrict the analysis to only Standard and Poor 500 stocks that paid dividends every year and never decreased the dividends. We argue that this restrictive criterion for selecting stock is a reasonable assumption for an investor interested in dividend income.

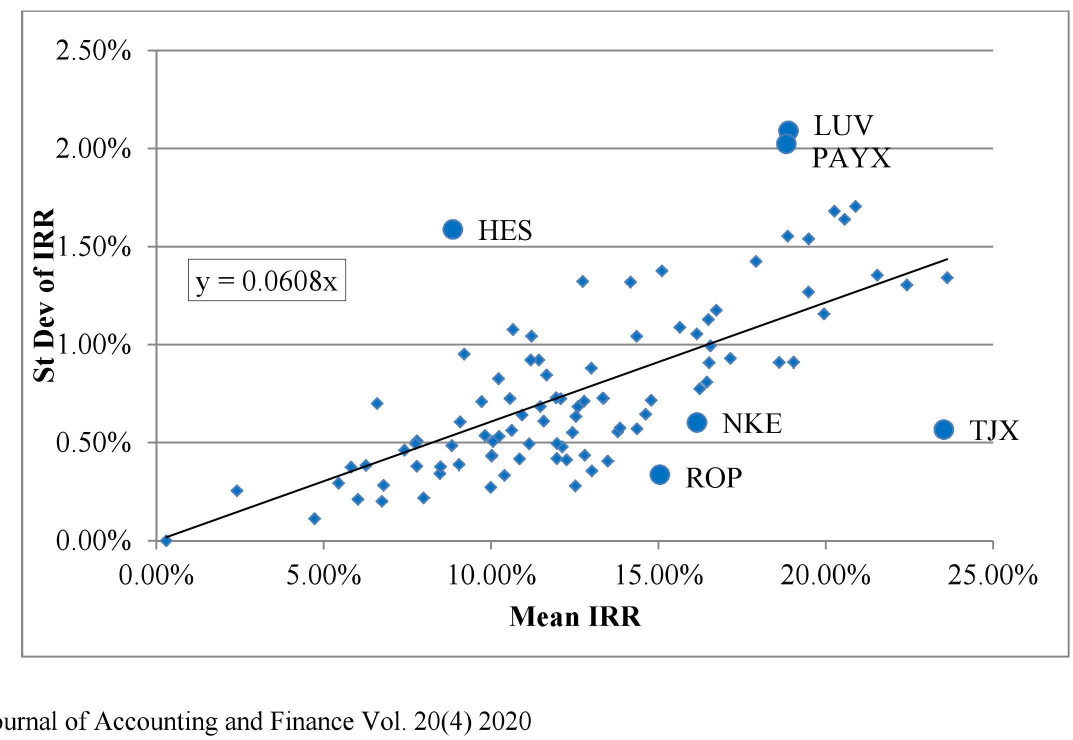
In some cases, we discovered that using all eighteen historical rates of growth in dividends in the simulation generated some undesirable results. For example, one of the stocks that we analyzed, Eversource Energy, increased its dividend from $0.10 to $0.45 in 2001, which represents a 350% increase, well above the mean growth of 8.9% for the other seventeen years for that stock. It is highly unlikely that in any future year, the dividend would again grow by 350%. We considered these significantly higher than expected growths in dividends as exceptions or anomalies and needed to make sure that they do not unduly influence the simulation results. Consequently, we elected to remove from the discrete growth distribution any annual rate of growth in dividends that differ from the mean rate by more than two standard deviations. Given the data and the simulation model calculations described in this section, we tabulated the simulation results for each selected stock and included the mean and the standard deviation of the dividend' internal rate of return (hereafter IRR.)

Measuring Dividend Risk

The internal rate of return approach to the dividend discount model produces a mean internal rate of return for an individual stock over the 5,000 trials. Just as importantly, the standard deviation of the internal rate of return over those trials gives us a measure of risk associated with the calculated return. The internal rate of return is a very different measure than dividend yield. An underperforming stock can have a very high current dividend yield based on a suppressed stock price. However, the ability of the underperforming company to increase the dividend or even to maintain it might be in serious doubt. The internal rate of return is a performance measure over a given period with a focus on a corporation's ability to maintain and increase dividends.

We illustrate the potential for measuring and comparing rates of return by applying the dividend discount model to the 96 S&P 500 stocks that have had a history of consistent non-decreasing dividend payments from 1999 to 2017. Figure 3 shows the relationship between the mean IRR and the standard deviation of the IRR for the 96 stocks, over 5,000 simulation trials.

FIGURE 3
RELATIONSHIP BETWEEN THE STANDARD DEVIATION (ST DEV) AND MEAN OF INTERNAL RATE OF RETURN (IRR) FOR 96 IDENTIFIED STOCKS



The line in the graph in Figure 3 represents the linear regression trend line assuming a zero intercept. The slope of the regression line measures the rate of change in the standard deviation versus the change in the mean. Since the coefficient of variation is the standard deviation divided by the mean, we can treat the slope of this regression line as a collective measure of a coefficient of variation for the group of 96 stocks. To facilitate further discussion, we will define three terms, the *group regression line*, the *group coefficient of variation,* and the *expected standard deviation of the internal rate of return*.

Definition 1: The *group regression line* is the regression line, assuming a zero intercept, associated with the plot of the standard deviation of the internal rate of return versus the mean of the internal rate of return for a group of stocks.

Definition 2: The *group coefficient of variation* is the slope of the group regression line.

Definition 3: The *expected standard deviation of the internal rate of return* is the value determined by the group regression line equation for the mean internal rate of return for the stock.

In Figure 3, data points above the group regression line represent stocks with a standard deviation higher than the expected standard deviation and, consequently, with coefficients of variation higher than the group coefficient of variation. Hence, at least based on the dividend history, the risk assigned to the internal rate of return of these stocks is higher than the overall risk of the group of 96 identified stocks. Similarly, stocks represented by data points below the trend line have a lower risk than that of the 96 stocks collectively.

When comparing these 96 stocks from the perspective of the potential for consistent dividend growth, the information in Figure 3 can be instructive. For example, the point that is the maximum distance below the group regression line would be the stock with the lowest risk relative to the return. For this particular group, that would be TJX Companies (TJX), the parent company of TJ Maxx. TJX Companies also has the second-highest mean IRR. All stocks with plotted data points to the left of TJX have lower mean rates of returns and higher levels of risk. From a dividend payout perspective, these stocks would be less desirable than TJX Companies, at least as judged by the dividend history. A closer look at the dividend history of TJX (see Figure 1), shows a company with consistently increasing dividend payments with an average annual growth in excess of 20%. Also highlighted in the graph of Figure 3 are Nike (NKE) and Roper Technologies (ROP). Both stocks have mean internal rates of return of over 15% while at the same time being less risky than the group as a whole.

At the other end of the spectrum, several stocks stand out as particularly risky from a dividend payment perspective. Hess Corporation (HES) increased its dividend only three times over the eighteen years. If the rare dividend increase occurs soon after an investor purchases a stock, the net present value over a long period will be much higher than if the rare increase does not happen for many years, hence the wide variation in internal rates of return. At the same time, the mean IRR is lower than the average for the 96 stocks in this group. Two other stocks, Southwest Airlines (LUV) and Paychex (PAYX), stand out for their high mean IRR but also much higher than expected standard deviation. Southwest failed to increase dividends from 2002 to 2011 but has had steady increases since then. Paychex has a more sporadic history with several periods of very low to no growth, followed by periods of higher growth.

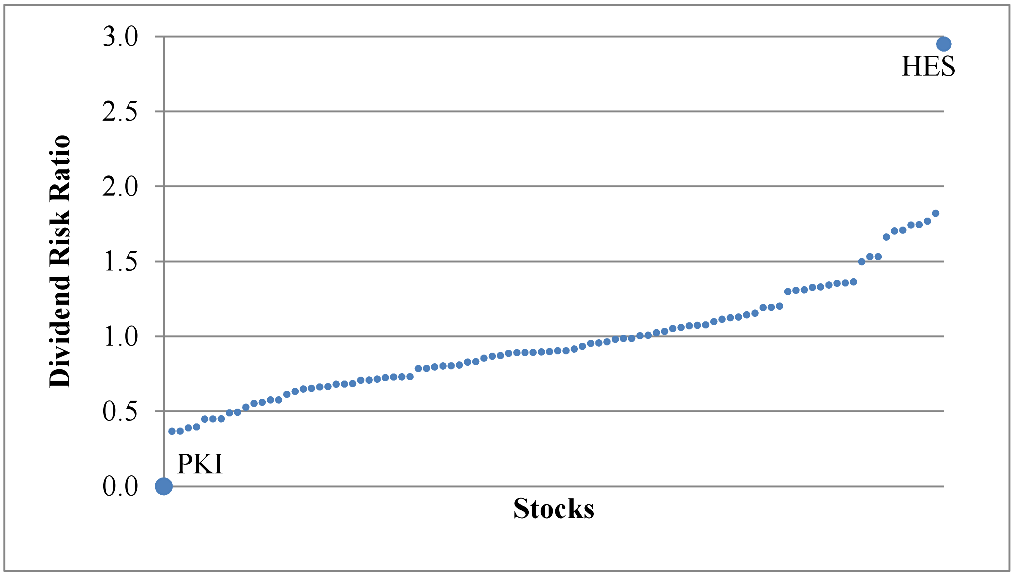
The difference between the standard deviation of the rate of return for a particular stock and the expected standard deviation is a measure of risk relative to the rest of the group. That measurement can be more naturally expressed as a ratio rather than as a difference. Consequently, we can define a *dividend risk ratio* as follows.

Definition 4: The *dividend risk ratio* for a stock is the standard deviation of the simulated internal rates of return divided by the expected standard deviation.

The coefficient of variation for the internal rate of return of a particular stock would be another common measure of risk, and a comparison to the group coefficient of variation is a way of determining risk relative to that of the group. The ratio of a stock's coefficient of variation and the group coefficient of variation produces an identical calculation of the dividend risk ratio.

Hence, we can think of the dividend risk ratio as either the ratio of the standard deviation of the internal rate of return to the expected standard deviation, or the ratio of the coefficient of variation to the group coefficient of variation.

FIGURE 4
RANGE OF VALUES FOR DIVIDEND RISK RATIO FOR 96 STOCKS



In Figure 4, we see that the dividend risk ratios for this group of stocks typically vary from about 0.4 to 1.8. The two extremes are Hess (HES), previously discussed, and PerkinElmer (PKI). The latter paid a constant $0.28 dividend over the entire eighteen-year period resulting in a zero standard deviation.

COMPARISON OF THE DIVIDEND RISK RATIO TO THE BETA VALUE

The dividend risk ratio (DRR) provides investors with a new measure of the financial health of a company, one derived solely from the company's history of dividend payments. It could be particularly helpful for investors primarily interested in dividend income. However, such investors would not ignore the potential return from the increase in the price of the stock and the associated risk for that return. To assess further the contribution of the newly defined dividend risk ratio, we compare the information obtained from the dividend risk ratio to the beta value. The beta value is also a ratio that measures the magnitude of the change in the stock's price relative to the change in the value of a market index over a specified period. We will also include in our comparison two measures of the investment return, the newly defined mean of the IRR for dividends, and an annual rate of return based on the change in the price of the stock. Our goal will be to determine the extent to which the new dividend based measures provide different information than measures based on the annual return on the investment, as well as how the different measures might provide complementary insights for a dividend investor.

For illustrative purposes, we elected to calculate the beta value based on the return over the same period used to calculate the dividend risk ratio. We base the market "index" on the same group of 96 stocks used to calculate the dividend risk ratio. We defined the "index" to be a weighted average of the 96 stocks using the 12/29/2017 capitalization of each stock as the weights. Although beta ratios are typically calculated over shorter time-periods, we elected to base this comparison of the two ratios on the same stocks and the same historical period that we used to define the dividend risk ratio. Since growth and income are different investment goals, we would expect that returns based on dividends would be different from returns based on growth in price.

FIGURE 5
ANNUAL RATE OF RETURN VERSUS MEANS OF DIVIDEND IRR

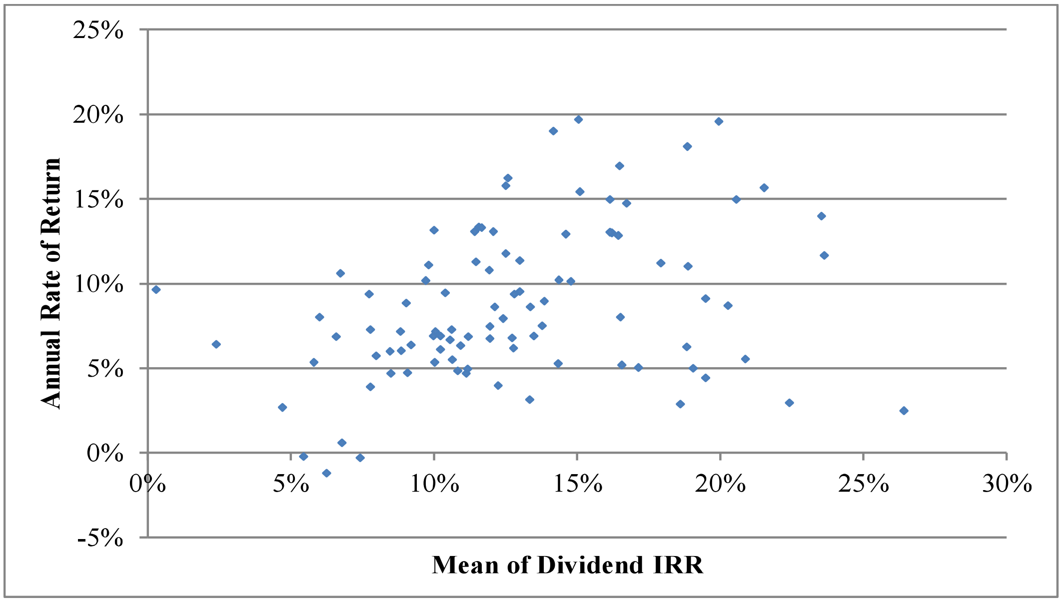


Figure 5 illustrates the relationship between the mean of the dividend based IRR and the annual rate of return of each stock based on the growth in price over the same eighteen-year period. There is clear evidence of a positive relationship between the two values ($p = .00093$). However, the variation in one explains only slightly more than 10% of the variation in the other. As expected, as one increases, the other tends to increase, but they are arguably very different measures. The primary contribution of this work, however, is the ability to measure the risk associated with dividend payments. Hence, we are more interested in the relationship between the dividend risk ratio and the beta value.

FIGURE 6
BETA VALUE VERSUS DIVIDEND RISK RATIO FOR 96 STOCKS

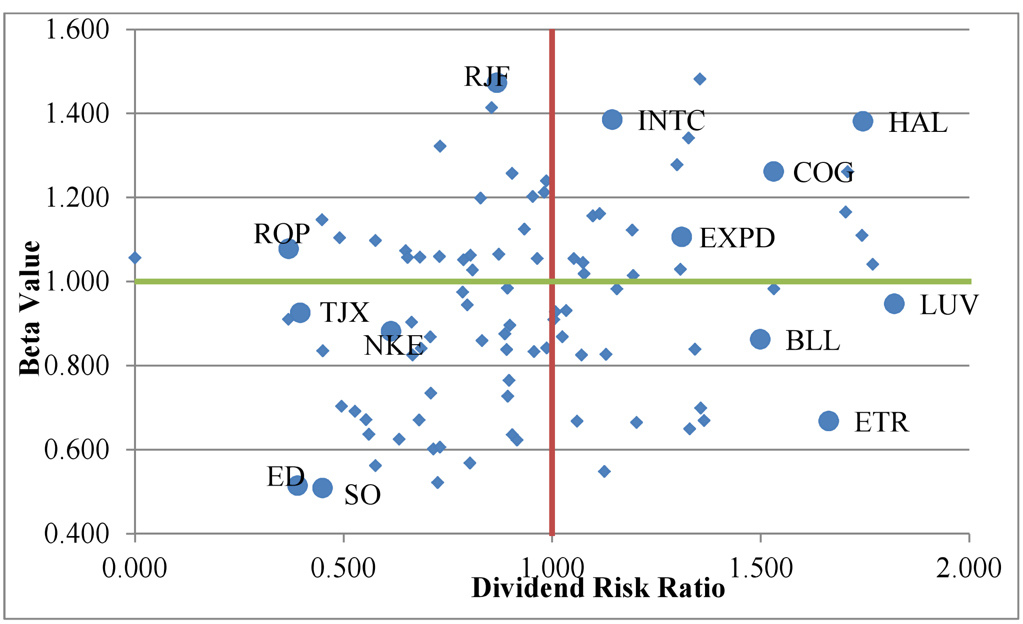


Figure 6 illustrates that relationship for the 96 stocks. It also identifies some particular stocks that we will discuss in more detail. Again, we have clear evidence of a positive relationship between the values (p = .0024), but the variation of one explains less than 10% of the variation in the other.

For many stocks, the risk associated with stock price growth and the risk associated with dividend growth are similar (i.e., both risk values are greater than one, or both values are less than one), and one measure seems to reinforce the other.

Table 2 contains data for the thirty-five stocks that have dividend risk ratios and beta values, both less than one. The data includes the mean of the dividend' internal rate of return, the dividend risk ratio, the beta value, and the annual rate of return associated with the increase in stock prices over the eighteen years. Since we are primarily interested in dividend payments, we sorted the stocks by the mean of the dividend IRR. Table 2 also shows that in some instances, the DRR provides no different insight than the beta value. Stocks such as Consolidated Edison (ED) and The Southern Company (SO) are very low-risk utility stocks with correspondingly low rates of return for both dividends and price growth. However, there are stocks in this category for which the dividend risk ratio provides additional insights. Two such companies are TJX Companies (TJX) and Nike (NKE). Both have beta values less than but close to 1. They also offer higher than average annual rates of return and hence might be among a list of generally attractive stocks. However, the very low DRR's (0.396 and 0.614 respectively) call attention to two stocks with significantly lower risk from a dividend perspective that also have very high mean dividend IRR's (23.53% and 16.15% respectively). Consequently, investors interested in dividends might see these stocks as particularly attractive. In these two instances, the dividend risk ratio provided insights to the investor beyond those provided by the beta value alone.

TABLE 2
STOCKS WITH DIVIDEND RISK RATIO AND BETA VALUES BOTH LESS THAN ONE

Stock Symbol	Mean IRR	Dividend Risk Ratio	Beta Value	Annual Rate of Return
TJX	23.53%	0.396	0.926	13.98%
CAH	22.43%	0.957	0.834	2.95%
WMT	17.15%	0.891	0.838	5.04%
WBA	16.56%	0.987	0.842	5.18%
DHR	16.23%	0.785	0.975	13.00%
NKE	16.15%	0.614	0.882	14.98%
GWW	14.78%	0.796	0.945	10.13%
HRL	14.62%	0.726	0.522	12.91%
ADP	13.79%	0.663	0.903	7.52%
JNJ	13.49%	0.495	0.703	6.91%
SYY	13.36%	0.894	0.727	8.62%
UPS	13.34%	0.897	0.765	3.14%
GD	13.01%	0.450	0.835	11.36%
BDX	12.80%	0.560	0.637	9.37%
PEP	12.79%	0.916	0.623	6.16%
AOS	12.59%	0.893	0.984	16.22%
SHW	12.53%	0.832	0.860	15.77%
ECL	12.52%	0.368	0.910	11.77%
ES	12.43%	0.731	0.606	7.93%
PG	12.25%	0.554	0.671	3.96%
CL	11.97%	0.681	0.671	6.77%
HSY	11.96%	0.576	0.562	7.46%
KMB	10.85%	0.633	0.625	4.86%

Stock Symbol	Mean IRR	Dividend Risk Ratio	Beta Value	Annual Rate of Return
NEE	10.40%	0.527	0.692	9.44%
CLX	10.02%	0.715	0.602	5.33%
NOC	10.01%	0.709	0.734	13.16%
MMM	9.81%	0.899	0.896	11.07%
O	9.04%	0.708	0.868	8.83%
D	8.83%	0.904	0.636	7.15%
GPC	8.47%	0.665	0.825	5.97%
SO	7.98%	0.450	0.509	5.71%
K	7.78%	0.803	0.568	3.90%
VZ	6.78%	0.686	0.841	0.60%
BMY	5.44%	0.887	0.876	-0.21%
ED	4.72%	0.390	0.514	2.67%

At the opposite end of the spectrum would be a group of stocks with dividend risk ratios and beta values, both greater than one.

TABLE 3
STOCKS WITH DIVIDEND RISK RATIO AND BETA VALUES BOTH GREATER THAN ONE

Stock Symbol	Mean IRR	Dividend Risk Ratio	Beta Value	Annual Rate of Return
OMC	14.35%	1.194	1.015	5.25%
MLM	7.78%	1.077	1.019	7.30%
OKE	17.92%	1.308	1.029	11.20%
PAYX	18.82%	1.769	1.041	6.25%
BA	16.15%	1.074	1.045	13.01%
SNA	7.74%	1.052	1.055	9.36%
EXPD	20.57%	1.311	1.106	14.97%
L	2.41%	1.743	1.110	6.40%
DE	11.65%	1.192	1.123	13.29%
EMR	9.07%	1.098	1.156	4.75%
ETN	13.00%	1.114	1.162	9.54%
WHR	9.19%	1.704	1.166	6.38%
SLB	12.74%	1.708	1.262	6.79%
COG	14.17%	1.531	1.262	18.99%
TXN	19.49%	1.299	1.278	9.10%
HES	8.85%	2.949	1.301	6.02%
HP	11.42%	1.327	1.342	13.06%
HAL	6.59%	1.745	1.381	6.86%
INTC	26.42%	1.144	1.386	2.49%
CMI	18.86%	1.355	1.482	18.08%

Table 3 contains data for the twenty such stocks. We might evaluate stocks in this group as riskier from both a dividend and growth perspective. For stocks with high-evaluated risk, we would expect higher returns. For example, Cabot Oil and Gas (COG) and Expeditions International of Washington (EXPD) have demonstrated high rates of return in stock prices, as well as a high mean IRR for dividend growth and perhaps the risk, is justified by the high rates of return.

On the other hand, Hess (HES) and Haliburton (HAL) are examples of risker stocks combined with lower rates of return. Note, Hess has a dividend risk ratio of 2.949 that is beyond the grid in Figure 4. In these four examples, the two measures of risk provide similar insights. However, there are also stocks in this group, for which the dividend risk ratio does provide a different perspective. For example, Intel (INTC) has a particularly high beta value (1.386) and a low annual return. However, the dividend risk ratio is relatively low at 1.144, and the mean of the dividend IRR is very high at 26.42%. INTC is a stock that a dividend investor might find attractive despite the high beta value.

For some stocks, the two risk measures are substantially different, and the dividend risk ratio provides information of particular interest to a dividend investor.

TABLE 4
STOCKS WITH A DIVIDEND RISK RATIO LESS THAN ONE BUT A BETA VALUE GREATER THAN ONE

Stock Symbol	Mean IRR	Dividend Risk Ratio	Beta Value	Annual Rate of Return
LOW	23.63%	0.934	1.125	11.64%
EOG	19.95%	0.954	1.202	19.59%
TGT	19.04%	0.787	1.052	5.00%
IBM	18.61%	0.804	1.063	2.86%
AFL	16.52%	0.904	1.257	7.99%
PX	16.45%	0.809	1.028	12.83%
ROP	15.04%	0.368	1.078	19.69%
ITW	14.36%	0.654	1.058	10.21%
UTX	13.85%	0.683	1.058	8.97%
APD	12.13%	0.649	1.073	8.63%
PH	12.08%	0.986	1.240	13.08%
RJF	11.57%	0.868	1.473	13.33%
CAT	11.47%	0.981	1.212	11.28%
XOM	11.14%	0.730	1.060	4.70%
CVX	10.93%	0.965	1.055	6.33%
PNR	10.61%	0.873	1.065	7.29%
AXP	10.24%	0.855	1.414	6.91%
HON	10.05%	0.829	1.199	7.17%
DOV	9.99%	0.448	1.147	6.90%
NTRS	8.49%	0.731	1.322	4.71%
SWK	6.74%	0.490	1.104	10.58%
PPG	6.02%	0.576	1.098	8.02%
PKI	0.30%	0.000	1.057	9.66%

Table 4 contains data for stocks that have a beta value greater than one but a dividend risk ratio of less than one. Based on the beta value, these are stocks that risk-averse investors might tend to avoid. However, if the investor is primarily interested in dividend income, the lower dividend risks suggest the stocks could be given some consideration. For example, Raymond James (RJF) stock prices experienced the volatility associated with financial services over the last eighteen years, with a beta value of 1.473. However, the firm increased dividends in fifteen of those years and averaged over 17% annual increases in those years, resulting in a dividend risk ratio of 0.868. The low risk combined with a mean IRR return that is near the average for the 96 stocks might make this stock an attractive option for the dividend investor. The annual rate of return that is well above average could offer a potential upside beyond the anticipated dividend income. As another example, Roper Technologies (ROP) has a beta value slightly above one (1.078) but one of the lowest dividend risk ratios (0.368). Both the dividend IRR and the annual rate of return are well above average, and the dividends have increased consistently every year, with an average of 14.5% over the eighteen years and 20.5% over the last six years. Both of these stocks illustrate instances the dividend risk ratio provides conflicting information to that provided by the beta value that could be of particular significance to the investor focused on dividend income.

TABLE 5
STOCKS WITH A DIVIDEND RISK RATIO GREATER THAN ONE BUT A BETA VALUE LESS THAN ONE

Stock Symbol	Mean IRR	Dividend Risk Ratio	Beta Value	Annual Rate of Return
CHR	21.54%	1.034	0.931	15.67%
CVS	20.89%	1.343	0.839	5.53%
MCD	20.26%	1.364	0.670	8.70%
MDT	19.49%	1.071	0.825	4.41%
LUV	18.89%	1.820	0.947	11.02%
UNP	16.73%	1.156	0.983	14.75%
CHD	16.49%	1.125	0.548	16.95%
BLL	15.10%	1.499	0.863	15.43%
VFC	11.94%	1.004	0.910	10.78%
MTB	11.20%	1.531	0.983	6.85%
PPL	11.18%	1.356	0.699	4.97%
ETR	10.65%	1.663	0.668	5.49%
PBC	10.56%	1.129	0.827	6.67%
TAP	10.22%	1.330	0.650	6.11%
AJG	9.71%	1.202	0.665	10.19%
LLY	7.41%	1.025	0.869	-0.28%
MRK	6.26%	1.008	0.928	-1.20%
DTE	5.82%	1.060	0.668	5.35%

Finally, there are stocks with a beta value of less than one, but dividend risk ratios greater than one. Table 5 contains data for the eighteen stocks in this category. For an investor interested in dividend income, the high dividend risk ratio might provide a sense of caution that would otherwise be missed. Consider, for example, Ball Corporation (BLL). The beta value of 0.863 is very attractive, but the dividend risk ratio of 1.499 is one of the highest. While the mean IRR and annual rate of return are well above average, the company failed to increase dividends in ten of the eighteen years and had no dividend increase for five straight years.

Similarly, Southwest (LUV) also has generated above-average returns but failed to increase its dividends for ten straight years. Entergy Corporation (ETR) has a very low beta (0.668) expected of utilities along with a low annual rate of increase. However, income investors interested in utilities might be concerned about the very high dividend risk ratio (1.663), a consequence of failing to increase dividends in five years and averaging less than a one percent increase over the last six years.

The four above tables, Tables 2 to 5, provide the results for all 96 companies and summarize the different scenarios of comparison between the dividend risk ratio and the beta value. The results show a clear added value for the newly defined measure as it relates to a dividend investor's portfolio.

OBSERVATIONS AND CONCLUSIONS

In this section, we provide the general comments and conclusions derived from this initial study as well as proposed future work and possible extensions of the analysis. The internal rate of return, produced by the dividend discount model for each stock, provides the investor with a comparative measure of future rates of return based on the dividend history of a company. The simulation model delivers an analytical tool for generating future dividends and computes a mean internal rate of return based on dividends. Besides, the newly defined dividend risk ratio provides a useful measure of risk for dividend investors. Those investors are typically interested in stock dividend payments but may also believe that consistent dividend growth is an important component of an investment strategy.

Furthermore, for any investor, these measures provide additional information about the financial health of a company. When combined with price-based measures, the mean dividend internal rate of return and the dividend risk ratio gives investors additional tools for selecting ideal portfolios. Depending on investment goals, portfolio optimization models might be enhanced by the inclusion of constraints representing either a maximum allowed dividend risk ratio or a limit on an average risk ratio. Other constraints can also be specified on the desired dividend internal rate of return.

In this initial investigation of dividends-based analysis, the results show the meaningful utility of the defined measures, based on historical information. Further research can enhance the applicability of the concepts discussed in the paper. For example, the calculation of the dividend risk ratio might take on several variations, all of which can be worth investigating. The model entails identifying a comparison group of stocks. In this paper, we used all S&P 500 stocks that paid dividends over eighteen years without any decrease in annual dividend payments. This group of stocks is a reasonable comparison group for investors interested in dividend income. The model also entails defining a probability distribution for the random rates of change in annual dividend payments. Here we elected to use a discrete random variable with equal probabilities for our distribution. A modeler could change both the comparison group and the probability distribution.

Of course, the risk ratio can be calculated for companies that have decreased dividends, especially if they are rare and infrequent. The simulation can be adjusted to avoid an outcome where the decreases cause zero dividends, where Excel's internal rate of return calculation can fail to find a value. It is rare, but not without incident, for a company to experience dividend decreases two or three years in a row. A simulation model that includes instances of dividend decreases would work best if the random distribution of dividend rates of change provided for the minimum possibility of back-to-back dividend decreases. This adjustment can allow the analysis of a more varied group of stocks.

Similarly, the modeler can investigate variations on the selection of a probability distribution for the random rates of change in dividends in a few other ways. One possibility might be to assign higher probabilities to recent rates of changes in dividends if one believed that recent history is a better predictor of the future. For investors who are primarily interested in growth but who believe dividend history is also a good indicator of the financial health of a company, a more robust comparison group and more emphasis on how historical dividends might influence future dividend growth could be justified.

In summary, the model we propose presents a new paradigm toward a deeper understanding of the role dividends play in investment choices. The analysis presented in this paper could provide valuable insight into the desirability of stocks, especially as it relates to dividend payments.

REFERENCES

Baker, H. K., Farrelly, G. E., & Edelman R.B. (1985). A Survey of Management Views on Dividend Policy. *Financial Management*, 14(3), 78–84.

Baker, H. K., & Powell, G. E. (2000). Determinants of Corporate Dividend Policy: A Survey of NYSE Firms. *Financial Practice and Education*, 10(1), 29–40.

Bhattacharya, S. (1979). Imperfect Information, Dividend Policy, and 'The Bird in the Hand' Fallacy. *The Bell Journal of Economics*, 10(1), 259–70.

Black, F. (1976). The Dividend Puzzle. *The Journal of Portfolio Management*, 2(2), 5–8.

Conover, C.M., Jensen G.R., & Simpson M.W. (2016). What Difference Do Dividends Make? *Financial Analysts Journal*, 72(6), 28–40.

DeAngelo, H., & DeAngelo, L. (2007). Payout Policy Pedagogy: What Matters and Why? *European Financial Management*, 13(1), 11–27.

DeAngelo, H., DeAngelo, L., & Skinner D.J. (2004). Are Dividends Disappearing? Dividend Concentration and the Consolidation of Earnings. *Journal of Financial Economics*, 72(3), 425–56.

Denis, D.J., Denis, D.K., & Sarin A. (1994). The Information Content of Dividend Changes: Cash Flow Signaling, Overinvestment, and Dividend Clienteles. *The Journal of Financial and Quantitative Analysis*, 29(4), 567–87.

Easterbrook, F. (1984). Two Agency-Cost Explanations of Dividends. *The American Economic Review*, 74(4), 650–59.

Fama, E.F., & French, K.R. (2001). Disappearing Dividends: Changing Firm Characteristics or Lower Propensity to Pay? *Journal of Financial Economics*, 60(1), 3–43.

Frankfurter, G. M., & Wood, B. G. (2002). Dividend Policy Theories and Their Empirical Tests. *International Review of Financial Analysis*, 11(2), 111–38.

Gordon, M.J., & Shapiro, E. (1956). Capital Equipment Analysis: The Required Rate of Profit. *Management Science*, 3(1), 102–10.

Handjinicolaou, G., & Kalay, A. (1984). Wealth Redistributions or Changes in Firm Value. *Journal of Financial Economics*, 13(1), 35–63.

Lease, R., John, K., Kalay, A., Loewenstein, U., & Sarig, O.H. (1999). *Dividend Policy: Its Impact on Firm Value* (1st ed.). London: Oxford University Press.

Miller, M.H., & Modigliani, F. (1961). Dividend Policy, Growth, and the Valuation of Shares. *The Journal of Business*, 34(4), 411–33.

Myers, S., & Majluf, N. (1984). Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have. *Journal of Financial Economics*, 13(2), 187–221.

Siegel, J.J. (2014). *Stocks for the Long Run 5/E: The Definitive Guide to Financial Market Returns & Long-Term Investment Strategies* (5th ed.). New York: McGraw-Hill Education.

Sim, T., & Wright, R. (2017). Stock Valuation Using the Dividend Discount Model: An Internal Rate of Return Approach. In *Growing Presence of Real Options in Global Financial Markets*, 33, 19–32. Research in Finance. Emerald Publishing Limited.

Williams, J. B. (1938). *The Theory of Investment Value*. Cambridge, MA: Harvard University Press.