APPENDIX D

DISCOUNTED CASH FLOW ESTIMATES

The DCF Model

The standard alternative to risk premium models is the discounted cash flow model. This model infers the required rate of return by replicating the actions of an investor in valuing the firm's securities. To do this we need to define the costs and benefits attached to an investment. The cost is simply the price of the security (P_0, price at time zero) and the benefits, the stream of cash inflows expected at time t in the future (C_t). However, since the investor can always invest in alternative investments, future expected cash flows are not of equal value. As a result, future cash flows are "discounted," or reduced in value to reflect this "opportunity cost." This is the basic idea behind using the discounted cash flow model,

$$P_0 = \sum_{t=1}^{\infty} \frac{C_t}{(1+K)^t}$$

where K is the discount rate or investor's required rate of return.

Once we estimate the stream of future cash inflows, we can equate them to the current price and solve for the investor's required rate of return. For example, this is the standard way of valuing bonds. At the end of every business day investment banks simply take the coupon payments on a government bond, its terminal value and use the last trading value for the bond to solve the above equation for the bond's "yield to maturity." This yield to maturity is published in the newspaper as an objective measure of the investors' required rate of return for a default free security. I use this DCF estimate as part of my risk premium estimates. However, we can take this a stage further and estimate the DCF required return on equity directly using the same procedure.

The expected equity cash flows are the future expected dividends. Unlike the stream of cash flows on a bond the dividends are not contractual and are more difficult to forecast, particularly

for individual stocks. Consequently, the DCF model is only used for low-risk dividend paying stocks or the market, where the expected dividends can be assumed to grow at some long run average growth rate g. In this case, each dividend is expected to grow at the rate g, so we can substitute $d_1 = d_0 * (1+g)$ into the valuation equation. Taking this process to infinity and using the value of a geometric series, we can solve to get:

$$P_0 = \frac{d_1}{K - g}$$

This says the stock price is equal to the expected dividend per share, divided by the investor's required rate of return, minus the dividend growth expectation, g. The advantage of this formulation of the problem is that we can easily rearrange the equation to obtain,

$$K = \frac{d_1}{P_0} + g$$

This states that the investor's required rate of return can be estimated as the expected dividend yield plus the expected growth rate in dividends. This is the direct analogy with the yield to maturity on a bond. This formulation of the model is often called the Gordon (or dividend discount) model after my late colleague Professor Myron Gordon of the University of Toronto.

However, it is important to note that the expected dividend yield plus growth equation ONLY holds if the constant growth model also holds since it is simply a rearrangement of it. *This means that the constant growth rate assumption to infinity also holds*. Otherwise, the use of the formula for a geometric series does not hold since if g>K the series does not converge. In practise this means that the formula is only useful, as mentioned above, for very low risk companies and the overall market since for other firms short run growth rates from security analysts for example are often more than any reasonable equity cost.

Further, it is important that the constant growth rate assumption essentially applies to earnings book value and sales as well, at least as an approximation. It is then straightforward to show that increased dividends primarily come from increased future earnings, which are generated by the

firm retaining some of its current earnings for re-investment. If we set *X* as the earnings per share and denote *b* as the fraction of earnings retained within the firm, then *(1-b)X* is the dividend and *bX,* the retained earnings.[1] Provided the assumptions of the DCF model hold, it is straightforward to show that dividends and earnings will then grow at a long run growth rate estimated as the product of the firm's retention rate *(b)* and its return on common equity *(r)*, which is referred to as its *sustainable growth rate*.[2] Note that while *K* is the return that investor's require, *r* is the actual return on equity (*ROE*) the firm is expected to earn.[3] These are different concepts.[4]

An example may help to make these assumptions clear. Suppose as in Schedule 1, the firm's book value per share is $20 and its return on equity expected to be 12%. In this case, its earnings per share are expected to be $2.40 and with a 50% dividend payout rate, its dividends per share and retained earnings are both expected to be $1.20. Moreover, since $1.20 has been retained and reinvested within the firm, next period's book value per share increases to $21.20. As a result, the firm is expected to earn $2.544 in the following year, i.e., 14.4 cents more. This additional 14.4 cents comes from earning the 12% return on equity on the $1.20 of retained earnings. The increase in earnings per share, dividend per share and retained earnings is 6% each year and is calculated directly as the product of the firm's return on equity of 12% and its retention rate of 50%. Moreover, the value of the firm's common stock can be calculated from equation (1), which also increases at this 6% rate, since only the dividend per share is expected to change.

The importance of Schedule 1 is in showing some of the implications of the dividend growth model. First, note that if the investor's fair rate of return is 10%, the stock price in Schedule 1 is

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[1] This assumes that the only change in shareholder's equity comes from retentions, that is, everything flows through the income statement.

[2] This is consistent with industry practise and the Financial Post's definition in Schedule 3.

[3] There is an additional term (*sv*) if the firm repeatedly sells shares at a premium to its book value, but this term is small and rare for utilities as mature cash flow positive industries. Further it is usually dwarfed by estimation problems.

4 "br" growth is the third way of estimating dividend growth in Kolbe, Read and Hall, Estimating the rate of return for public utilities, MIT Press, 1984, page 55.

$30, determined as the expected dividend of $1.20 divided by the discount rate minus the growth rate (or 0.04). This price exceeds the book value of $20 by 50%. This is because the firm's return on equity (*r*) is 12% and the investor's required or fair rate of return (*K*) is only 10%. This is the reason why economists look at market-to-book ratios to infer the investor's opportunity cost. If market-to-book ratios exceed one for a regulated company, most economists immediately assume that the firm's return on equity exceeds the return required by stockholders, implying that the regulator should lower the firm's allowed rate of return. This is a standard proposition. For example, in Kolbe, Read and Hall (1984) they state (page 25)

> ***"on balance we believe that setting the allowed rate of return equal to the cost of capital is the policy that best meets the criterion of fairness."***

In our example the *ROE* exceeds the required rate of return by 2% which results in a market to book ratio of 150% and indicates that the ROE is excessive and should be lowered.

Second, it is the return on equity that drives the growth in both dividends per share and earnings per share, provided that the dividend payout is constant. If the dividend payout is gradually increased over time, then it is possible to *manufacture* a faster growth rate in dividends than earnings per share, from the same underlying level of profitability. For example, in Schedule 2 the same data is used as in Schedule 1 except that the dividend payout starts at 50% and then increases by 2% per year. By the end of year 5 earnings per share have only risen to $2.99 instead of the $3.03 in Schedule 1, because less money has been reinvested within the firm. As a result, there is less capital to generate earnings. Thus the earnings in Schedule 2 only grow at a 5.6% compound growth rate, down from the 6% of Schedule 1. Conversely, since more of the earnings are being paid out as dividends, dividends per share are up to $1.73 instead of $1.52. This is a 9.6% compound growth rate, rather than the 6% in Schedule 1.

In the short-run, Schedule 2 demonstrates that the growth in dividends per share can be artificially manipulated by increasing the dividend payout. This is not sustainable in the long run, since the dividend payout cannot be increased indefinitely. Moreover, the manipulation can be detected by performing the basic 'diagnostic' check of tracking the behaviour of the firm's dividend payout over time, and the firm's return on equity. However, if the analyst is not aware

of the change in the dividend payout, estimating the fair rate of return by adding this manipulated dividend growth rate to the expected dividend yield will overstate the investor's required rate of return. It is important in this case to base the estimate of the investor's required rate of return on a long run sustainable growth rate, estimated from the underlying growth in earnings and dividends and the two components of growth.

The third implication of Schedule 1 is that the DCF estimate using the historic growth rate is appropriate only when the assumptions of the model hold. This means that non-dividend paying firms, firms with highly fluctuating earnings and dividends, and firms with non-constant expected growth cannot be valued accurately using the formula. Usually, these assumptions hold for *pure* regulated utilities since the allowed rate of return applies to the book value of equity both old as well as on new investments. However, it may not hold for utility holding companies (UHCs) that may own a variety of different operating divisions with added debt at the parent level. For non-regulated firms and UHCs, these assumptions are frequently violated. As a result, estimating the investor's required rate of return by using the formula $K=d_1/P_0 + g$, is tenuous and subject to significant measurement error.

DCF Estimates for the "Market" as a whole

In terms of DCF estimates we can go from the broad to the specific. By broad, I mean the market, since by holding a diversified portfolio, an investor reduces the possibility of gains from one firm being the result of losses by another. In Schedule 4 is a graph of the dividend yield on the TSX Composite (Cansim V122628 plus recent date from the TSX) along with the yield to maturity on the long Canada (LTC) bond. The dividend yield on the TSX Composite finished out the year (December 2021) at 2.54%, while the LTC yield was 1.75%. This is a highly unusual situation, which has prevailed since the end of 2011. It is unusual since equities are a claim on real resources and should grow in line with the growth rate in profits and GDP. In contrast, the yield on the long Canada bond is fixed and is all an investor can earn when the bond is held to maturity. As a result, we would expect the TSX dividend yield to be below that on the long

Canada bond. This inversion of normal market relationships is indicative of the recent anomalous level of long Canada bond yields.

In forecasting a DCF estimate for the overall stock market it is normal to start with GDP forecasts and then adjust for the state of the economy and the equity market. For example, in 2012 RBC[5] used what they termed a "Grinold-Kroner-Siegel" supply side model for forecasting the fair rate of return on the US market. Schedule 5 is their description of the model. However, despite the new name this is simply a Gordon or constant growth rate DCF model with minor adjustments.

First, the basic constant growth model is the dividend yield plus the forecast nominal growth rate of the economy split into its two parts: inflation and the real growth rate. This part of the DCF equation implicitly assumes that aggregate profits and dividends increase in line with GDP consistent with the basic DCF model. Second, are the two minor tweaks where RBC adjusts for the change in the number of shares outstanding plus a pricing adjustment. We don't normally adjust for changes in the number of shares since we normally estimate the growth rate based on a current firm's share price. However, as a claim on aggregate profits this is needed if in aggregate some shares are being repurchased and new shares issued as new firms enter the market. The final term is a subjective assessment of whether the market is over or undervalued. This is not normally done in a DCF model since the basic assumption is that the discount rate and thus price earnings multiple is constant, so the price increases in line with dividend and earnings.

In 2012 RBC's estimated "DCF" equity cost for the U.S market started with a 2.1% dividend yield and 4.3% nominal growth comprising 2.1% inflation and 2.2% real growth. They then estimated net share issuance of -0.5% that is share repurchases were exceeded by new shares issued to the tune of 0.5%. As a result, the future dividends were allocated to a greater number of shares implying a 5.9% DCF base expected return. They then assessed the U.S market as being

5 RBC Capital markets, U.S Equity Strategy Weekly, July 18, 2012.

over-valued and deducted 1.0% for the then currently high market values to get a forecast return of 4.9%. Their numbers are below.

S&P 500 10 year Return Forecast	
+ Dividend yield	2.1%
- Net Share Issuance	-0.5%
+ Inflation	2.1%
+ Real Earnings Growth	2.2%
+ Change in PE	-1.0%
= Total Equity Return	4.9%

Source: RBC Capital Markets

- On a positive note, assuming 15% price volatility going forward, the 4.9% per annum return forecast is likely to be realized over a 10-year horizon.

Morgan asset management adopted a similar approach in their 2021 capital market assumptions as below.[6] Morgan starts with top line revenue growth from nominal GDP but add a margin factor to indicate whether earnings will grow faster than revenues. For 2021 they added 0.1% to get earnings growth of 5.3%; similar to RBC they then added 0.1% for their forecast that share buy-backs would exceed new share issues to get 5.4% growth in earnings per share. With a 1.8% dividend yield this gives an adjusted DCF estimate of 7.2% from which they subtracted 3.0% for what they felt was an over-valued U.S stock market to get 4.1% for the US, 5.2% for the Eurozone, 5.1% for Japan and 6.7% for the UK. J. P. Morgan's forecast is heavily dependent on their judgment as to the over or under valuation of the stock market. Personally, I am not willing to make that call as it assumes market irrationality. If the market adjustment is ignored Morgan's estimates are 7.2%, 7.4%, 6.9% and 8.2% for the four regions. However, note that apart from the

6 J. P Morgan, Long-Term Capital market Assumptions, J.P Morgan Asset Management, 2021.

UK their long run equity returns were lower than the pervious year.

This year, our equity return assumptions decline across most regions

EXHIBIT 5A: SELECTED DEVELOPED MARKET EQUITY LONG-TERM RETURN ASSUMPTIONS AND BUILDING BLOCKS

Equity assumptions	U.S. large cap	Eurozone	Japan	UK
Revenue growth	5.2	4.4	3.4	5.3
+ Margins impact	0.1	1.5	1.5	0.2
Earnings growth	5.3	5.9	5.0	5.5
+ Gross dilution	-2.0	-2.0	-2.0	-2.0
+ Buybacks	2.1	1.1	1.5	1.2
EPS growth	5.4	4.9	4.4	4.7
+ Valuation impact	-3.0	-2.2	-1.9	-1.5
Price return	2.4	2.7	2.6	3.1
+ Dividend yield (DY)	1.8	2.5	2.5	3.5
Total return, local currency	4.1	5.2	5.1	6.7
Change vs. 2020 LTCMAs	-1.5	-0.6	-0.4	0.6

Source: J.P. Morgan Asset Management; estimates as of September 30, 2019, and September 30, 2020.
Components may not add up to totals due to rounding.

Both RBC and J.P Morgan assume that dividends and earnings will grow at the long run nominal GDP growth rate. It's difficult to make an alternative assumption when the growth rate is infinite, and any deviation would mean that they would either constantly increase or decrease as a share of GDP. The real Canadian growth rate since 1961 is in Schedule 6 and has averaged 3.06%. The Bank of Canada's operating band for inflation centres on 2.0% and despite short run inflationary pressures putting it at the top of the band, both the Bank of Canada and the Government of Canada renewed their agreement on December 13, 2021. The CPI inflation rate since 1914 is in Schedule 7 and shows how successful the Bank of Canada has been in targeting a 2% inflation rate over the last thirty years or so. If the experienced growth rate over the last 60 years reflects the future growth rate, then we can expect long-run growth in dividends and earnings of 5.12% (1.02*1.0306).

This growth estimate is probably marginally low once we account for the shift to a knowledge-based economy as it has become more difficult to estimate the value of productivity changes in GDP Of note is that one side benefit of the pandemic has been a boost to the application of modern technology. This has resulted in a range of artificial intelligence (AI) applications as well

as the well-known "Zoom" phenomenon and led to the dominance of tech stocks in the stock market. McKinsey Global Institute has recently estimated that the application of these technologies could raise productivity in Western Europe and the US by 1.0%.[7] We might also expect some short run growth as we continue to pull out of the effects of the pandemic. With these caveats and a TSX dividend yield of 2.54% t the end of 2021 a ballpark figure for a DCF estimate for Canada is 7.79% ((1.0254*1.0512)-1) which is probably a minor under-estimate.

An alternative estimate of future growth for the overall market is to use the "*br*" or sustainable growth rate. In Schedule 8 is the dividend payout of the firms listed in the TSX Composite (and earlier the TSE300 index) since 1956. We can clearly see the effects of two major recessions. The first in the early 1990's reflected the impact of the Free Trade Agreement with the U.S that caused TSX earnings to collapse and the payout to exceed 100%. The second was in the early 2000's when the bursting of the internet bubble and collapse of Nortel caused TSX earnings to go negative. Both exaggerate the normal dividend payout since it is the earnings volatility that is creating the very high and negative payouts. Consequently, the better estimate of the payout is to focus on the median payout of 52% which was also the general level prior to the pandemic.

In Schedule 9 is the earned ROE from Statistics Canada for all Canadian firms. Again, we can see the business cycle as very low profitability in the mid 1990's and again in 2003 and 2009 which caused problems with the TSX payout estimate. The median ROE is 9.78%. Combining the median retention rate (1-dividend payout) and median ROE gives a sustainable growth rate of 4. 7% and DCF equity cost of 7.35%.

Finally, we can look at the growth rate of the TSX dividends directly rather than indirectly by looking at their payout and profitability. Below are three estimates for the dividend per share growth since 1956 on the TSX

Average growth rate:	5.36%

[7] The pandemic's productivity dividend, *Bloomberg Business Week*, May 10, 2021.

Ordinary least squares growth rate:	5.46%
Compound growth rate:	5.23%

With the 2.54% end of December 2021 dividend yield these imply a DCF cost of equity of 8.03%.

In Schedule 10 is a graph of the dividend yield on the S&P500 index which finished 2021 at 1.292% while Schedule 11 is a graph of the dividend payout rate for the firms in the S&P500 index. The median dividend payout since 1956 is 43% slightly lower than in Canada. This means that typically 57% of the earnings for S&P500 firms are reinvested to generate future growth in earnings. However, note from the graph that the S&P500 firms suffered significant problems in 2007-2009 during the financial crisis, which was not as evident in the Canadian data. In contrast, there is no evidence of the serious problems suffered by Corporate Canada in the recessions in the early 1980s, 1990s and 2000's.

In Schedule 14 is the S&P ROE data for the S&P500 firms since 1977, where the median ROE 13.9%. These are higher than the average Canadian ROE since the data is for the largest firms in the US economy and includes a large proportion of foreign earnings, whereas that for Canada is for all firms and only for Canada. If I pair the median payout with the median ROE, the "*br*" growth rate for the S&P500 firms is 7.9%. Combining these with the current dividend yield on the S&P500 index of 1.29% gives a fair return on the S&P500 of 9.3%. Note the higher sustainable growth rate for the S&P500 is offset by its lower US dividend yield or put another way these US firms are perceived to have better long run growth prospects than Canada as a whole and investors are paying for that growth by driving prices up and dividend yields down. As a result, the combination of yield plus growth estimates for the S&P500 is higher than for Canada. With U.S. long run nominal sales growth similar to Canada as per J.P Morgan's forecast of 5.2% compared to my 5.12% for Canada, the *br* growth rate for the SP500 looks high and significantly higher than J.P Morgan's recent value of 7.2%.

Using the DCF model to estimate the market's required return on equity (equity cost) would indicate a value of 7.35-8.01% for Canada and 7.2%-9.3% for the US. These numbers look more

accurate than they really are and bearing in mind the stage in the business cycle I would estimate a DCF fair rate of return for the overall stock market of 8.0-9.0% or a real return of 6.0-7.0% consistent with long run experience.

Individual company estimates

The DCF estimates for the overall market are more reliable than those for individual companies due to the significant measurement error attached to forecasting future growth rates. For example, the forecast growth rate for the economy is more accurate since the growth rate in profits for the overall market is constrained by the growth rate in the economy. Otherwise, corporate profits will inexorably increase as a share of GDP at the expense of wages and salaried income. However, these growth rates are mechanically estimated and may not reflect market estimates. Consequently, some use analysts forecast of earnings growth as a proxy for the sustainable growth rates in the former estimates. In my judgment these are no more reliable as can be illustrated by looking at a sample of US gas utilities.

Schedules 15 I extracted data on February 24, 2022, for the six U.S. gas companies for which I also estimated their betas. The Schedule contains the critical values for a mechanical DCF analysis. The average dividend yield based on the trailing dividend per share is 3.43% and the median 3.51% both of which are significantly higher than the yield on the S&P500 index at the end of 2021 of 1.292% as one would expect for lower-risk utilities. Using the forecast five-year analyst growth rates in a simply constant growth mode gives the K (*Est g*). The higher estimates are for Northwest Natural and Spire due to the poor past five-year history where analysts expected the future growth rate to rebound. However, in contrast the dividend yield for both these companies is higher than average which would normally reflect lower future growth than average. The low estimates are for One Gas and Southwest Gas due to their low forecast earnings growth. As a result, the DCF estimates range from 6.01% for One Gas to 10.26% for Northwest Natural with a median value of 9.15% and average value of 8.66%. These *may* appear to be reasonable estimates, but there are several problems.

First, if these UHCs reflect the risk of regulated utilities they are clearly lower risk than the

overall market, while the median estimate of 9.15% is almost my *br* estimate for the SP500 and is much greater than J.P Morgan's. This is confirmed by their average (median) five-year growth forecasts of 5.56% -(5.95%) which are both higher than most estimates for U.S. long run GDP growth. Third, the average ROE in 2021 was 9.24% and the median 9.06% which are both about the same as the estimated cost of equity. However, as mentioned previously this should mean a market to book ratio close to 1.0. However, the average (median) Market or price to book ratio is 1.68 (1.67). These observations indicate that the "optimism bias" amongst security analysts, where these "sell side" analysts tend to be optimistic also seems to apply to these utility holding companies.

It must be emphasised that the DCF model assumes growth *forever* at this constant forecast growth rate. For these firms to grow at their median growth rate of 5.10% with a 40% retention rate means earning an ROE of 12.9% significantly higher than their current ROEs. Again, this confirms the optimism bias. In Schedule 16 is an article from the Economist (December 3, 2016) which clearly states:

> ***"Sell side analysts, whose firms make money from trading and investment banking, are notoriously bullish. As one joke goes, stock analysts rated Enron as a "can't miss" until it got into trouble at which point it was lowered to a "sure thing". Only when the company filed for bankruptcy did a few bold analysts dare to downgrade it to a "hot buy".***

"Optimistic" can be substituted for "bullish", but there is little doubt that security analysts are optimistic, which is to say their earnings forecasts are higher than what is expected. The Economist goes on to say that analysts are forecasting S&P500 earnings to be $130.83 in 2017 and $146.33 in 2018, but it is better to discount them to $127.85 and $134.30 respectively. The actual earnings were $109.87 in 2017 and$132.47 in 2018 below even the "discounted" values used by the Economist.

The analyst optimism bias is well known. At Schedule 17 is a Globe and Mail article from May 2010 reporting on an updated McKinsey study which found that analyst forecast accuracy did improve after the disciplinary effects of the global settlement where investment banks were fined

for fraudulent reports and some analysts fired. However, as they also point out old habits soon re-emerged. At Schedule 18 is an extract from the Royal Bank of Canada's Investment Strategy Playbook (February 2016) reporting the exact same phenomena. This is essentially that analysts start out optimistic in terms of future earnings, which are some distance away, and then get more realistic as that date gets closer, or as a cynic might put it they get better forward guidance from the company itself.

This analyst optimism bias has been in the academic literature for years. Easton and Sommers[8] for example, have documented the optimism bias at 2.84% where they also state (page 986)

> Our estimate of the implied expected rate of return on the market from the value-weighted regression, after removing the effect of bias in analysts' forecasts, is 9.67% with an implied equity risk premium of 4.43%. Of course, this estimate of the equity risk premium is more reasonable than that obtained when all observations have equal weight.[8]

Easton and Summers estimate in 2007 were broadly in line with my own estimate of the expected return on the US market. More importantly there is no reason to believe that analyst optimism has suddenly disappeared. In fact, this optimism bias persists in current studies to the extent that authors refer to it as "well documented" that is, researchers are so used to the optimism bias that they automatically take it into account. The Financial Times also noted that analyst optimism exists in Europe, where they quote Goldman Sachs that "going back 25 years analysts have been too optimistic about earnings growth in 20 years out of the 25 and by 8 percentage points on average over the whole period." ***A Google search on analyst optimism on February 2, 2022, produced 9,380,000 hits.***

Mark Grinblatt of UCLA recently looked at the optimism bias and a summary of his research[9] and reported that

[8] "Effect of analyst's optimism on estimates of the expected rate of return implied by earnings forecasts, Journal of Accounting Research, 45-5, December 2007.

[9] https://www.anderson.ucla.edu/faculty-and-research/anderson-review/analyst-bias

"When analysts were either most biased or most optimistic, it was by a lot: Among the 20 percent of companies about which analysts most optimistically forecasted earnings — those analysts' estimates were on the high side by about 50 percent. By contrast, among the 20 percent of companies about which analysts were least optimistically biased, earnings forecasts overshot actual results by less than 1.0 percent."

Of importance is that even amongst the least biased they are still biased, even though by less than 1.0%.

Recent research[10] has indicated that after the global settlement precipitated changes in the regulation of analysts to make them independent of investment banking, the star analysts left. This is consistent with the research of Espahbad et al[11] that there was a short run improvement in the forecast accuracy of analysts after new regulations were introduced, but that over the longer period forecast accuracy has declined. I therefore place little reliance on analyst growth estimates since they are inaccurate and known to be biased.

A standard way of alleviating the effects of analyst growth optimism is to use the sustainable growth rate, which indicates that growth in earnings and dividends generally comes from reinvesting earnings at a positive rate of return. This was what I documented theoretically in Schedules 1 and 2. From the data on the gas utilities in Schedule 15 their retention rate of earnings averages 34% with a median of 41%. As we would expect, these mature utilities normally reinvest less of their earnings than do typical SP500 companies so we would expect them to grow at less than their average earnings growth rate which is approximately that of GDP. With the recent ROE for each utility the sustainable growth rate averages 3.37% and the median slightly higher at 3.59%. The difference between the median sustainable growth rate and the analyst forecast growth rate of 2.0% exceeds Grinblatt's observation where the "least biased" analyst forecasts undershoot by less than 1.0%.

10 Guan, Li, Lu and Wong, "Regulations and brain drain: Evidence from Wall Street Star Analysts' career Choices", Management Science (forthcoming)

11 Espahbad, Espahbad and Espahbad, "Did analyst forecast accuracy and dispersion improve after 2002 following the increase in regulation, Financial Analyst Journal, (Sept/Oct 2015)

The DCF estimates using sustainable growth rates produce an average (median) equity cost of 6.91% (7.24%) consistent with their average (median) market to book (MB) ratios of 1.68 (1.67), and the fact investors are "happy" with the average (median) earned ROE of 9.24% (9.06%). Further, we can always back out from analyst growth forecasts an implicit ROE. For example, with a median growth forecast of 5.10% and a retention rate of 40%, the implied future ROE is ROE = .0510/.40 or 12.86%[12] which significantly exceeds their current median ROE of 9.15% as well as the highest 2021 ROE earned by any of these UHCs.

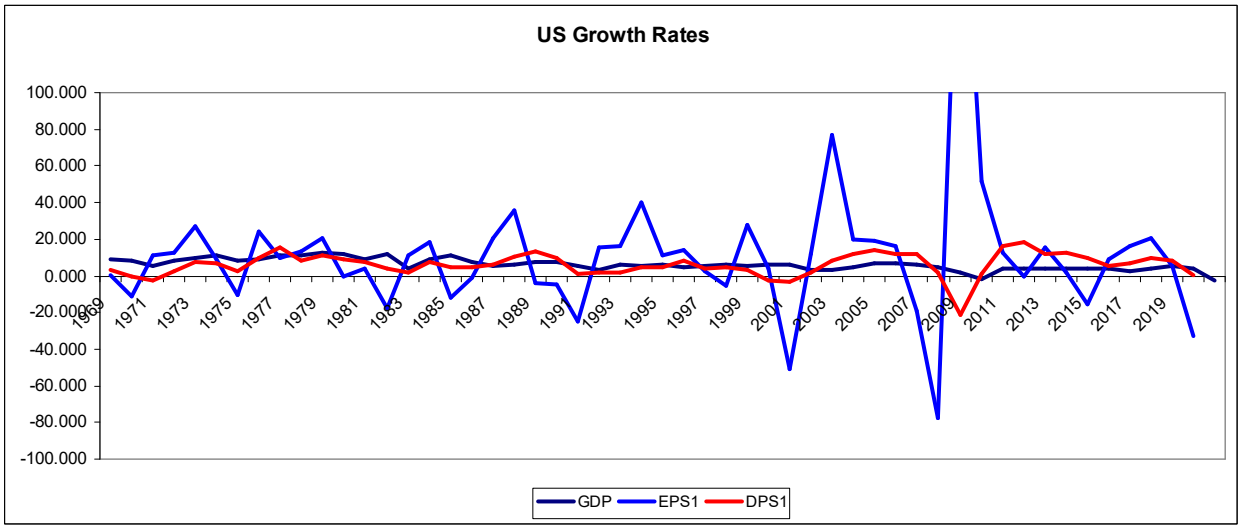
Earnings versus dividends

A final problem with the use of analyst forecasts is that they are based on earnings, not dividends, whereas the DCF model values dividends not earnings! Earnings are more volatile than dividends so that short-term earnings growth forecasts are on average higher than for dividends, even if their long run, or compound, growth rates are unbiased and the same! This is due to the common practise of smoothing dividend payments, or put another way, firms only increase their dividend after their fundamental earnings have increased and not as a result of temporary factors.

To illustrate the problem in using earnings rather than dividends I used the S&P Analyst Handbook for the S&P500 index. This index comprises most of the value of US companies and is representative of Corporate USA. It includes EPS and DPS data from which I calculated annual growth rates. I did the same for the nominal GDP series available in the Federal Reserve Bank of St Louis Economic data bank (FRED, GDPA). The following is a graph of the EPS and DPS growth rates starting in 1969 and finishing in 2020. The earnings series is clearly more volatile even for the index of 500 companies, which diversifies away the unique results of any individual company. We can see for example, the dramatic effect of the financial crisis when 2008 aggregate EPS dropped from $66.17 to $14.88 for a growth rate of -77.5%. The EPS of the S&P500 then recovered to $50.87 with a 242.5% increase, but the average of these two growth

[12] This just reverses g = b*ROE.

rates of 83% still left earnings below their 2007 level. In contrast, DPS slightly increased in 2008 by 1.83% before dropping in 2009 by 21.06% as firms reacted to the lower earnings with a lag.



Over the entire period from 1967, the following is the data on average growth rates:

	GDP	EPS	DPS
Average	6.25%	11.14%	6.00%
Median	5.88%	10.98%	6.40%
Volatility	3.18%	39.87%	6.26%
Compound	6.20%	5.57%	5.03%
OLS	6.19%	6.04%	5.65%

US GDP grew at 6.25% (5.88%) using the simple average (median) of the annual growth rates whereas earnings per share for the S&P500 firms "grew" at almost twice that rate at 11.14% (10.98%). In comparison, annual dividends per share grew at 6.00% (6.48%) only slightly less than GDP while the median grew slightly faster. The ordinary least squares estimate of the annual growth rates are 6.19% for GDP, 6.04% for earnings and 5.65% for dividends.

How can earnings grow so much faster than either GDP or dividends? The answer is that they can't in the very long run, as it is a *statistical oddity* similar to the difference between arithmetic

(simple average) and compound growth rates. If a stock drops 50% and then increases by 100% then it is back to where it started, and the compound growth rate is zero even though the arithmetic growth rate or simple average of -50% and+100% is +25%. The greater the volatility the bigger the difference between the arithmetic and compound growth rates of any economic series. The volatility of US GDP growth is only 3.18% versus almost twice that for dividends and 13 times that for earnings! The result is that the compound growth rate of US GDP was 6.20% over this very long period only slightly less than the simple arithmetic growth rate. In contrast, dividends per share grew at 5.03% or 0.97% below the arithmetic growth rate mainly due to 2020, but earnings grew at a compound growth rate of 5.57%, slightly below GDP and fully 5.57% or exactly half the arithmetic growth rate. ***Generally, this means that the true long run growth rate of earnings is half that of the simply average growth rate due to the volatility in earnings.***

Finally, the "best" estimate of the growth rate is normally that obtained by using ordinary least squares (OLS) since this statistical procedure minimises the variability around the estimated annual growth rate. For GDP it lowers the growth rate estimate to 6.19%, which is almost the same as the earnings growth rate estimate of 6.04%. For dividends, it lowers the growth rate to 5.65% or 0.39% below the GDP growth rate. Possibly the lower dividend growth rate reflects the cumulative impact of share buybacks, but the problem is that the impact of these buybacks should show up in a higher earnings per share growth rate and it does not.

What this means is that analyst growth expectations are biased inputs into the constant growth model, even if the analysts themselves are neither fraudulent nor suffering from the optimism bias. This is because the limited growth forecasts that are available are all relatively short term and at most for five years. This is very short-term relative to infinity! Long term, the best estimate for earnings growth for the overall stock market is the growth rate in GDP, since both EPS and DPS growth have broadly tracked GDP growth since 1969.

I would also note that these comments obviously apply to the US utilities as well. Until 2018 S&P produced an Analyst Handbook that had earnings and dividends for the utility sector similar

to that for the Index as a whole. Further S&P sub divided utilities into gas, electric and multi-utilities. However, even in the 2018 edition there was no data for gas utilities after 2015 since they had been acquired.[13] However, for the overall utility index the growth rates were as follows:

	EPS	DPS	GDP
Average	4.25%	3.10%	6.49%
Median	3.91%	4.10%	5.99%
Volatility	20.46%	12.81%	3.18%
Compound	2.04%	2.37%	6.45%
OLS	1.34%	1.67%	6.11%

Over the period from 1967-2017 US GDP grew on average (median) 6.49% (5.99%), both slightly above the full period due to the absence of the 2020 negative growth rate. In contrast, these US utilities had average (median) dividend per share growth of 3.1% (4.10%) with average (median) earnings growth of only 4.25% and 3.91%. The compound growth rates are even worse at 2.04% for earnings and 2.37% for dividends, while the least squares regression results are worse still at 1.34% and 1.67%. The reason for the latter two is that they implicitly put more weight on the later performance where the utility EPS was $12.01 in 2017, but was also $12.36 in 2009, and $10.48 as far back as 1993. So, there is little evidence of significant earnings growth even in nominal terms let alone real terms

This evidence from the S&P500 utility data is for the larger utilities included in the S&P500 index and this reflects the problems of holding companies like Duke Energy and PG&E. However, this is also in the minds of investors in utility stocks in the U.S. From this data it is extremely difficult to justify U.S utilities growing at rates higher than the US GDP growth rate as is implied in the use of analyst growth forecasts. It is also difficult to justify including growth at the GDP growth rate when a multi-stage DCF model is used. I would regard long run growth at

[13] What is playing out in the utility sector is very similar to what happened prior to the passage of the PUHCA in the U.S in 1935 when the SEC took significant responsibility for supervising U.S utilities because of double leverage at the holding company level.

65-68% of the GDP growth rate as being reasonable based on actual experienced median growth rates.[14] This would mean 3.3-3.4% long run growth rates based on a 5% GDP growth rate, which with a 3.51% median yield would mean a DCF equity cost of 6.9-7.0%. This estimate is broadly consistent with the sustainable growth rate estimates and a risk hierarchy when compared with the overall stock market equity cost of 8.00-9.00%.

Conclusion

From the forgoing DCF estimates I draw the following conclusions:

- The overall equity market return in Canada is in a range 7.35%-8.0% and that for the U.S SP500 firms slightly higher at 9.3% with a reasonable range of 8.0-9.0%.

- The individual DCF estimates for US gas companies based on analyst growth forecasts would put their equity cost at 8.66-9.15%. However, these forecasts are biased high and inaccurate estimates of their underlying DPS growth rates. Removing this bias by using sustainable growth forecasts lowers this estimate to 6.91-7.25%.

- Analyst earnings growth rate forecasts are optimistic (biased) estimates of dividend growth rates since earnings are much more volatile. Over long periods of time, the growth rate of earnings and dividends for S&P500 firms is approximately that of US GDP. However, simple average growth rates of earnings, which are what analysts forecast, are almost twice as high as for dividends making them biased when used in the constant growth DCF model.

- Utility earnings and dividend growth rates since 1967 confirm that over very long periods neither have grown at close to the US GDP growth rate. This is what logic would dictate since their dividend yields are twice that of the SP500 index meaning that with the same forecast growth rate their equity cost is higher. Logic and actual beta estimates confirm that these U.S. UHCs are lower risk due to the impact of regulation.

- My best estimate is that U.S utilities can grow at 65-68% of the growth rate of U.S GDP in the long run, which is the historic experience since 1967. This implies a DCF equity cost less than 7.0%. Adding a 0.50% floatation cost allowance implies a fair rate of return similar to my estimates for Canadian UHCs of 7.5%

[14] Actual ratios are EPS (3.91/5.99) or 65% and DPS 4.1/5.99 or 68%.

SCHEDULE 1

YEAR	BEGINNING BOOK VALUE PER SHARE	EARNINGS PER SHARE	DIVIDEND PER SHARE	RETENTIONS PER SHARE
1	20.00	2.40	1.20	1.20
2	21.20	2.54	1.27	1.27
3	22.47	2.70	1.35	1.35
4	23.80	2.86	1.43	1.43
5	25.24	3.03	1.52	1.52

ASSUMPTIONS: Return on Equity = 12%
Dividend Payout = 50%
Cost of Equity = 10%

SCHEDULE 2

YEAR	BEGINNING BOOK VALUE PER SHARE	EARNINGS PER SHARE	DIVIDENDS PER SHARE	RETENTIONS PER SHARE
1	20.00	2.40	1.20	1.20
2	21.20	2.54	1.32	1.22
3	22.40	2.69	1.45	1.24
4	23.70	2.83	1.59	1.25
5	24.90	2.99	1.73	1.26

ASSUMPTIONS:

Return on Equity	=	12%
Dividend Payout	=	50% + 2% p.a.
Required Return	=	10%

Definition of the Sustainable Growth rate

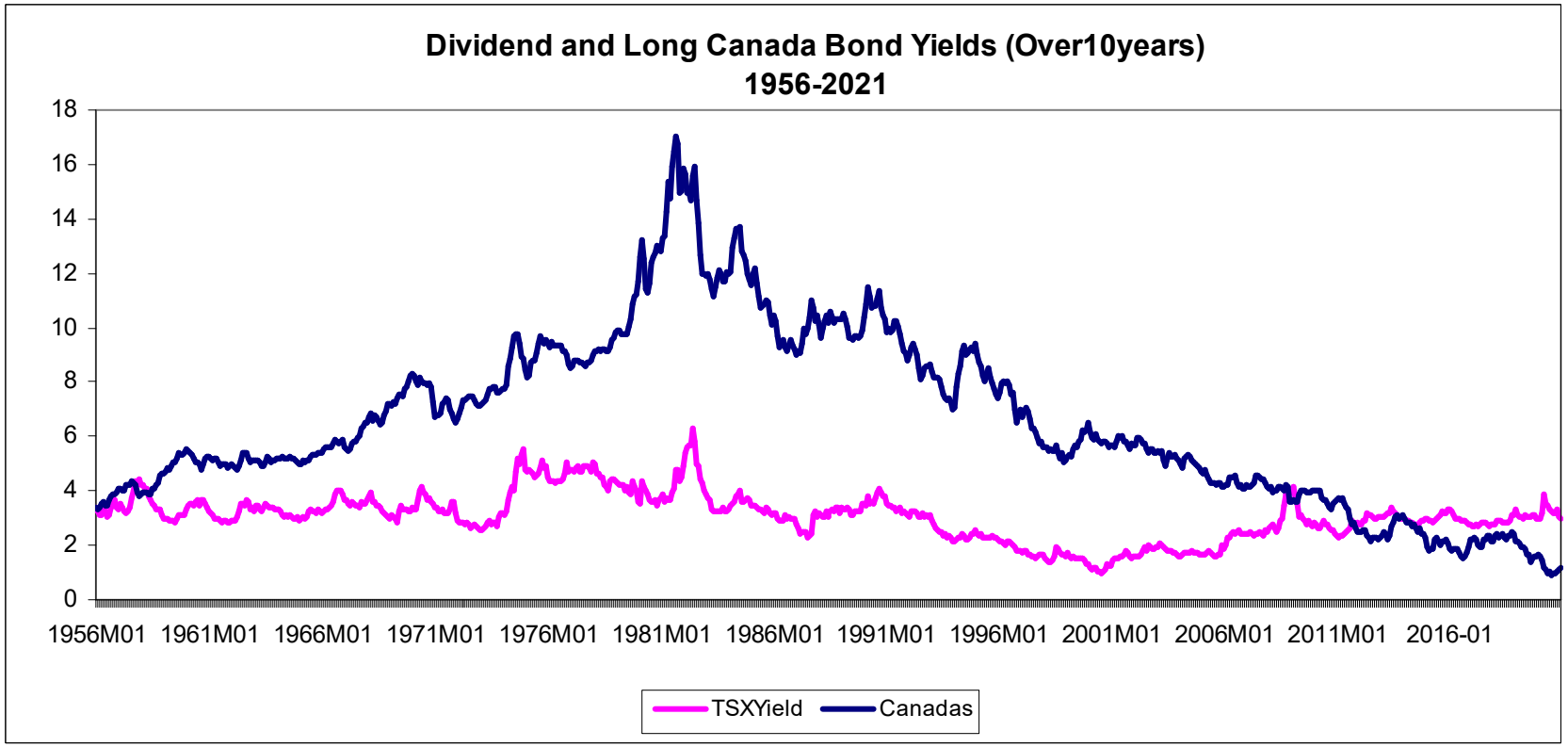
(From the Financial Post Corporate Analyzer data base)

Sales (CY − 1)

X401 - Sustainable Growth (%) - This calculation is the rate at which company sales can increase without the company experiencing financial strain or requiring additional financing to fund continued growth. Many executives believe growth should be maximized. In reality, uncontrolled growth can result in financial strain or worse, bankruptcy, if not managed properly. Conversely, lack of growth can make a company vulnerable to a takeover. To determine the possible strategies the company may employ in managing their growth, see the Growth Rates Section which describes the ratio combination of Sales Growth and the Sustainable Growth rate.

$$ROE \times \left(1 - \left(\frac{\text{Common Dividends}}{\text{Net Income before Discontinued Operations} - \text{Preferred Dividends}}\right)\right)$$

SCHEDULE 4

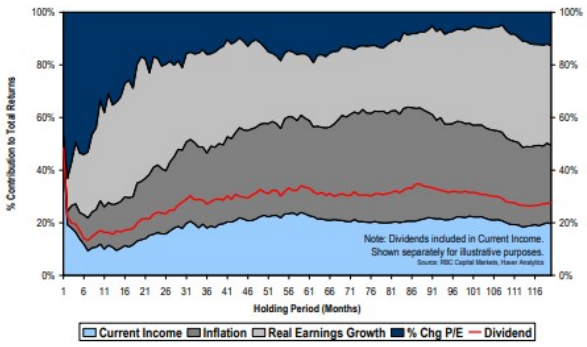

Dividend and Long Canada Bond Yields (Over10years)
1956-2021
18
16
14
12
10
8
6
4
2
0
1956M01
1961M01
1966M01
1971M01
1976M01
1981M01
1986M01
1991M01
1996M01
2001M01
2006M01
2011M01
2016-01
TSXYield
Canadas

A Supply-Side Framework: The Grinold-Kroner-Siegel Model

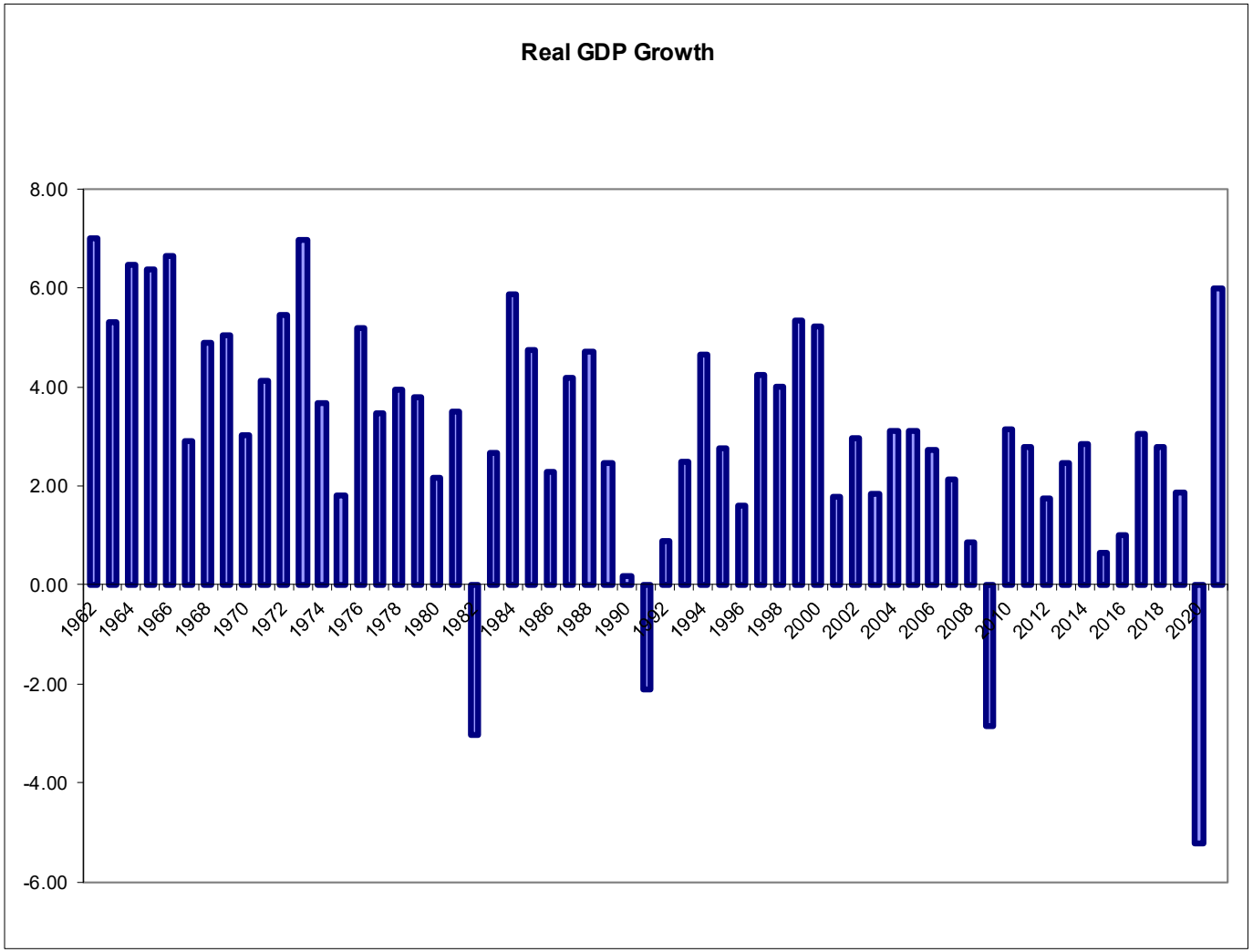
$$R = \underbrace{\frac{D}{P}}_{\text{Income}} \underbrace{- \Delta S + i + g}_{\text{Earnings Growth}} \underbrace{+ \Delta PE}_{\text{Repricing}}$$

- Supply-side models look at what the economy or, more specifically, the group of stocks in question, can supply the market in the way of earnings and ultimately cash flows. The advantage of this framework is that it decomposes market returns into a few easy to think about factors.
- We focus on the intuitive Grinold-Kroner-Siegel model, which consists of 5 factors that approximate total equity returns. These factors can be broadly grouped into the following three components: (1) Income, made up of dividend yield less net share issuance; (2) Earnings Growth, made up of inflation plus real aggregate earnings growth; and (3) Repricing, which is the change in the PE ratio.

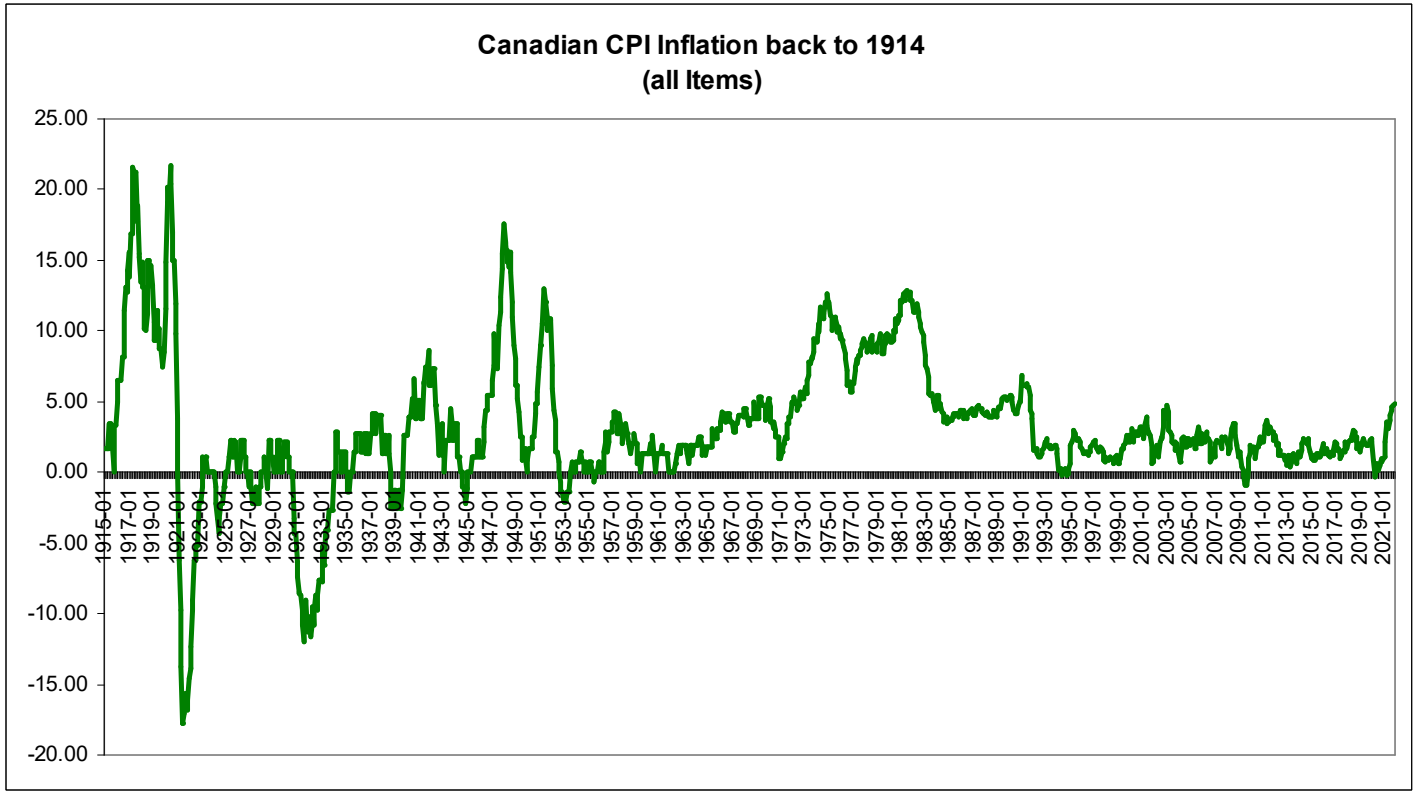
- Evaluating this model using historical data shows that ~50% of earnings growth is attributable to inflation and that income, notably dividends, is an important part of returns. And, as we have shown numerous times in the past, psychology (PE change) is a key driver of short-term returns. Over the longer term, however, real EPS growth is the major contributor to equity returns.
- We now need to establish a forward-looking (let's say, a decade long) estimate for each of the three broadly defined components in order to come closer to an equity return estimate. The steps to do this will be provided over the next few pages.



SCHEDULE 6


Real GDP Growth
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020

SCHEDULE 7


Canadian CPI Inflation back to 1914
(all Items)
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
1915-01
1917-01
1919-01
1921-01
1923-01
1925-01
1927-01
1929-01
1931-01
1933-01
1935-01
1937-01
1939-01
1941-01
1943-01
1945-01
1947-01
1949-01
1951-01
1953-01
1955-01
1957-01
1959-01
1961-01
1963-01
1965-01
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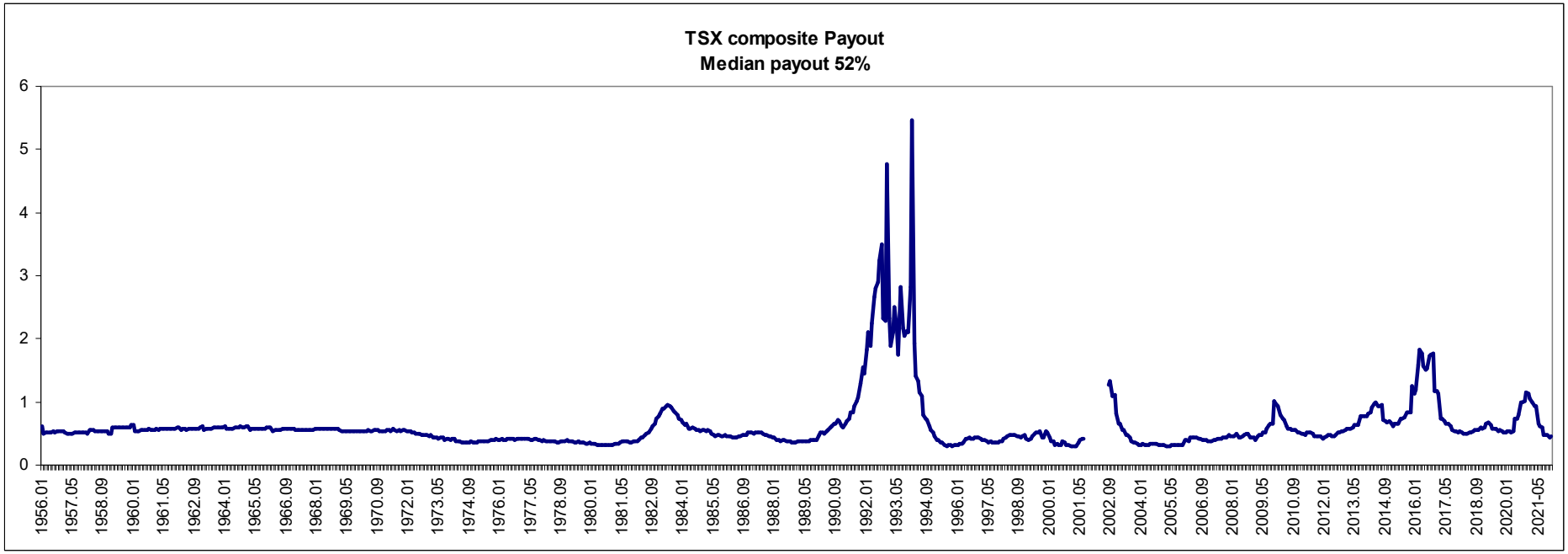
1985-01
1987-01
1989-01
1991-01
1993-01
1995-01
1997-01
1999-01
2001-01
2003-01
2005-01
2007-01
2009-01
2011-01
2013-01
2015-01
2017-01
2019-01
2021-01

SCHEDULE 8


TSX composite Payout
Median payout 52%
6
5
4
3
2
1
0
1956.01
1957.05
1958.09
1960.01
1961.05
1962.09
1964.01
1965.05
1966.09
1968.01
1969.05
1970.09
1972.01
1973.05
1974.09
1976.01
1977.05
1978.09
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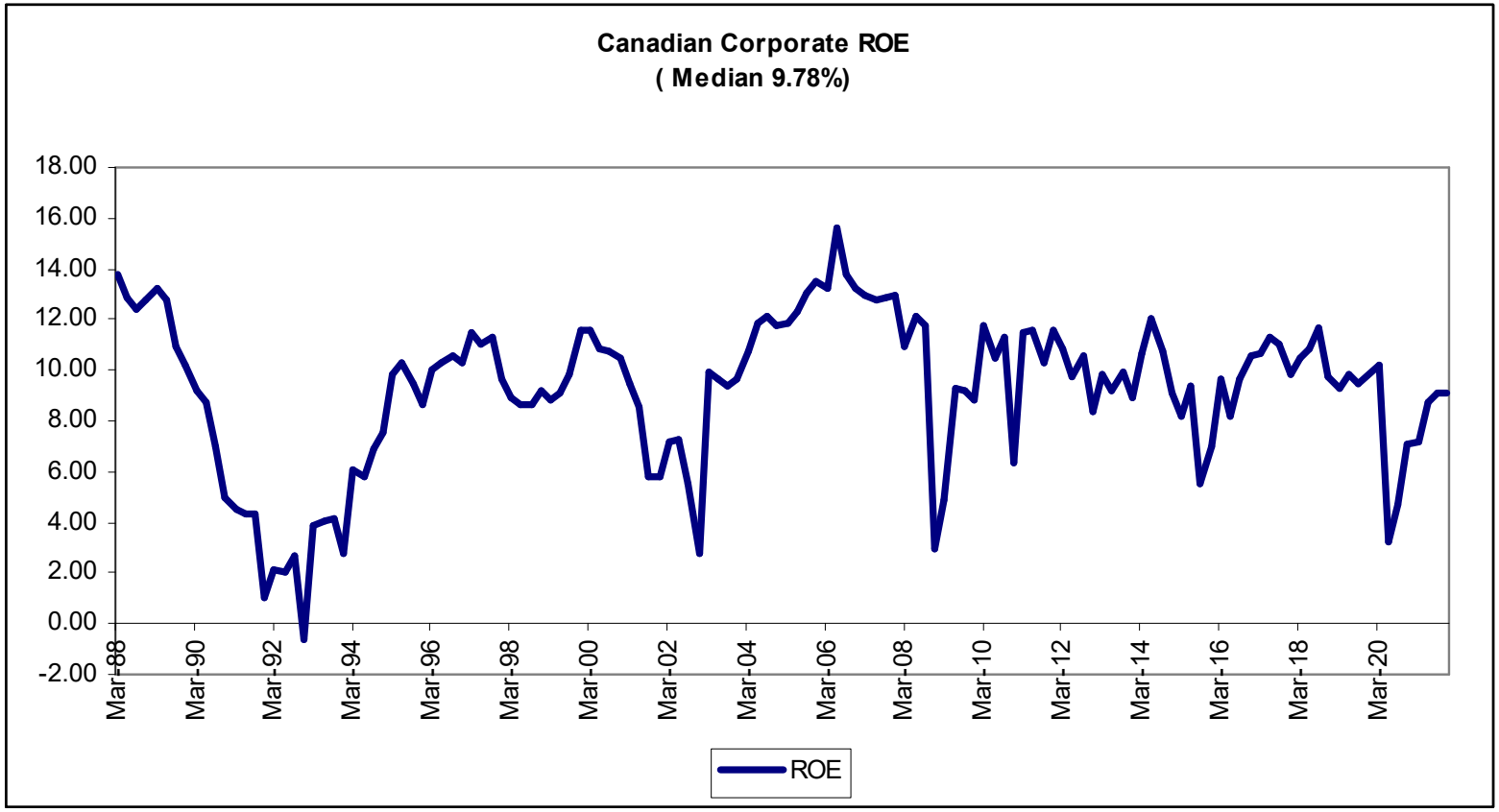
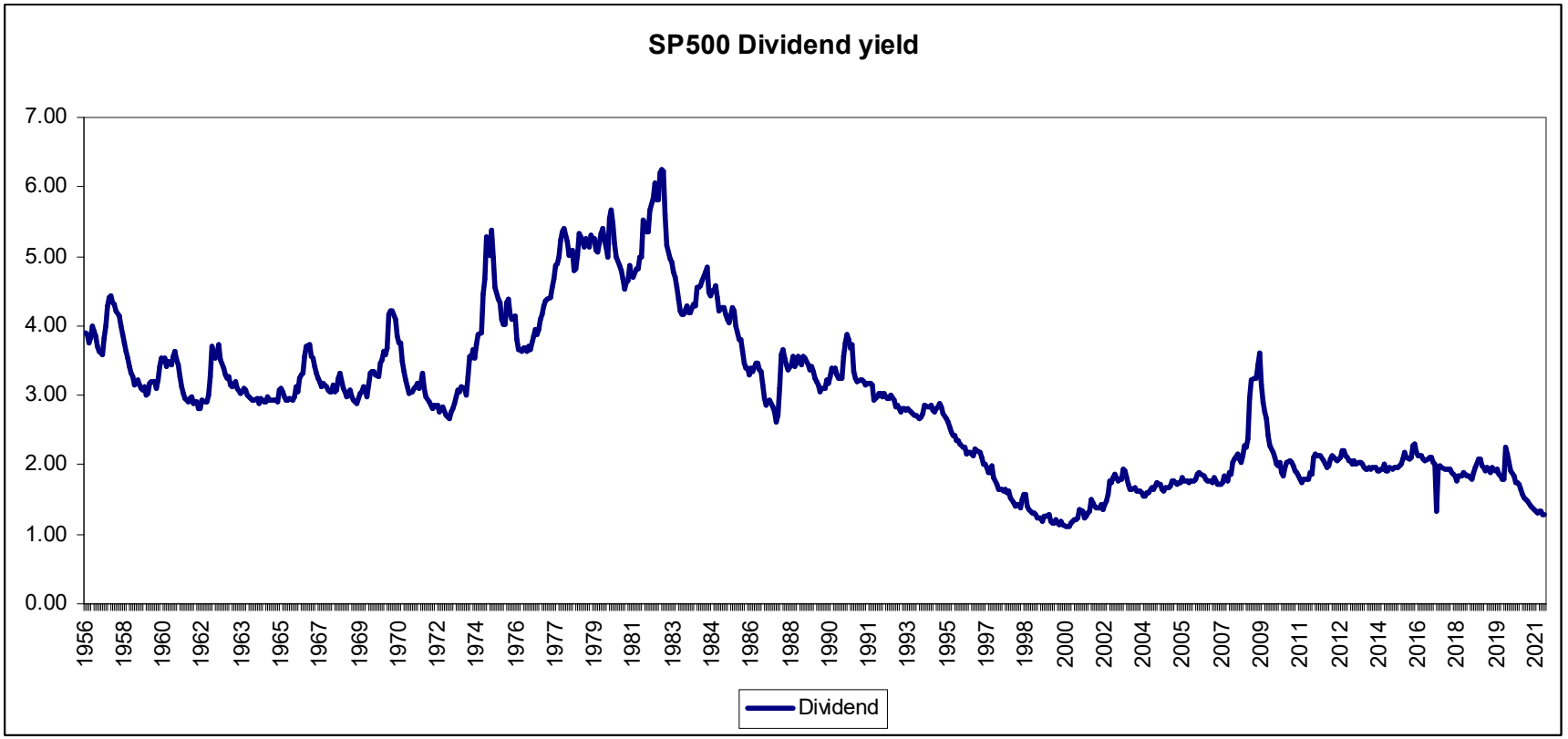
1993.05
1994.09
1996.01
1997.05
1998.09
2000.01
2001.05
2002.09
2004.01
2005.05
2006.09
2008.01
2009.05
2010.09
2012.01
2013.05
2014.09
2016.01
2017.05
2018.09
2020.01
2021-05

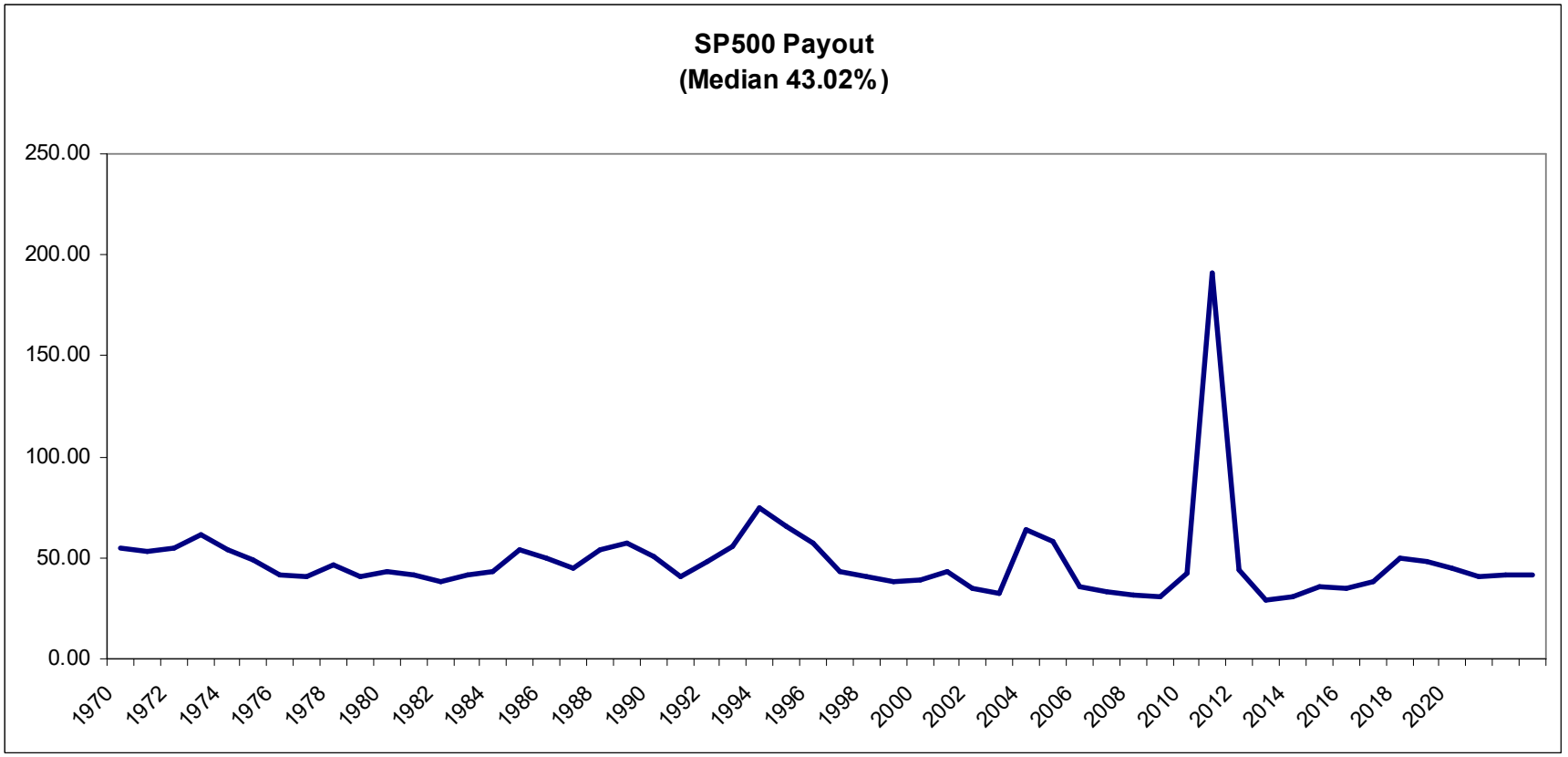
SCHEDULE 9

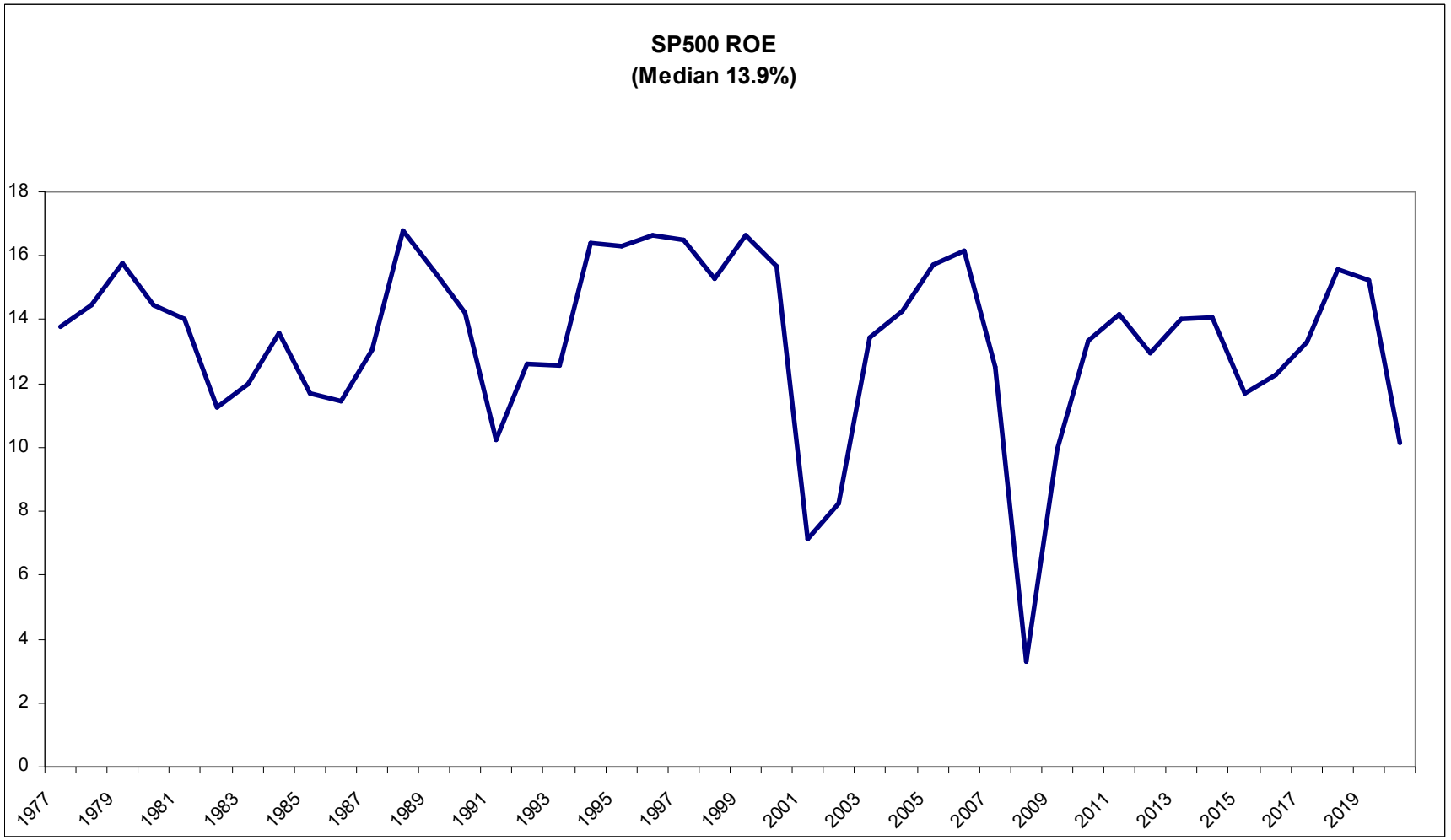


SCHEDULE 10


SP500 Dividend yield
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1956
1958
1960
1962
1963
1965
1967
1969
1970
1972
1974
1976
1977
1979
1981
1983
1984
1986
1988
1990
1991
1993
1995
1997
1998
2000
2002
2004
2005
2007
2009
2011
2012
2014
2016
2018
2019
2021
Dividend

SCHEDULE 11


SP500 Payout
(Median 43.02%)
250.00
200.00
150.00
100.00
50.00
0.00
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020


SP500 ROE
(Median 13.9%)
18
16
14
12
10
8
6
4
2
0
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019

US Gas UHC Data

	MKT Value $billion	Past growth	Future growth	# Analysts	Yield	K (*Est g*)	ROE	Retention	SUST G	K (*SG*)	MB	DPS	EPS
One Gas	4.15	15.32	2.9	7	3.02	***6.01***	9.05	0.40	3.63	***6.76***	1.79	2.28	3.81
Northwest Natural	1.43	-5.39	5.9	6	4.12	***10.26***	9.62	0.35	3.34	***7.60***	1.6	1.92	2.94
New Jersey Resources	3.96	50.73	6	5	3.46	***9.67***	8.68	0.10	0.85	***4.33***	2.24	1.39	1.54
Spire	3.32	-3.96	4.3	7	4.19	***8.67***	9.07	0.39	3.55	***7.89***	1.34	2.63	4.32
ATMOS	14.13	8.41	7.25	8	2.21	***9.62***	8.89	0.52	4.59	***6.90***	1.73	2.56	5.29
South West Gas	3.97	6.39	4	5	3.56	***7.70***	10.15	0.42	4.27	***7.98***	1.36	2.33	4.02
Average	5.16	11.92	5.06	6.33	3.43	8.66	9.24	0.36	3.37	6.91	1.68		
Median	3.97	7.40	5.10	6.50	3.51	9.15	9.06	0.40	3.59	7.25	1.67		

growth is over the past 5 years and that expected for the next five years
MKT Va; is the market value or capitalisation
K(*Est g*) is the implied discount rate using the analyst growth forecast
K (*SG*) is the growth using the current ROE and retentiionr rate

ment of Lloyd's itself on a hypothetical hacker-caused blackout of the entire power grid of the American north-east. It estimated this would cause direct losses to business revenues of $222bn, and a total dent in GDP of over $1trn over five years.

Many insurers are turning to outside expertise. Matt Webb of Hiscox, a specialist insurer, describes an "arms race" between analytics firms such as RMS and Symantec, offering their long-standing modelling prowess (RMS is already well-trusted on hurricane modelling, for example) to help insurers understand their cyber-liabilities.

But even if exposures are better understood, limiting them may prove tricky. Kevin Kalinich of Aon, an insurance-broker, points to the near-impossibility of drawing a line, for example, between cyber-war or cyberterrorism and "normal" hacking. Cyber-crime knows no geographical bounds, unlike, say, a Florida hurricane. Mr Webb reckons that insurance policies will at a minimum need explicitly to recognise that cyber-risks are covered or to exclude them—just as many policies already include exemptions for terrorism or war.

Although insurers are already helping companies with more humdrum data breaches, the industry still lacks a clearly formulated response to a larger-scale cyber-calamity. Inga Beale, CEO of Lloyd's, is optimistic that the market, thanks to its exacting modelling exercises and its unique risk-sharing structure, is better equipped than most. But only a devastating, real-life cyber-attack would test how effective its preparations have been. ■

Analyst forecasts

Discounting the bull

Stock analysts' forecasts tend to be wrong in reassuringly predictable ways

"SELL-SIDE" analysts, whose firms make money from trading and investment banking, are notoriously bullish. As one joke goes, stock analysts rated Enron as a "can't miss" until it got into trouble, at which point it was lowered to a "sure thing". Only when the company filed for bankruptcy did a few bold analysts dare to downgrade it to a "hot buy".

Economic research shows that there is some truth to the ribbing. The latest figures from FactSet, a financial-data provider, show that 49% of firms in the S&P 500 index of leading companies are currently rated as "buy", 45% are rated as "hold", and just 6% are rated as "sell". In the past year, 30% of S&P 500 companies yielded negative returns.

Profits forecasts made more than a few months ahead have a dismal record of inaccuracy. According to Morgan Stanley, a bank, forecasts for American firms' total annual earnings per share made in the first half of the year had to be revised down in 34 of the past 40 years. Studying their forecasts over time reveals a predictable pattern (see chart 1).

In theory, a diligent share analyst should do his own analysis—that is, by projecting a firm's future revenue and expenses, and discounting them to the present. Such models, however, are extremely sensitive to different assumptions of growth rates. Since no one can know the future, analysts cheat.

Three statistical sins are common. Analysts can look at comparable companies to glean reasonable profits estimates, and then work backwards from their conclusions. Or they can simply echo what their peers are saying, and follow the herd. Or, most important, they can simply ask the companies they are following what their actual earnings numbers are.

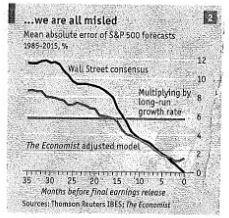
Surveys conducted by Lawrence Brown of Temple University found that two-thirds of sell-side analysts found private calls with company managements to be "very useful" in making their estimates. Analysts' need to maintain relationships with the companies they cover must colour their projections. They are judged primarily on the accuracy of their short-term forecasts, so there is little risk in issuing flattering, if unrealistic, long-term projections. In the short run, however, they have an incentive to issue ever-so-slightly pessimistic forecasts, so companies can "beat" expectations. Since the financial crisis, company profits have exceeded short-term analyst forecasts around 70% of the time.

So are forecasts are useless? Simply taking the market's earnings figures from the previous year and multiplying by 1.07 (corresponding with the stockmarket's long-run growth rate) can be expected to yield a more accurate forecast of profits more than a year in the future.

Yet the very predictability of the errors in analysts' forecasts suggests they could be informative, if they are properly interpreted. Taking forecasts of S&P 500 earnings from 1985-2015, *The Economist* has built a simple statistical model to try to take out the bias that taints Wall Street's prognostications. After controlling for the forecasts' lead time and whether or not they were made during a recession, we find that even our relatively crude model can improve upon the Wall Street consensus for forecasts made more than a quarter in advance (see chart 2).

Adjusting for bias in short-term forecasts is harder. It is tempting simply to accept the errors—after all, they tend to be off by just a little. Data from Bloomberg show that the 320 S&P 500 companies that beat earnings expectations in 2015 did so only by a median of 1.4%. An alternative is to look at crowdsourcing websites such as Estimize. There punters—some amateur, and some professional—are shown Wall Street consensus estimates and asked to make their own forecasts. Estimize users beat Wall Street estimates two-thirds of time.

To some extent, judging Wall Street by its ability to make accurate predictions is silly. Harrison Hong, an economist at Columbia University, reckons that stock analysts should be viewed "more like media". The latest forecasts aggregated by Thomson Reuters suggest that the S&P 500 will yield earnings per share of $130.83 in 2017 and $146.33 in 2018. According to our model, that would imply that they believe the actual numbers will be closer to $127.85 and $134.30. Share analysts want to tell the truth. They just like making it difficult. ■



Wall St.'s woeful forecasting not getting better

David Parkinson The Globe and Mail

PublishedFriday, May. 21 2010, 6:00 PM EDT

http://www.theglobeandmail.com/globe-investor/investment-ideas/wall-sts-woeful-forecasting-not-getting-better/article4353202/

Nearly a decade ago - about the time the bursting tech bubble had raised serious questions about conflicts of interest in Wall Street equity research - consulting firm McKinsey & Co. did a study on the accuracy of analysts' company earnings forecasts. The results were discouraging: Analysts were routinely over-optimistic about earnings growth, too slow to revise forecasts when economic conditions changed, and prone to increasingly inaccurate forecasts when the economy slowed.

Since then, major scandals involving tainted research have come to light, Wall Street's biggest firms have paid $1.4-billion (U.S.) in penalties for those practices, and regulators have put rules in place aimed at creating equity research with more independence and distance from the investment-banking side of the business. Unfortunately, McKinsey reports, the changes have had little effect on the accuracy of analysts' projections.

Downturn reveals same old habits In an update of the 2001 study, McKinsey researchers found that from 2003 to 2006, analysts' earnings projections actually did look less unrealistically rosy. In each of those years, analysts, on average, actually underestimated S&P 500 annual earnings for significant portions of the year - and undershot through the entire year in 2005 and 2006.

But lest we think this was evidence of a new kind of thinking within Wall Street research departments, the Street's wide-eyed optimism came back with a vengeance starting in 2007.

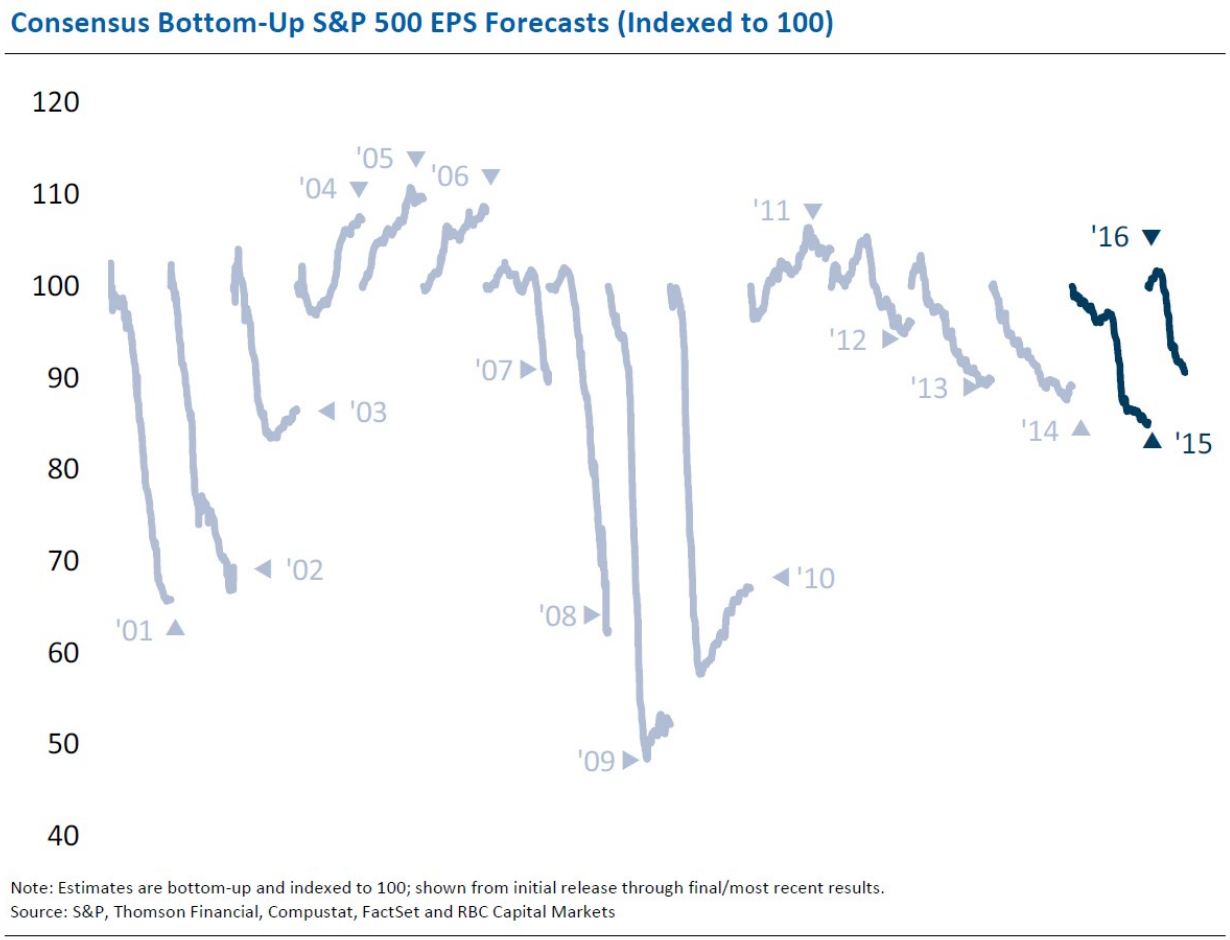
Going back over the past 25 years, McKinsey found that, on average, analysts' earnings-growth forecasts "have been nearly 100-per-cent too high." Annual S&P 500 consensus growth forecasts have typically been in the 10- to 12-per-cent range, while actual earnings growth has averaged 6 per cent.

Broken-clock accuracy Looking at five-year rolling average growth estimates, there have only been two periods in the past 25 years when the earnings met or exceeded analysts' forecasts. Both were in recovery periods after the U.S. recessions of the early 1990s and the early 2000s.

"This pattern confirms our earlier findings that analysts typically lag behind events in revising their forecasts to reflect new economic conditions," McKinsey researchers wrote. "When economic growth accelerates, the size of the forecast error declines; when economic growth slows, it increases."

This pattern means that when the analysts are accurate with their forecasts, it's sort of the same way a broken clock is accurate - twice a day.

"As economic growth cycles up and down, the actual earnings S&P 500 companies report occasionally coincide with the analysts' forecasts."



Source: RBC Investment Strategy Playbook, February 2016