

PROPOSED REVISIONS TO THE BOARD'S METHODOLOGY FOR DETERMINING THE  
RAILROAD INDUSTRY'S COST OF CAPITAL

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WRITTEN TESTIMONY  
SUBMITTED BY  
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248771

ENTERED  
Office of Proceedings  
November 4, 2019  
Part of  
Public Record

1. INTRODUCTION

There has been disagreement with the Surface Transportation Board's (the "Board") use of two models to estimate the cost of equity capital, the CAPM and the MSDCF in large part due to the differences in the cost of capital estimates.

An important distinction between those two models is the use of expected growth rates in cash flows in the MSDCF. Stage one uses growth rates specific to the individual railroads (i.e., their organic cash flow growth rates expected without the impact on growth in the year of any unknown future acquisitions) and step two uses a growth rate for the railroad industry as the companies exist. In the third stage (years 11 and onwards), the growth rate that has been employed is the long-run nominal growth rate of the U.S. economy. This long-run nominal growth rate is estimated by using the historical growth in real Gross Domestic Product ("GDP") plus the long-run expected inflation rate.

After studying the data, I have concluded that this may be an incorrect specification for the stage three growth rate in this application of the MSDCF.

This stage three growth rate is inconsistent with the growth rates for stages one and two. The stage three growth rate as has been defined might be applicable were we trying to estimate the

average cost of equity capital for the macroeconomy (i.e., the economy as a whole). But it may be the incorrect specification for estimating the cost of equity capital for the railroads. Therefore, a consistent definition for this application of the MSDCF would be the expected long-term organic growth rate in cash flows for the railroad industry.

That distinction is important because if the stage three growth rate estimate is too high, the resulting cost of equity capital estimate from the MSDCF will be too high and will increase the difference with the estimate resulting from the CAPM.

I am submitting this comment to assist the Board in better understanding of the underlying data used in the MSDCF (and the data that would be used in the proposed Step MSDCF).

## 2. MY BACKGROUND

I am a Managing Director of Duff & Phelps. Duff & Phelps is the global advisor that protects, restores and maximizes value for clients in the areas of valuation, corporate finance, investigations, disputes, cyber security, compliance and regulatory matters, and other governance-related issues. We work with clients across diverse sectors, mitigating risk to assets, operations and people. With Kroll, a division of Duff & Phelps since 2018, our firm has nearly 3,500 professionals in 28 countries around the world.

I am co-author (with Shannon P. Pratt) of the *Cost of Capital: Applications and Examples* 5<sup>th</sup> ed. (John Wiley & Sons, 2014). In that book we discuss both the theory and the limitations of various models used for estimating cost of equity capital including the Capital Asset Pricing Model (“CAPM”) and the Ibbotson Multi-Stage Discounted Cash Flow Model (“MSDCF”)<sup>1</sup>.

I have been co-author of the annual Duff & Phelps *Valuation Handbook – U.S. Industry Cost of Capital* since 2014. In that book (and quarterly updates), we present the theory behind the Capital Asset Pricing Model (CAPM) and the Ibbotson Multi-Stage Discounted Cash Flow Model (MSDCF) as well as estimates of the cost of capital for many industries using these and other models.

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<sup>1</sup> The title is more correctly the Ibbotson Multi-Stage Discounted Cash Flow Model (MSDCF) as Morningstar stopped publishing books and data focused on cost of capital in 2013.

I also have been conducting research with Dr. Ashok Abbott of the University of West Virginia, on long-term growth rates in revenues and cash flows as companies move from growth phases to long-term maturity, focusing on organic growth (that is, removing the impact on growth due to acquisitions).

### 3. LONG-TERM GROWTH

The historic growth in real GDP is the result of existing companies (e.g., railroads) and new companies (e.g., technology companies). Two recognized studies on this topic are: William J. Bernstein and Robert D. Arnott, “Earnings Growth: The Two Percent Dilution” (*Financial Analysts Journal*, September/October 2003) and Bradford Cornell, “Economic Growth and Equity Investing” (*Financial Analysts Journal*, January/February 2010). I have attached copies of these papers for the convenience of the Board.

Bernstein and Arnott state:

“Thus, per share earnings and dividends grew 2 percent a year slower than the macroeconomy. If aggregate earnings and dividends grew as quickly as the economy while per share earnings and dividends were growing at an average of 2 percent a year slower, then shareholders have seen a slippage or dilution of 2 percent a year in the per share growth of earnings and dividends.

The dilution is the result of the net creation of shares as existing and new companies capitalize their businesses with equity. An often overlooked, but unsurprising, fact is that more than half of aggregate economic growth comes from new ideas and the creation of new enterprises, not from the growth of established enterprises.” (page 49)

Cornell states:

“The average rate of dilution over the entire period is 2 percent. The primary source of dilution is the net creation of new shares as new companies capitalize their businesses with equity. The impact of start-ups is not surprising in light of the fact that more than half of U.S. economic growth comes from new enterprises, not from the growth of established businesses. Given the continuing importance of start-ups, the rate of dilution is highly unlikely to subside unless the rate of innovation slows. If the rate of innovation slows, however, GDP growth will

also decline. Consequently, to conclude that the rate of growth of earnings, net of dilution, will remain largely constant is reasonable. Therefore, to estimate the growth rate of earnings to which current investors have a claim, approximately 2 percent must be deducted from the growth rate of aggregate earnings.

Putting the pieces together, we can see that growth theory predicts that current investors should count on long-run growth in real earnings of no more than 1 percent. This rate equals real growth of 3 percent in aggregate earnings, adjusted downward by 2 percent to account for dilution.” (page 61)

#### 4. RECOMMENDATION

As a result of this research, I recommend that the Board investigate the appropriate long-term growth in cash flows for railroads and potentially modifying the stage three growth rate used in the MSDCF (or to be used in the proposed Step MSDCF) to better represent the long-run expected cash flow growth of the railroads. If it is found that the appropriate long-term growth in cash flows for the railroads should be consistent with the observations of Bernstein and Arnot and Cornell, that long-run nominal growth rate would be estimated as follows:

- start with the historical growth in real GDP,
- multiply by one-third (to account for the dilution in real GDP created by new businesses),
- and add the long-run expected inflation rate.

I believe that such an adjustment would bring the estimated cost of equity capital from applying the MSDCF closer to the estimates provided by the CAPM.

Respectfully submitted:



Roger J. Grabowski

Managing Director

Duff & Phelps

# Earnings Growth: The Two Percent Dilution

William J. Bernstein and Robert D. Arnott

*Two important concepts played a key role in the bull market of the 1990s. Both represent fundamental flaws in logic. Both are demonstrably untrue. First, many investors believed that earnings could grow faster than the macroeconomy. In fact, earnings must grow slower than GDP because the growth of existing enterprises contributes only part of GDP growth; the role of entrepreneurial capitalism, the creation of new enterprises, is a key driver of GDP growth, and it does not contribute to the growth in earnings and dividends of existing enterprises. During the 20th century, growth in stock prices and dividends was 2 percent less than underlying macroeconomic growth. Second, many investors believed that stock buybacks would permit earnings to grow faster than GDP. The important metric is not the volume of buybacks, however, but net buybacks—stock buybacks less new share issuance, whether in existing enterprises or through IPOs. We demonstrate, using two methodologies, that during the 20th century, new share issuance in many nations almost always exceeded stock buybacks by an average of 2 percent or more a year.*

The bull market of the 1990s was largely built on a foundation of two immense misconceptions. Whether their originators were knaves or fools is immaterial; the errors themselves were, and still are, important. Investors were told the following:

1. With a technology revolution and a “new paradigm” of low payout ratios and internal reinvestment, earnings will grow faster than ever before. Real growth of 5 percent will be easy to achieve.

Like the myth of Santa Claus, this story is highly agreeable but is supported by neither observable current evidence nor history.

2. When earnings are not distributed as dividends and not reinvested into stellar growth opportunities, they are distributed back to shareholders in the form of stock buybacks, which are a vastly preferable way of distributing company resources to the shareholders from a tax perspective.

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William J. Bernstein is principal at Efficient Frontier Advisors, LLC, Eastford, Connecticut. Robert D. Arnott is chairman of First Quadrant, LP, and Research Affiliates, LLC, Pasadena, California.

Note: This article was accepted for publication prior to Mr. Arnott's appointment as editor of the Financial Analysts Journal.

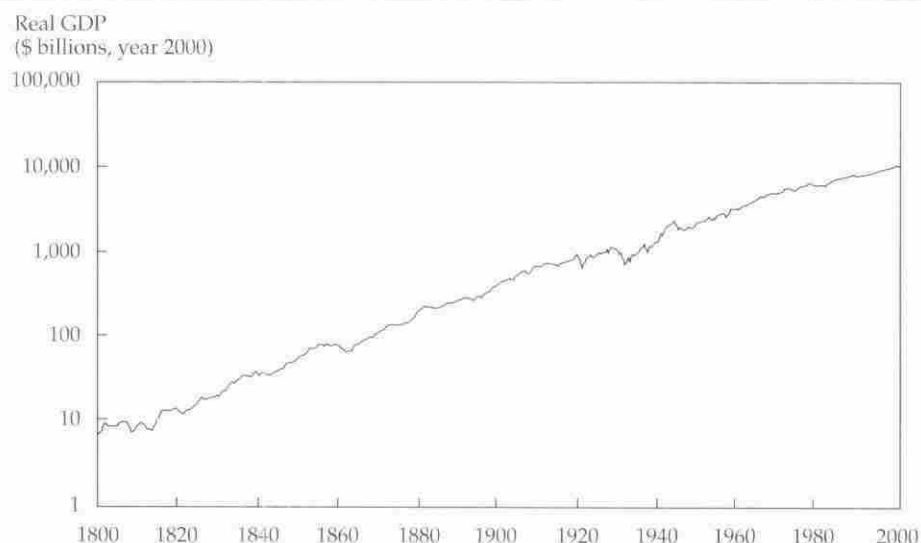
True, except that over the long term, net buybacks (that is, buybacks minus new issuance and options) have been reliably negative.

The vast majority of the institutional investing community has believed these untruths and has acted accordingly. Whether these tales are lies or merely errors, our implied indictment of these misconceptions is a serious one—demanding data. This article examines some of the data.

## Big Lie #1: Rapid Earnings Growth

In the past two centuries, common stocks have provided a sizable risk premium to U.S. investors: For the 200 years from 1802 through 2001 (inclusive), the returns for stocks, bonds, and bills were, respectively, 8.42 percent, 4.88 percent, and 4.21 percent. In the most simplistic terms, the reason is obvious: A bill or a bond is a promise to pay interest and principal, and as such, its upside is sharply limited. Shares of common stock, however, are a claim on the future dividend stream of the nation's businesses. While the investor in fixed-income securities is receiving a modest fixed trickle from low-risk securities, the shareholder is the beneficiary of the ever-increasing fruits of innovation-driven economic growth.

Viewed over the decades, the powerful U.S. economic engine has produced remarkably steady growth. **Figure 1** plots the real GDP of the United States since 1800 as reported by the U.S. Department

**Figure 1. Real U.S. GDP Growth, 1800–2000**

of Commerce. From that year to 2000, the economy as measured by real GDP, averaging about 3.7 percent growth a year, has grown a thousandfold. The long-term uniformity of economic growth demonstrated in Figure 1 is both a blessing and a curse. To know that real U.S. GDP doubles every 20 years is reassuring. But it is also a dire warning to those predicting a rapid acceleration of economic growth from the computer and Internet revolutions. Such extrapolations of technology-driven increased growth are painfully oblivious to the broad sweep of scientific and financial history, in which innovation and change are constant and are neither new to the current generation nor unique.

The impact of recent advances in computer science pales in comparison with the technological explosion that occurred between 1820 and 1855. This earlier era saw the deepest and most far reaching technology-driven changes in everyday existence ever seen in human history. The changes profoundly affected the lives of those from the top to the bottom of the social fabric in ways that can scarcely be imagined today. At a stroke, the speed of transportation increased tenfold. Before 1820, people, goods, and information could not move faster than the speed of the horse. Within a generation, journeys that had previously taken weeks and months involved an order of magnitude less time, expense, danger, and discomfort. Moreover, important information that previously required the same long journeys could now be transmitted instantaneously.

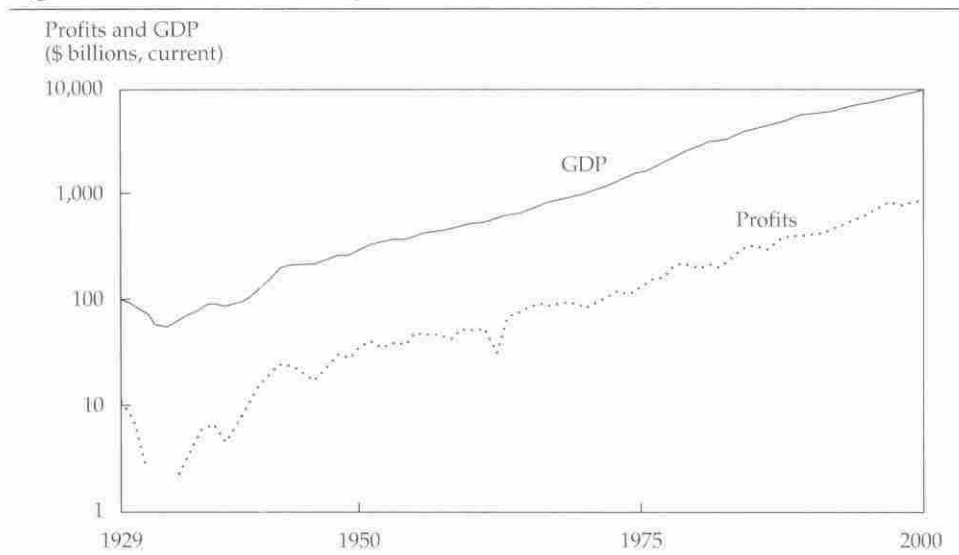
The average inhabitant of 1820 would have found the world 35 years later incomprehensible, whereas a person transported from 1967 to 2002 would have little trouble understanding the inter-

vening changes in everyday life. From 1820 to 1855, the U.S. economy grew sixfold, four times the growth seen in the “tech revolution” of the past 35 years. More importantly, a close look at the right edge of Figure 1—the last decade of the 20th century—shows that the acceleration in growth during the “new paradigm” of the tech revolution of the 1990s was negligible when measured against the broad sweep of history.

The relatively uniform increase in GDP shown in Figure 1 suggests that corporate profits experienced a similar uniformity in growth. And, indeed, **Figure 2** demonstrates that, except for the Great Depression, during which overall corporate profits briefly disappeared, nominal aggregate corporate earnings growth has tracked nominal GDP growth, with corporate earnings remaining constant at 8–10 percent of GDP since 1929. The trend growth in corporate profits shown in Figure 2 is nearly identical, within a remarkable 20 bps, to the trend growth in GDP.<sup>1</sup>

Cannot stock prices also, then, be assumed to grow at the same rate as GDP? After all, a direct relationship between aggregate corporate profits and GDP has existed since at least 1929. The problem with this assumption is that per share earnings and dividends keep up with GDP *only if* no new shares are created. Entrepreneurial capitalism, however, creates a “dilution effect” through new enterprises and new stock in existing enterprises. So, per share earnings and dividends grow considerably slower than the economy.

In fact, since 1871, real stock prices have grown at 2.48 percent a year—versus 3.45 percent a year for GDP. Despite rising price-earnings ratios, we observe a “slippage” of 97 bps a year between stock

**Figure 2. Nominal U.S. Corporate Profits and GDP, 1929–2000**

prices and GDP. The true degree of slippage is much higher because almost half of the 2.48 percent rise in real stock prices after 1871 came from a substantial upward revaluation. The highly illiquid industrial stocks of the post-Civil War period rarely sold at more than 10 times earnings; often, they sold for multiples as low as 3 or 4 times earnings. These closely held industrial stocks gave way to instantly and cheaply tradable common shares, which today are priced nearly an order of magnitude more dearly.

Until the bull market of 1982–1999, the average stock was valued at 12–16 times earnings and 20–25 years' worth of dividends. By the peak of the bull market, both figures had tripled. Although the bull market was compressed into 18 years of the total period under discussion, this tripling of valuation levels was worth almost 100 bps a year—even when amortized over the full 130-year span. Thus, per share earnings and dividends grew 2 percent a year slower than the macroeconomy. If aggregate earnings and dividends grew as quickly as the economy while per share earnings and dividends were growing at an average of 2 percent a year slower, then shareholders have seen a slippage or dilution of 2 percent a year in the per share growth of earnings and dividends.

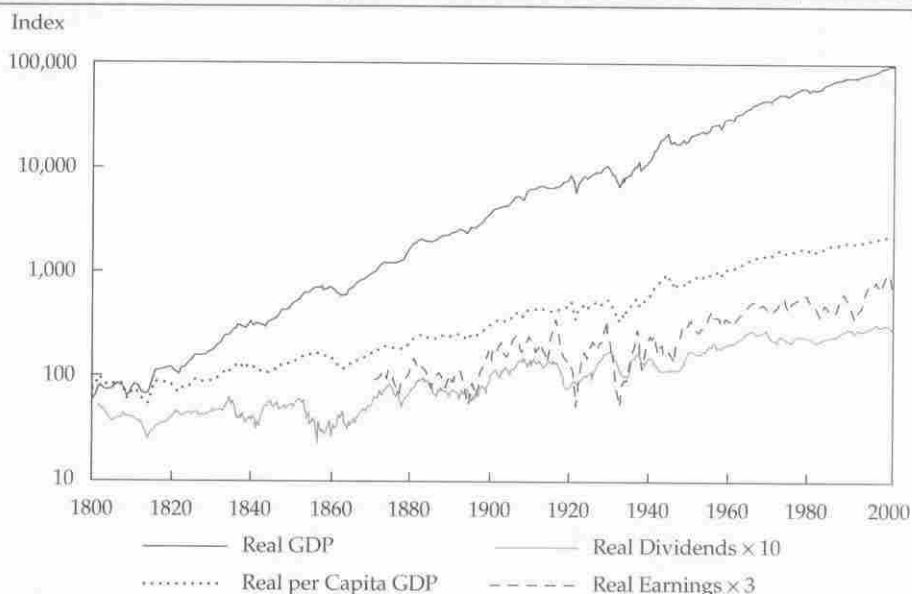
The dilution is the result of the net creation of shares as existing and new companies capitalize their businesses with equity. An often overlooked, but unsurprising, fact is that more than half of aggregate economic growth comes from new ideas and the creation of new enterprises, not from the growth of established enterprises. Stock investments can participate only in the growth of estab-

lished businesses; venture capital participates only in the new businesses. The same investment capital cannot be simultaneously invested in both.

"Intrapreneurial capitalism," or the creation of new enterprises within existing companies, is a sound engine for economic growth, but it does not supplant the creation of new enterprises. Nor does it reduce the 2 percent gap between economic growth and earnings and dividend growth.

Note also that earnings and dividends grow at a pace very similar to that of per capita GDP (with some slippage associated with the "entrepreneurial" stock rewards to management). Consider that per capita GDP is a measure of productivity (with slight differences for changes in the work force) and aggregate economic wealth per capita can grow only in close alignment with productivity growth. Productivity growth is also the key driver of per capita income and of per share earnings and dividends. Accordingly, no one should be surprised that *per capita GDP, per capita income, per share earnings, and per share dividends—all grow in reasonably close proportion to productivity growth.*

If earnings and dividends grow faster than productivity, the result is a migration from return on labor to return on capital; if earnings and dividends grow more slowly, by a margin larger than the stock awards to management, then the economy migrates from rewarding capital to rewarding labor. Either way, such a change in the orientation of the economy cannot continue indefinitely. **Figure 3** demonstrates the close link between the growth of real corporate earnings and dividends and the growth of real per capita GDP; note that all of these measures exhibit growth far below the growth of real GDP.

**Figure 3. Link of U.S. Earnings and Dividends to Economic Growth, 1802–2001**

Note: Real GDP, real per capita GDP, and real stock prices were all constructed so that the series are on a common basis of January 1802 = 100.

## A Global Laboratory

Is the United States unique? For an answer, we compared dividend growth, price growth, and total return with data on GDP growth and per capita GDP growth for the 16 countries covered by Dimson, Marsh, and Staunton (2002) spanning the 20th century.<sup>2</sup> The GDP data came from Maddison's (1995, 2001) world GDP survey for 1900–1998 and International Finance Corporation data for 1998–2000. The interrelationships of the data shown in **Table 1** are complex:

- The first column contains the real return (in U.S. dollars) of each national stock market.
- The second is real per share dividend growth.
- The third is real aggregate GDP growth for each nation (measured in U.S. dollars).
- The fifth is growth of real per capita GDP (measured in U.S. dollars).
- Thus, the fourth column measures the gap between growth in per share dividends and aggregate GDP—an excellent measure of the leakage that occurs between macroeconomic growth and the growth of stock prices.
- The last column represents the gap between the growth in per share dividends and per capita GDP.

For the full 16-nation sample in Table 1, the average gap between dividend growth and the growth in aggregate GDP is a startling 3.3 percent. The annual shortfall between dividend growth and per capita GDP growth is still 2.4 percent.

The 20th century was not without turmoil. Therefore, we divided the 16 nations into two groups according to the degree of devastation visited upon them by the era's calamities. The first group suffered substantial destruction of the countries' productive physical capital at least once during the century; the second group did not.

The nine nations in Group 1—Belgium, Denmark, France, Germany, Italy, Japan, the Netherlands, Spain, and the United Kingdom—were devastated by one or both of the two world wars or by civil war. The remaining seven—Australia, Canada, Ireland, South Africa, Sweden, Switzerland, and the United States—suffered relatively little direct damage. Even in this fortunate group, Table 1 shows dividend growth that is 2.3 percent less than GDP growth and 1.1 percent less than per capita GDP growth, on average. These gaps are close to the 2.7 percent and 1.4 percent figures observed in the United States during the 20th century.

The data for nations that were devastated during World Wars I and II and the Spanish Civil War are even more striking: The good news is that the economies in Group 1 repaired the devastations wrought by the 20th century; they enjoyed overall GDP growth and per capita GDP growth that rivaled the growth of the less-scarred Group 2 nations. The bad news is that the same cannot be said for per share equity performance; a 4.1 percent slippage occurred between the growth of their economies and per share corporate payouts. The

**Table 1. Dilution of GDP Growth as It Flows Through to Dividend Growth: 16 Countries, 1900–2000**

| Country                      | Constituents of Real Stock Returns |                 | Real GDP Growth | Dilution in Dividend Growth (vis-à-vis GDP growth) | Real per Capita GDP Growth | Dilution in Dividend Growth (vis-à-vis per capita GDP growth) |
|------------------------------|------------------------------------|-----------------|-----------------|----------------------------------------------------|----------------------------|---------------------------------------------------------------|
|                              | Real Return                        | Dividend Growth |                 |                                                    |                            |                                                               |
| Australia                    | 7.5%                               | 0.9%            | 3.3%            | -2.4%                                              | 1.6%                       | -0.7%                                                         |
| Belgium                      | 2.5                                | -1.7            | 2.2             | -3.9                                               | 1.8                        | -3.5                                                          |
| Canada                       | 6.4                                | 0.3             | 4.0             | -3.7                                               | 2.2                        | -1.9                                                          |
| Denmark                      | 4.6                                | -1.9            | 2.7             | -4.6                                               | 2.0                        | -3.9                                                          |
| France                       | 3.6                                | -1.1            | 2.2             | -3.3                                               | 1.8                        | -2.9                                                          |
| Germany                      | 3.6                                | -1.3            | 2.6             | -3.9                                               | 1.6                        | -2.9                                                          |
| Ireland                      | 4.8                                | -0.8            | 2.3             | -3.1                                               | 2.1                        | -2.9                                                          |
| Italy                        | 2.7                                | -2.2            | 2.8             | -5.0                                               | 2.2                        | -4.4                                                          |
| Japan                        | 4.2                                | -3.3            | 4.2             | -7.5                                               | 3.1                        | -6.4                                                          |
| Netherlands                  | 5.8                                | -0.5            | 2.8             | -3.3                                               | 1.7                        | -2.2                                                          |
| South Africa                 | 6.8                                | 1.5             | 3.4             | -1.9                                               | 1.2                        | 0.3                                                           |
| Spain                        | 3.6                                | -0.8            | 2.7             | -3.5                                               | 1.9                        | -2.7                                                          |
| Sweden                       | 7.6                                | 2.3             | 2.5             | -0.2                                               | 2.0                        | 0.3                                                           |
| Switzerland                  | 5.0                                | 0.1             | 2.5             | -2.4                                               | 1.7                        | -1.6                                                          |
| United Kingdom               | 5.8                                | 0.4             | 1.9             | -1.5                                               | 1.4                        | -1.0                                                          |
| United States                | 6.7                                | 0.6             | 3.3             | -2.7                                               | 2.0                        | -1.4                                                          |
| Full-sample average          | 5.1                                | -0.5            | 2.8             | -3.3                                               | 1.9                        | -2.4                                                          |
| War-torn Group 1 average     | 4.0                                | -1.4            | 2.7             | -4.1                                               | 1.9                        | -3.3                                                          |
| Non-war-torn Group 2 average | 6.4                                | 0.7             | 3.0             | -2.3                                               | 1.8                        | -1.1                                                          |

creation of new enterprises in the wake of war was an even more important engine for economic recovery than in the Group 2 nations.

Thus, in Group 2 “normal nations” (i.e., those untroubled by war, political instability, and government confiscation of wealth), the natural ongoing capitalization of new technologies apparently produces a net dilution of outstanding shares of slightly more than 2 percent a year. The Group 1 nations scarred badly by war represent a more fascinating phenomenon; they can be thought of as experiments of nature in which physical capital is devastated and must be rebuilt. Fortunately, destroying a nation’s intellectual, cultural, and human capital is much harder than destroying its economy; within little more than a generation, the GDP and per capita GDP of war-torn nations catch up with, and in some cases surpass, those of the undamaged nations. Unfortunately, the effort requires a high rate of equity recapitalization, which is reflected in the substantial dilution seen in Table 1 for the war-torn countries. This recapitalization savages existing shareholders.

In short, the U.S. experience was not unique. Around the world, every one of these countries except Sweden experienced dividend growth sharply slower than GDP growth, and only two countries experienced dividend growth even slightly faster than per capita GDP growth. The U.S. experience was better than most and was

similar to that of the other nations that were not devastated by war.

The data for the individual countries in Table 1 show that the average real growth in dividends was negative for most countries. It also shows that dilution of GDP growth (the fourth column) was substantial for all the countries studied and that dilution of per capita GDP growth (the last column) was substantial for most countries but fit dividend growth with much less “noise” than did the dilution of overall GDP growth.

This analysis has disturbing implications for “paradigmistas” convinced of the revolutionary nature of biotechnology, Internet, and telecommunications/broadband companies. A rapid rate of technological change may, in effect, turn “normal” Group 2 nations into strife-torn Group 1 nations: An increased rate of obsolescence effectively destroys the economic value of plant and equipment as surely as bombs and bullets, with the resultant dilution of per share payouts happening much faster than the technology-driven acceleration of economic growth—if such acceleration exists. How many of the paradigmistas truly believe that the tech revolution will benefit the shareholders of existing enterprises remotely as much as it can benefit the entrepreneurs creating the new enterprises that make up the vanguard of this revolution?

Whatever the true nature of the interaction of technological progress and per share earnings, dividends, and prices, it will come as an unpleasant surprise to many that even in the Group 2 nations, average real per share dividend growth was only 0.66 percent a year (rounded in Table 1 to 0.7 percent); for the war-torn Group 1 nations, it was disturbingly negative.

In short, the equity investor in a nation blessed by prolonged peace cannot expect a real return greatly in excess of the much-maligned dividend yield; the investor cannot expect to be rescued by more rapid economic growth. Not only is outsized economic growth unlikely to occur, but even if it does, its benefits will be more than offset by the dilution of the existing investor's ownership interest by technology-driven increased capital needs.

## Big Lie #2: Stock Buybacks

Stock buybacks are attractive to companies and beneficial to investors. They are a tax-advantaged means of providing a return on shareholder capital and preferable to dividends, which are taxed twice. Buybacks have enormous appeal. But contrary to popular belief, they did not occur in any meaningful way in the 1990s.

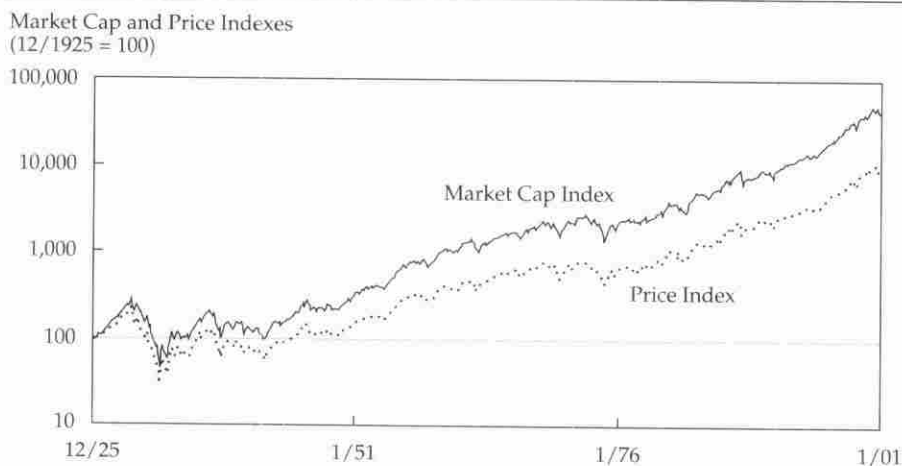
To support this contention, we begin with a remarkably simple measure of slippage in per share earnings and dividend growth: the ratio of the proportionate increase in market capitalization to the proportionate increase in stock price. For example, if over a given period, the market cap increases by a factor of 10 and the cap-weighted price index increases by a factor of 5, a 100 percent net share issuance has taken place in the interim. Formally,

$$\text{Net dilution} = \left( \frac{1+c}{1+r} \right) - 1,$$

where  $c$  is capitalization increase and  $r$  is price return. This relationship has the advantage of factoring out valuation changes, which are embedded in both the numerator and denominator, and neutralizing the impact of stock splits. Furthermore, it holds only for universal market indexes, such as the CRSP 1-10 or the Wilshire 5000, because less inclusive indexes can vary the ratio simply by adding or dropping securities. **Figure 4** contains plots of the total market cap and price indexes of the CRSP 1-10 beginning at the end of 1925.

The CRSP data contained NYSE-listed stocks until 1962. Even the CRSP data, however, can involve adding securities: CRSP added the Amex stocks in July 1962 and the Nasdaq stocks in July 1972, which created artificial discontinuities on those dates. The adjustment for these shifts is evident in **Figure 5**, for which we held the dilution ratio constant during the two months in question.<sup>3</sup> Note how market cap slowly and gradually pulls away from market price. The gap does not look large in **Figure 4**, but by the end of 2001, the cap index had grown 5.49 times larger than the price index, suggesting that for every share of stock extant in 1926, 5.49 shares existed in late 2001. The implication is that net new share issuance occurred at an annualized rate of 2.3 percent a year. Note that this rate is identical to the average dilution for non-war-torn countries during the 20th century given in Table 1. To give a better idea of how this dilution has proceeded over the past 75 years, **Figure 5** provides a dilution index, defined as the ratio of capitalization growth to price index growth.

**Figure 4. CRSP 1-10 Market Cap and Price Indexes, 31 December 1925–June 2002**



**Figure 5. Cumulative Excess Growth of Market Cap Relative to Price Index, 31 December 1925 through June 2002**

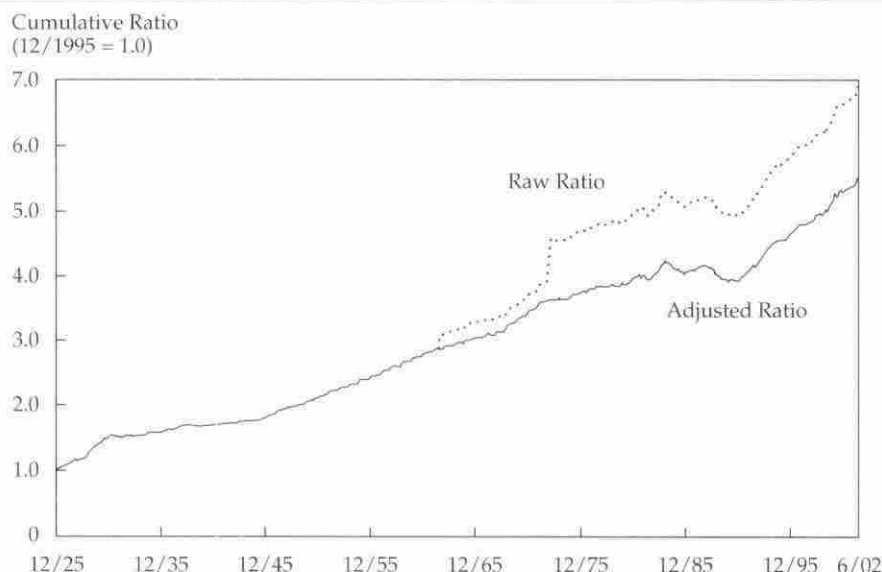
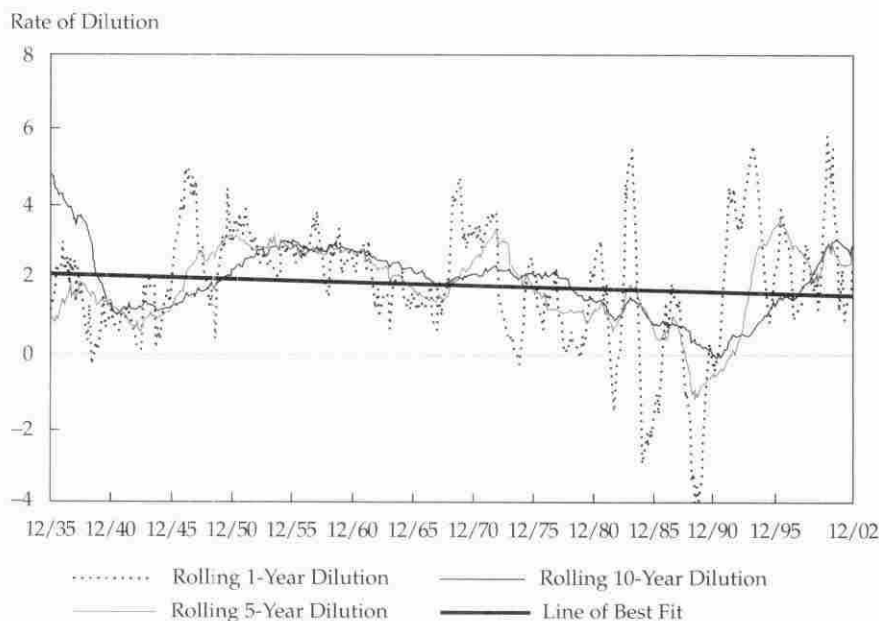


Figure 5 traces the growth in the ratio of the capitalization of the CRSP 1–10 Index as compared with the market-value-weighted price appreciation of these same stocks. The fact that this line rises nearly monotonically shows clearly that new-share issuance almost always sharply exceeds stock buybacks. The notable exception occurred in the late 1980s, when buybacks modestly outpaced new share issuance (evident from the fact that the line falls slightly during these “Milken years”). This

development probably played a key role in precipitating the popular illusion that buybacks were replacing dividends. For a time, they did. But that stock buybacks were an important force in the 1990s is simply a myth. And belief in the myth may have been an important force in the bull market of the 1990s.

Figure 6 shows the rolling 1-year, 5-year, and 10-year dilution effect on existing equity shareholders as a consequence of a growth in the aggregate

**Figure 6. Annualized Rate of Shareholder Dilution, 31 December 1935 through June 2002**



supply of equity shares. Keep in mind that every 1 percent rise in equity capital is a 1 percent rise in market cap in which existing shareholders did not (could not) participate. Aside from the 1980s, this dilution effect on shareholders was essentially never negative—not even on a one-year basis. One can see how the myth of stock buybacks gained traction after the 1980s; even the 10-year average rate of dilution briefly dipped negative in the late 1980s. But then, during the late 1990s, stock buybacks were outstripped by new share issuance at a pace that was only exceeded in the IPO binge of 1926–1930. These conclusions hold true whether one is looking at net new share issuance on a 1-year, 5-year, or 10-year basis.

Those who argue that stock buybacks will allow future earnings growth to exceed GDP growth can draw scant support from history. Investors did see enormous earnings growth, far faster than real economic growth, from 1990 to 2000. But Figure 3 shows how tiny that surge of growth was in the context of 130 years of earnings history. Much of the earnings surge of the 1990s was dubious, at best.

## The Eye of the Storm?

The big question today is whether the markets are likely to rebound into a new bull market or have merely been in the eye of the storm. We think the markets are in the eye.

The rapid earnings growth of the 1990s, which many pointed to as “proof” of a new paradigm, had several interesting characteristics:

1. A trough in earnings in the 1990 recession transformed into a peak in earnings in the 2000 bubble. Measuring growth from trough to peak is an obvious error; extrapolating that growth is even worse. This decade covered a large chunk of the careers of most people on Wall Street, many of whom have come to believe that earnings can grow very fast for a very long time. Part of conventional wisdom now is that earnings growth can outstrip macroeconomic growth.
2. Influenced by the new paradigm, analysts frequently ignored write-offs to focus increasingly on operating earnings. This practice is acceptable if write-offs are truly “extraordinary items,” but it is not acceptable if write-offs become a recurring annual or biannual event, as was commonplace in the 1990s. Furthermore, what are extraordinary items for a single company are entirely ordinary for the economy as a whole. In some companies and some sectors, write-offs are commonplace. The focus on oper-

ating earnings for the broad market averages is misguided at best and deceptive at worst.

3. Those peak earnings of 1999–2000 consisted of three dubious components. The first is an underrecognition of the impact of stock options, which various Wall Street strategists estimated at 10–15 percent of earnings. The second is pension expense (or pension “earnings”) based on assumptions of a 9.5 percent return, which were realistic then but are no longer; this factor pumped up earnings by approximately 15 percent at the peak and 20–30 percent from current depressed levels. The third component is Enron-style “earnings management,” which various observers have estimated to be 5–10 percent of the peak earnings. (We suspect this percentage will turn out to be conservative.)

If these three sources of earnings overstatement (aggressive pension accounting, failure to expense management stock options, and outright fraud) are removed, the \$54 peak earnings per share for the S&P 500 Index in 2000 turn out to be closer to \$36. This figure implies normalized earnings a notch lower still. If the normalized earnings for the S&P 500 are in the \$30–\$36 range, as we suspect is the case, then the market at mid-year 2003 was still at a relatively rich 27–32 times normalized earnings. Using Shiller’s (2000) valuation model (real S&P 500 level divided by 10-year average of real reported earnings) confirms this analysis. Shiller’s model pegs the current multiple at nearly 30 times normalized earnings in mid-2003.

In principle, several conditions could allow earnings growth to exceed GDP growth. Massive stock buybacks are one. But we have demonstrated that buybacks in the 20th century were far more smoke than fire. Buybacks have been much touted as the basis for sustained earnings growth at unprecedented rates, but they simply do not show up in the data on market capitalization relative to market index price levels. Cross-holdings could also offer an interesting complication. But again, their impact does not show up in the objective shareholder dilution data. We have demonstrated that buybacks and cross-holdings do not yet show any signs of offsetting the historical 2 percent dilution, but the exploration of the possible impact of buybacks and cross-holdings is beyond the scope of this study.

## Conclusion

Expected stock returns would be agreeable if dividend growth, and thus price growth, proceeded at the same rate as, or a higher rate than, aggregate economic growth. Unfortunately, dividends do not

grow at such a rate: When we compared the Dimson et al. 20th century dividend growth series with aggregate GDP growth, we found that even in nations that were not savaged by the century's tragedies, dividends grew 2.3 percent more slowly, on average, than GDP. Similarly, by measuring the gap between the growth of market cap and share prices in the CRSP database, we found that between 1926 and the present, a 2.3 percent net annual dilution has occurred in the outstanding number of shares in the United States.

Two independent analytical methods point to the same conclusion: In stable nations, a roughly 2 percent net annual creation of new shares—the Two Percent Dilution—leads to a separation between long-term economic growth and long-term growth in dividends per share, earnings per share, and share price.

The markets are probably in the eye of a storm and can expect further turmoil as the rest of the storm passes over. If normalized S&P 500 earnings are \$30–\$36 per share, if payout ratios on those normalized earnings are at the low end of the historical range (implying lower-than-normal future earnings growth), if normal earnings growth is really only about 1 percent a year above inflation, if stock buybacks have been little more than an appealing fairy tale, if the credibility of earnings is at an all-time low, and if demographics suggest Baby Boomer dis-saving in the next 20 years, then we have a problem.

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*The authors would like to acknowledge the help, suggestions, and encouragement of Cliff Asness, Peter Bernstein, and Max Darnell.*

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## Notes

1. In calculating "trend growth," we used a loglinear line of best fit to minimize the impact of distortions from an unusually high or low starting or ending date. The loss years of 1932 and 1933 were excluded because of loglinear calculation.
2. The Dimson et al. book is a masterwork. If you do not have a copy, you should.
3. We assumed the dilution factor to be zero in those two months. If a massive stock buyback or a massive new IPO occurred during one of these two months, we may have missed it. But net buybacks or net new share issuance during months in which the "index" saw a major reconstitution would be difficult to measure.

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# Economic Growth and Equity Investing

Bradford Cornell

*The performance of equity investments is inextricably linked to economic growth. Nonetheless, few studies on investing have explicitly taken research on economic growth into account. This study bridges that gap by examining the implications for equity investing of both theoretical models and empirical results from growth theory. The study concludes that over the long run, investors should anticipate real returns on common stock to average no more than about 4 percent.*

**T**he performance of equity investments is inextricably linked to economic growth. Earnings, the source of value for equity investments, are themselves driven by economic activity. Unless corporate profits rise as a percentage of GDP, which cannot continue indefinitely, earnings growth is constrained by GDP growth. This dynamic means that the same factors that determine the rate of economic growth also place bounds on earnings growth and, thereby, the performance of equity investments. Despite these well-known facts, few studies on equity investing have explicitly taken the literature on economic growth into account. This observation is not meant to imply that research connecting economic growth with equity returns is sparse. Numerous contributions in that area include several provocative pieces by Arnott and Bernstein (2002), Arnott and Asness (2003), and Bernstein and Arnott (2003). Nonetheless, rarely has this research been expressly tied to the literature on the theory of economic growth. By bridging that gap, further insight can be gained into the relationship between economic growth and equity returns and forecasts regarding future returns can be placed on a more solid foundation.

## Economic Growth: Theory and Data

The focus of economic growth theory is explaining expansion in the standard of living as measured by real per capita GDP. In the neoclassical model of economic growth, originally developed by Solow (1956), per capita GDP growth over the long run is entirely attributable to exogenous technological innovation.<sup>1</sup> This conclusion may surprise those not steeped in growth theory, given the intuitive

thinking that output per capita can always be increased by simply adding more capital. Although adding capital does increase output per capita, it does so at a declining rate. Consequently, rational producers stop adding capital when the marginal product of capital drops to its marginal cost. When the economy reaches that point, it is said to be in a steady state. Once the economy reaches the steady state growth path, the ratio of capital to labor ( $C/L$ ) remains constant and per capita GDP growth ceases unless the production function changes so as to increase the marginal product of capital.

The source of change in the production function is technological innovation. By increasing the marginal product of capital, technological progress breaks the deadlock imposed by diminishing returns and makes further growth in per capita output profitable. So long as the technological innovation continues, so too does the growth in per capita GDP.

This conclusion is not limited to such early models as Solow's, in which the rate of technological change is exogenous. Following Romer (1990), a variety of growth models have been developed in which the amount of investment in R&D—and thus the rate of technological progress—is endogenous. Even in these more sophisticated models, however, the declining marginal product of capital ensures that long-run per capita growth is bounded by the rate of technological progress. The word "bounded" is important because the ability of a society to exploit modern technology effectively is not a foregone conclusion. For example, from 1960 to 2005, all the countries of sub-Saharan Africa, with the exception of South Africa, experienced little or no growth. This failure of certain poor countries to grow is one of the fundamental mysteries of economics, but it is not a relevant consideration here.<sup>2</sup> Virtually the entire global stock

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market capitalization is concentrated in a relatively few highly developed countries. For those countries, the impediments to effective adoption of technology have proved to be minor, at least to date.

Before turning to the data on economic growth, I need to address one remaining issue. The conclusion that growth is attributable exclusively to technological innovation is based on the assumption that the economy has reached the steady state. If the capital stock is below the steady state—and thus the marginal product of capital exceeds its marginal cost—room still exists for the deepening of capital. In that situation, a country's growth rate can exceed the steady state growth rate because it is spurred by capital deepening, as well as by technological innovation. As  $C/L$  rises toward its steady state value, the growth rate converges to the steady state level that is attributable to technological change.

The capital stock of a country may be below its steady state level for a variety of reasons. An obvious example is warfare. Another is the opening of a previously closed society. Whatever the reason, growth theory predicts that a country with a  $C/L$  below the steady state level will grow more rapidly during a period of capital deepening. Growth theorists refer to this "catch-up" as convergence.

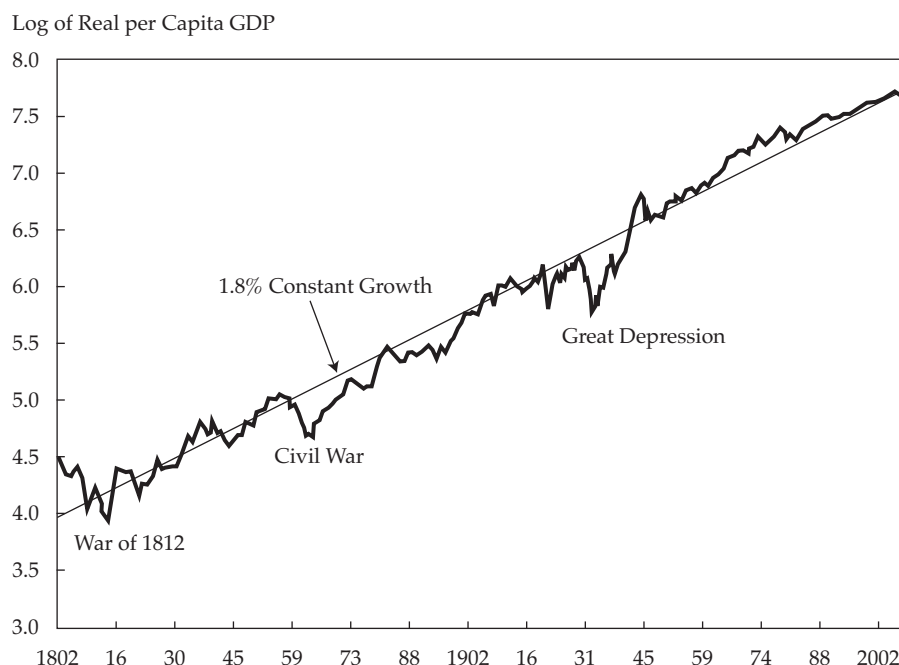
Convergence is important to bear in mind when analyzing historical growth rates with the goal of forecasting future growth. If the historical sample

includes growth rates of countries that are in the process of converging to a steady state, the historical growth rates will exceed the future rates that will apply once the steady state has been achieved.

Convergence also helps explain why long-run growth rates for a particular country are remarkably constant. To illustrate, **Figure 1** plots the log of real per capita GDP in the United States from 1802 through 2008. The long-run average growth rate of 1.8 percent is also shown. Over this period, even the largest downturns (associated with the U.S. Civil War and the Great Depression) appear only as temporary dips in a remarkably smooth progression. That smooth progression is attributable in part to the fact that accelerations in economic growth, associated with capital accumulation, followed the dips, which were tied to a drop in the capital stock below its steady state level.

With that background, **Table 1** presents Barro and Ursúa's (2008) update of Maddison's (2003) compilation of information on world economic growth from 1923 to 2006. The starting point in Table 1 is 1923, the first year for which Barro and Ursúa had data for all the countries in their sample. Extending the sample backward for those countries with longer time series available does not affect the essential nature of the findings. Table 1 also reports growth rates for a shorter sample period (beginning in 1960) to take into account the possibility of nonstationarity in the data.

**Figure 1. Logarithm of Real per Capita GDP, 1802–2008**



**Table 1. Real Growth Rates in per Capita GDP, 1923–2006**

| Country                                                    | 1923–2006 | 1960–2006 |
|------------------------------------------------------------|-----------|-----------|
| <i>A. Mature Economies</i>                                 |           |           |
| Australia                                                  | 1.85%     | 2.16%     |
| Austria                                                    | 2.53      | 2.76      |
| Belgium                                                    | 2.11      | 2.62      |
| Canada                                                     | 2.22      | 2.27      |
| Denmark                                                    | 1.97      | 2.11      |
| France                                                     | 2.28      | 2.51      |
| Germany                                                    | 2.41      | 2.23      |
| Italy                                                      | 2.57      | 2.98      |
| Japan                                                      | 3.11      | 3.86      |
| Netherlands                                                | 2.01      | 2.35      |
| Spain                                                      | 2.30      | 3.42      |
| Sweden                                                     | 2.50      | 2.25      |
| Switzerland                                                | 1.63      | 1.51      |
| United Kingdom                                             | 1.95      | 2.15      |
| United States                                              | 1.42      | 1.14      |
| Average                                                    | 2.19%     | 2.42%     |
| <i>B. Developing and More Recently Developed Economies</i> |           |           |
| Argentina                                                  | 1.10%     | 1.16%     |
| Brazil                                                     | 2.68      | 2.34      |
| Chile                                                      | 1.95      | 2.47      |
| Colombia                                                   | 2.18      | 2.24      |
| Egypt                                                      | 1.45      | 3.09      |
| Finland                                                    | 2.91      | 2.92      |
| Greece                                                     | 2.77      | 3.23      |
| Iceland                                                    | 3.24      | 2.87      |
| India                                                      | 1.74      | 2.88      |
| Indonesia                                                  | 1.81      | 3.08      |
| S. Korea                                                   | 3.55      | 5.72      |
| Malaysia                                                   | 1.91      | 2.14      |
| Mexico                                                     | 2.70      | 4.16      |
| New Zealand                                                | 1.51      | 1.36      |
| Norway                                                     | 2.86      | 3.01      |
| Peru                                                       | 1.44      | 0.97      |
| Philippines                                                | 1.32      | 1.46      |
| Portugal                                                   | 2.75      | 3.43      |
| S. Africa                                                  | 1.53      | 1.01      |
| Singapore                                                  | 3.33      | 5.72      |
| Sri Lanka                                                  | 1.93      | 3.06      |
| Taiwan                                                     | 3.78      | 6.24      |
| Turkey                                                     | 2.75      | 2.40      |
| Uruguay                                                    | 2.19      | 2.24      |
| Venezuela                                                  | 2.54      | 0.45      |
| Average                                                    | 2.32%     | 2.79%     |

Source: Barro and Ursúa (2008).

The results are reported in terms of compound growth rates. The following example illustrates why using compound growth rates is preferable to using averages of annual growth rates. Suppose that the ratio of corporate profits to GDP is station-

ary but not constant. In particular, assume (as the data will later show) that corporate profits are more variable than GDP. In that case, even though the compound growth rates of the two variables must converge in the long run, the arithmetic mean of annual growth rates for corporate profits will exceed that for GDP because of the variance effect.<sup>3</sup> The higher mean growth rate in earnings is illusory, however, because it fails to take into account the mean reversion in earnings growth that must occur for the ratio to be stationary.

The results reported in Table 1 are divided into two groups. The first group comprises mature economies that were already developed before World War II. These countries, which account for virtually the entire global stock market capitalization, are the focus of this study. The second group consists of economies that were developed more recently or are still considered developing. Results for the second group are presented for completeness and to provide perspective on the impact of convergence.

Consistent with the hypothesis that a common rate of technological advance is driving growth in all the developed countries, the results for the first group are remarkably homogeneous. Virtually all the growth rates for the full sample are close to the average of 2.19 percent. The exceptions are the United States, on the low end, and Japan, on the high end. The former's rate of 1.42 percent reflects the fact that the United States was the closest to steady state growth in 1923, after emerging from World War I relatively unscathed. The higher growth rate for Japan reflects convergence. At the start of the sample period, Japan was a relatively undeveloped country whose capital stock was below the steady state level. Convergence is also evident in the shorter sample period, beginning in 1960. The European countries and Japan, whose capital stocks were damaged in World War II, grew more rapidly than the United States, Switzerland, and Australia, all of which avoided war-related domestic destruction.

The results for the second group are more heterogeneous, reflecting the fact that growth in some countries (e.g., Peru and Venezuela) has stalled for reasons not fully understood whereas others (e.g., South Korea and Taiwan) have experienced rapid convergence. Despite the heterogeneity, however, the average growth rates of 2.32 percent for the sample period beginning in 1923 and 2.79 percent for the sample period beginning in 1960 are close to the averages for the first group of countries.

The averages reported in Table 1 are simple averages. If the growth rates for the first group of countries are weighted by market capitalization,

the average falls to about 2 percent in both periods because of the predominant role of the United States. Giving the United States a higher weight is reasonable not only because of its large market capitalization but also because its economy is closest to steady state growth. Given the long period of time since World War II, to assume that all the countries in the first group will eventually converge to steady state growth is reasonable. Therefore, they are more likely to grow at rates comparable to the U.S. historical rate than at their own historical rates. This likelihood suggests that 2 percent real per capita growth, which exceeds the recent U.S. growth rate by 0.5 percent, is the most that investors can reasonably expect in the long run. Furthermore, although growth could be stalled by a catastrophe, such as another world war, the speed of technological innovation has proved almost impossible to accelerate meaningfully. In the remainder of this article, therefore, I will use 2 percent as the estimate of future per capita GDP growth. This number should be thought of as an achievable, but not necessarily expected, outcome.

In addition to the possibility of a catastrophe are two other reasons why 2 percent may prove to be an optimistic growth forecast. First, national income accounting does not deduct costs associated with pollution and environmental degradation in the calculation of GDP. Although these costs have been a tiny fraction of GDP in the past, concern that they are growing rapidly is widespread. If that concern is justified, properly accounting for these costs will reduce the future growth rate of per capita GDP. Second, whether the historical rate of technological innovation is sustainable is far from clear. Weil (2009, p. 260) noted that the rate of growth of real per capita GDP attributable to technological progress remained largely constant from 1950 to 2005, but over the same period, the number of researchers in the G-20 countries grew from 251,000 to 2.6 million. This finding suggests a declining marginal product of research as making and applying new discoveries become more difficult. If this trend continues, it could lead to falling rates of growth in per capita GDP.

## Population Growth

Business opportunities depend on total economic activity, not per capita output. To see why, consider a hypothetical example of an economy for which technological innovation—and thus productivity growth—is zero but which is experiencing 5 percent population growth. Companies that provide goods and services in this economy will, on average, experience 5 percent growth in real revenues.

Assuming that their margins remain constant, this rate translates into 5 percent growth in real earnings. Of course, in a dynamic economy, existing companies could lose business to start-ups, which could result in dilution for existing investors (which is a separate issue addressed later in the article). For companies in the aggregate, real earnings should be tied to real GDP, as data presented later in the article reveal to be the case.

Converting per capita growth to aggregate growth requires an estimate of population growth. Fortunately, population growth rates change even more slowly and are more predictable than growth rates of real per capita GDP.

Data on population growth for the sample countries are reported in **Table 2**. The first column presents historical growth rates from 2000 to 2007 taken from the U.S. Central Intelligence Agency's *2008 World Fact Book*. The second column presents United Nations (2007) forecasts of population growth rates from 2005 to 2010. That the two columns are very similar reflects the slowly changing nature of population growth.

The data in Table 2 are consistent with the widely documented fact that population growth is negatively correlated with per capita GDP.<sup>4</sup> The average population growth rate for the first group of countries is less than half that for the second group. Even for the second group, however, both the average historical growth rate and the average projected growth rate are less than 1 percent. Presumably, as per capita GDP continues to rise, these growth rates will continue to decline.

On the basis of the data presented in Table 2, population growth can be expected to add no more than 1 percent to the growth rate in per capita GDP. In fact, an assumption of a zero long-run future growth rate for the developed countries would not be unreasonable. Given real per capita growth of 2 percent, this assumption implies that investors cannot reasonably expect long-run future growth in real GDP to exceed 3 percent.

## Earnings and GDP

The fundamental source of value for equity investors is earnings, not GDP. That long-run real GDP growth is reasonably bounded at 3 percent does not necessarily mean that the same is true of earnings, which depends on whether the ratio of earnings to GDP ( $E/GDP$ ) is stationary. To test that hypothesis requires data on aggregate earnings.

Two primary measures of aggregate earnings are used in the United States. The first measure is derived from the national income and product accounts (NIPAs), produced by the U.S. Department

**Table 2. Historical and Projected Population Growth Rates, 2000–2010**

| Country                                                    | Historical | Projected |
|------------------------------------------------------------|------------|-----------|
|                                                            | 2000–2007  | 2005–2010 |
| <i>A. Mature Economies</i>                                 |            |           |
| Australia                                                  | 1.22%      | 1.01%     |
| Austria                                                    | 0.06       | 0.36      |
| Belgium                                                    | 0.11       | 0.24      |
| Canada                                                     | 0.83       | 0.90      |
| Denmark                                                    | 0.30       | 0.90      |
| France                                                     | 0.57       | 0.49      |
| Germany                                                    | –0.04      | –0.07     |
| Italy                                                      | 0.00       | 0.13      |
| Japan                                                      | –0.14      | –0.02     |
| Netherlands                                                | 0.44       | 0.21      |
| Spain                                                      | 0.10       | 0.77      |
| Sweden                                                     | 0.16       | 0.45      |
| Switzerland                                                | 0.33       | 0.38      |
| United Kingdom                                             | 0.28       | 0.42      |
| United States                                              | 0.88       | 0.97      |
| Average                                                    | 0.34%      | 0.48%     |
| <i>B. Developing and More Recently Developed Economies</i> |            |           |
| Argentina                                                  | 1.07%      | 1.00%     |
| Brazil                                                     | 1.23       | 1.26      |
| Chile                                                      | 0.91       | 1.00      |
| Colombia                                                   | 1.41       | 1.27      |
| Egypt                                                      | 1.68       | 1.76      |
| Finland                                                    | 0.11       | 0.29      |
| Greece                                                     | 0.15       | 0.21      |
| Iceland                                                    | 0.78       | 0.84      |
| India                                                      | 1.58       | 1.46      |
| Indonesia                                                  | 0.18       | 1.16      |
| S. Korea                                                   | 0.27       | 0.33      |
| Malaysia                                                   | 1.74       | 1.69      |
| Mexico                                                     | 1.14       | 1.12      |
| New Zealand                                                | 0.97       | 0.90      |
| Norway                                                     | 0.35       | 0.62      |
| Peru                                                       | 1.26       | 1.15      |
| Philippines                                                | 1.99       | 1.72      |
| Portugal                                                   | 0.31       | 0.37      |
| S. Africa                                                  | 0.83       | 0.55      |
| Singapore                                                  | 1.14       | 1.19      |
| Sri Lanka                                                  | 0.94       | 0.47      |
| Taiwan                                                     | 0.24       | 0.36      |
| Turkey                                                     | 1.01       | 1.26      |
| Uruguay                                                    | 0.49       | 0.29      |
| Venezuela                                                  | 1.50       | 1.67      |
| Average                                                    | 0.94%      | 0.96%     |

Sources: Central Intelligence Agency (2008) and the United Nations (2007).

of Commerce's Bureau of Economic Analysis. The NIPAs contain an estimate of aggregate corporate profits that is based on data collected from corporate income tax returns. The second measure of aggregate earnings is derived by Standard & Poor's from data collected from corporate financial reports. Because the two measures are not identical, distinguishing what is included in each measure before using the data is important.

The NIPA profit measure is designed to provide a time series of the income earned from the current production of all U.S. corporations. The sample is not limited to publicly traded companies. The tax rules on which the NIPAs are based are designed to expedite the timely and uniform completion of corporate tax returns. For that reason, all corporations use a highly uniform set of rules for tax accounting.

Because the NIPAs are designed to measure economic activity connected with current production, the NIPA definition of corporate profits includes only receipts arising from current production less associated expenses. The NIPA definition, therefore, excludes transactions that reflect the acquisition or sale of assets or liabilities. Dividend receipts from domestic corporations are excluded to avoid a double counting of profits. For the same reason, bad-debt expenses and capital losses are also excluded.

The Standard & Poor's estimate of aggregate earnings is derived from reported financial statements. Rather than being based on a unified set of tax rules, financial accounting is based on GAAP, which is designed to allow management to tailor financial statements so as to reveal information that is useful to a particular company. Furthermore, financial accounting provides for depreciation and amortization schedules that allow companies to attempt to match expenses with the associated stream of income.

The aggregate earnings data available from Standard & Poor's are for the companies in the S&P 500 Index. Each year's data consist of the aggregate GAAP after-tax earnings for the 500 companies in the S&P 500 for that year. Thus, the sample of companies in the aggregate is constantly changing as the index is updated. Because the S&P 500 earnings reflect a shifting sample of corporations, the series of reported earnings can be discontinuous over time. Fortunately, given the size of the index, these discontinuities are small and have little impact on estimated earnings growth.

The differences between financial and tax accounting create two dissimilarities between the measures of earnings for the same company.<sup>5</sup> First,

intertemporal differences arise because of the timing of revenue, and expense recognition often differs between the two systems. The best example is depreciation because tax rules generally allow for more rapid depreciation than companies choose to report under GAAP. Second, permanent differences exist because the revenues and expenses recognized under the two systems are not the same. Although important in the short run, these differences tend to cancel out over long horizons, and thus, the long-run growth rates in the two measures are similar. For example, the average growth rate in NIPA real corporate profits from 1947 to 2008 was 3.23 percent, as compared with a growth rate of 3.17 percent in S&P 500 real aggregate earnings.

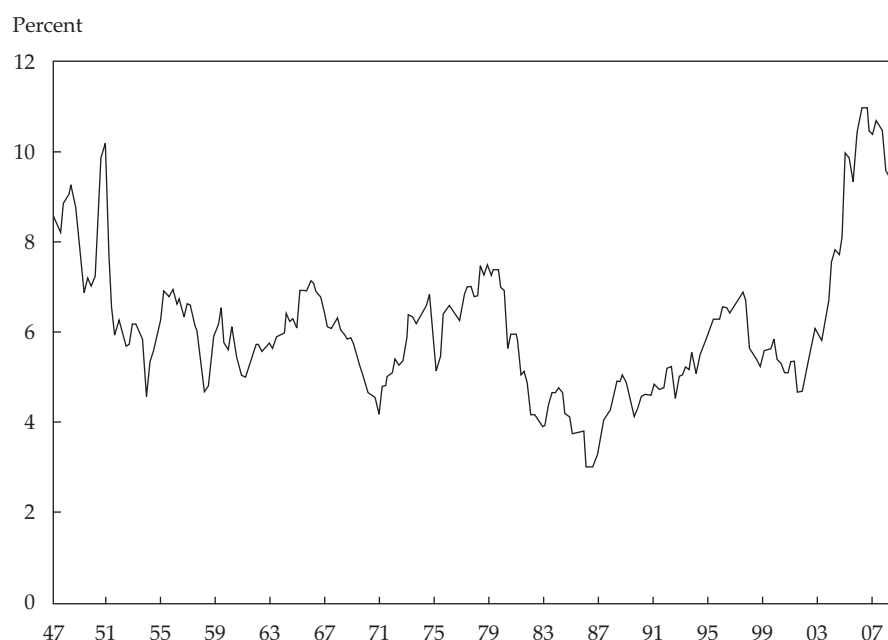
As an aid in examining the behavior of  $E/GDP$ , **Figure 2** plots after-tax corporate profits from the NIPAs as a fraction of GDP for 1947–2008. The figure reveals no overall trend. The fraction is approximately the same at the end as at the beginning, and thus, the growth rate of corporate profits is almost identical to that of GDP. The same is largely true of S&P 500 aggregate earnings as a fraction of GDP, which is plotted in **Figure 3** (normalized to start at 8.23 percent to facilitate comparison with Figure 2). The fraction for the S&P 500 earnings is smaller because the S&P 500 measure is less comprehensive than the NIPA measure. Unlike the NIPA data, the S&P 500 ratio exhibits a slight downward trend, reflecting the fact that as the economy has grown, the S&P 500 companies have

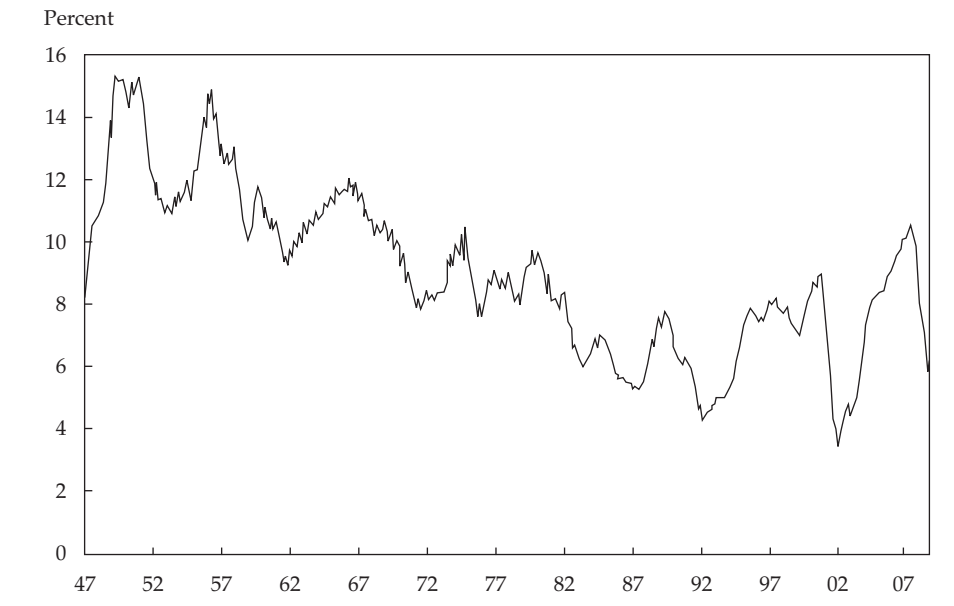
become a progressively smaller fraction of total earnings. Therefore, the data are generally consistent with the hypothesis that over the long run, aggregate earnings are a stationary fraction of GDP. Certainly, no evidence exists of a persistent increase in the ratio, no matter which measure of earnings is chosen. This observation implies that the long-run growth rates of GDP place a limit on the long-run growth rates of earnings.

Although the data largely support the hypothesis that  $E/GDP$  is stationary, it is far from constant. Figure 2 shows that corporate profits vary between 3 percent and 11 percent of GDP. The variability of the ratio for S&P 500 earnings is even greater. This variability suggests that when earnings are low relative to GDP, they grow more quickly; the reverse is true when earnings are relatively high. This mean reversion in the growth rate of earnings maintains the stationarity of  $E/GDP$ .

Note that in an efficient market, the mean reversion in earnings growth would have no impact on stock returns because it would be impounded into current prices. Campbell and Shiller (1998), however, provided evidence that long-run average earnings are, in fact, predictive of future stock returns. Specifically, when the ratio of price to average earnings over the previous 10 years is high, future stock returns tend to be low; the reverse is true when the ratio is low. This finding suggests that the market does not fully account for the mean-reverting nature of long-run earnings growth.

**Figure 2. Corporate Profits as a Percentage of GDP, 1947–2008**



**Figure 3. S&P 500 Earnings as a Percentage of GDP, 1947–2008**

That the ratio of aggregate earnings to GDP is stationary implies that investors can expect aggregate real earnings growth to match, but not exceed, real GDP growth in the long run. Unfortunately, the same is not true of the earnings to which current investors have a claim. Two reasons explain this discrepancy. First, an investor's pro rata portion of a company's earnings will be affected by the company's share issuances and repurchases. If this dilution (or accretion) is ongoing, growth in aggregate earnings and earnings per share will diverge. Second and more important, current investors do not participate in the earnings of new businesses unless they dilute their current holdings to purchase shares in start-ups. Therefore, start-ups drive a wedge between the growth in aggregate earnings and the growth in the earnings to which current investors have a claim.

To illustrate the second effect, consider a simple example in which all companies in the economy are identical and earn \$10 a share per period. Furthermore, assume that each company has a market value of \$100 a share and has 1,000 shares outstanding. All earnings are paid out, so the values of the companies remain constant. Finally, assume that at the outset only two companies are in the economy, so aggregate earnings are \$20,000. A current investor who holds 1 percent of each company has a pro rata share of aggregate earnings of \$200. Now assume that the economy grows and a third company is started. As a result, aggregate earnings rise to \$30,000, but the current investor does not participate in that growth and thus still holds 1 percent of the first two companies with rights to earnings of \$200. If the current

investor wanted to add the third company to the portfolio without investing new cash, the investor would have to dilute the portfolio's holdings in the first two companies. After the dilution, the investor would hold 0.67 percent of each of the three companies and would thus still have rights to earnings of \$200. Therefore, the growth in earnings experienced by the current investor does not match the growth in aggregate earnings.

Bernstein and Arnott (2003) suggested an ingenious procedure for estimating the combined impact of both effects on the rate of growth of earnings to which current investors have a claim. They noted that total dilution on a marketwide basis can be measured by the ratio of the proportionate increase in market capitalization to the value-weighted proportionate increase in stock price. More precisely, net dilution for each period is given by the equation

$$\text{Net dilution} = \frac{1+c}{1+k} - 1, \quad (1)$$

where  $c$  is the percentage capitalization increase and  $k$  is the percentage increase in the value-weighted price index. Note that this dilution measure holds exactly only for the aggregate market portfolio. For narrower indices, the measure can be artificially affected if securities are added to or deleted from the index.

To account for the impact of dilution, the Bernstein–Arnott measure was estimated by using monthly data for the entire universe of CRSP stocks from 1926 to 2008. Using CRSP data for this purpose presents one problem. The CRSP universe was expanded twice during the sample period: in

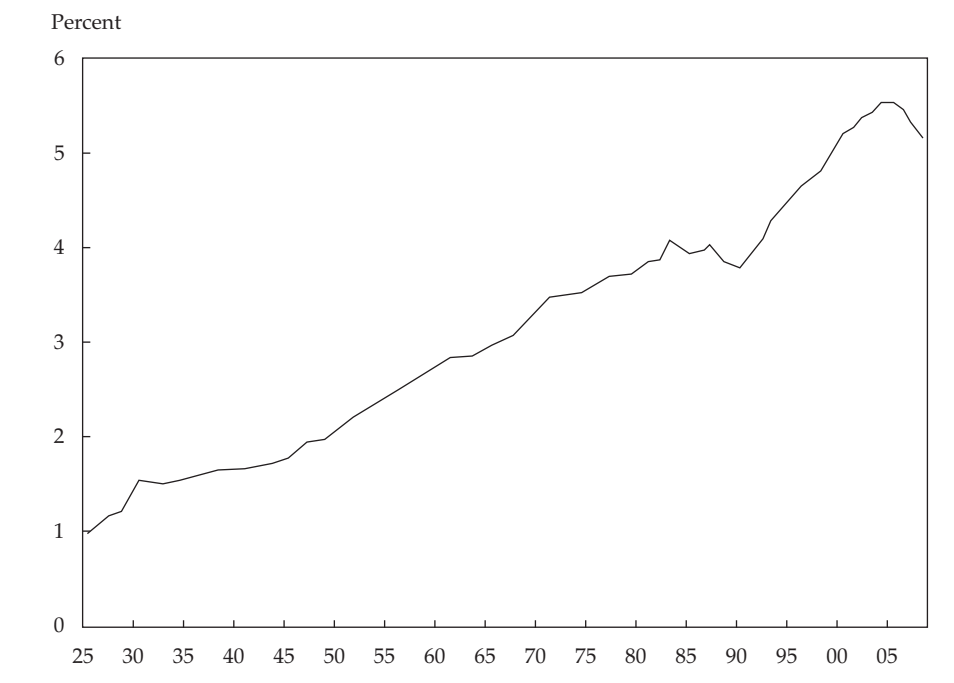
July 1962, when Amex stocks were added, and in July 1972, when NASDAQ stocks were added. Both these additions caused a significant increase in market capitalization unaccompanied by a corresponding increase in the value-weighted price. To eliminate the impact of these artificial discontinuities, I set the estimate of net dilution at zero for both July 1962 and July 1972.

**Figure 4** plots the compounded estimate of net dilution from 1926 to 2008. It rises continuously except for downturns in the early 1990s and in 2006–2008. The average rate of dilution over the entire period is 2 percent. The primary source of dilution is the net creation of new shares as new companies capitalize their businesses with equity. The impact of start-ups is not surprising in light of the fact that more than half of U.S. economic growth comes from new enterprises, not from the growth of established businesses. Given the continuing importance of start-ups, the rate of dilution is highly unlikely to subside unless the rate of innovation slows. If the rate of innovation slows, however, GDP growth will also decline. Consequently, to conclude that the rate of growth of earnings, net of dilution, will remain largely constant is reasonable. Therefore, to estimate the growth rate of earnings to which current investors have a claim, approximately 2 percent must be deducted from the growth rate of aggregate earnings.

Putting the pieces together, we can see that growth theory predicts that current investors should count on long-run growth in real earnings of no more than 1 percent. This rate equals real growth of 3 percent in aggregate earnings, adjusted downward by 2 percent to account for dilution.

Arnott and Bernstein (2002) and Bernstein and Arnott (2003, p. 49) observed that “earnings and dividends grow at a pace very similar to that of per capita GDP.” This observation correctly summarizes U.S. economic history, but it may not be true for other countries and it may not hold for the United States in the future. In terms of my analysis, the reason that earnings and dividends mirror per capita GDP is that population growth and dilution have both been about 2 percent between 1870 and 2008. Consequently, these two terms cancel each other out when we move from estimated growth in real per capita GDP to estimated growth in real earnings per share. But there is no theoretical reason why this cancellation should necessarily occur. For instance, population growth in Western Europe has fallen essentially to zero. If the United States were to follow suit but dilution were to continue at about 2 percent a year, growth in real earnings would be 2 percentage points *less* than growth in per capita GDP. In short, the Arnott–Bernstein observation is a shortcut that has historically held in the United States but is not a necessary condition. Therefore, a more complete analysis that takes into

**Figure 4. The Impact of Dilution on Investor Earnings, 1926–2008**



account both population growth and dilution is generally preferable. I do not present that analysis here because of limitations on dilution data for countries other than the United States.

## Implications of Economic Growth Theory for Expected Stock Returns

The story thus far is that economic growth places a limit on the long-run growth of real earnings per share available to investors. On the basis of the data I have analyzed here, that limit is what many investors might consider a relatively anemic 1 percent. The next step is to explore the implications of that limitation for future returns on common stocks.

By definition, the rate of return on stock in period  $t$  is given by

$$R_t = \frac{D_t}{P_{t-1}} + GP_t, \quad (2)$$

where  $D_t$  is the dividend for year  $t$ ,  $P_{t-1}$  is the price at the end of year  $t - 1$ , and  $GP_t = (P_t - P_{t-1})/P_{t-1}$ . Following Fama and French (2002), we can write Equation 2 in terms of long-run average values, denoted by  $A()$ , as

$$A(R_t) = A\left(\frac{D_t}{P_{t-1}}\right) + A(GP_t). \quad (3)$$

Equation 3 states that the long-run average return equals the average dividend yield plus the average capital gain.

Equation 3 holds *ex ante* as well as *ex post*. It implies that the long-run future average return equals the future average dividend yield plus the future average capital gain. Assuming that the earnings-to-price ratio is stationary, the long-run average earnings growth rate,  $A(GE_t)$ , can be substituted for the average capital gain rate, giving

$$A(R_t) = A\left(\frac{D_t}{P_{t-1}}\right) + A(GE_t). \quad (4)$$

My preceding analysis implies that  $A(GE_t)$  in Equation 4 should be no more than about 1 percent in the future. In addition, as of December 2008, the current dividend yield was 3.1 percent and the previous 50-year average was 3.3 percent. Because the two are nearly equal, substituting either into Equation 4 as a proxy for the future average yield suggests that investors should not expect long-run real returns on common stocks to go much beyond 4 percent. Note that this calculation does not need to be adjusted for repurchases because the impact of repurchases is already accounted for in the dilution calculation. An adjustment is required only if future repurchases are expected to exceed their past average.

Equation 4 can also be used to approximate the equity risk premium. Because the real return on short-term government securities has averaged about 1 percent over the last 80 years, Equation 4 implies that the equity risk premium measured with respect to short-term government securities is approximately equal to the expected average dividend yield. Using either the current yield or the past average yield translates this number into a long-run average equity risk premium of just more than 3 percent. If the premium is measured with respect to longer-maturity government securities with greater expected real returns, the equity premium is commensurately less. This result is markedly less than the average historical risk premium measured over the 1926–2008 period that is commonly referenced. It is consistent, however, with a long-running body of empirical work that shows the *ex ante* risk premium to be significantly smaller than the historical average.<sup>6</sup>

Thus far, all the results have been stated in terms of compound growth rates. For many purposes, however, the object of interest is the annual expected return. For example, discounted-cash-flow valuations typically require annual estimates of the discount rate. To convert compound growth rates, which are geometric averages, into arithmetic averages requires taking the variance effect into account. This step can be well approximated by adding one-half of the annual variance of returns to the compound growth rate.

Because earnings are volatile, the variance effect adds about 1 percent to the compound growth rates. This result means that growth theory predicts that future annual real returns on common stocks should average no more than about 5 percent and that the annual equity risk premium for short-term government securities is about 4 percent.

Using annual data, we can tie the growth theory analysis to the long-run performance of company investments. If a company retains a fraction,  $b$ , of its earnings and invests those funds at a real rate of return,  $k$ , then basic finance theory teaches that the earnings per share will grow at the rate  $(b)(k)$ . Growth theory predicts that the annual long-run average growth in real earnings per share is about 2 percent, taking into account both dilution and the variance effect. From 1960 to 2008, companies in the S&P 500 retained, on average, 54 percent of their earnings. Solving for  $k$ , this retention ratio implies a real return on corporate investments of about 4 percent.

One possible adjustment might be made to the foregoing results. Recall that the dilution calculation was based on the assumption of a stable repurchase rate throughout the sample period. In fact,

repurchases accelerated following the passage, in 1982, of U.S. SEC Rule 10b-18, which greatly reduced the legal risk associated with repurchases. More specifically, a pronounced trend toward repurchases as the preferred form of marginal payout to shareholders took place. Brav, Graham, Harvey, and Michaely (2005) reported that following the SEC ruling, managers began behaving as if a significant capital market penalty were associated with cutting dividends but not with reducing repurchases. Accordingly, dividends are set conservatively and repurchases are used to absorb variations in total payout. To the extent that this reliance on repurchases is expected to continue, the estimated 2 percent dilution effect might be too large and growth rates would have to be adjusted upward. Most of the 2 percent dilution, however, is associated not with the actions of existing companies but with start-ups that finance their businesses with new equity. Therefore, the adjustment in the overall rate of future dilution should not be large.

## International Considerations

Thus far, I have limited my analysis to the United States. This restriction is an obvious shortcoming because most major corporations are becoming increasingly global. Although a detailed examination of international data is beyond the scope of this article, several general conclusions can be drawn. First, the data presented in Table 2 suggest that real per capita GDP growth rates for the other developed countries should be comparable to the U.S. growth rate in the future. Second, for the other developed countries, population growth rates are forecasted to be lower. As a result, the implied limitations on earnings growth remain largely unchanged and are perhaps even lower when other developed countries are included in the sample. Third, with respect to the developing countries—particularly India and China, which are the most important by virtue of their size—convergence predicts that they will experience higher growth rates in real per capita GDP

than the United States. In addition, most developing countries are forecasted to have comparable or higher population growth rates than the United States. These forecasts suggest that companies doing business in the developing world will experience higher rates of earnings growth than they achieve in the developed world. Nonetheless, as those countries develop, both real GDP and population growth rates should decline. Furthermore, the fraction of total earnings attributable to business in the developing world is relatively small for most companies. Therefore, if a complete analysis were done on a global basis, the earnings bounds derived from U.S. data and the related predictions regarding stock returns would be unlikely to be markedly affected.

## Conclusion

The long-run performance of equity investments is fundamentally linked to growth in earnings. Earnings growth, in turn, depends on growth in real GDP. This article demonstrates that both theoretical research and empirical research in development economics suggest relatively strict limits on future growth. In particular, real GDP growth in excess of 3 percent in the long run is highly unlikely in the developed world. In light of ongoing dilution in earnings per share, this finding implies that investors should anticipate real returns on U.S. common stocks to average no more than about 4–5 percent in real terms. Although more work needs to be done before equally definitive predictions can be made with respect to international equities, the basic outlook appears to be quite similar.

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*I thank Rob Arnott, Eugene Fama, Kenneth French, John Haut, John Hirshleifer, Jason Hsu, and Brian Palmer for helpful comments on earlier versions of this article. Data were graciously provided by Robert Barro and by Research Associates, LLC.*

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*This article qualifies for 1 CE credit.*

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## Notes

1. For details on the Solow model and more recent elaborations, see Barro and Sala-i-Martin (2004).
2. Hall and Jones (1999) described the problem in detail and offered an intriguing solution.
3. As a first-order approximation, the annual arithmetic mean equals the compound growth rate plus one-half the standard deviation of the annual growth rates.
4. See, for example, Weil (2009, ch. 4).
5. For further details on the relationship between reported earnings and NIPA profits, see Mead, Moulton, and Petrick (2004).
6. Contributions in this area include those of Rozeff (1984); Ross, Brown, and Goetzmann (1995); Claus and Thomas (2001); Fama and French (2002); and Cornell and Moroz (forthcoming).

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