DEPARTMENT OF PUBLIC SERVICE REGULATION
BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MONTANA

* * * * *

IN THE MATTER OF the Application of	)	REGULATORY DIVISION
Montana Dakota Utilities Company for	)	
Authority to Establish Increased Rates for	)	DOCKET NO. D2015.6.51
Electric Service in the State of Montana	)	

DATA RESPONSES OF THE MONTANA CONSUMER COUNSEL TO MONTANA-DAKOTA UTILITIES

MDU-001

Regarding: Direct Testimony of John Wilson
Witness: Wilson.

Please provide electronic files in Excel format, with formulas intact for all Exhibits and Schedules that provide the analytical support for the conclusions reached by Dr. Wilson.

RESPONSE:

See attachments provided in Response to PSC-073.

MDU-002

Regarding: Direct Testimony of John Wilson
Witness: John W. Wilson

Please provide complete copies of each document, article, text report or treatise cited by Dr. Wilson in his Direct Testimony, Appendices and Exhibits in this case.

RESPONSE:

See Attachment for response to MDU-002.

Attachment

Data Response – MDU-002

D2015.6.51

Montana-Dakota Utilities

December 18, 2015

Business Strategy Review, 2000, Volume 11 Issue 2, pp 1-18

Risk and Return in the 20th and 21st Centuries

Elroy Dimson, Paul Marsh and Mike Staunton

The single most important contemporary issue in finance is the equity risk premium. This drives future equity returns, and is the key determinant of the cost of capital. The risk premium – the expected reward for bearing the risk of investing in equities, rather than in low-risk investments such as bills or bonds – is usually estimated from historical data. This article starts by summarising new evidence on historical returns in twelve major world markets from the authors' recent book, "The Millennium Book: A Century of Investment Returns". The authors show that the historical equity risk premium has been lower than previously believed, and argue that the future risk premium is likely to be lower still. They discuss what this implies for the cost of capital, stock market values, and companies' target rates of return. They suggest that many companies are seeking too high a rate of return and thus run the risk of under-investing.

Today, investors have more cause than ever to ask where the markets are heading. What returns can be expected from equities? How might bonds be expected to perform? What are the risks of stock market investment? And what are the rewards? Companies also need answers to these questions, to understand what returns their shareholders and bondholders require, and to ensure they raise and use capital to best effect. Similarly, these are crucial issues for governments, since market returns provide the yardsticks for judging the worth of public sector projects, and for raising and managing government debt. Regulators, too, need to know the cost of capital in order to set 'fair' rates of return for regulated industries.

The recent equity bull run has few, if any, parallels in the 20th century. This makes a long-term perspective on market returns more important than ever before. Measuring what has happened in the past is the starting point for assessing the future. Interpretation of the data and being able to apply it to a modern-day canvas are just as important. But without good quality, consistent data the whole process falls at the first hurdle. In this article we use new indices which we compiled for our recent book, *The Millennium Book: A Century of Investment Returns*. These indices measure the returns on equities, long-term government bonds, treasury bills (short-term risk-free deposits) and inflation in twelve countries over the entire 20th century. Taken together, these twelve countries make up 90% of today's world market capitalisation. Our new indices are more representative than those used

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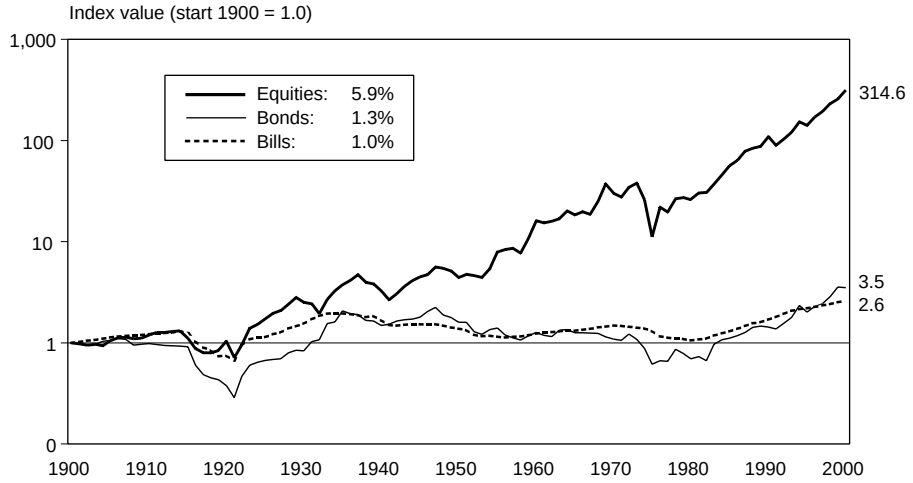
Figure 1
Real returns on UK equities, bonds and bills, 1900-2000



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

in any previous study, and cover a longer time span for a larger number of countries.

The article starts by summarising the main findings about long-term investment returns based on our new index series. These findings challenge some of the accepted beliefs about long-term returns. One notable conclusion is that for much of the 20th century, the risks of equity investment were higher and the rewards lower than is suggested either by past studies or by recent market performance statistics.

Using the findings from *The Millennium Book*, we then focus on the all-important issue of the equity risk premium. We explain why the size of the risk premium is the single most important contemporary issue in finance. We use *The Millennium Book* data to show what the historical risk premium has been in different world markets, and that this, too, has been lower than previously estimated.

We then turn to the future and discuss what the historical risk premium tells us about the future risk premium, and hence the cost of capital. Finally, we speculate about likely future market returns, whether current stock market valuations can be justified, and whether companies are setting excessively high target rates of return, and hence may be under-investing.

Main Findings of *The Millennium Book*

The key findings of the research published in *The Millennium Book* were:

- Equities were the best performing asset class in all twelve countries.
- Equities had highest risk.
- Inflation was a major force in the 20th century.
- Bonds proved a disappointing investment over the 20th century.
- Although equities performed best, equity returns were lower than previous studies have suggested.

Our research approach is summarised in the Appendix.

Equities were the best performers

In every country, equities proved to be the best performing investment over the 20th century. In the UK, £1 invested in the equity market at the end of 1899 would have grown to £16,946 by the start of 2000, before investors' taxes and dealing costs, and with dividends reinvested. This represents an annualised return of 10.2%. Over this same period, UK inflation averaged 4.1%, and so in real terms, equities provided an annualised real return of 5.9%. Figure 1 compares the inflation-adjusted performance of equities with that of bonds and bills. It shows that £1 invested in equities at the start of the 20th century grew to nearly £315 in terms of equivalent purchasing power (ie, a real return of 5.9% pa) by the start of 2000. This compares with just £3.5 for bonds (a real return of 1.3% pa) and £2.6 for bills (a real return of 1.0% pa).

Figure 2 shows annualised real equity and real bond returns over the 20th century for all twelve countries

in our study. There are noticeable variations across countries, with some national markets having provided strikingly good real equity returns, while others turned in more modest results. The worst performing equity market was Italy, with a real return of 2.7% pa, while the best was Sweden, with a real return of 8.2% pa. The average real return across all twelve markets was 5.6%, as shown by the left-hand bar of the paired bars labelled 'AVG' in figure 2.

Figure 2 shows that, despite the variation across countries, equity market returns were ahead of inflation in all twelve countries, including those that experienced major dislocations from wars and economic turmoil. Similarly, figure 2 shows that equities outperformed bonds by a considerable margin in every country.

Equities had highest risk

Although equities gave the highest return in every country, the returns from shares were far more volatile, and hence riskier, than for bonds or short-term deposits. Indeed, equity investors have at times faced large losses. In October 1987, US shares fell 23% in one day, and the crash echoed around the world with even larger one-day losses in some markets. Following the legendary Wall Street Crash in 1929, shares fell 60% in real terms over 1929-31. More recently, in 1973-74, UK investors suffered a still greater loss of 71% in real terms. But the largest losses recorded in our study were in Germany and Japan at the end of World War II, with real returns of –91% in Germany (1945-48), and –97% in Japan (1944-47).

The risk of an investment is usually measured by its volatility (standard deviation) of returns. Assuming investment returns are approximately normally distributed, an investment with a standard deviation of 10% would be one where, in about one year in six, the return was likely to underperform expectations by 10% or more, and vice versa. The volatility (standard deviation) of real equity returns in the UK over the 20th century was 20% pa. This compares with a 14.6% standard deviation for UK bonds and 6.6% for bills. This ranking was common across the world. In every country, equities proved more volatile than bonds, while bonds were more risky than bills.

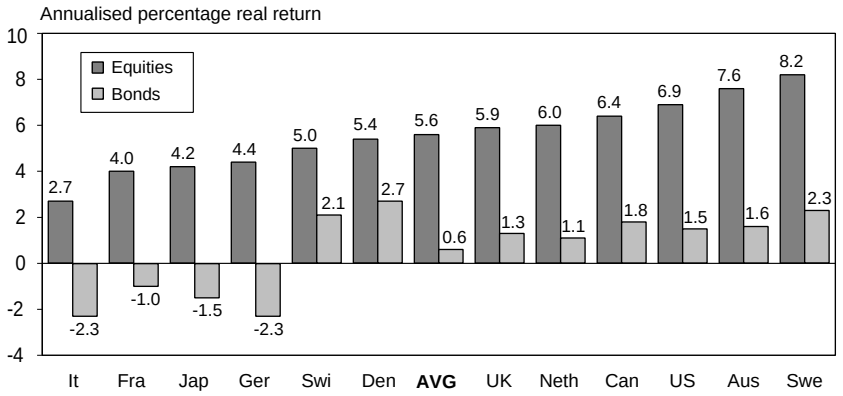
During the 20th century, the UK stock market was less volatile than most others. The average volatility (standard deviation) for the twelve countries was 23%. Germany, Japan and Italy had the highest volatilities; only Australia and Canada were lower than the UK.

Inflation was a major force in the 20th century

UK inflation averaged 4.1% pa over the 20th century. £1 in 1900 had the same purchasing power as £54 today. But while the UK may view itself as having been afflicted by inflation, it was in fact slightly below average for the 20th century taken as a whole. The average inflation rate for all twelve countries was 4.8% pa.

This average figure, however, hides considerable variation across countries. The extreme case was German hyperinflation in 1922/3, which ran at an annual percentage rate in the billions. Three other countries experienced very high inflation around the end of World War II: 344% in Italy in 1944, 317% in Japan in 1946, and 74% in France in 1946.

Figure 2
Real returns on world equity and bond markets, 1900-2000



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

All countries also experienced deflation at some time during the 1920s and early 1930s. UK retail prices rose from £1 in 1900 to £3.13 in 1920, then fell to £1.66 by 1933, and did not regain their 1920 level until 1952.

Inflation and a number of other variables in our study have shown some tendency to regress towards the mean. For example, after being the highest inflation country in the first half-century, Germany enjoyed the lowest rate (2.8%) in the second half (see figure 3). In contrast, the UK had low inflation (2.0%) in the first half century, because the years of higher inflation were partially offset by the deflationary period in the twenties and early thirties. However, in the second half-century, it had the second-highest inflation (after Italy): 6.2% pa from 1950-99, peaking at 25% in 1975.

Bonds proved a disappointing investment

High and unexpected levels of inflation ensured that the 20th century was not the century for bond investors. In the UK, long-term government bonds (gilts) provided a disappointing return of 5.4% pa, or just 1.3% after inflation of 4.1% pa. Risk-free short-dated treasury bills returned 5.1%, or just 1.0% pa in real terms (see figure 1 above).

UK bill and bond returns were around the median of the twelve countries in our study. Four countries – Germany, Japan, Italy and France – experienced negative real returns on both bonds and bills over the 20th century taken as a whole.

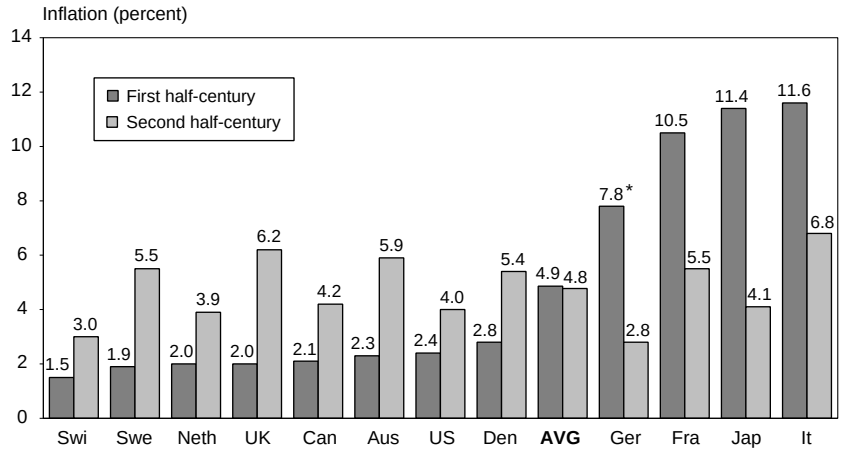
Across all 12 countries, the average real bond return was 0.6% pa, while the bond maturity premium (the difference between long-bond returns and the short-term interest rate) was also 0.6%. Since investment in long bonds is much riskier than investment in short-term deposits, especially at times of high or uncertain inflation, a maturity premium of just 0.6% appears low for the incremental risks involved. It seems highly likely, therefore, that in many markets the returns on bonds fell short of investors' expectations because inflation proved to be higher and more volatile than expected.

The most extreme example of this was naturally during a period of hyperinflation. In 1922/3, German investors who held bonds or even short-term deposits lost everything, reminding us that, although we normally regard government bills as risk-free, and bonds as lower risk than equities, there can be extreme circumstances where this ceases to be true. Over 1922/3, *The Millennium Book* reveals that the real return on German equities was 13%.

Interestingly, the four countries which experienced the lowest bond returns due to high inflation during the first half of the 20th century – Germany, Japan, Italy and France – were amongst the best-performing bond markets over the most recent 50 years (see figure 4). For these countries, bond prices at the mid-point of the century had reflected an expectation of continuing debasement of the domestic currency. Post-war control of inflation typically provided a boost to bond market returns.

Financial market returns thus reflect the turbulence of the 20th century. Through the lens of the markets, we can see the decimating impact of wars and their aftermath, inflation, high interest rates, stock market

Figure 3
International inflation: first *versus* second half of 20th century



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS) * Excludes 1922-3

crashes and the great depression. These events have impacted not only on investment returns, but also on the volatility of the financial markets.

Equity returns were lower than previously believed

Although equities performed best in every country, equity returns over the 20th century proved somewhat lower than has previously been believed. There are two main reasons for this. First, several previous studies have over-estimated equity returns by placing reliance on indices constructed using hindsight. Second, most previous studies have focussed on data that was easy to collect, typically taken from the second half-century, when equities performed especially well.

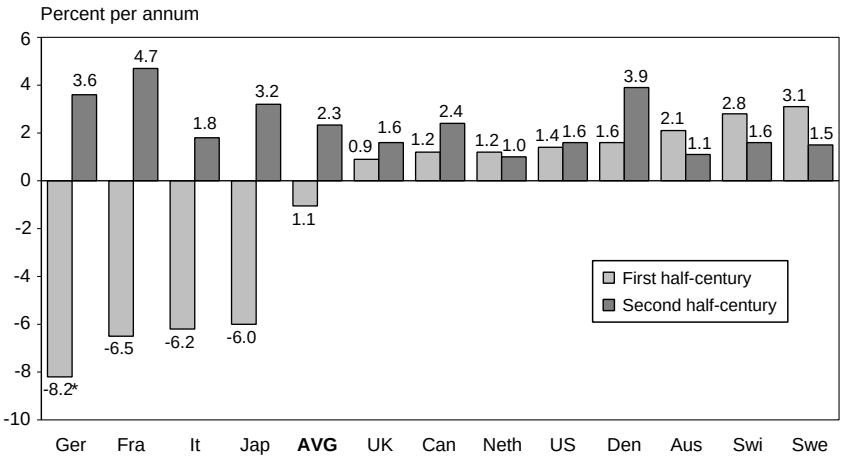
Focusing first on the problem of hindsight, we have taken great pains in *The Millennium Book* to avoid hindsight in the construction of our new indices. Previous research, however, is not always hindsight free. Some researchers have compiled indices based only on surviving or successful companies or industries, and this has led them to overstate equity performance. Within the British stock market one illustration is the omission, from a standard equity index back-history, of the entire railway sector, which in 1900 represented over one third of the entire value of the UK equity market. At the start of the 20th century, investors could not have known that railway stocks were destined to disappear from the market.

In the UK, the standard reference work on long-run UK equity returns has been the BZW equity index (see Barclays Capital, 1999, and CSFB, 1999), which covers the period from 1919 onwards. This went live in 1955, and provides unbiased estimates of equity returns from 1955 onwards, though with narrower market coverage than our *Millennium Book* indices. For the period 1919-54, however, the BZW equity index is based on a reconstructed backhistory, which included companies that were subsequently incorporated into a large-company index. It was thus constructed with hindsight, since an investor back in 1919 would clearly not have known which companies were destined to be successful, ie, to grow large. This use of hindsight, coupled with other problems in index construction, led to the BZW equity index overstating equity returns by 2.34% pa over the period 1919-54.

The second and even more pervasive reason why previous studies have documented higher returns than *The Millennium Book* is their reliance on easy data. Again, we can illustrate this for UK returns. The BZW index starts after the end of World War I, whereas we select 1900 as the common base date for all our indices. By omitting years of turmoil early in the 20th century, while including the post-war recovery, equity market returns are flattered in the BZW and other studies. The effect of starting the BZW history in 1919 rather than 1900 is to add an additional 2.62% pa to the pre-1955 real return on UK equities. Since post-WWI equity returns are more readily available than older data, the differential performance of the BZW index arose from a focus on data that is relatively easy to obtain.

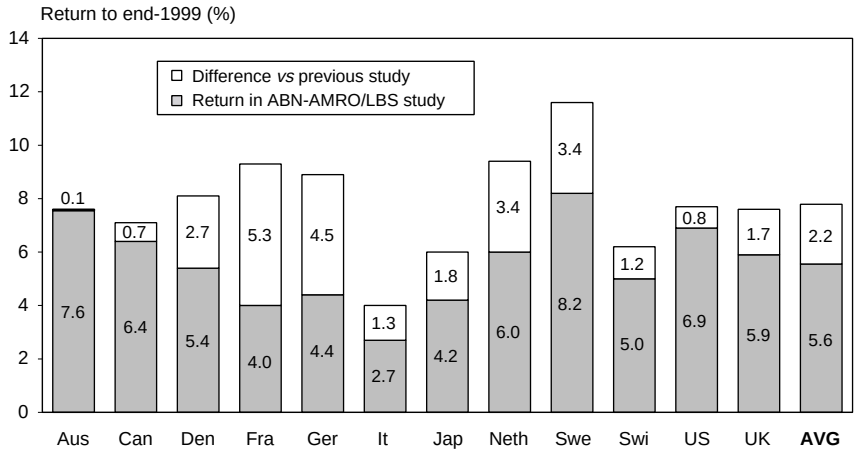
This problem is quite prevalent. Most studies are based on records that are relatively accessible. By avoiding

Figure 4
Real bond returns: first *versus* second half of 20th century



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS) * Excludes 1922-3

Figure 5
This study *versus* previous research: easy data bias



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

inaccessible, controversial or infrequently-published data, periods of poor market performance are often omitted. This tends to give rise to over-estimates of long-run rates of return. Easy data generally exclude periods with breaks in trading activity or times which are regarded as otherwise unusual, such as periods of unrest and economic upheaval, and wars and their aftermath. Easily available data also typically relates to more recent time periods, when equities have performed especially strongly. This is true of the BZW studies for other countries (France, Germany and the Netherlands) and of the Ibbotson studies of the equity risk premium in other countries (Ibbotson Associates, 1999), all of which span far less than the full century examined in *The Millennium Book*.

Compared to estimates over the periods spanned by other studies, our 100-year estimates of equity returns and equity risk premia are markedly lower. In figure 5 we review twelve studies which, despite covering periods that are sometimes as brief as thirty years, might hitherto have been taken as the standard reference for each country. These references generate a misleading impression of 20th century investment performance. They cover intervals during which equity returns exceed the actual returns for the century by, on average, 2.2% per year.

The Equity Risk Premium and Why It Matters

The equity risk premium is the difference between the return on equities and the return on a risk-free asset, typically treasury bills, but sometimes government bonds. The risk premium is important because it represents the reward for, or price of, bearing risk. Investors do not knowingly take on risk unless there is some expected compensation for their risk exposure. For taking on the risks of the equity market, this compensation takes the form of the equity risk premium. To measure this premium, and establish the price of risk, we need to look at the markets where equity risk is traded, namely the world's leading stock markets.

The risk premium matters because it is central to projecting future investment returns, calculating a company's cost of equity capital, valuing companies and shares, appraising investment projects and determining fair rates of return for regulated utilities. *The Millennium Book* provides extensive direct evidence on the equity risk premium, and this is undoubtedly the most important variable documented in the study. Many finance professionals and financial economists regard the equity risk premium as the single most important number in finance.

By definition, an unbiased estimate of the risk premium required by investors tells us what returns we can expect from the equity market in the future, relative to bills or bonds. A low (high) risk premium automatically implies low (high) future returns from equities. If this were not the case, then the highly competitive conditions prevailing in the world's leading stock markets would ensure that share prices rapidly rose (fell) until promised returns were aligned with required returns.

By combining the risk premium estimate with a forecast of future market volatility, we can also infer

the price of risk, ie, the additional percentage return investors require per unit of market volatility. The price of risk, coupled with estimates of future market returns, provide crucial inputs to investors' asset allocation choices, namely how to allocate funds between stocks, bonds, bills and other asset classes. The risk premium is thus central, either explicitly or implicitly, to asset allocation decisions made by investment professionals, individuals and firms.

At the same time, the equity risk premium is of fundamental importance to company managers and regulators. To company managers, the cost of capital is central to setting minimum target rates of return for proposed investment projects. Finally, many utilities and other companies face a situation where part or all of their business is subject to price or rate-of-return regulation. This is designed to ensure that the firms in question do not abuse their market power, and earn an unfairly-high rate of return. The benchmark for judging whether returns are excessive should be the company's cost of capital, which in turn, depends on the equity risk premium.

Measuring the Risk Premium

The equity risk premium is typically measured in one of two ways. The first uses treasury bills (short-term, default-free, fixed-income government securities) as the risk-free or 'safe' benchmark. The second measures the risk premium relative to long-term government bonds. Of these two, only treasury bills can really be considered risk-free, and even here hyperinflation can cause bill investors to experience large losses in real terms. Long-term government bonds are generally appreciably more risky than bills, since bond prices are sensitive both to changes in real interest rates and to inflationary expectations. Since bonds are riskier than bills, we would expect the equity risk premium relative to bonds to be lower than the premium relative to bills.

Long-term bonds nevertheless have one advantage as a benchmark in that long-bond prices reflect not only today's short-term interest rate, but also future expected interest rates. Thus for valuing shares or projects where the cash flows extend many years into the future, the promised return on long bonds will encapsulate the expected sequence of returns on short-

The Risk Premium and Share Valuation

The risk premium is crucial for valuing shares. It has long been recognised that the value of a share is the present value of the discounted stream of cash flows to the shareholder. This statement can be translated into a dividend discount (or dividend growth) valuation model. Alternatively, it may be reformulated as a model that values the portion of the company's free cash flows which is attributable to shareholders.

All these valuation models require a discount rate, which by definition is the shareholders' required return. This required return will be the risk-free rate plus a premium for risk, where the latter will be the equity risk premium for the market, adjusted for the risk of the share in question. If the Capital Asset Pricing Model is being used to determine discount rates, the risk adjustment will depend on the share's systematic risk, or beta – a measure of the extent to which a share's performance fluctuates with the market. UK share betas are published in the London Business School *Risk Measurement Service*. But whichever pricing or valuation model is used, the size of the equity risk premium will, explicitly or implicitly, play a central role.

Just as the external valuation of a company's shares should be driven by the shareholders' required rate of return (the 'cost of equity capital'), so should internal valuations within the company. When reviewing new projects and investments, acquisitions and divestments, or whether existing businesses are providing an adequate return, the benchmark used by managers should be the return required in the capital markets.

The required return on a company's investments should reflect not only the costs of borrowing money, but the cost of equity capital (see, eg, Brealey and Myers 2000, chapters 7-9, for further details on calculating the cost of capital). Projects that fail to cover the cost of capital should not be undertaken, while those that exceed it will be value enhancing. Once again, therefore, the equity risk premium is vital, since if managers over-estimate the required premium, and hence their cost of capital, this will lead to under-investment, and vice versa. Shareholders will be worse off whenever the premium is under- or over-estimated.

dated bills over the remaining term of the bond. The corresponding disadvantage is that long-bond prices will also encapsulate a maturity risk premium, the magnitude of which is hard to measure.

We cannot observe directly what risk premium investors expect for the future. But we can measure the historical risk premium, and if the measurement interval is long enough, we can use this as a starting point for inferences about what investors might expect. We measure the risk premium by taking the geometric difference between the equity return and the risk-free return. The formula for the equity risk premium is *1 + Equity rate of return* divided by *1 + Riskless return*, minus *1*. For example, if shares with a one-year return of 21% are being evaluated relative to treasury bills yielding 10%, the equity risk premium would be 10%. This is because $(1 + {}^{21}/_{100})$ divided by $(1 + {}^{10}/_{100})$ is equal to $(1 + {}^{10}/_{100})$.

The equity risk premium, measured relative to bill or bond returns, is a ratio. It is hence unaffected by whether returns are computed in dollars or (say) French francs, or whether returns are computed in nominal or real (inflation-adjusted) terms.

The range of premia that are encountered over investment periods of a single year is very broad, reflecting the fact that year-to-year equity returns are volatile. In the US, for example, the one-year equity risk premium relative to treasury bills varied over the 20th century between –45% (in 1931) and +55% (in 1933). No one would suggest on the basis of these observations that investors required a risk premium of either –45% or +55%! The outcomes for these two years simply represent one particularly disappointing, and one especially good, year for equities. To infer investors' expectations for the risk premium requires one to look at realised premia over investment horizons that are much longer than a year, and conventional wisdom suggests one should select the longest period possible.

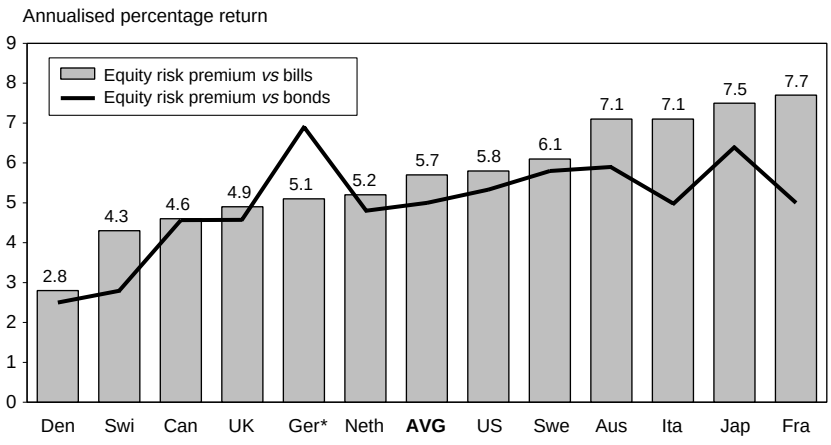
Evidence on the Historical Risk Premium

The twelve countries' equity risk premia over the entire 20th century are shown in figure 6 below. The bars in figure 6 show the risk premium relative to treasury bills, while the line plot shows the premium relative to long bonds. In the case of Germany, the risk premium figures are based on data for 98 years, since we have excluded the hyperinflationary years of 1922/3 when bills and bonds returned –100% in real terms.

While the equity risk premium has clearly varied across countries, the century-long averages fall within a fairly narrow range. Figure 6 shows that, relative to bills, the equity risk premium averaged 5.7%, and ranged from a high of 7.7% for France down to 4.3% for Switzerland, the only outlier being Denmark at 2.8%. We find that the equity risk premium for the US is remarkably close to the middle of the distribution of equity premia, whether the latter are estimated relative to bills or bonds. In particular, the 100-year US equity risk premium relative to bills of 5.8%, was very close to the mean of 5.7% for the twelve countries. The UK experience was also close to the mean, with a 100-year equity risk premium of 4.9%.

The line plot in figure 6 shows the equity risk premium relative to long-term government bonds. As can be seen, this was generally lower than the premium

Figure 6
Annualised equity risk premia relative to bills and bonds



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS) * Excludes 1922-3

relative to bills. This is because, over the century as a whole, the return on government bonds exceeded the return on treasury bills. The average risk premium relative to bonds across the twelve countries was 5.0%, ranging from a high of 6.9% for Germany to a low of 2.5% for Denmark. Once again, the risk premia of 5.3% for the US and 4.6% for the UK are close to the mean for all twelve countries.

As we noted above, the evidence suggests that bond returns over the 20th century proved lower than investors' expectations because of unexpectedly high rates of inflation. If bond performance had been in line with expectations, realised bond returns would have been higher, and equity risk premia would have been lower. This suggests that the historical risk premia relative to bonds, shown in figure 6, are likely to overstate investors' expectations.

Furthermore, the unanticipated losses experienced during the century's worst inflation episodes afflicted bondholders more than shareholders. The risk premia reported in figure 6 are therefore subject to a further caveat in relation to those countries that experienced the worst real bond returns. Germany's appearance at the top of the league table of risk premia relative to bonds is thus attributable much more to the disappointing return on bonds, than to the good performance of German equities (even after excluding 1922/3). This is borne out by the fact that figure 6 shows that Germany was the only country in which the risk premium relative to bonds exceeded the risk premium relative to bills.

The Risk Premium and the Cost of Capital

The risk premia reported above were computed as geometric means. This has intuitive appeal from an investment perspective, since, when past performance is being considered, the geometric mean summarises the annualised rate of return over a historical period. The geometric mean of n returns is the nth root of (*1+the first return*) x (*1+the second return*) x … x (*1+the* n^{th} *return*), minus *1*. When decisions are being taken on a forward-looking basis, however, the arithmetic mean is the appropriate measure, since it represents the mean of all the returns that may possibly occur over the investment holding period. The arithmetic mean of n returns is the sum of all n returns, divided by n.

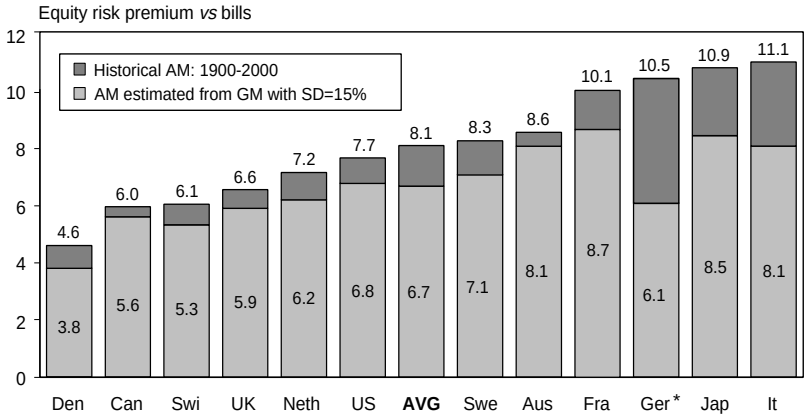
The arithmetic mean of a sequence of different returns is always larger than the geometric mean. To understand this, consider successive returns of +25% in one year, followed by –20% in the following year. The arithmetic mean of these two returns is 2½% (ie, 25 minus 20, divided by 2). The geometric mean of these two rates is zero (since $(1 + {}^{25}/_{100}) \times (1 - {}^{20}/_{100}) - 1 = 0$). The more volatile or risky the sequence of returns, the greater will be the difference between the two means. For very risky investments, the arithmetic mean return can be much higher than the geometric mean.

As we saw above, one of the key uses of the equity risk premium is to determine investors' required returns, and hence the cost of capital for use as the discount rate in valuing shares and in project appraisal. For discounting uncertain future cash flows it is necessary to use the expected risk premium. The expected premium is the arithmetic mean of the one-year premia. In figure 7 (overleaf), the full height of the bars shows the historical arithmetic mean risk premium relative to bills over the last 100 years for each of the twelve countries. The average figure is 8.1%, while the figures for the US and UK are 7.7% and 6.6% respectively. As we would expect, the arithmetic mean risk premium is noticeably higher than the geometric mean premia recorded in figure 6 above. Furthermore, the arithmetic mean is at its largest, both in absolute terms and relative to the geometric mean, for the four countries which experienced the greatest turmoil and hence volatility of returns over the 20th century (see the right-most four bars of figure 7).

The historical arithmetic means in figure 7 are thus clearly influenced by the periods of extreme volatility during the 20th century. All market analysts agree, however, that repetition of certain types of historical event is so implausible that the past must be interpreted with care. Extreme hyperinflation is widely regarded as something that will not again afflict major economies; and a world war would be of a different nature if it were to happen in the future. (If there were another world war, the good news is that we would never again need to concern ourselves with the risk premium.)

We are thus likely to obtain more plausible estimates of the expected future arithmetic risk premium if we adjust the historical estimates in figure 7 downwards to reflect today's best guesses about future equity market volatility levels. The approach we follow here is to take the historical geometric means from figure 6

Figure 7
Arithmetic equity risk premia



Note: AM = Arithmetic Mean; GM = Geometric Mean; SD = Standard Deviation * Excludes 1922-3

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

as given; that is, we treat them as unbiased estimates of the future geometric mean. We then recalculate the arithmetic means, assuming an illustrative, but more plausible, estimate of early 21st century levels of volatility. To do this, we use the result that with lognormally distributed returns, the geometric and arithmetic means are linked by the standard deviation (or volatility) of returns. (Some statistical assumptions that underpin our calculations, but are glossed over here, are discussed in Cooper 1996 and Dimson and Marsh 2001.) For illustrative purposes only, we have assumed a current volatility level of 15% for all twelve markets.

The resultant arithmetic mean risk premia are shown by the lower part of the bars in figure 7. The premia range from 3.8% for Denmark to 8.7% for France, with a mean of 6.7%. The figure for the US is 6.8%, and that for the UK is 5.9%. Note that even when we use 100 years of data, the standard errors around these risk premia estimates are very high, ranging from 1.7% (for Australia and Canada) to 3.6% (for Germany). The standard error for both the US and the UK is 2%. This means that while the figure of 5.9% for the UK remains our best estimate, we can be only 68% confident that the true mean lies within one standard error of this, ie, within the range 5.9 ± 2%, namely between 3.9% and 7.9%. These high standard errors are the reason why conventional wisdom prescribes that the longest possible series of stock market data should be used to estimate risk premia.

We should sound a cautionary note. Even *The Millennium Book's* estimates of long-run returns – which use the longest-run series and most accurate data available to date – may still be slightly upward biased. This is because our study is restricted to the twelve countries for which total returns can currently be estimated. We omit markets that at some point failed to survive – Russia, Argentina, China, Poland and so on. Some of these experienced returns of –100%, and their exclusion will inflate our estimates, which are based only on surviving markets. Mostly, though, these markets were small, so their omission probably has only a minor impact in market capitalisation weighted terms. Our study also excludes some markets which existed in 1900 and still exist today (eg, Spain), but where a full century of data has so far eluded us. Our research thus suffers from some element of the survivorship and easy data bias to which we referred earlier. This may mean that even our global average historical risk premium is slightly upward biased, though hopefully this is mitigated by the large proportion of world market capitalisation covered by our twelve markets. The important qualitative point is that, insofar as our research too may suffer from data biases, it is in the direction of over-estimating the equity risk premium, not under-estimating it.

To obtain a cost-of-capital estimate for use in discounting future cash flows, we require a forecast of the future arithmetic risk premium. For those who believe that estimates based on a long-run series of historical returns are a good guide to future risk premia, and who are prepared to accept that our data are relatively free of survivorship and easy data bias, then the numbers illustrated in the lower bars of figure 7 are the relevant numbers to employ. This indicates

that for the twelve countries in our sample, the average risk premium (for typical risk equities, in a typical risk market) would be 6.7%. Hence, the current cost of equity would be the current risk-free rate of interest, plus a premium of 6.7%.

What This Means for the Future

The key remaining question is whether this 6.7% global average historical risk premium should be used as our best estimate of the future risk premium. In a recent paper, Goyal and Welch (1999) specifically state that "in the absence of any variable known to robustly predict the equity premium out of sample, the [finance] profession should assume that no variable can predict the equity premium better than its own past average". Certainly, many leading textbooks advocate the use of the arithmetic mean of historical equity premia; these include Brealey and Myers (2000) and Bodie, Kane and Marcus (1999).

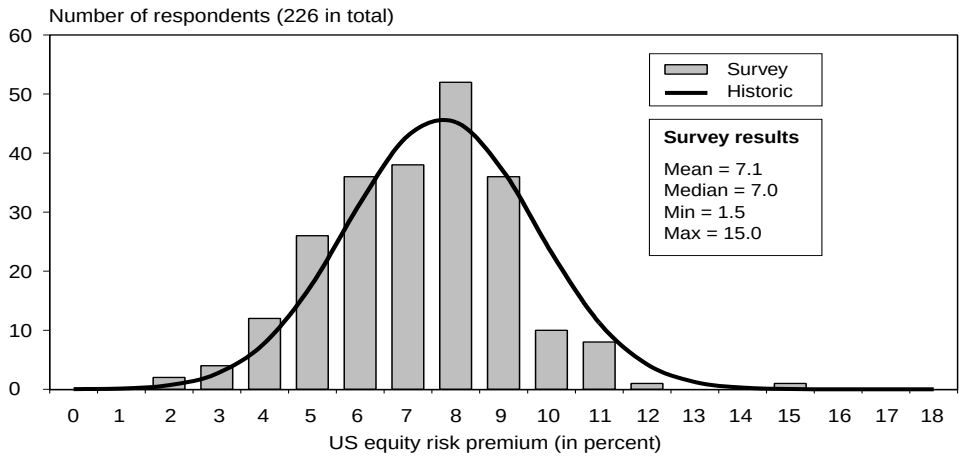
A recent survey by Ivo Welch (2000) casts light on whether academic finance professionals do, in fact, extrapolate from the historical record into the future. Rather than looking at a cross-section of countries, Welch studies the opinions of 226 financial economists who were asked to forecast the arithmetic equity risk premium in the US over a number of time horizons. He finds that the consensus forecast of the arithmetic 30-year equity premium is about 7%. The consensus is that a pessimistic outcome (with a 5% probability of occurrence) would be an equity premium of 2–3%; the consensus regarding an optimistic outcome is for a 12–13% equity premium.

The bars in figure 8 represent the distribution from the Welch survey, while the curved line represents the normal distribution based on the historic mean (7.7%) and associated standard error (2.0%) using the century of observations for the US equity risk premium. An important aspect is the similar spread in both distributions. The uncertainty across financial experts about the risk premium is as large as the uncertainty that arises from statistical analysis of historical returns.

Most respondents to the Welch survey would have regarded the Ibbotson *1999 Yearbook* as the definitive study of the historical US risk premium. The survey mean was lower than the Ibbotson benchmark, and since survey respondents claimed to revise their risk premium forecasts downwards when the equity market rises, this difference may well be explained by the recent strong performance of the market. Consistent with this, the survey respondents also perceived the profession's consensus to be higher than it really was, ie, they thought the mean was ½ to 1% higher than the 7% figure shown in figure 8.

These survey figures represent what is being taught in the world's leading business schools and economics departments. As such, they will also be widely used by finance professionals and corporate executives. Similarly, they will be cited by regulators and used in rate-of-return regulation disputes. Their influence will thus extend from the classroom to the boardroom, the dealing room, and the courtroom.

Figure 8
Views of financial economists *versus* historical results



Source: Welch (2000)

Whether a mean of 7% is correct is quite another matter. As noted above (see figure 5), our new estimate of the annualised 1900-1999 US premium is nearly one percentage point lower than the Ibbotson estimate, which was for 1926-1999. To the extent that survey respondents were calibrating their forecasts relative to the Ibbotson benchmark, these same respondents might now wish to lower their estimates of the equity risk premium to figures based on the new estimates from *The Millennium Book*. This assumes, of course, that they are still content to use historical means as the anchor for their future forecasts.

Interpreting History to Estimate Future Risk Premia

Clearly, history can be no more than a starting point for predicting the equity risk premium. Financial economists may be reluctant to diverge markedly from the historical mean. Decision-makers, on the other hand, cannot rely merely on the average premium observed from past observations. They correctly wish to go beyond using only the past, and to identify the market's implicit expectation for future performance.

There are coherent arguments in favour of going beyond raw historical estimates of the risk premium. First, the whole notion of using the achieved risk premium to forecast the required risk premium depends on having a long enough time period to iron out good and bad luck. Even with a century of data, standard errors are still high.

Second, the equity risk premium could change over time. This might be because the underlying business risk of equities has fluctuated, as the world or the corporate sector became riskier or safer. Or it might be because the risks faced by investors have been transformed, as enhanced diversification opportunities became available, both domestically and internationally. Alternatively, it might be a consequence of systematic changes in investors' levels of risk aversion.

Third, we must take account of the fact that stock market outcomes are influenced by many factors. Some of those that were important in the past may be non-repeatable. If so, projections of the future risk premium should deviate from extrapolations based on the past. The financial history of our twelve stock markets has been so variable over time that it is worthwhile exploring this argument further.

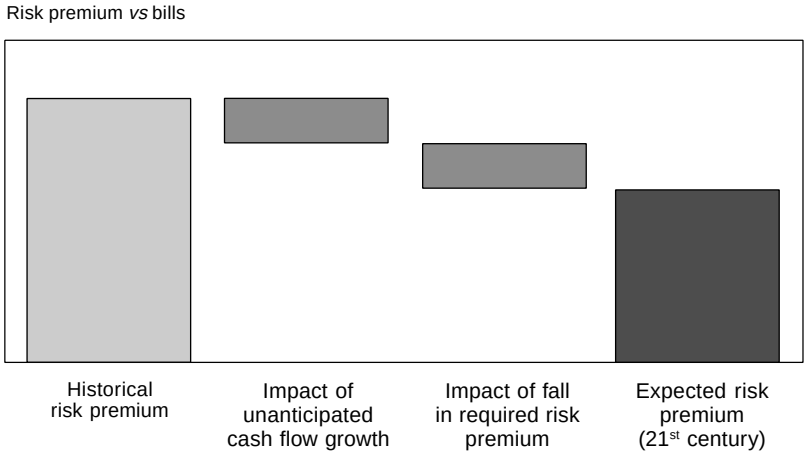
A comparison between the first and second halves of the 20th century makes the point. Over the first half-century the US equity risk premium had an arithmetic average of 6.5%, whereas the second half-century gave rise to a 9.0% risk premium relative to treasury bills. This pattern is common to most of the twelve countries we study in *The Millennium Book*. (The exceptions are Australia, Canada and Italy – and Germany because of its interwar hyperinflation.) The cross-sectional mean for all countries (excluding Germany) in the first half-century was an arithmetic average risk premium of 6.5%, as compared to 9.3% for the twelve-country mean in the second half-century.

The large risk premia achieved during the second half of the 20th century are attributable to two factors. First, there was unprecedented growth in productivity and efficiency, as well as improvements in management and corporate governance, and there was also extensive technological change. As Europe, North America and the Asia-Pacific region emerged from the turmoil of World War II, expectations for improvement were limited to what could be imagined. Reality exceeded investors' expectations. Corporate cash flows grew faster than investors had anticipated. This higher growth is now known to the market, and built into today's higher stock prices.

Second, stock prices have almost certainly also risen because of a fall in the required rate of return, due to diminished investment risk. The economic and political lessons of the 20th century have surely been learned, international trade and investment flows have increased, and the Cold War has ended, leading to a more secure business environment. A further factor that may have lowered required returns is that investors now have much more opportunity to diversify, both domestically and internationally, than they had a century ago. Diversification allows investors to lower their risk exposure without detriment to expected return. Transaction costs are also lower now than a century ago. Factors such as these, which have led to a reduction in the required risk premium, have contributed further to the upward re-rating of share prices.

To convert from a pure historical estimate of the risk premium into a forward-looking projection, we need to reverse-engineer the factors that have driven up stock markets over the last 100 years. This is illustrated conceptually in figure 9. The left-hand bar in figure 9

Figure 9
Historical and expected geometric risk premia



portrays the historical risk premium on the equity market. This includes the impact of unanticipated growth in cash flows and of falls in the required risk premium. We therefore deduct the impact of these two factors. What remains is an indication of the risk premium demanded by investors today (see the right-hand bar in figure 9). The key qualitative point is that it is lower than the raw historical risk premium.

One final point. The use of historical averages as estimates of current required returns implies that France has a very high equity risk premium, while Denmark's risk premium is very low. There may, of course, be differences in risk between markets, but this is unlikely to account for cross-sectional differences in historical premia. Indeed, much of the cross-country variation in historical equity premia is attributable to country-specific historical events that will not recur. When making future projections there is therefore a strong case, particularly given the increasingly global nature of capital markets, for taking a global, rather than a country-by-country, approach to determining the cost of capital.

What Returns Can We Expect over the 21st Century?

The arguments above all lean in one direction, namely that the historical risk premium is likely to exaggerate investors' current required equity risk premium. This has important implications. The bad news is that some investors may have observed these high past returns and assumed they would continue, when in reality they were due to a gradual re-rating that may now be complete. Returns will certainly not persist at the annual level of 16% that was recently cited as the expectation of British private investors (Gallup poll, reported in the *Financial Times* on 15 November 1999). Nor is the premium likely to be as high as the 9.5% arithmetic mean reported in the Ibbotson Associates *2000 Yearbook*. As Siegel (1998) and Shiller (2000) point out, future stock market returns are likely to be lower than many investors are expecting.

If investors continue to require a relatively low risk premium in future, then equities can be expected to outperform risk-free investments, though by a lower margin than over the 20th century. If instead required rates of return rise, share prices will fall, and thus equities will underperform. Perversely, only if the expected equity risk premium is now at a permanently lower level can today's high stock prices be justified.

Readers may now be pondering what our view is of the long-term prospects for equities. As academics, and with investment track records like our own, we are naturally reluctant to forecast investment returns. However, three trends seem likely. First, and uncontroversially, in the 21st century, investment in equities will remain risky. This is because business itself is risky, and because the new century will bring its own forms of turmoil and volatility. Our second prediction follows from our first. If equities remain risky, as must certainly be the case, equity investors should continue to expect a positive risk premium. This implies that, when investors look back 100 years from now, equities should prove to have been the best-performing asset class over the 21st century. Our third prediction is that the risk premium will turn out to be

lower than it has been during the 20th century, even when it is calculated, as in this study, to include the turbulent earlier half of the 20th century.

These are long-term forecasts, the accuracy of which should not be judged for a further one hundred years. Even then, note that with 200 observations the standard error associated with estimates based on historic data will still be of the order of 1.5%.

Are Companies Under-investing?

It has become clear that the current level of the equity risk premium is unlikely to be as high as was considered reasonable in the mid-1990s. The arithmetic mean of 8½% recommended by Ross, Westerfield and Jaffe (1993), the 8-9% suggested (with caveats) by Brealey and Myers (2000), the 7½% recommended by Weston, Chung and Sui (1997), and a similar figure inferred from the Copeland, Koller and Murrin (1995) geometric mean of 5-6%, all look excessive. The market is almost certainly building lower risk premia than this into stock prices.

At the same time, real interest rates have declined. For example, the real yield on UK index-linked government bonds has fallen from well over 4% a few years ago to around 2% today. To compute the expected return on equity investment, we have to add the risk premium to the real interest rate. Since both components have declined, it follows that in real terms, the required rate of return on equity capital is markedly lower than it was. With lower inflation and lower real interest rates, the expected return on conventional bonds has also fallen. So the required return on debt capital is also lower than it was.

The cost of capital has thus fallen substantially in recent years. Moreover, as we show in *The Millennium Book*, most countries share the experience we describe. Many companies, however, are still living in the past. They are seeking a required rate of return on new investment which is simply too high. By ignoring the worldwide fall in the costs of both debt and equity capital, there is a danger that these companies are under-investing, or are waiting too long before embarking on important projects.

Cancellation or deferral of worthwhile projects erodes the competitive position of established companies. The biggest losers are likely to be those firms that risk being overtaken by new competitors who are in a position to exploit new technologies and innovative processes. These losers will experience downgrading of their market ratings and erosion of their share prices. Ironically, this stock market reaction may be misinterpreted as an increase in the cost of capital, and contribute to a vicious circle of continuing under-investment and loss of shareholder value.

Is mis-estimation of the cost of capital the only explanation for the woes of 'old economy' companies? Of course not: it is not that simple. Markets have risen because of lower required rates of return. But they have also responded to a benevolent economic environment and the emergence of new technologies. To share in the improved profits outlook, it has been necessary to be doing the right thing. This means investing in worthwhile projects, rather than simply expanding through projects that fail to cover the cost of capital.

Some companies have been overtaken by the fast pace of change in the economy, and are not in a position to benefit from today's low cost of capital by investing in worthwhile projects. While these firms should be looking for profitable new investments, they may well conclude that the best they can do is to return excess funds to their shareholders. These shareholders then have the option of investing their money in other shares that do offer the normal return from equity investment.

To make the right decision, it is important that managers have insight into the returns that can be expected from investing in the capital market. History can be misleading as a guide to the future, and undoubtedly needs to be interpreted with care. Nevertheless, financial market history provides a starting point. By understanding the capital markets, managers can be empowered to focus on investments that add to the market value of their company.

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Appendix: The Research Approach

Prior to publication of *The Millennium Book*, there was a paucity of reliable, comparable evidence on long-run rates of return in the world's major markets over the 20th century. The US was the exception, since for many years high quality data had been available, at least from 1926 to date. However, America has had a remarkably successful economy, and it would have been dangerous to extrapolate the future from the US experience.

The Millennium Book sought to fill the gap in our knowledge about long-term rates of return. For the UK, this was achieved by constructing an entire new family of equity and bond indices from 1900-2000 especially for the study. For the eleven other markets, we assembled and linked together the best quality indices and returns data available from previous academic studies and other sources.

For our own home market, the UK, there was until now no satisfactory record of long-run equity performance. We therefore used the London Business School Share Price Database to construct an index, starting in 1955, of the total return from investing in the entire UK equity market. This index is described in our forthcoming article in the *Journal of Business* (2001). From 1900 onwards, we constructed an index of the performance of the largest 100 companies. This involved a process of painstaking financial archaeology, collecting original data on share prices, dividends, and other data from archives in the City of London. By linking these two indices together, we have compiled an authoritative record of UK equity performance over the last 100 years. Similarly, for government bonds, we constructed a new returns index from 1900-2000, which tracks the returns on perpetuals until 1954, and thereafter on a portfolio of bonds with an average maturity of 20 years.

The eleven other markets covered are the US and Canada; Denmark, France, Germany, Italy, the Netherlands, Sweden and Switzerland; and Australia and Japan. In each country, we cover the same asset classes: equities, bonds and bills; and inflation. To span the century, for each asset class, we typically needed to link several different studies/index series.

Unlike most previous long-term studies of global markets, all our investment returns include reinvested income as well as capital gains. Many early equity indices measure just capital gains, ignoring dividends, while many early bond indices record just yields, ignoring price movements. Furthermore, our database is more comprehensive and accurate than previous research, spans a longer period, and the common start-date of 1900 aids international comparisons. In contrast, one of the most frequently cited previous studies, Jorion and Goetzmann (1999), identified only four non-Anglo Saxon markets with pre-1970 dividends, and none of these index series started before the 1920s. Finally, as noted above, we have taken pains to avoid any hindsight.

Capital market returns

For each asset class within each country, we have computed a series of annual nominal returns, calculated in local currency, for each calendar year from 1900 to 1999. From these, we compute the annualised (geometric mean) rate of return over the full century, and over any chosen sub-period. These annualised rates are the returns that investors would have earned before personal taxes and dealing costs. When compounded up, they indicate the terminal wealth that would have been generated by the initial investment.

Inflation was a major force in all countries during the 20th century. In addition to nominal returns, we therefore also calculate real, or inflation-adjusted, returns. The real return is defined as *1 + Nominal rate of return* divided by *1 + Inflation rate*, minus *1*. Because real returns are measured in constant purchasing power, they provide a far more meaningful measure of investment performance. Furthermore, real returns can readily be compared across different countries, since they have no obvious currency numeraire.

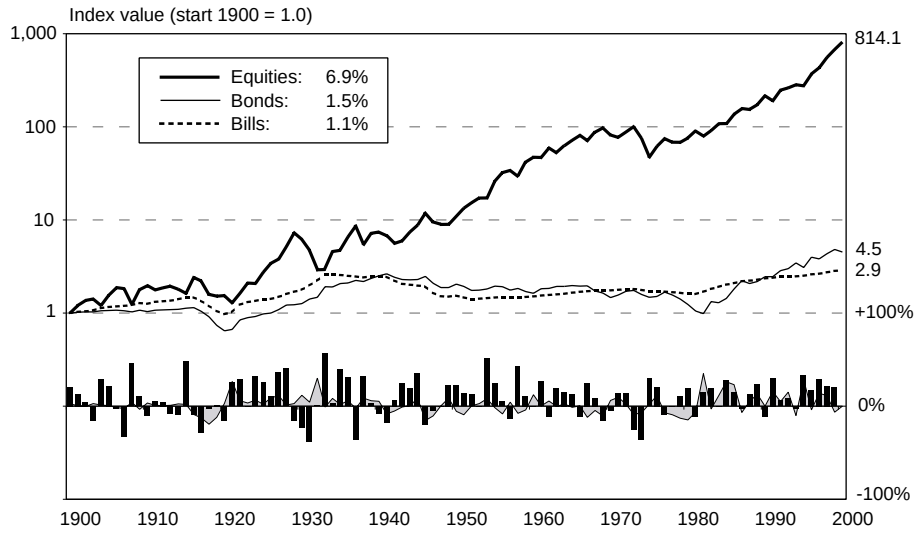
The nature of our underlying returns data is illustrated in the two-page box which shows summary data taken from the second half of *The Millennium Book*. While the first part of the book deals mainly with international comparisons, the second part contains a separate chapter for each country, describing the data sources, and presenting summary charts and statistics of returns data. The data shown overleaf is extracted from the chapter covering the US. A similar template is used for all twelve countries.

Long-run Rates of Return in the United States

In this box we illustrate the process of compiling a long-term performance record for each market. We follow the same procedure – adapting it slightly – for each of our twelve countries. We cover the three main asset categories – equities, government bonds and treasury bills – and inflation. Out of 48 asset/country combinations, 44 have a complete century-long record, while four have an unbroken history that covers nearly ninety years.

For all assets and markets we compile estimates of capital appreciation, income and total return, including reinvested dividends. Occasionally, as for the UK, our research involved assembling a new index from underlying stock price data. But for most countries, we simply identified the highest quality and most authoritative research studies over a sequence of time periods. The least troublesome market, from this point of view, was the US. We use the Schwert (1990) equity market returns for the first 26 years of the 20th century, which we link to the University of Chicago's index of all New York Stock Exchange

Figure 10
Real returns on US equities, bonds and bills, 1900-2000



Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

Table 1
Distribution of US asset returns, 1900-2000

Return % pa	Asset	Arithmetic mean	Geometric mean	Minimum return	Maximum return	Standard deviation
Nominal return	Equities	12.2	10.3	-43.9	57.6	20.0
	Bonds	5.0	4.7	-9.2	40.4	8.1
	Bills	4.3	4.3	0.0	15.2	2.8
	Inflation	3.3	3.2	-10.8	20.4	5.0
Real return	Equities	8.9	6.9	-38.1	56.4	20.3
	Bonds	2.0	1.5	-19.3	35.2	9.9
	Bills	1.2	1.1	-15.0	20.0	4.9

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

Table 2
US real rates of return over various periods, 1900-2000

	From 1 January									
To	**1900**	**1910**	**1920**	**1930**	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**
1 Jan					**Real return on equities**					
1910	7.1									
1920	2.2	-2.5								
1930	6.2	5.8	14.9							
1940	5.1	4.5	8.2	1.9						
1950	4.9	4.4	6.8	2.9	4.0					
1960	6.6	6.5	8.9	7.0	9.7	15.7				
1970	6.5	6.4	8.3	6.7	8.3	10.5	5.6			
1980	5.6	5.3	6.7	5.2	6.0	6.7	2.4	-0.7		
1990	6.1	6.0	7.3	6.1	7.0	7.7	5.2	5.0	11.0	
2000	6.9	6.9	8.2	7.2	8.1	9.0	7.4	8.0	12.6	14.2
1 Jan					**Real return on bonds**					
1910	0.3									
1920	-2.2	-4.6								
1930	0.8	1.0	7.0							
1940	2.3	3.0	7.0	7.1						
1950	1.4	1.7	3.9	2.4	-2.0					
1960	0.8	0.9	2.3	0.8	-2.1	-2.2				
1970	0.5	0.6	1.7	0.4	-1.8	-1.6	-1.0			
1980	0.3	0.3	1.1	-0.1	-1.8	-1.7	-1.4	-1.7		
1990	1.0	1.1	1.9	1.1	0.0	0.5	1.4	2.6	7.2	
2000	1.5	1.7	2.5	1.8	1.0	1.6	2.6	3.8	6.7	6.3
1 Jan					**Real return on bills**					
1910	2.3									
1920	-0.1	-2.5								
1930	1.9	1.8	6.2							
1940	2.3	2.3	4.8	3.4						
1950	0.9	0.5	1.5	-0.7	-4.6					
1960	0.7	0.4	1.1	-0.5	-2.4	-0.2				
1970	0.8	0.6	1.2	0.0	-1.1	0.6	1.5			
1980	0.6	0.4	0.8	-0.2	-1.1	0.1	0.3	-0.9		
1990	1.0	0.8	1.3	0.5	-0.1	1.1	1.5	1.5	3.9	
2000	1.1	0.9	1.4	0.7	0.2	1.3	1.6	1.7	3.0	2.0
1 Jan					**Inflation**					
1910	2.4									
1920	4.8	7.3								
1930	2.9	3.1	-0.9							
1940	1.6	1.4	-1.5	-2.0						
1950	2.4	2.4	0.7	1.6	5.4					
1960	2.3	2.3	1.1	1.8	3.8	2.2				
1970	2.4	2.4	1.4	2.0	3.4	2.4	2.5			
1980	3.0	3.1	2.4	3.0	4.3	4.0	4.9	7.4		
1990	3.2	3.3	2.7	3.4	4.5	4.3	5.0	6.2	5.1	
2000	3.2	3.3	2.8	3.3	4.2	4.0	4.5	5.1	4.0	2.9

Source: Dimson, Marsh and Staunton (ABN AMRO/LBS)

stocks (1926-61) and their index of all NYSE, American and Nasdaq stocks (1962-70), and to the Wilshire 5000 index (1971-1999). We follow a similar procedure for assembling the bond, bill and inflation indices.

Inflation-adjusted returns are more comparable across countries, so we focus here on the real returns on US asset categories. Figure 10 shows the cumulative real return from an investment of one dollar in each of equities, long-term government bonds, and short-dated treasury bills made at the end of 1899 and held throughout the 20th century. The bar chart in the lower section of figure 10 displays the year-by-year real returns on US equities and government bonds.

Table 1 summarises the data represented in figure 10, listing the arithmetic and geometric means and the standard deviation of annual returns, and the minimum and maximum returns experienced in the US over the entire 20th century. The returns are shown both in nominal terms (upper panel) and in real, inflation-adjusted terms (lower panel).

Table 2 lists annualised real returns over all possible intervals of duration 10, 9…1 decades, from an initial investment made in 1900, 1910…1990. This table covers equity, bond and bill returns, as well as inflation. The top panel of table 2 reveals the good fortune experienced over recent decades by equity investors. Look at the bottom row of the top panel. The entries towards the right-hand side show that over 1990-2000 the annualised real equity return was 14.2%, as compared to lower levels over longer intervals, such as the 12.6% recorded for 1980-2000, 8.0% over 1970-2000, and 7.4% over 1960-2000. The body of the same panel reveals that the preceding thirty years gave rise to an annualised real return on equities of 7.0% (1930-1960), while the first thirty years of the century yielded real returns of only 6.2% (1900-1930). By taking a long-term perspective, we mitigate the problem of drawing inferences from recent experience that may be unrepresentative of the future.

Figure 10 shows real returns on US assets. The upper section shows the cumulative real returns from an investment of $1 in each of equities, long-term government bonds, and short-dated treasury bills made at the end of 1899 and held throughout the 20th century. The lower section comprises a bar chart of the year-by-year real returns on US equities and government bonds.

It can be seen immediately from both the triangles and the table in the box that, for the US market, the annualised real return on equities over the 20th century was 6.9% per annum. A real return of 6.9% pa on an initial investment of $1 held over 100 years would have resulted in real terminal wealth of $814.1 as shown in figure 10. Real bond and bill returns were a much lower, 1.5% and 1.1% respectively, while inflation averaged 3.2%. Note, however, that the variability (standard deviation) of equity returns has been twice that of bonds, which in turn had twice the variability of bills.

As noted above, the history of US stocks, bonds, bills and inflation has hitherto been far better documented than in any other country, while researchers have been concerned that the US results may be non-typical since the US has been such a successful economy. A major contribution of *The Millennium Book* is that we have been able to assemble comparable 100-year series for the same asset classes for eleven other countries. We can now set this alongside the US data and make international comparisons that help set the US experience in perspective.

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DIVIDEND YIELDS AND EXPECTED STOCK RETURNS*

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The power of dividend yields to forecast stock returns, measured by regression R^2, increases with the return horizon. We offer a two-part explanation. (1) High autocorrelation causes the variance of expected returns to grow faster than the return horizon. (2) The growth of the variance of unexpected returns with the return horizon is attenuated by a discount-rate effect – shocks to expected returns generate opposite shocks to current prices. We estimate that, on average, the future price increases implied by higher expected returns are just offset by the decline in the current price. Thus, time-varying expected returns generate 'temporary' components of prices.

1. Introduction

There is much evidence that stock returns are predictable. The common conclusion, usually from tests on monthly data, is that the predictable component of returns, or equivalently, the variation through time of expected returns, is a small fraction (usually less than 3%) of return variances. See, for example, Fama and Schwert (1977), Fama (1981), Keim and Stambaugh (1986), and French, Schwert, and Stambaugh (1987). Recently, however, Fama and French (1987a) find that portfolio returns for holding periods beyond a year have strong negative autocorrelation. They show that under some assumptions about the nature of the price process, the autocorrelations imply that time-varying expected returns explain 25–40% of three- to five-year return variances. Using variance-ratio tests, Poterba and Summers (1987) also estimate that long-horizon stock returns have large predictable components.

Univariate tests on long-horizon returns are imprecise. Although their point estimates suggest strong predictability, Poterba and Summers (1987) cannot reject the hypothesis that stock prices are random walks, even with variance ratios estimated on returns from 1871 to 1985. Fama and French (1987a) find reliable negative autocorrelation in tests on long-horizon returns for the

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1926–1985 period, but subperiod results suggest that the autocorrelation is largely due to the 1926–1940 period. Because sample sizes for long-horizon returns are small, however, it is impossible to make reliable inferences about changes in their time-series properties.

We use dividend/price ratios (D/P), henceforth called dividend yields, to forecast returns on the value- and equal-weighted portfolios of New York Stock Exchange (NYSE) stocks for return horizons (holding periods) from one month to four years. Our tests confirm existing evidence that the predictable (expected) component of returns is a small fraction of short-horizon return variances. Regressions of returns on yields typically explain less than 5% of monthly or quarterly return variances. More interesting, our results add statistical power to the evidence that the predictable component of returns is a larger fraction of the variation of long-horizon returns. Regressions of returns on D/P often explain more than 25% of the variances of two- to four-year returns. In contrast to the univariate tests of Fama and French (1987a) and Poterba and Summers (1987), regressions of returns on yields provide reliable evidence of forecast power for subperiods as well as for the 1927–1986 sample period.

The hypothesis that D/P forecasts returns has a long tradition among practitioners and academics [for example, Dow (1920) and Ball (1978)]. The intuition of the 'efficient markets' version of the hypothesis is that stock prices are low relative to dividends when discount rates and expected returns are high, and vice versa, so that D/P varies with expected returns. There is also evidence, primarily for annual returns, that supports the hypothesis. See, for example, Rozeff (1984), Shiller (1984), Flood, Hodrick, and Kaplan (1986), and Campbell and Shiller (1987). Thus, neither the hypothesis nor the evidence that D/P forecasts returns is new. What we offer are (a) evidence that forecast power increases with the return horizon, (b) an economic story to explain this result, and (c) evidence consistent with the explanation.

Part of the story for why the predictable component of returns becomes more important for longer return horizons is easy to document. If expected returns have strong positive autocorrelation, rational forecasts of one-year returns one to four years ahead are highly correlated. As a consequence, the variance of expected returns grows faster with the return horizon than the variance of unexpected returns – the variation of expected returns becomes a larger fraction of the variation of returns. Our results, like those of others, indicate that expected returns are highly autocorrelated.

The second part of the story for forecast power that increases with the return horizon is more interesting. It starts from the observation that residual variances for regressions of returns on yields (the unexpected returns estimated from the regressions) increase less than in proportion to the return horizon. Our explanation centers on what we call the discount-rate effect, that is, the offsetting adjustment of current prices triggered by shocks to discount rates and expected returns. We find that estimated shocks to expected returns

are indeed associated with opposite shocks to prices. The cumulative price effect of these shocks is roughly zero; on average, the expected future price increases implied by higher expected returns are offset by the immediate decline in the current price.

These results are consistent with models [for example, Summers (1986)] in which time-varying expected returns generate mean-reverting components of prices. The interesting economic question, motivated but unresolved by our results, is whether the predictability of returns implied by such temporary price components is driven by rational economic behavior (the investment opportunities of firms and the tastes of investors for current versus risky future consumption) – or by animal spirits.

2. Dividend yields

Consider a discrete-time perfect-certainty model in which $D(t)$, the dividend per share for the time period from $t-1$ to t, grows at the constant rate g, and the market interest rate that relates the stream of future dividends to the stock price $P(t-1)$ at time $t-1$ is the constant r. In this model, the price $P(t-1)$ is

$$P(t-1)=\frac{D(t)}{1+r}\left(1+\frac{1+g}{1+r}+\frac{(1+g)^2}{(1+r)^2}+\cdots\right)=\frac{D(t)}{r-g}. \tag{1}$$

The dividend yield is the interest rate less the dividend growth rate,

$$\frac{D(t)}{P(t-1)}=r-g. \tag{2}$$

In the certainty model, the interest rate r is the discount rate for dividends and the period-by-period return on the stock. The transition from certainty to a model that (a) accommodates uncertain future dividends and discount rates and (b) shows the correspondence between discount rates and time-varying expected returns is difficult. See Campbell and Shiller (1987) and Poterba and Summers (1987). The direct relation between the dividend yield and the interest rate in the certainty model (2) suffices, however, to illustrate that yields are likely to capture variation in expected returns.

3. Variables for the basic regressions

3.1. Returns and dividend yields

Fama and French (1987a) find that the predictability of long-horizon returns implied by negative autocorrelation is stronger for portfolios of small firms. They also find that the return behavior of large- and small-firm portfolios

is typified by the value- and equal-weighted portfolios of NYSE stocks constructed by the Center for Research in Security Prices (CRSP). Our tests use continuously compounded returns $r(t, t+T)$ on the two market portfolios for return horizons T of one month, one quarter, and one to four years. The monthly, quarterly, and annual returns are nonoverlapping. The two- to four-year returns are overlapping annual (end-of-year) observations. The sample period for the returns is 1927–1986.

The tests center on regressions of the future return, $r(t, t+T)$, on two measures of the time t dividend yield, $Y(t)$,

$$r(t, t+T) = \alpha(T) + \beta(T)Y(t) + \varepsilon(t, t+T). \tag{3}$$

The yields are constructed from returns, with and without dividends, provided by CRSP. Consider a one-dollar investment in either the value- or equal-weighted market portfolio at the end of December 1925. If dividends are not reinvested, the value of the portfolio at the end of the month m is

$$P(m) = \exp[r_0(1) + r_0(2) + r_0(3) + \cdots + r_0(m)], \tag{4}$$

where $r_0(m)$ is the continuously compounded without-dividend return for month m. If the continuously compounded with-dividend return is $r(m)$, the dividend on the portfolio in month m is

$$D(m) = P(m-1)\exp[r(m)] - P(m). \tag{5}$$

Two dividend yields, $D(t)/P(t-1)$ and $D(t)/P(t)$, are computed by summing the monthly dividends, from (5), for the year preceding time t and dividing by the value of the portfolio at the beginning or end of the year, from (4). We use annual yields to avoid seasonal differences in dividend payments. The annual yields are used in the estimates of (3) for all return horizons.

3.2. Estimation problems and the definition of the yield

The certainty model (2) shows that the dividend yield is a noisy proxy for expected returns because it also reflects expected dividend growth. Variation in the dividend yield, $Y(t)$, due to changes in the expected growth of dividends can cloud the information in the yield about time-varying expected returns. More generally, any variation in $Y(t)$ that is unrelated to variation in the time t expected return, $E_t r(t, t+T)$, is noise that tends to cause the regression of $r(t, t+T)$ on $Y(t)$ to miss some of the variation in expected returns – it shows up in the regression residuals.

On the other hand, when expected returns vary through time, the discount-rate effect tends to cause estimates of (3) to overstate the variation of expected

returns. Suppose an expected return shock at t increases discount rates. If the discount-rate increases are not offset by increases in expected dividends, the expected return shock causes an unexpected decline in $P(t)$. If dividend yields forecast returns, the expected return shock also causes an unexpected increase in $Y(t)$. Thus, because of the discount-rate effect, expected return shocks produce a negative correlation between unexpected returns and contemporaneous yield shocks that tends to produce upward biased slopes in regressions of returns on yields. [See Stambaugh (1986)]. This bias arises only when yields track time-varying expected returns. It does not bias the tests toward false conclusions that yields have forecast power.

Upward bias of the estimated slope in (3) due to the discount-rate effect and downward bias due to variation in $Y(t)$ unrelated to $E_t r(t, t+T)$ can arise for any definition of the yield. Other problems in estimating (3) are specific to the definition of $Y(t)$ as $D(t)/P(t)$ or $D(t)/P(t-1)$. For example, because we would like a yield with up-to-date but known information about expected returns for periods forward from t, $D(t)/P(t)$ is a natural choice. Because stock prices are forward-looking, however, $D(t)$ is old relative to the dividend forecasts in $P(t)$. Good news about future dividends produces a high price $P(t)$ relative to the current dividend $D(t)$ and a low dividend yield $D(t)/P(t)$. Good news about dividends also produces a high return $r(t-T, t)$. The result is a negative correlation between the disturbance $\varepsilon(t-T, t)$ and the time t shock to $D(t)/P(t)$ that again tends to produce upward-baised slopes in regressions of $r(t, t+T)$ on $D(t)/P(t)$.

Table 1 shows that the cross-correlations between one-year stock returns and dividend changes more than a year ahead are close to 0.0. These results suggest that stock prices do not forecast dividend charges more than a year ahead. Thus, variation in the dividend yield due to a denominator price that looks beyond the dividend in the numerator is substantially reduced when $Y(t)$ is defined as $D(t)/P(t-1)$, where $P(t-1)$ is the price at the beginning of the year covered by $D(t)$. If stock prices do not forecast dividend changes more than a year ahead, the dividend forecasts in $P(t-1)$ will not produce variation in $D(t)/P(t-1)$, and they will not produce upward-biased slopes in regressions of $r(t, t+T)$ on $D(t)/P(t-1)$.

Confident conclusions that $D(t)/P(t)$ or $D(t)/P(t-1)$ produces regressions that overstate or understate the variation of expected returns can not be made on *a priori* grounds. $D(t)/P(t-1)$ is more conservative. Any upward bias in the slopes it produces occurs only when expected returns vary through time (the discount-rate effect). Thus, regressions that use $D(t)/P(t-1)$ are more likely to avoid a false positive conclusion that yields track expected returns. They are, however, also more likely to be too conservative. The deviation of $D(t)$ from its expected value at $t-1$ is noise that tends to cause regressions of $r(t, t+T)$ on $D(t)/P(t-1)$ to understate the variation of expected returns. Moreover, because $P(t-1)$ can only reflect information

Table 1

Cross-correlations between one-year continuously-compounded returns and current and future one-year changes in the log of annual dividends for the CRSP value-weighted and equal-weighted NYSE portfolios.

$$\mathrm{Cor}[r(t-1,t), \ln D(t+i) - \ln D(t+i-1)]$$

Period	Lead i					$s(0)$[a]
	0	1	2	3	4	
	Value-weighted nominal returns					
1927–1986	0.10	0.68	0.22	0.03	−0.16	0.13
1927–1956	0.13	0.78	0.26	0.08	−0.18	0.18
1957–1986	−0.09	0.37	0.05	−0.29	−0.10	0.18
1941–1986	−0.12	0.26	0.00	−0.16	−0.05	0.15
	Equal-weighted nominal returns					
1927–1986	0.17	0.72	0.21	0.04	−0.20	0.13
1927–1956	0.19	0.80	0.23	0.08	−0.22	0.18
1957–1986	0.09	0.46	0.13	−0.11	−0.10	0.18
1941–1986	0.03	0.46	0.11	−0.01	−0.12	0.15

[a] $s(0)$ is the asymptotic standard error of the contemporaneous cross-correlation, that is, $n^{-0.5}$, where n is the sample size. Real returns produce correlations similar to those shown for nominal returns.

about expected returns available at $t-1$, $D(t)/P(t-1)$ is about a year out of date with respect to expected returns measured forward from t. If current shocks have a decaying effect on expected returns, using an 'old' yield to track expected returns is likely to understate the variation of expected returns. We present results for the more timely measure, $D(t)/P(t)$, as well as for $D(t)/P(t-1)$.

4. Summary statistics

Table 2 shows summary statistics for one-year nominal and real returns on the value- and equal-weighted portfolios. Standard deviations of returns are about 50% higher during the 1927–1956 period than during the 1957–1986 period. As in Blume (1968), the high variability of returns for 1927–1956 is largely due to the 1927–1940 period. The standard deviations of returns are similar for 1957–1986 and 1941–1986. We shall find that the regression results are also similar for these periods.

Like stock returns, dividend changes are more variable toward the beginning of the sample. The standard deviations of year-to-year changes in the logs of annual dividends on the value- and equal-weighted portfolios for 1957–1986 are about 25% of those for 1927–1956. Dividend variability declines relative to that of returns. During the 1927–1956 period, dividend changes are almost as

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Table 2

Summary statistics for one-year nominal and real returns, dividend yields, and changes in the logs of annual dividends for the CRSP value-weighted and equal-weighted NYSE portfolios.[a]

Period	Mean	S.D.	Autocorrelations 1	2	3	4	5	Mean	S.D.	Autocorrelations 1	2	3	4	5
			Value-weighted nominal returns							Equal-weighted nominal returns				
1927–1986	0.092	0.206	0.10	−0.20	−0.07	−0.15	−0.02	0.125	0.280	0.13	−0.18	−0.14	−0.23	−0.11
1927–1956	0.088	0.244	0.21	−0.10	−0.18	−0.44	−0.03	0.124	0.336	0.19	−0.11	−0.23	−0.51	−0.12
1957–1986	0.096	0.163	−0.16	−0.39	0.19	0.30	0.06	0.125	0.216	−0.04	−0.36	0.13	0.26	−0.07
1941–1986	0.112	0.155	−0.08	−0.33	0.03	0.27	0.10	0.143	0.210	0.04	−0.28	−0.07	0.17	−0.01
			Value-weighted real returns							Equal-weighted real returns				
1927–1986	0.062	0.208	0.04	−0.24	−0.08	−0.09	0.05	0.094	0.282	0.08	−0.22	−0.15	−0.19	−0.04
1927–1956	0.074	0.239	0.11	−0.17	−0.22	−0.40	0.06	0.109	0.334	0.13	−0.15	−0.26	−0.47	−0.04
1957–1986	0.050	0.174	−0.10	−0.38	0.18	0.29	0.06	0.079	0.224	−0.03	−0.39	0.11	0.26	−0.05
1941–1986	0.068	0.173	−0.01	−0.29	−0.01	0.24	0.16	0.099	0.223	0.04	−0.31	−0.12	0.15	0.05
			Value-weighted $\ln D(t+1) - \ln D(t)$							Equal-weighted $\ln D(t+1) - \ln D(t)$				
1927–1986	0.041	0.133	0.30	−0.10	−0.17	−0.20	−0.00	0.079	0.220	0.31	−0.15	−0.16	−0.28	−0.20
1927–1956	0.028	0.184	0.28	−0.13	−0.21	−0.23	−0.00	0.083	0.304	0.30	−0.18	−0.17	−0.30	−0.21
1957–1986	0.055	0.041	0.54	0.30	0.22	0.08	−0.19	0.075	0.077	0.55	0.37	0.12	−0.09	−0.22
1941–1986	0.058	0.058	0.25	0.10	0.11	−0.21	−0.34	0.089	0.087	0.33	0.21	0.14	0.12	0.02
			Value-weighted $D(t)/P(t-1)$							Equal-weighted $D(t)/P(t-1)$				
1926–1985	0.047	0.012	0.81	0.59	0.48	0.44	0.39	0.044	0.013	0.78	0.51	0.36	0.30	0.28
1926–1955	0.053	0.009	0.64	0.18	−0.14	−0.25	−0.10	0.048	0.015	0.79	0.50	0.26	0.18	0.28
1956–1985	0.040	0.010	0.79	0.65	0.64	0.58	0.41	0.040	0.010	0.65	0.34	0.32	0.30	0.10
1940–1985	0.046	0.013	0.84	0.67	0.57	0.50	0.41	0.046	0.014	0.78	0.51	0.39	0.40	0.38

[a]The one-year value- and equal-weighted portfolio returns are continuously compounded. Real returns are calculated by summing the differences between monthly continuously compounded nominal returns and the one-month inflation rate, calculated from the U.S. Consumer Price Index (CPI). $D(t)/P(t-1)$ is the ratio of dividends for year t to the value of the portfolio at the end of year $t-1$. The time periods for $D(t)/P(t-1)$ are those for $D(t)$. The periods for $D(t)/P(t-1)$ match the periods to be used in the regressions of one-year returns on the yields. For example, the returns for 1927–1986 are regressed on the yields for 1926–1985.

variable as returns. After 1940 returns are more than 2.4 times as variable as dividend changes.

Dividend variability also declines relative to the variability of earnings. For the 1927–1956 period, the standard deviation of annual changes in the log of annual earnings on the Standard and Poor's (S&P) Composite Index (0.259) is about 43% greater than that of changes in annual Index dividends (0.181). For 1957–1986, the standard deviation of changes in earnings (0.113) is more than three times that of dividend changes (0.037).

The estimated speed of adjustment of dividends to target dividends in Lintner's (1956) dividend model also declines over the sample period. Lintner postulates that a firm's target dividend $D^*(t)$ for year t is a constant fraction of earnings $E(t)$,

$$D^*(t) = kE(t). \tag{6}$$

The change in the actual dividends from $t-1$ to t is assumed to follow a partial adjustment model,

$$D(t) - D(t-1) = a + s\left[D^*(t) - D(t-1)\right] + u(t). \tag{7}$$

When this model is fitted to the annual S&P earnings and dividends, the estimated speed of adjustment s drops from 49% per year for 1927–1956 to 12% per year for 1941–1986, and 11% for 1957–1986.

In short, the data suggest systematic changes in the dividend policies of firms (toward dividends that are smoother relative to earnings) during the sample period. For our purposes, changes in dividend policy are important because they can produce variation in yields that obscures information about expected returns or causes the relation between the yield and expected returns to change through time.

Finally, table 2 shows summary statistics for end-of-year observations on the yield $D(t)/P(t-1)$, the explanatory variable in regressions of $r(t, t+T)$ on $D(t)/P(t-1)$ for one- to four-year returns. The first-order autocorrelations of $D(t)/P(t-1)$ are large, but the autocorrelations decay across longer lags. If yields track expected returns, high first-order autocorrelation implies persistence in expected returns. The decay of the autocorrelations across longer lags then suggests the appealing conclusion that, though highly autocorrelated, expected returns have a mean-reverting tendency.

5. Regressions for nominal and real returns

The change in return variability around 1940 suggests that a weighted least squares (WLS) approach that deflates the observations by estimates of return variability will produce more efficient estimates of regressions of returns on

dividend yields. Some of our more interesting analysis, however, involves explaining why the expected return variation tracked by yields is a larger fraction of the variation of returns for longer return horizons. WLS estimates would complicate the analysis by changing the meaning of what is being explained. Thus the text uses ordinary least squares (OLS) estimates. WLS regressions produce slopes that are similar to OLS slopes, however, and so produce similar estimates of the variation in expected returns. In fact, for periods that overlap the shift in return variances around 1940 (for example, 1927–1986 and 1927–1956), WLS estimates actually give a stronger view of the statistical reliability of return forecasts from yields. The WLS estimates are available on request.

Tables 3 and 4 summarize the OLS regressions of the value- and equal-weighted portfolio returns, $r(t, t+T)$, on their *ex ante* yields, $D(t)/P(t-1)$ and $D(t)/P(t)$. Because the regressions are the central evidence on the variation of expected returns, the results are shown in some detail. Each table splits the 1927–1986 sample into 30-year periods (1927–1956 and 1957–1986). Results for the 1941–1986 period of roughly constant return variances are also shown. Estimates of regression slopes and their t-statistics for 1946–1986 and 1936–1986 (not shown) are close to those for 1941–1986. Finally, to illustrate that the results are similar for different definitions of returns, regressions for nominal and real returns are shown.

5.1. Nominal returns

All the regression slopes in tables 3 and 4 are positive. For value-weighted nominal returns, regressions that use the less timely $D(t)/P(t-1)$ as the explanatory variable produce only one slope less than 1.8 standard errors from 0.0. Slopes for value-weighted nominal returns more than 2.0 standard errors from 0.0 are the rule, and slopes more than 2.5 standard errors from 0.0 are common. For 1941–1986, the longest period of roughly constant return variances, all the slopes for value-weighted nominal returns are more than 2.4 standard errors from 0.0.

Except for the 1927–1956 period, the regressions of equal-weighted nominal returns on $D(t)/P(t-1)$ are also strong evidence that expected returns vary through time. For the 1927–1986 sample period and the 1941–1986 and 1957–1986 subperiods, the regression slopes for equal-weighted nominal returns are typically more than 2.0 standard errors from 0.0. Moreover, the weak results for equal-weighted returns for 1927–1956 are a consequence of the high variability of returns in the early years of the sample. The slopes for 1927–1956 are similar to those for the 1941–1986 period of lower return variances, and the 1941–1986 slopes are all more than 2.6 standard errors from 0.0.

Regressions that use the more timely $D(t)/P(t)$ to explain nominal returns also produce strong evidence of forecast power for the 1927–1986 period and

Table 3

Regressions of nominal and real CRSP value-weighted NYSE portfolio returns on dividend yields.[a]

$$r(t, t+T) = a + bY(t) + e(t, t+T)$$

Return horizon		Nominal returns								Real returns							
		$Y(t) = D(t)/P(t-1)$				$Y(t) = D(t)/P(t)$				$Y(t) = D(t)/P(t-1)$				$Y(t) = D(t)/P(t)$			
T	N	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$
								1927–1986									
M	720	0.53	2.99	0.01	0.06	0.21	1.40	0.00	0.06	0.49	2.76	0.01	0.06	0.28	1.83	0.00	0.06
Q	240	1.12	1.87	0.01	0.11	1.07	2.10	0.01	0.11	1.04	1.71	0.01	0.11	1.26	2.48	0.02	0.11
1	60	5.37	2.40	0.07	0.20	2.47	1.27	0.01	0.20	5.32	2.35	0.07	0.20	3.35	1.72	0.03	0.20
2	59	9.10	2.18	0.10	0.29	7.38	2.04	0.09	0.29	9.08	2.31	0.11	0.28	8.77	2.59	0.15	0.28
3	58	11.56	2.14	0.13	0.33	9.94	2.21	0.13	0.33	11.73	2.51	0.15	0.31	11.53	2.93	0.21	0.30
4	57	12.68	1.93	0.13	0.37	12.86	2.43	0.19	0.36	13.44	2.46	0.17	0.33	14.43	3.25	0.29	0.31
								1927–1956									
M	360	0.93	2.77	0.02	0.07	0.17	0.69	−0.00	0.07	0.78	2.33	0.01	0.07	0.27	1.08	0.00	0.07
Q	120	1.79	1.55	0.01	0.14	1.16	1.41	0.01	0.14	1.38	1.20	0.00	0.14	1.42	1.75	0.02	0.13
1	30	11.04	2.49	0.15	0.22	1.50	0.46	−0.03	0.25	9.61	2.16	0.11	0.23	2.62	0.83	−0.01	0.24
2	29	22.49	2.88	0.28	0.33	8.92	1.49	0.07	0.37	19.43	2.65	0.23	0.32	10.16	1.89	0.13	0.34
3	28	29.24	2.86	0.33	0.39	15.27	2.21	0.18	0.43	24.73	2.74	0.29	0.36	15.94	2.73	0.26	0.36
4	27	28.16	2.25	0.24	0.46	20.86	3.14	0.30	0.44	23.00	2.21	0.22	0.40	20.39	3.70	0.40	0.35
								1957–1986									
M	360	0.53	2.31	0.01	0.04	0.68	2.66	0.02	0.04	0.42	1.79	0.01	0.04	0.51	1.95	0.01	0.04
Q	120	1.40	1.82	0.02	0.08	2.33	2.78	0.05	0.08	1.11	1.40	0.01	0.08	1.87	2.14	0.03	0.08
1	30	5.60	1.86	0.08	0.16	9.32	3.02	0.22	0.14	4.58	1.39	0.03	0.17	7.74	2.21	0.12	0.16
2	29	7.51	1.89	0.09	0.20	16.40	4.04	0.45	0.16	5.68	1.10	0.02	0.23	14.06	2.53	0.25	0.20
3	28	10.41	3.01	0.21	0.19	17.12	4.12	0.51	0.15	8.16	1.38	0.08	0.23	14.03	2.05	0.24	0.21
4	27	15.05	3.37	0.38	0.18	19.69	3.87	0.57	0.15	12.48	1.57	0.17	0.24	16.21	1.83	0.26	0.23
								1941–1986									
M	552	0.39	2.95	0.01	0.04	0.36	2.59	0.01	0.04	0.37	2.73	0.01	0.04	0.32	2.20	0.01	0.04
Q	184	1.07	2.47	0.03	0.08	1.20	2.64	0.03	0.08	1.04	2.28	0.02	0.08	1.07	2.23	0.02	0.08
1	46	4.46	2.62	0.12	0.15	5.09	2.88	0.14	0.14	4.40	2.29	0.09	0.17	4.82	2.38	0.09	0.16
2	45	7.15	3.04	0.17	0.19	10.34	4.18	0.35	0.17	7.21	2.36	0.13	0.23	10.26	3.15	0.25	0.21
3	44	9.42	4.77	0.29	0.19	12.94	5.68	0.51	0.15	9.66	2.91	0.21	0.24	13.10	3.53	0.36	0.21
4	43	12.75	5.49	0.49	0.17	15.35	5.62	0.64	0.14	13.34	3.18	0.36	0.23	15.71	3.31	0.45	0.22

[a] N is the number of observations. $P(t)$ is the time t price. $D(t)$ is the dividend for the year preceding t. $r(t, t+T)$ is the continuously compounded return from t to $t+T$. The regressions for T = one month (M), one quarter (Q), and one year use nonoverlapping returns. The regressions for two- to four-year returns use overlapping annual observations. The standard errors in the t-statistic $t(b)$ for the two- to four-year slopes are adjusted for the sample autocorrelation of overlapping residuals with the method of Hansen and Hodrick (1980). Regression slopes and t-statistics for 1946–1986 and 1936–1986 (not shown) are close to those for 1941–1986.

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Table 4

Regressions of nominal and real CRSP equal-weighted NYSE portfolio returns on dividend yields.[a]

$$r(t, t+T) = a + bY(t) + e(t, t+T)$$

Return horizon		Nominal returns								Real returns							
		$Y(t) = D(t)/P(t-1)$				$Y(t) = D(t)/P(t)$				$Y(t) = D(t)/P(t-1)$				$Y(t) = D(t)/P(t)$			
T	N	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$	b	$t(b)$	R^2	$s(e)$
								1927–1986									
M	720	0.52	2.40	0.01	0.07	0.21	0.97	−0.00	0.07	0.45	2.10	0.00	0.07	0.24	1.15	0.00	0.08
Q	240	1.07	1.41	0.00	0.15	1.28	1.74	0.01	0.15	0.91	1.19	0.00	0.16	1.40	1.90	0.01	0.15
1	60	5.87	2.21	0.06	0.27	2.69	1.06	0.00	0.28	5.48	2.04	0.05	0.27	3.38	1.33	0.01	0.28
2	59	10.75	2.14	0.10	0.40	9.91	2.15	0.10	0.40	10.06	2.05	0.09	0.40	11.23	2.54	0.14	0.39
3	58	13.60	2.09	0.12	0.47	14.68	2.63	0.17	0.46	12.38	2.02	0.10	0.46	16.08	3.14	0.22	0.43
4	57	14.28	1.96	0.11	0.53	17.96	2.95	0.21	0.49	12.64	1.86	0.09	0.50	18.91	3.47	0.27	0.45
								1927–1956									
M	360	0.49	1.50	0.00	0.09	0.06	0.20	−0.00	0.09	0.38	1.18	0.00	0.09	0.10	0.34	−0.00	0.09
Q	120	0.85	0.73	−0.00	0.19	0.91	0.83	−0.00	0.19	0.56	0.48	−0.01	0.19	1.03	0.95	−0.00	0.19
1	30	5.14	1.25	0.02	0.33	0.38	0.10	−0.04	0.34	4.21	1.02	0.00	0.33	1.13	0.31	−0.03	0.34
2	29	11.97	1.45	0.09	0.50	7.86	1.11	0.03	0.52	10.18	1.28	0.06	0.49	8.97	1.35	0.05	0.49
3	28	16.05	1.44	0.11	0.61	14.92	1.73	0.13	0.61	12.92	1.23	0.07	0.59	15.65	2.00	0.17	0.56
4	27	13.92	1.11	0.05	0.71	19.35	2.03	0.19	0.65	9.58	0.84	0.01	0.66	18.93	2.23	0.22	0.59
								1957–1986									
M	360	0.87	2.76	0.02	0.05	0.99	2.80	0.02	0.05	0.76	2.37	0.01	0.05	0.82	2.30	0.01	0.05
Q	120	2.24	2.08	0.03	0.10	3.68	3.18	0.07	0.10	1.97	1.78	0.02	0.11	3.28	2.75	0.05	0.10
1	30	10.01	2.68	0.18	0.20	12.58	3.28	0.25	0.19	9.31	2.35	0.13	0.21	11.56	2.79	0.19	0.20
2	29	13.02	2.39	0.16	0.28	23.85	4.59	0.51	0.21	11.82	1.93	0.11	0.30	22.86	3.83	0.42	0.24
3	28	16.22	2.66	0.22	0.29	23.87	3.84	0.45	0.24	14.77	2.14	0.17	0.31	22.84	3.30	0.3[illegible]	0.26
4	27	21.99	3.01	0.35	0.30	25.98	3.39	0.42	0.28	20.26	2.47	0.28	0.32	24.85	3.00	0.3[illegible]	0.30
								1941–1986									
M	552	0.51	3.21	0.02	0.05	0.45	2.57	0.01	0.05	0.51	3.18	0.02	0.05	0.44	2.49	0.01	0.05
Q	184	1.42	2.64	0.03	0.10	1.64	2.78	0.04	0.10	1.47	2.64	0.03	0.10	1.63	2.67	0.03	0.10
1	46	6.75	3.35	0.19	0.19	7.05	3.15	0.17	0.19	6.99	3.24	0.17	0.20	7.27	3.03	0.15	0.21
2	45	10.38	3.15	0.22	0.27	14.64	4.02	0.37	0.24	10.89	3.07	0.21	0.29	15.51	4.00	0.36	0.26
3	44	11.90	2.94	0.23	0.30	17.71	4.02	0.43	0.26	12.37	2.96	0.22	0.32	18.99	4.25	0.45	0.27
4	43	13.68	2.76	0.26	0.32	19.00	3.60	0.43	0.28	14.19	2.90	0.27	0.33	20.50	3.97	0.47	0.28

[a] N is the number of observations. $P(t)$ is the time t price. $D(t)$ is the dividend for the year preceding t. $r(t, t+T)$ is the continuously compounded return from t to $t+T$. The regressions for T = one month (M), one quarter (Q), and one year use nonoverlapping returns. The regressions for two- to four-year returns use overlapping annual observations. The standard errors in the t-statistic $t(b)$ for the two- to four-year slopes are adjusted for the sample autocorrelation of overlapping residuals with the method of Hansen and Hodrick (1980). Regression slopes and t-statistics for 1946–1986 and 1936–1986 (not shown) are close to those for 1941–1986.

especially for 1941–1986 and 1957–1986. For the two post-1940 periods, the slopes for $D(t)/P(t)$ are more than 2.5 standard errors from 0.0 for both market portfolios and for all return horizons. Slopes more than 4.0 standard errors from 0.0 are common.

5.2. Real returns

The slopes for real returns in tables 3 and 4 are typically close to those for nominal returns. Because the real and nominal regressions have the same explanatory variable, similar slopes indicate that variation in expected nominal returns translates into similar variation in expected real returns. If the market is efficient, the results indicate that dividend yields signal variation in equilibrium expected real returns.

Fama and French (1987b) show regressions of excess stock returns on dividend yields. Excess returns for horizons beyond a month are calculated by cumulating the differences between monthly nominal stock returns and the one-month U.S. Treasury bill rate. The results for excess returns are similar to those for real returns in tables 3 and 4. Thus the variation in expected real stock returns tracked by dividend yields is also present in the expected premiums of stock returns over one-month bill returns.

5.3. The behavior of the regression slopes

The slopes in the regressions of real or nominal returns $r(t, t+T)$ on $Y(t)$ increase with the return horizon T. When the explanatory variable is $D(t)/P(t-1)$, the increase in the slopes is roughly proportional to T for horizons to one year, but less than proportional to T for two- to four-year returns. For the more timely $D(t)/P(t)$ and for periods after 1940, the slopes increase roughly in proportion to T for return horizons to four years, but more slowly thereafter.

This behavior of the slopes has an appealing explanation. The slope in the regression of the T-period return $r(t, t+T)$ on $Y(t)$ is the sum of the slopes in the T regressions of the one-period returns, $r(t, t+1), \ldots, r(t+T-1, t+T)$, on $Y(t)$. Slopes in regressions of $r(t, t+T)$ on $Y(t)$ that increase in proportion to T for horizons of one or two years thus imply that variation in $Y(t)$ signals similar variation in one-period expected returns out to one or two years. Slopes that increase less than in proportion to T for longer return horizons suggest that $Y(t)$ signals less variation in more distant one-period expected returns. This behavior of the slopes suggests that expected returns are highly autocorrelated but slowly mean-reverting. The decay of the autocorrelations of $D(t)/P(t-1)$ in table 2 also suggests slow mean reversion.

5.4. Other tests

The intuition of the hypothesis that dividend yields forecast returns is that stock prices are low relative to dividends when discount rates and expected returns are high, and vice versa, so that yields capture variation in expected returns. There is a similar intuition for earnings/price ratios (E/P).

We have estimated regressions (available on request) of value- and equal-weighted NYSE returns, $r(t, t+T)$, on $E(t)/P(t-1)$ and $E(t)/P(t)$. $E(t)$ is earnings per share on the Standard and Poor's (S&P) Composite Index for calendar year t, as reported by S&P. $P(t)$ is the value of the index at the end of the year. In many ways the E/P results are similar to the D/P results. For example, the regression slopes and R^2 produced by E/P increase with the return horizon. The t's for the slopes suggest that E/P has reliable forecast power. E/P tends, however, to have less explanatory power than D/P.

Earnings are more variable than dividends. (See section 4). If this higher variability is unrelated to the variation in expected returns, E/P is a noisier measure of expected returns than D/P. This 'numerator noise' argument may also explain why the forecast power of dividend yields is higher in the periods after 1940, when the variability of dividends declines substantially relative to the variability of returns.

It would seem that a solution to problems caused by noise in the numerator of E/P or D/P is to use $1/P$ as the forecast variable. Miller and Scholes (1982) show that the cross-section of $1/P$ for common stocks helps explain the cross-section of expected returns. Suppose, however, that reinvestment of earnings causes stock prices to have an upward-drifting nonstationary component. Then $1/P$ is nonstationary (it tends to drift downward), and it is not a good variable for tracking expected returns in time-series tests. In fact, for the value- and equal-weighted NYSE portfolios, regressions (not shown) of $r(t, t+T)$ on $1/P(t)$, where $P(t)$ is the value of the portfolio at t produce slopes and R^2 close to 0.0.

6. Out-of-sample forecasts

The slopes in tables 3 and 4 are apparently strong evidence that yields signal variation in expected returns. Given the uncertainty about the bias of the slopes, however, further testing is in order. One approach is to use the regressions to forecast out-of-sample returns. We forecast returns for the 20-year period 1967–1986. Each forecast is from a regression of $r(t, t+T)$ on $Y(t)$ estimated with returns that begin and end in the preceding 30-year period. For example, to forecast the first one-year return (1967), we use coefficients estimated with the 30 one-year returns for 1937–1966. To forecast the first four-year return (1967–1970), we use coefficients estimated with the

27 overlapping annual observations on the four-year returns that begin and end in the 1937–1966 period. For monthly and quarterly returns, the 30-year estimation period rolls forward in monthly or quarterly steps. For one- to four-year returns, the estimation period rolls forward in annual increments.

We start the estimation periods in 1937 because of the evidence that returns and yields behave differently during the first ten years of the sample. Because the overlap of annual observations on multiyear returns reduces effective sample sizes, we judge that estimation periods shorter than 30 years would not produce meaningful forecasts of two- to four-year returns. The 1937 starting date and the choice of 30-year estimation periods then limit the forecast period to 1967–1986. For this 20-year forecast period, there are only five nonoverlapping forecasts of four-year returns.

6.1. Perspective

With respect to possible bias of the regression slopes, the out-of-sample tests are conservative. They correct for bias that causes the in-sample slopes to overstate the variation of expected returns, but they leave the estimation problems that cause the regressions to understate the variation of expected returns.

Thus, section 3 argues that negative correlation between shocks to returns and yields (because of the discount-rate effect or because yields and returns respond to dividend forecasts) produces positive bias in the slope estimates for dividend yields, with possibly more bias in the slopes for $D(t)/P(t)$ than in the slopes for $D(t)/P(t-1)$. The bias means that in-sample R^2 tend to overstate explanatory power. The bias decreases out-of-sample forecast power, however, so out-of-sample tests are appropriately punitive.

On the other hand, yields contain noise (variation unrelated to expected returns) that tends to cause estimates of (3) to understate the variation of expected returns. Since the noise reduces both in-sample and out-of-sample forecast power, out-of-sample tests do not correct for this source of error. Likewise, if regressions of $r(t, t+T)$ on the less timely $D(t)/P(t-1)$ understate the variation of expected returns, the understatement remains in out-of-sample forecasts.

6.2. Results

Table 5 summarizes the mean squared errors (MSE) of the out-of-sample forecasts. To compare the forecasts with the in-sample fit of the regressions, the MSE are reported as R^2. Specifically, the MSE R^2 in table 5 is $1 - (\text{MSE}/s^2[r(t, t+T)])$, where $s^2[r(t, t+T)]$ is the out-of-sample variance of the forecasted return. The out-of-sample forecasts cover 1967–1986. The

Table 5

Mean squared error R^2 for out-of-sample forecasts for NYSE portfolio returns for 1967–1986 and R^2 for in-sample forecasts for 1957–1986.[a]

Return horizon T	$D(t)/P(t-1)$ Out	$D(t)/P(t-1)$ In	$D(t)/P(t)$ Out	$D(t)/P(t)$ In	$D(t)/P(t-1)$ Out	$D(t)/P(t-1)$ In	$D(t)/P(t)$ Out	$D(t)/P(t)$ In
	Value-weighted nominal returns				Value-weighted real returns			
M	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01
Q	0.03	0.02	0.06	0.05	0.01	0.01	0.03	0.03
1	0.13	0.08	0.[illegible]	0.22	0.07	0.03	0.13	0.12
2	0.20	0.09	0.43	0.45	0.05	0.02	0.22	0.25
3	0.24	0.21	0.48	0.51	−0.18	0.08	0.00	0.24
4	0.35	0.38	0.50	0.57	−0.38	0.17	−0.26	0.26
	Equal-weighted nominal returns				Equal-weighted real returns			
M	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01
Q	0.02	0.03	0.04	0.07	0.02	0.02	0.04	0.05
1	0.17	0.18	0.16	0.25	0.17	0.13	0.15	0.19
2	0.18	0.16	0.34	0.51	0.18	0.11	0.35	0.42
3	0.16	0.22	0.35	0.45	0.10	0.17	0.36	0.38
4	0.23	0.35	0.36	0.42	0.09	0.28	0.36	0.37

[a]The out-of-sample (Out) mean squared error R^2 is $1-(\mathrm{MSE}/s^2[r(t,t+T)])$. Each out-of-sample forecast is made with coefficients estimated using the previous 30 years of returns and yields. Monthly (M), quarterly (Q), and one-year forecasts are for nonoverlapping periods. The two- to four-year forecasts are overlapping annual observations. The in-sample regressions are in tables 3 and 4.

in-sample R^2 for 1957–1986, the most comparable period in tables 3 and 4, are also shown in table 5.

For horizons out to two years, the MSE R^2 for the 1967–1986 out-of-sample return forecasts from $D(t)/P(t-1)$ and $D(t)/P(t)$ are close to the in-sample R^2 for 1957–1986. The signs of the differences between the in-sample R^2 and the out-of-sample MSE R^2 are random. The MSE R^2 for forecasts of three- and four-year value-weighted nominal returns from $D(t)/P(t-1)$ are also similar to the in-sample R^2. Otherwise, the MSE R^2 produced by $D(t)/P(t-1)$ deteriorate relative to the in-sample R^2 in three- and four-year forecasts. (The obvious worst cases are the negative MSE R^2 for forecasts of value-weighted three- and four-year real returns.) The results for longer return horizons are less reliable, however, because they involve fewer independent returns during the 20-year forecast period. The uniform similarity of in- and out-of-sample forecast power for horizons to two years suggests that regressions of $r(t,t+T)$ on either $D(t)/P(t-1)$ or $D(t)/P(t)$ do not produce strongly biased slopes and thus biased estimates of explanatory power.

The out-of-sample forecasts do not confirm that $D(t)/P(t)$ slopes are more biased than $D(t)/P(t-1)$ slopes. The out-of-sample forecast power of

$D(t)/P(t)$ actually matches in-sample explanatory power better than $D(t)/P(t-1)$. Only the out-of-sample MSE R^2 for forecasts of three- and four-year value-weighted real returns from $D(t)/P(t)$ are much less than the in-sample R^2. Thus there is no evidence in the out-of-sample tests that slope estimates for the more timely $D(t)/P(t)$ exaggerate the variation in expected returns.

On the other hand, like the in-sample R^2, the MSE R^2 for out-of-sample forecasts from $D(t)/P(t)$ are higher, often much higher, than those for forecasts from $D(t)/P(t-1)$. For example, the MSE R^2 for forecasts of two- to four-year returns from $D(t)/P(t)$ commonly exceed 0.35, while those for forecasts from $D(t)/P(t-1)$ are typically less than 0.20. The out-of-sample forecasts thus confirm that using the less timely $D(t)/P(t-1)$ to avoid false positive conclusions about forecast power produces regressions that understate the variation of expected returns.

7. Why does forecast power increase with the return horizon?

The out-of-sample MSE R^2 tend to confirm the more extensive evidence from the in-sample R^2 in tables 3 and 4 that the explanatory power of the regressions increases with the return horizon. The in-sample R^2 in tables 3 and 4 and the out-of-sample MSE R^2 in table 5 are 0.07 or less for monthly and quarterly returns, but they are often greater than 0.25 for two- to four-year returns. That the same yields capture more return variance for longer forecast horizons is an interesting and challenging result.

Algebraically, the regression R^2 increase with the return horizon because the variance of the fitted values grows more quickly than the horizon, whereas the variance of the residuals generally grows less quickly than the horizon. Our goal is to explain why.

7.1. *The regression fitted values and residuals*

In the regressions of returns on dividend yields, the explanatory variable is the same for all return horizons. Thus, as return horizon increases, the variance of the fitted values grows in proportion to the square of the regression slopes. The slopes in tables 3 and 4 increase roughly in proportion to the return horizon out to one or two years, and then more slowly. As noted earlier, this behavior suggests that short-horizon expected returns are autocorrelated but slowly mean-reverting. The persistence of short-horizon expected returns implied by slow mean reversion causes the variances of multiperiod expected returns to grow more than in proportion to the return horizon.

On the other hand, tables 3 and 4 show that for periods after 1940, the residual variances in regressions of $r(t, t+T)$ on $Y(t)$ grow less than in proportion to the return horizon, at least for one- to four-year returns. For

Table 6

Correlations of residuals from regressions of one-year real CRSP value- and equal-weighted NYSE returns on the dividend yield $D(t)/P(t-1)$.[a]

$$r(t+i-1, t+i) = a + bD(t)/P(t-1) + e(t+i-1, t+i)$$

$$\mathrm{Cor}[e(t+i-1, t+i), e(t+j-1, t+j)], \quad i = 2,3,4, \quad j = 1,2,3$$

Lead	Value-weighted returns Lead j			Equal-weighted returns Lead j		
i	1	2	3	1	2	3
			1927–1986			
2	−0.05			−0.00		
3	−0.30	−0.05		−0.29	−0.00	
4	−0.14	−0.31	0.1	−0.20	−0.26	0.09
			1941–1986			
2	−0.15			−0.18		
3	−0.39	−0.09		−0.43	−0.00	
4	−0.08	−0.39	−0.05	−0.17	−0.35	0.02

[a]The residuals are from regressions that use $D(t)/P(t-1)$ to forecast one-year returns one, two, three, and four years ahead.

$\mathrm{Cor}[e(t+i-1, t+i), e(t+j-1, t+j)]$ is the correlation between the residual for the regression forecast of the one-year return i years ahead and the residual for the regression forecast of the one-year return j years ahead.

The correlations for nominal returns and for the other subperiods in tables 3 and 4 are similar to those shown. Using $D(t)/P(t)$ as the forecast variable produces similar results.

example, the residual standard errors for four-year returns never come close to twice the one-year standard errors. The residual in the regression of the multiyear return $r(t, t+T)$ on $Y(t)$ is the sum of the residuals from regressions of the one-year returns, $r(t, t+1), \ldots, r(t+T-1, t+T)$, on $Y(t)$. If multiyear residual variances grow less than in proportion to the return horizon, the correlations of the residuals from the one-year regressions must on average be negative. The negative correlation is documented in table 6. It has an economic explanation that, along with the persistence of expected returns, completes the story for the predictability of long-horizon returns.

7.2. *Stock prices and expected return shocks*

Suppose there is a shock at $t+1$ that increases expected returns. Since the shock occurs after the yield $Y(t)$ is set, fitted values from regressions of $r(t+1, t+2), \ldots, r(t+T-1, t+T)$ on $Y(t)$ will tend to underestimate returns after $t+1$, and the residuals will tend to be positive. On the other hand, if expected return shocks generate opposite unexpected changes in prices (the discount-rate effect), the positive shock to expected returns at $t+1$ will tend to produce a negative residual in the regression of the one-year return

$r(t, t+1)$ on $Y(t)$. Thus, because of the discount-rate effect, the residual from the regression of $r(t, t+1)$ on $Y(t)$ is negatively correlated with the residuals from regressions of $r(t+1, t+2), \ldots, r(t+T-1, t+T)$ on $Y(t)$. A similar argument implies that the residuals from the regression of $r(t+k-1, t+k)$ on $Y(t)$ tend to be negatively correlated with the residuals from regressions of one-year returns after $t+k$ on $Y(t)$.

The next section presents further tests for the discount-rate effect, based on estimates of the relation between contemporaneous return and dividend yield shocks.

8. Yields and temporary components of stock prices

8.1. Yield shocks, price shocks, and future expected returns

Table 1 suggests that one-year returns are uncorrelated with dividend changes more than one year ahead. This suggests that $D(t+1)$ is an unbiased (but noisy) measure of the information in $P(t)$ about future dividends, so that $D(t+1)/P(t)$ is relatively free of variation due to dividend forecasts. Thus, the unexpected component of $D(t+1)/P(t)$ can be interpreted as a (noisy) measure of the shock to expected returns at t.

Preliminary tests (not shown) indicated that the highly autocorrelated yields on the value- and equal-weighted portfolios are approximated well by first-order autoregressions (AR1s), with AR1 parameters close to the first-order autocorrelations in table 2. We use residuals from AR1s estimated on end-of-year yields to measure yield shocks,

$$D(t+1)/P(t) = \alpha + \phi D(t)/P(t-1) + v(t-1, t). \tag{8}$$

We use the yield shock $v(t-1, t)$ as a proxy for the expected return shock from $t-1$ to t.

The discount-rate effect implies a negative relation between expected return shocks and contemporaneous returns; an unexpected increase in expected returns drives the current price down. We measure this relation with the slope δ in the regression of $r(t-1, t)$ on $v(t-1, t)$,

$$r(t-1, t) + \gamma + \delta v(t-1, t) + u(t-1, t). \tag{9}$$

We interpret δ as the response of $P(t)$ per unit of the time t yield shock. The slope $\beta(T)$ in the regression of $r(t, t+T)$ on $D(t)/P(t-1)$ then measures the T-period expected future price change due to the changes in expected returns implied by a yield shock. Comparing estimates of δ and $\beta(T)$ allows us to judge the relative magnitudes of the current and expected future price responses to yield shocks. The logic of this approach is that we want estimates of $\beta(T)$ for a long return horizon (we use $T = 4$ years), since the autocorrelation of expected returns implies that a yield shock has a slowly decaying effect on one-period expected future price changes.

Table 7

Tests for a discount-rate effect in stock returns.

Comparisons of the relation between contemporaneous real returns and dividend yield shocks (δ) and the relation between future returns and current dividend yields (b).[a]

$$D(t+1)/P(t) = \alpha + \phi D(t)/P(t-1) + v(t-1,t)$$

$$r(t-1,t) = \gamma + \delta v(t-1,t) + u(t-1,t)$$

$$r(t,t+4) = a + bY(t) + e(t,t+4)$$

			$Y(t) = D(t)/P(t-1)$		$Y(t) = D(t)/P(t)$	
Period	δ	$s(\delta)$	$b(4)$	$s[b(4)]$	$b(4)$	$s[b(4)]$
			Value-weighted real returns			
1927–1986	−22.27	2.71	13.44	5.47	14.43	4.44
1927–1956	−20.42	4.69	23.00	10.40	20.39	5.51
1957–1986	−25.72	2.44	12.48	7.94	16.21	8.88
1941–1986	−20.10	2.15	13.34	4.19	15.71	4.75
			Equal-weighted real returns			
1927–1986	−20.42	3.48	12.64	6.81	18.91	5.45
1927–1956	−17.80	5.95	9.58	11.45	18.93	8.47
1957–1986	−24.73	3.17	20.26	8.22	24.85	8.29
1941–1986	−20.37	2.23	14.19	4.90	20.50	5.16

[a]δ, the contemporaneous response of the return $r(t-1,t)$ to the yield shock $v(t-1,t)$ is estimated with regressions of annual observations on one-year returns on the residuals from a first-order autoregression for the yield. The estimates of $b(4)$, interpreted as the response of future one-year returns to a current yield shock, are from tables 3 and 4. $s(\delta)$ and $s[b(4)]$ are standard errors. The results for nominal returns are similar.

Estimates of δ in (9) must be interpreted cautiously. The lack of correlation between returns and dividend changes more than a year ahead suggests that $D(t+1)/P(t)$ is relatively free of variation due to dividend forecasts. But this does not mean that all variation in $D(t+1)/P(t)$ is due to expected returns. Moreover, whatever its source, variation in $P(t)$ that results in variation in $D(t+1)/P(t)$ tends to produce a negative correlation between $r(t-1,t)$ and the yield shock $v(t-1,t)$. Thus negative estimates of δ are not per se evidence of a discount-rate effect. To infer that negative estimates of δ reflect offsetting changes in current prices related to changes in expected future returns, we need the complementary evidence from estimates of $\beta(T)$ that yields track expected returns so that yield shocks imply expected future price changes of the same sign.

8.2. The estimates

Table 7 shows estimates of δ for real returns on the NYSE value- and equal-weighted portfolios. The estimates are always negative, less than −17.0, and more than 2.9 standard errors from 0.0. Table 7 also shows estimates of

$\beta(T)$ for $T = 4$ years. Despite large standard errors, the estimates are usually more than 2.0 standard errors above 0.0. We conclude from the estimates of δ and $\beta(4)$ that dividend yield shocks are associated with (a) contemporaneous price changes of the opposite sign and (b) expected future price changes of the same sign.

The positive estimates of $\beta(4)$ from regressions of $r(t, t+T)$ on $D(t)/P(t-1)$ are large but typically smaller in magnitude than the negative estimates of δ. The out-of-sample forecasts in table 5 suggest, however, that the $D(t)/P(t-1)$ slopes understate the variation of expected returns because the information in $D(t)/P(t-1)$ is about a year out of date for expected returns measured forward from t. The estimates of $\beta(4)$ for regressions of $r(t, t+4)$ on the more timely $D(t)/P(t)$ are closer in magnitude to (usually within 1.0 standard error of) the estimates of δ.

We interpret the estimates of δ and $\beta(4)$ as suggesting that, on average, the expected future price increases implied by higher expected returns are just offset by the immediate price decline due to the discount-rate effect. Thus, as postulated in Summers (1986) and Fama and French (1987a), positively autocorrelated expected returns generate mean-reverting components of prices. We consider next competing scenarios for such temporary price components.

8.3. *Temporary price components*

Temporary components of prices and the forecast power of yields are consistent with an efficient market. Suppose investor tastes for current versus risky future consumption and the stochastic evolution of firms' investment opportunities result in equilibrium expected returns that are highly autocorrelated but mean-reverting. Suppose shocks to expected returns and shocks to rational forecasts of dividends are independent. Then a shock to expected returns has no effect on expected dividends or expected returns in the distant future. Thus, the shock has no long-term effect on expected prices. The cumulative effect of a shock on expected returns must be exactly offset by an opposite adjustment in the current price. It follows that mean-reverting equilibrium expected returns can give rise to mean-reverting (temporary) components of stock prices. See Poterba and Summers (1987) for a formal analysis.

On the other hand, temporary components of prices and the forecast power of yields are also consistent with common models of an inefficient market, such as Keynes (1936), Shiller (1984), DeBondt and Thaler (1985), and Summers (1986), in which stock prices take long temporary swings away from fundamental values. In this view, high D/P ratios signal that future returns will be high because stock prices are temporarily irrationally low. Conversely, low D/P ratios signal irrationally high prices and low future returns.

As always, market efficiency per se is not testable. It must be tested jointly with restrictions on the behavior of equilibrium expected returns. [See Fama (1970).] One reasonable restriction is that equilibrium in an efficient market never implies predictable price declines (negative expected nominal returns) for the value- and equal-weighted NYSE portfolios. The behavior of the fitted values for the regressions in tables 3 and 4 supports this hypothesis.

The fitted values from the regressions of nominal returns on dividend yields are rarely negative. For example, when the explanatory variable is the more timely $D(t)/P(t)$, the regressions for equal-weighted returns for all horizons produce a total of six negative fitted values during the 1927–1986 period and no negative fitted values during the 1941–1986 period. The regressions of value-weighted nominal returns on $D(t)/P(t)$ produce no negative fitted values in either period. In both the $D(t)/P(t)$ and the $D(t)/P(t-1)$ regressions, no negative fitted value is close to 2.0 standard errors from 0.0. As a rule at least two-thirds of the return forecasts are more than 2.0 standard errors above 0.0.

A stronger hypothesis is that equilibrium in an efficient market never implies negative expected real returns for the value- and equal-weighted NYSE portfolios. The regression fitted values are more often negative for real returns than for nominal returns, but again no negative forecast of real returns is more than 2.0 standard errors from 0.0, whereas typically more than half of the forecasts are more than 2.0 standard errors above 0.0.

In short, low dividend yields forecast that nominal returns will be relatively low, but they do not forecast that prices will decline. Likewise, the strong forecast power of yields does not imply that expected real returns are ever reliably negative.

8.4. Dividend yields and the autocorrelation of returns

Autocorrelated expected returns and the opposite response of prices to expected return shocks (the discount-rate effect) can combine to produce mean-reverting components of stock prices. Fama and French (1987a) show that mean-reverting price components tend to induce negative autocorrelation in long-horizon returns. Thus, the negative autocorrelation of long-horizon returns in the earlier work is consistent with the positive autocorrelation of expected returns documented here.

But a mean-reverting, positively autocorrelated expected return does not necessarily imply negative autocorrelated returns or a mean-reverting component of prices. If shocks to expected returns and expected dividends are positively correlated, the opposite response of prices to expected return shocks can disappear. In this case, the positive autocorrelation of expected returns will imply positively autocorrelated returns, and time-varying expected returns will not generate mean-reverting price components. Moreover, changes through

time in the autocorrelation of expected returns, or in the relation between shocks to expected returns and expected dividends, can change the time-series properties of returns and obscure tests of forecast power based on autocorrelation.

In contrast, as long as yields move with expected returns, regressions of returns on yields can document time-varying expected returns irrespective of changes in the autocorrelation of returns. This may explain why yields have strong forecast power in post-1940 periods, when the autocorrelations of returns in Fama and French (1987a) give weak indications of time-varying expected returns.

Does the variation of expected returns tracked by yields subsume the predictability of long-horizon returns implied by the negative autocorrelation in Fama and French (1987a)? We have estimated multiple regressions of $r(t, t+T)$ on $D(t)/P(t)$ and the lagged return $r(t-T, t)$. The lagged return rarely has marginal explanatory power. Negative slopes for the lagged return are typically less than 1.0 standard error from 0.0. In contrast, as in the univariate regressions, the slopes for the dividend yield in the multiple regressions increase with the return horizon and are typically more than 2.0 standard errors from 0.0 for the 1927–1986 period and for all periods after 1935. Thus including the lagged return in the regressions has no effect on the conclusion that dividend yields have systematic forecast power across different time periods and return horizons.

9. Conclusions

Like previous work, our regressions of returns on dividend yields indicate that time variation in expected returns accounts for small fractions of the variances of short-horizon returns. Dividend yields typically explain less than 5% of the variances of monthly or quarterly returns. An interesting and challenging feature of our evidence is that time variation in expected returns accounts for more of the variation of long-horizon returns. Dividend yields often explain more than 25% of the variances of two- to four-year returns. We offer a simple explanation.

The persistence (high positive autocorrelation) of expected returns causes the variance of expected returns, measured by the fitted values in the regressions of returns on dividend yields, to grow more than in proportion to the return horizon. On the other hand, the growth of the variance of the regression residuals is attenuated by a discount-rate effect: shocks to expected returns are associated with opposite shocks to current prices.

The cumulative price effect of an expected return shock and the associated price shock is roughly zero. On average, the expected future price increases implied by higher expected returns are just offset by the immediate decline in the current price. Thus the time variation of expected returns gives rise to mean-reverting or temporary components of prices.

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Views of Financial Economists on the Equity Premium and on Professional Controversies*

The consensus of 226 academic financial economists forecasts an arithmetic equity premium of 7% per year over 10- and 30-year horizons and of 6%–7% over 1- and 5-year horizons. Pessimistic and optimistic 30-year scenario forecasts average 2% and 13%, respectively. Respondents claim to revise their forecast downward when the stock market rises. They perceive the profession's consensus to be higher than it really is and are influenced by this perception. There is agreement that markets are efficient and lack arbitrage opportunities and that government intervention in financial markets is detrimental.

The equity premium is perhaps the single most important number in financial economics: the rate by which risky stocks are expected to outperform safe fixed-income investments, such as bonds or bills. It is the main input both in asset allocation decisions—how much of one's portfolio an investor should put into stocks versus bonds—and in the capital asset pricing model (CAPM)—the model used by most practitioners in computing an appropriate hurdle rate for accepting investment projects.

The academic finance profession has been teaching asset allocation and CAPM budgeting for many years. But oddly, it has been relatively quiet in recommending an appropriate ''standard'' for the equity premium, the key input to these models. This is unfortunate, in that without a good estimate of the equity premium, the mainstream theories are really quite useless from a practical perspective. The main reason for the scarcity of good justifications and recommendations for a ''good practical estimate'' is, of course, that neither do financial economists know what the correct equity premium is nor is there

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a consensus on how it should be estimated. Existing estimates are discussed in more detail in Section I.

This article intends to supplement existing equity premium estimates with a ''common practice estimate,'' the consensus in the academic profession. Although this consensus is itself likely to be a weighted estimate obtained by other methods, the distribution of estimated values among academics is itself interesting. The consensus estimate can be a number of some relevance in classroom, courtroom, and boardroom discussions, even if it may not be the best estimate of the equity premium itself. Then again, if there was agreement on how to calculate the best estimate, there would be no need for a survey of financial economists to begin with. Still, surveys in general and this survey in particular have shortcomings, and these are discussed in Section II, which describes the design of the survey.

Section III discusses the principal survey results, that is, the consensus view about the equity premium among the 226 responding financial economists. The most important findings, in brief, follow. The arithmetic 30-year equity premium consensus forecast is about 7%. It is between 0.5% and 1.5% lower on the 1-year horizon, depending on the central statistic. The consensus perception of a pessimistic outcome (at one in 20 probability assessments) over 30 years is 2%–3%; the optimistic equivalent is 12%–13%. There is evidence for a ''false-consensus effect,'' in that economists seem to anchor their forecast to what they perceive the consensus to be—and this perceived consensus is about 0.5%–1% above the actual consensus. Finally, economists claim that increases in the stock market would, on the margin, cause them to reduce their forecast of the equity premium. Section IV briefly discusses the answers to a set of issues of interest to both financial academics and financial practitioners. The strongest consensus obtains that markets are efficient and lack arbitrage opportunities and that government intervention in financial markets is detrimental. Section V concludes with a summary of the findings.

I. Existing Estimates of the Equity Premium

Cochrane (1997) and Siegel and Thaler (1997) provide comprehensive surveys of the macroeconomics and finance literature about the equity premium puzzle—the question as to why stocks have historically performed so well relative to bonds. This section briefly discusses existing methods to estimate the equity premium.

A. Equity Premium Measurement Issues

Unfortunately, there is neither a uniformly accepted precise definition nor agreement on how the equity premium should be computed and applied.

First, the geometric average is earned by a buy-and-hold investment strategy that is long on stocks and short on interest-bearing securities, while the arithmetic average is earned by a strategy that rebalances investment to a fixed amount each year. Mathematically, the geometric mean is always lower than the arithmetic mean. For example, a 50% decrease followed by a 100% increase leaves an investor with a 0% geometric return, although the arithmetic average would suggest a positive 25% return. Historically, the 30-year geometric mean equity premium has been about 2% lower than the arithmetic mean (see app. A for more detail). It is not clear whether the arithmetic or the geometric average should be used in capital budgeting applications using the CAPM (Indro and Lee 1997).

Second, stocks are long-term investments, and the most common method to compute the equity premium—subtracting a short-term bond return from a long-term equity return—is neither parsimonious nor necessarily a fair investment holding-period comparison.[1] Subtracting off the return to long-term bonds instead of the return to short-term bonds for a 30-year equity premium computation decreases the long-term equity premium by between 1% and 2%. Shiller (1989) subtracts a bond index that splices corporate bonds with treasuries. This, too, results in a lower equity premium.

Lacking formal agreement on how the equity premium should be computed and used, even identical views on the implied equity premium can easily lead different individuals to respond with and themselves use different estimates for the same task. This article describes arithmetic equity premia relative to short-term bills, unless otherwise indicated.

B. Historical Average Equity Premia

Perhaps the most popular method to obtain an estimate of the equity risk premium is an extrapolation of historically realized equity premia into the future. Table 1 shows that practitioners can advocate a whole range of estimates as ''their'' equity premium choice. The use of Ibbotson equity premia estimates seems to be particularly widespread. For example, the most popular finance textbook, Brealey and Myers (1996, p. 146), recommended 8.2%–8.5% in 1996, as sourced from the *Ibbotson 1995 Yearbook.* Table 1 shows that as of December 1998, the equivalent 1926–98 Ibbotson historical arithmetic equity premium average has risen to 9.4%. Shiller (1989, ch. 26) has assembled a longer data set, which can justify as low an equity premium average as 4.3%, using geometric averages over the entire 129-year history.

1. Abel (1999) decomposes the equity premium into a risk and a term premium. Not surprisingly, the term premium accounts for about 25% of the observed equity premium.

TABLE 1 Historical Stock Market and Equity Premium Performance

Source and Time Frame	Number of Years	Geometric Mean (%)	Arithmetic Mean (%)	Arithmetic SD (%)	Arithmetic Minimum (%)	Arithmetic Maximum (%)	Arithmetic SE (%)
Stock market return historical averages:							
Shiller 1870–1998	129	9.3	10.8	17.8	−42.9	54.9	1.6
Shiller 1899–1998	100	10.2	11.9	18.6	−42.9	54.9	1.9
Ibbotson 1926–98	73	11.2	13.2	20.3	NA	NA	2.4
Shiller 1926–98	73	11.0	12.8	19.3	−42.9	55	2.3
Shiller 1949–98	50	13.3	14.3	15.1	−21	46	2.1
Shiller 1974–98	25	14.8	15.9	15.5	−20.8	38.6	3.1
Shiller 1994–98	5	23.8	24.5	13.4	.0	35.1	7.4
Equity premiums historical averages:							
Shiller 1870–1998	129	4.3	6.0	18.5	−45.4	53.4	1.6
Shiller 1899–1998	100	5.3	7.1	19.1	−45.4	53.4	1.9
Ibbotson 1926–98	73	7.1	9.4	NA	NA	NA	NA
Shiller 1926–98	73	6.1	8.0	19.8	−45.4	53.4	2.3
Shiller 1949–98	50	6.9	8.2	16.1	−31.8	44.1	2.3
Shiller 1974–98	25	6.5	7.9	16.3	−31.8	31.3	3.3
Shiller 1994–98	5	18.4	19.0	12.7	−.0	28.6	5.7

NOTE.—Ibbotson estimates are published in the Year-End Summary Report (1998). They are based on the Standard and Poor's 500 Stock Index (S&P500) return with dividends (''large company stocks'') and 30-day-to-maturity Treasury bills. Shiller indices are published in Shiller (1989, ch. 26) and updated on http://www.econ.yale.edu/~shiller/chap26.html. They are based on the dividend-adjusted S&P500 (formerly called the Standard and Poor's Composite Index) and a short interest rate spliced from corporates and treasuries, and are computed from January-to-January index averages (of the following year), not December-to-December closing prices. Thus, the last price used in the computations is an average January 1999 index price. The indices differ primarily because of the use of different interest rates. Geometric means are computed as $g_T = \sqrt{[\Pi_{y=1}^{T}(1 + rm_y)]/[\Pi_{y=1}^{T}(1 + rf_y)]}$, where rm_y is the market return and rf_y is the risk-free rate in year y. Arithmetic statistics are computed from a T-year series of $(rm_y - rf_y)$ in a standard fashion. Unreported: averages computed using the value-weighted stock market index obtained from Center for Research in Security Prices have means of about 0.3% more and standard deviations of about 2% more than equivalent S&P returns. Unreported: inflation from 1926 to 1997 was about 3.1%. NA = not available.

Yet, historical averages have limits. Even from a theoretical perspective, an observer could interpret recently high historical stock returns to be indicative of lower (not higher) future stock returns. If the true expected rate of return on stocks were to have fallen over the last couple of years because investors were unexpectedly streaming into the stock market and competing away previously higher expected rates of return, because investors became less risk averse, or because volatility declined, recent increases in stock prices (high stock returns) would soon be followed by lower stock returns in the future. There is also the more mundane nonstationarity problem that 50-year old equity premia may have little relevance to the world today. But stock returns are so volatile that shorter time series have too high a standard deviation to be useful estimators. For example, a 95% confidence interval (plus or minus two standard errors) for the true equity premium average over the 1994–98 period ranges from +7.6% to +30.4%—not a useful range for practical capital budgeting purposes.

C. Predictive Regressions

An alternative popular method to estimate future expected returns relies on the observation that, in the very long run, expected corporate payouts and expected investment returns must be equal. The stock price today must be the present value of all future dividend payouts (or earnings). Many researchers (e.g., Campbell and Shiller 1988; Fama and French 1988; Blanchard 1993) have used this observation to predict future equity returns and equity premia with dividend yields (and, to a lesser extent, other variables).[2] As of 1999, a regression of annual data from 1927–97 yields

$$\mathrm{EQP}_y = -11.5\% + 3.95\left(\frac{D_{y-1}}{P_{y-2}}\right) + \mathrm{noise}_y, \qquad (1)$$

where EQP_y is the equity premium (here the difference between the return on a value-weighted stock index and short-term treasury investments) in year y, and D_{y-1}/P_{y-2} is the lagged dividend yield. As of 1999, with a dividend yield of below 1.5%, this regression predicts a 1-year-ahead forecast of less than −10%. (Longer period forecasts converge to the historical average.) Variations of such ''conditional models'' predict equity premia ranging from about −10% to about 0%. These are not comfortable estimates. After all, why would anyone hold equity if stocks did not offer higher expected returns than bills? And, what

2. ''Fortunately,'' aside from a number of statistical problems, such models have predicted consistently poorly out of sample at least since 1946. Goyal and Welch (1999) show that this is because simple linear models are unstable—the coefficients have declined over time.

does this imply for firms' capital budgeting decisions—should firms place a lower hurdle rate on riskier projects?

D. Theoretical Arguments

Yet another popular approach to estimating the expected equity premium relies on calculations of what reasonable expected rates of returns are necessary to entice the average investor to be roughly indifferent between investing in stocks and bonds, given historical aggregate volatility and covariances. Assuming reasonable risk aversion for such an investor (and introspection), such estimates typically arrive at estimates of about 1%–3% (Mehra and Prescott 1985).

Unfortunately, these calculations have predicted about 1%–3% for decades, while the historical 1926–98 average has increased to an all-time high of 9.4%. This puzzle deepens even further if the average investor is not tax-exempt, because equity capital gains face lower effective tax rates than bond interest receipts. Cochrane (1997) and Siegel and Thaler (1997) both conclude that economic theory has great difficulty in explaining such high figures (even with high degrees of risk aversion and all sorts of modifications to standard consumer choice models).[3] Still, they remain skeptical about the continued presence of an equity premium in the (often quoted) 6%–8% range.

E. Popular Views

Small investor surveys tend to find equity premium expectations between 10% and 15% per year. On October 10, 1997, The *New York Times* reports that a Montgomery Asset Management telephone survey found an expected 1-year stock market return of 22%. On November 22, 1999, *Fortune* Magazine mentions that a similar Paine-Webber survey in July 1999 found expected stock market returns in excess of 20% for both the 1-year and 10-year horizons. On November 15, 1999, the *Financial Times* reports a Gallup/Paine-Webber poll that found ''only'' a 16% expected stock market return over both 1- and 10-year horizons.[4]

3. In addition to models based on standard representative agent utility maximization, these summary papers also discuss other, more ''radical'' explanations, such as behavioral explanations (e.g., Benartzi and Thaler 1995) and ex post survival bias (e.g., Jorion and Goetzmann 1999).

4. Not surprisingly, investors have poured into the stock market in unprecedented numbers. In the 1996 *Mutual Fund Fact Book,* the Investment Company Institute reports a strong positive correlation between stock market rallies and mutual fund net inflows (p. 130). In 1995, investors poured in $164 billion, which was up from $2.8 billion, just after the crash (in 1988), up from a $40 billion/year average throughout the 1980s, and up from net outflows during the 1970s. (In general, the more aggressive the equity fund investment style, the larger the net fund inflows in the 1990s.) Aggregate net inflows into the three major public equity markets (equity issues minus dividends and repurchases and bankruptcies) have seen multiyear levels unprecedented since the Great Depression.

In contrast, professionals tend to be more conservative. A survey of pension fund executives and other institutional investors by *Pensions and Investments* (January 12, 1998, p. 1) found an expected equity premium of 3%, and the 1997 Greenwich Associates survey of fund professionals found an expected 5-year equity premium of 4%–6%.[5]

Individual organizations tend to be in line with professional investors. Financial Engines appears to use a short-term equity premium of about 6%. McKinsey seems to have standardized recently on an equity premium arithmetic figure of 5%–5.5% for valuation purposes. The Social Security Administration Office assumes a 7%–3% = 4% geometric equity premium, based on a dated historical average. Naturally, those arguing that rescuing Social Security requires an asset reallocation into equities contend that the 4% equity premium is too low, based on observed historical averages; others consider this figure too high (Diamond 1999).

A sampling of finance textbooks shows that, for instance, Copeland, Koller, and Murrin (1995, p. 260) recommends a 5%–6% geometric average. Grinblatt and Titman (1998, p. 174) uses 10% in an example but, after giving a discussion, is notably silent on giving any estimate (see p. 176). Ross, Westerfield, and Jaffe (1993, p. 257) recommends 8.5%, Van Horne (1992, p. 214) 3%–7%, and Weston, Chung, and Siu (1997, p. 190) 7.5%.

F. Summary

In sum, there are wide discrepancies in estimates of the expected equity premium, ranging all the way from −10% to +20%, depending on the source of the forecast. Such disagreement about the expected equity premium can lead to absurd consequences in the classroom, courtroom, and boardroom: the same project may require passing a hurdle rate of 10% in one company and 20% in another; the same investor may receive retirement advice that suggests vastly different retirement ages, saving needs, and investment policies; and politicians may or may not advocate different reforms of the social security system, each based on a different estimate of the equity premium and each backed up by a generally accepted estimation method.

The goal of this survey is to provide a ''metaestimate,'' that is, a

5. Fund managers predicted the Standard and Poor's 500 Stock Index (i.e., without dividends that account for about 1%–2% per year) to offer a 10.4% mean and a 9.8% median. A range of 8%–14% represents about two-thirds of the distribution. The survey was taken in September and October 1997 and encompassed 2,309 funds, of which about 75% responded. It is published in ''What Now?'' by Greenwich Associates. Prior academic research on investment expectation can be found in Shiller (1987, 1999), Pound and Shiller (1989), and Kon-Ya, Shiller, and Tsutsui (1991, 1996). An update of Kon-Ya et al. (1996) of their 1991 article on Shiller's website (http//aida.econ.yale.edu/Schiller/data.htm) shows a 1-year stock market expectation of 6.6% by U.S. respondents but high year-to-year variability.

weighted average of estimates used by financial economists, which could become a focal point different from the aforementioned estimates. Although this consensus has no claim that it offers the correct best ex ante estimate, it is at least an appropriate common-practice estimate among one group of well-informed individuals, who are usually asked to provide such estimates in their ordinary course of instruction and who are without financial incentives to radiate biased estimates.

II. The Survey Design

This article summarizes the results of two surveys, henceforth referred to as the first and second survey.

A. The First Survey

The first survey is reprinted in appendix B. This article reports statistics for (*a*) forecasts of the mean and 5% and 95% confidence intervals for the equity risk premium (stocks minus equivalent horizon bonds) for 1-year, 5-year, 10-year, and 30-year horizons; (*b*) an estimate of the mean that other academics would provide on this survey; and (*c*) views regarding nine issues of relevance to the academic finance literature.

This survey was posted on my World Wide Web site (http://linux.agsm.ucla.edu/) in October 1997. In addition, a hard copy was mailed to finance professors at 11 universities with large finance faculties, associate editors at three major journals, and my colleagues at the University of California, Los Angeles. Almost all of the responses came from the mailings, not from visitors to the Web site. There were 114 valid completed forms, the first arriving in October 1997, the last in February 1998.

To correct the major ambiguity in the first survey, whether participants had responded with a geometric or arithmetic average, respondents were contacted by e-mail in October 1998 and asked whether their 30-year answers were arithmetic or geometric averages and whether their views on the 30-year equity premium forecast had changed. Eighty-five participants responded to the request for clarification; only 29 did not. Overall figures provided in the tables reflect appropriate adjustments to the first-survey estimates, as described in appendix A, to make them equivalent to answers to the second survey.

B. The Second Survey

The second survey is reprinted in appendix C. It was shorter than and corrected several shortcomings of the first survey. It elicited explicitly both geometric and arithmetic 30-year averages, requested an equity premium defined as the difference between stocks and short-term bills, posed a question about how an increase in equity prices would influence

a researcher's views, and added questions on the 100-year equity premium and 30-year inflation, on whether the respondent considered himself an expert or had published on the subject, and on survey completion time and clarity of the survey. This second version was posted both on my Web site and on the *Journal of Finance* World Wide Web site and elicited 112 responses by Ph.D.-level financial economists.[6] The first response was received in January 1999, the last in May 1999. Reported figures in the tables break out responses to this second (more accurate) survey.

C. Problems

The surveys admittedly suffer from a number of problems. First, economists had no powerful incentive to reveal their best estimates. However, the cost of jotting down a number that all finance professors have to tell students on a daily basis is low. The majority of professors contacted were willing to participate. Even though it is possible that participants represent a biased sample, a visual inspection reveals a fairly large subset of professors at many leading universities. Second, the surveys were not a controlled experiment but an attempt to take the pulse of the profession. The surveys did not permit anonymous responses, and none was received. I was clearly identified as the person asking the question. Most finance professors would be unlikely to answer a survey sent by someone they do not know. Indeed, most responses were received only after private e-mail reminders. Third, second-survey participants answered 1 year later—after a significant market rise and after the first write-up of this article was available. Yet, even if the circulated first draft of the article had changed some participants' views, I would be interested more in their revised than in their original views for this article. Fourth, the presence of the Brealey and Myers's (1996) historical figures on the right of each question may have induced respondents to anchor on them. In defense, the Ibbotson numbers are familiar to most finance professors, and their presence may have increased the survey response rate by allowing participants to answer without delaying until they could find the time to verify the Ibbotson numbers. (Moreover, these figures were originally intended to clarify whether I was asking for a geometric or arithmetic average.) Fifth, the questions in the first survey were ambiguously phrased and required e-mail clarification and adjustments. Unfortunately, it is not possible to find a fresh set of participants to replenish the pool. Fortu-

6. Fourteen responses were from individuals who were not financial economists with a Ph.D. (mostly finance Ph.D. students; their 30-year arithmetic average forecast was 5.3% on average, with a median of 5.9%).

nately, clarified adjusted answers to the first survey are very close to the answers of the second survey.

III. The Academic Equity Premium Consensus

A. Long-Horizon Equity Premia

Figure 1*D* plots the distribution of 226 answers to the 30-year arithmetic forecast for the equity premium using the largest set of answers. Impulse lines within the bars on the 30-year graph plot the distribution of answers to the second survey only.

Table 2 shows that various central statistics (the mean, the 5% and 95% truncated mean, and median) suggest an academic expected arithmetic 30-year equity premium consensus of about 7%.[7] Figure 1 shows that the mode response is about 8%. Still, only about 20% of participants on either the first or the second survey picked an (unadjusted)[8] number between 8% and 8.9% (8.5% being the largest), equal to the historical Ibbotson estimate quoted by the questionnaire itself. The historical average does seem to have strong influence, but about 80% of the participants provided their own estimate instead. The standard deviation of the expected 30-year premium is about 2.0%,[9] the first quartile is 6%, and the third quartile is 8.4%. There is a pronounced clustering between 5% and 9%, but there are more individuals below 5% than there are above 9%. Remarkably, figure 1 does not indicate multimodality—the profession does not divide neatly into two or three camps, each of which forecasts its own number. Most individuals choose a convex combination of the above-mentioned forecast methods, with most of the weight on the long-term historical average.

As to differences between the first and second survey, 112 second-survey respondents offered an equity premium estimate of 6.7%–7.0%, depending on the central statistic. Adding in the e-mail-clarified responses (for a total of 197 clear responses), the mean 30-year equity premium forecast rises back to the 7.1%, equal to the average of all 226 respondents. The (relatively small) difference of 0.4% can thus be mostly attributed to a sampling variation across individuals (perhaps because of the increased stock market level by the time the second

7. There is one outlier of 15%, which is responsible for a 0.04% higher estimate. In correlation and regression computations, this observation was eliminated.

8. This is the only exception where the frequency of unadjusted estimates to the first survey is quoted. This is because there is a question as to how many individuals just copied the provided 8% Ibbotson estimate provided by the survey. The median and mean unadjusted response to the first survey was about 6%, not 8%.

9. Nordhaus (1994) surveys a set of economic and natural researchers about the potential impact of global warming and finds remarkably high dispersion in expert opinion. This equity premium survey mirrors this dispersion in expert opinion in finding high across-expert dispersion.

survey was run; see Sec. III*E*) and only secondarily to remaining miscorrection in the adjustment calculation.

In sum, 6.8%–7.0% is a robust estimate for the consensus about the 30-year arithmetic equity premium among financial economists. However, there is considerable disagreement across economists. The following are not reported in table 2.

Geometric average. About half the respondents explicitly offered a geometric 30-year equity premium forecast. The academic consensus for the geometric 30-year equity premium is around 5.2% per year.

One-hundred-year equity premium forecast. Among 45 responses to the (optional) request for 100-year forecasts on the second survey, the 100-year arithmetic equity premium forecast mean was 6.5%, which was about 1% less than the same respondents' 30-year forecast mean.

Stock market forecast. Respondents to the second survey offered a 30-year arithmetic stock market forecast of 11% (SD of 2.1%).

Recent updating. Among 85 first-survey respondents contacted by e-mail about a year later, only nine individuals chose to reduce their estimates; four individuals chose to increase their estimates.

B. Shorter-Horizon Equity Premia

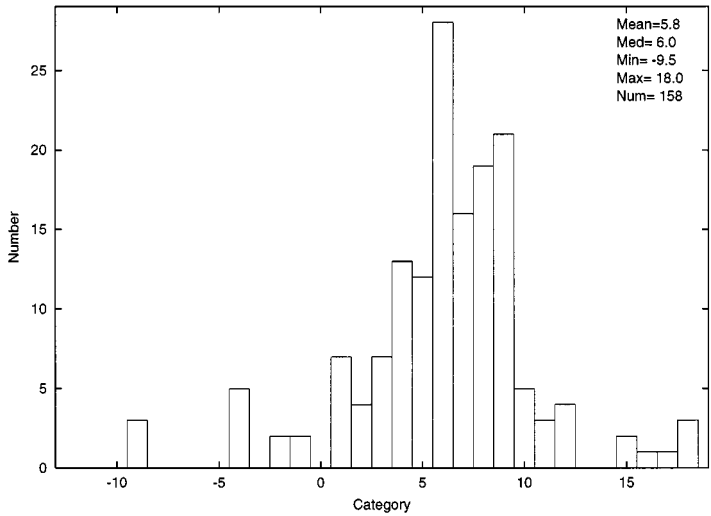
Table 2 shows that the largest set of adjusted responses, 170 in total,[10] indicates an arithmetic 10-year equity premium forecast of 7% (SD: 2%). For the 58 individuals answering this question on the second survey, the average was slightly lower and practically identical to the average of these respondents' 30-year arithmetic equity premium forecasts; both were 6.8%. (The average difference between 10-year and 30-year arithmetic equity premia forecasts when both are available is 0.2%.) It is fair to characterize any difference between 10- and 30-year equity premia forecasts as insignificant.

However, the two shorter-term (1-year and 5-year) arithmetic equity premium forecasts are lower, both in economic and statistical terms.[11] Relative to the 10-year and 30-year forecasts of about 7.1%, the 5-year untruncated forecast mean is about 0.5% lower, and the 1-year untruncated mean forecast is about 1% lower. (Truncated mean differences are smaller, and the average drops for respondents for which I

10. In the second survey, shorter-term equity premia estimates were optimal. There is no real difference between statistics computed over all reported answers or only for those individuals' answers where both shorter- and longer-equity premia forecasts were available. See app. A for more details.

11. About 20% of survey participants offered an expected premium term structure that was monotonically increasing in horizon; 50% had the expected premium term structure monotonically decreasing. This decline in forecast by horizon is comforting in another sense: many financial economists did not just copy the provided Ibbotson estimate but instead provided their own estimate. The number of unadjusted 8% answers drops from the 20% for the 30-year estimate to about 15% for the 1-year estimate.

A



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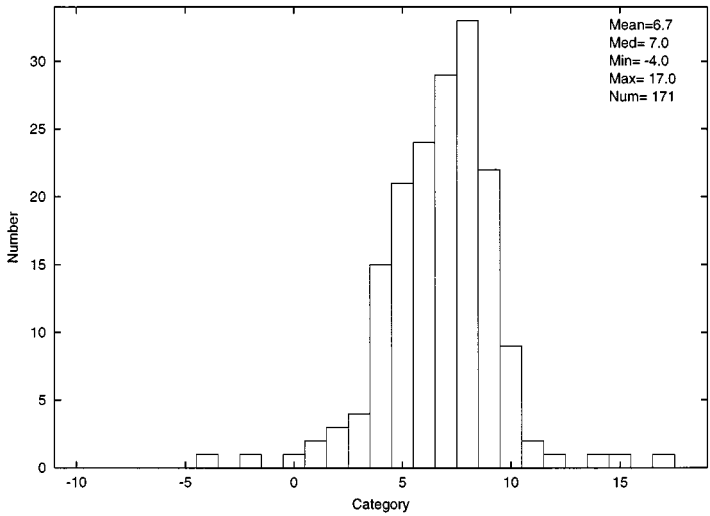
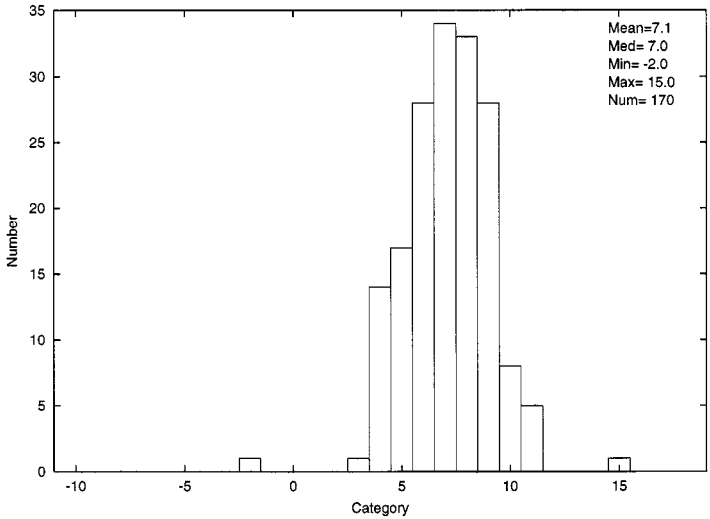


FIG. 1.—The distribution of arithmetic equity premia forecasts by financial economists. The surveys from which these histograms were computed are reproduced in appendices B and C. Statistics are over both the first and second survey (after adjustments to first-survey responses explained in app. A). *A*, Distribution of the 5-year expected equity premium; *B*, distribution of the 1-year expected equity premium; *C*, distribution of the 30-year expected equity premium; and *D*, distribution of the 10-year expected equity premium. 1*D* reports responses to the second survey as impulse lines inside the bars.

C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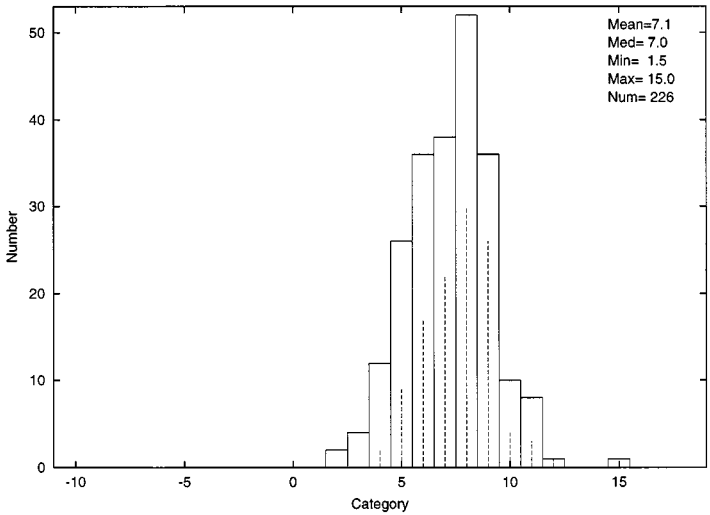
D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Num= 226
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-10
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15

TABLE 2 Univariate Statistics for Arithmetic Equity Premia Forecasts

Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
30-year forecast	7.1	7.2	1.7	2.0	1.5	6	7	8.4	15	226
30-year forecast (S2)	6.7	6.8	2.0	2.2	1.5	5	7	8	15	112
10-year forecast	7.0	7.1	1.9	2.0	−2	6	7	8.4	15	170
5-year forecast	6.7	6.7	2.0	2.6	−4	5	7	8.0	17	171
1-year forecast	6.5	5.8	2.4	4.5	−9.5	4	6	8.5	18	158

NOTE.—The table presents the distribution of arithmetic equity premia forecasts by financial economists. The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviation after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

have a 30-year forecast are 0.7% and 1.4%.) This is primarily because of a more frequent presence of negative forecasts rather than a left shift of the distribution. Twelve respondents recommend an estimate that suggests that they believe Treasury bills will outperform stocks over the next year (two believe that this will occur over the next 5 years). Compared to the long-term forecast, there is also considerably more disagreement among economists for what the best short-term equity premium forecast is. The truncated standard deviation across financial economists rises from the 1.7% for 30-year forecasts to about 2.5% for a 1-year forecast; the untruncated standard deviation rises even more.

C. Optimistic and Pessimistic Scenarios

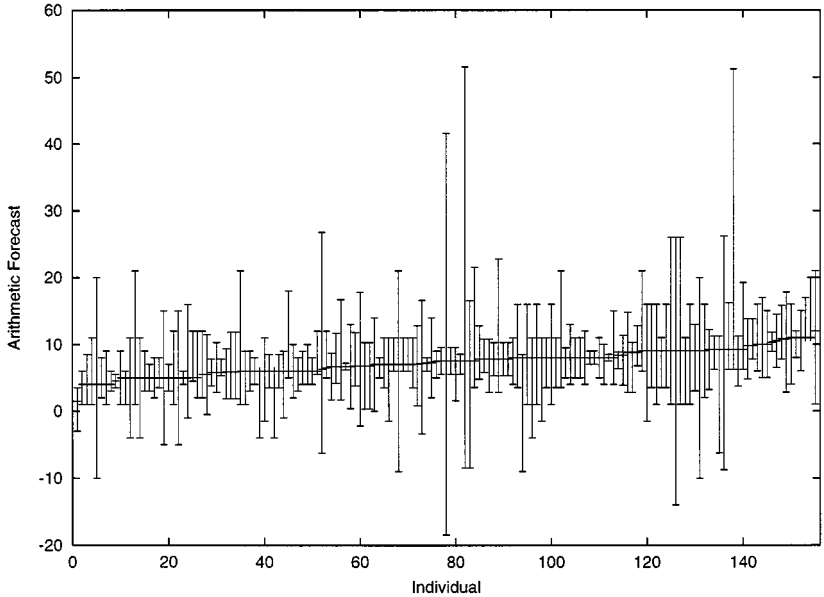
Respondents were also asked to provide their fifth percentile and ninety-fifth percentile scenarios for the equity premium. This was an optional question, so the number of responses to these questions is lower than the number of responses to the earlier question about the 30-year mean forecast. Most finance professors are unlikely to have given much thought to this question, because they do not usually have to provide such figures. Consequently, scenario estimates are intrinsically less reliable than economists' own expected forecasts. This unreliability is reflected in a much wider dispersion of answers and some inconsistencies.[12] The reader should focus primarily on the more robust statistics based on medians and truncated means and not on the simple means.

Figure 2 graphs the expected, most optimistic, and most pessimistic scenarios when individuals are sorted by their 30-year arithmetic forecasts. The statistics are provided in table 3. The top half of table 3 shows that the most optimistic arithmetic 30-year equity premium scenario consensus is somewhere between 11% and 13% per year. (For 56 answers to the second survey, the median and mean is about 11%.) Shorter-term optimistic-case scenarios are successively more optimistic, but the magnitude depends strongly on the central statistic used. The 10-year optimistic scenario arithmetic equity premium forecast lies at around 15%, the 5-year optimistic scenario lies at around 20%, and the 1-year optimistic scenario lies between 25% and 30%. In the minds of many academics, the most recent 3 years were rather unusual (one in 20) realizations.

The bottom half of table 3 shows that the consensus for the pessimistic arithmetic 30-year equity premium scenario (at the 5% level) is between 2% and 3% (median) per year. (For 55 answers to the second survey, the median and mean are about 4%—higher than they are in

12. There were four responses for which the optimistic scenario was not better than the average forecast and one response for which the pessimistic scenario was not worse than the average forecast. These five responses were first eliminated.

A



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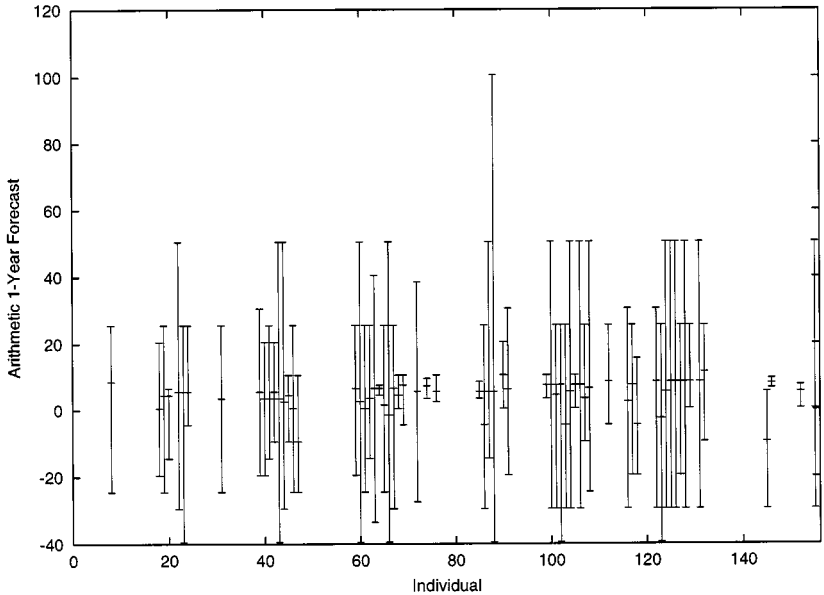

FIG. 2.—The pessimistic-scenario, average, and optimistic-scenario 30-year arithmetic equity premium forecast by 226 financial economists. Forecasts from the first survey were adjusted, as explained in appendix A. In both figures, individuals are indexed (lined up) identically, sorted by their mean forecast. Clustering in 1-year responses is induced because of discreteness in 30-year responses and the sorting procedure. *A*, Distribution of the 1-year expected equity premium; *B*, distribution of the 10-year expected equity premium.

TABLE 3 Univariate Statistics for Arithmetic Equity Premia Optimistic and Pessimistic Outcome Forecasts

Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
Optimistic:										
30-year scenario	12.8	13.3	4.9	6.7	3.5	9	11.2	16	51.5	158
10-year scenario	15.4	16.5	5.5	10.9	6	11	15.4	19.1	101.2	104
5-year scenario	21.2	23.1	11.5	22.3	8	11	17.8	26	201	101
1-year scenario	28.6	29.2	14.9	17.0	6	17	26	51	101	71
Pessimistic:										
30-year scenario	2.2	2.2	4.0	4.5	−18.5	1	3.2	5	11	159
10-year scenario	−.8	−1.0	5.4	6.2	−24	−4	1	2.8	8.9	106
5-year scenario	−8.3	−9.0	10.2	12.4	−59	−14	−7.2	.3	8.9	102
1-year scenario	−19.2	−19.6	13.5	11.9	−39	−29	−24	−9	6.5	72

NOTE.—The table presents the distribution of arithmetic equity premia pessimistic and optimistic scenarios (at the 5% level) by financial economists. The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviation after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

the overall sample [not lower as is the mean forecast].) Shorter-term pessimistic-case scenarios are successively more pessimistic. The 10-year pessimistic scenario forecast lies around 0%, the 5-year pessimistic scenario lies around −8%, and the 1-year pessimistic scenario lies between −20% and −25%.

It is remarkable that even at a probability of one in 20, financial economists tend not to believe that a meltdown of Japanese-style proportion lasts for 10–30 years. Indeed, the confidence of financial economists is remarkable: the typical pessimistic one-in-20-case 30-year scenario foreseen by financial economists is about the equity premium that Mehra and Prescott (1985) consider to be consistent with reasonable risk aversion. This low a number would be consistent with the hypothesis that recent high stock returns are simply reflections of lower required future equity returns, which coincides with the personal view of Siegel (1999) and myself.[13]

There is a negative correlation between the optimistic and pessimistic estimates across economists—economists who indicate a more positive optimistic scenario also indicate a more negative pessimistic scenario. Thus, variation in optimistic/pessimistic scenarios are driven more by differences in confidence than by differences in estimates of the mean. The correlation between the pessimistic and mean equity premium forecast is positive—economists with higher equity premium mean forecasts also provided more favorable pessimistic scenarios. Thus, the pessimistic estimates in the survey tend less to reflect disagreement on where the economy lies in terms of the risk-return tradeoff—in which case one would expect individuals indicating a more positive equity premium mean also to indicate a more negative possible outcome—but more to reflect across-economist views about the attractiveness of the stock market. The term structure of volatility that can be extracted from these extreme forecasts is roughly consistent with a random walk with a volatility of about 15%.

D. The Perceived Consensus

What equity premium do financial economists believe their peers are recommending? This is interesting for a number of reasons. Economists are likely to weigh their otherwise private estimates against what they perceive to be a common consensus and to come up with a posterior estimate that averages the two. An incorrect perception of the estimates of others can delay the process of collective adjustment. If one believes that everyone else believes the equity premium to be 8%, then one may be reluctant to quickly adjust one's view away from 8%. In this sense,

13. To avoid economists' 7% consensus from becoming the ''Welch number,'' I must take the unusual step of quoting my own personal estimate: 2–3% arithmetically over 30 years (see also Welch 1998).

this survey may aid the profession's aggregation of opinions. Further, the perception might indicate the extent to which this survey is informative to researchers. If economists' personal views and views of the profession's consensus already coincided, this article would be less informative and economists' estimates could be considered more reliable.

Table 4 shows that economists' perceived consensus is not monotonic in the horizon, although differences are small. The belief is that the 30-year and 5-year equity premium consensuses are each about 7.5%, about 8% for the 10-year consensus, and 6% for the 1-year consensus. When this is compared to the equity premia forecasts themselves (on the left side), the popular view is that their own consensus is between 0.5% and 1% higher than what it actually is. Except on the 1-year horizon (which has fewer responses and higher standard series deviation), the difference is statistically significant. Note also that economists believe more in their ability to judge the consensus than to judge the equity premium itself, even over 30 years. However, there is still substantial disagreement among economists.

The influence of this overestimate is further explored in table 5. The left part of the table provides the univariate means and standard deviations for the set of researchers with both a forecast and a consensus estimate. Again, the misperception is between 0.5% and 1.0%. However, economists' own estimates need not be influenced by their perceptions of the prevailing consensus—for example, everyone may invariably believe that others use the Ibbotson 8% figure and, thereby, have their own equity premium forecast be unaffected. To explore whether there is an ''anchoring'' effect, that is, whether economists have a perception of the consensus and shade their own equity premium forecast toward this perception, table 5 describes the results of a regression with the demeaned consensus on the demeaned forecasts.[14] A coefficient of one indicates perfect shading, a coefficient of zero perfect irrelevance.

The regressions reported on the right side of table 5 show that the same economists who indicate that they believe the professional consensus to be higher also offer a higher equity premium forecast themselves. This is especially pronounced on the 1-year and 30-year horizons. It is weaker on the 5-year and 10-year horizons. Perhaps financial economists often use either short-horizon (1-year) or long-horizon (30-year) rates but less often use either 5-year or 10-year rates.

14. Naturally, economists may settle on their own forecast and believe that it is also held by the profession. Ross, Greene, and House (1977, p. 280) reported a series of studies in which subjects show a tendency to ''see their own behavior choices and judgments as relatively common and appropriate to existing circumstances while viewing alternative responses as uncommon, deviant, or inappropriate.'' Marks and Miller (1987) summarize this literature and describe some explanations. However, in this equity premium survey context (in which there is no temporal precedence), it is not even clear if there is a philosophical difference between this view (in which own choices influence the consensus perception) and the view stated in the text.

TABLE 4 Univariate Statistics for Economists' Arithmetic Equity Premia Consensus Estimates

Actual Mean (%)	Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
7.1	Perception 30-year	7.6	7.6	1.5	1.7	1	6.5	7.8	9	12	216
6.7	Perception 30-year (S2)	7.5	7.4	1.6	1.9	1	6	7	9	12	112
7.0	Perception 10-year	8.1	8.2	1.3	1.4	4	7	8	9	12	101
6.7	Perception 5-year	7.7	7.6	1.6	1.7	1	7	8	9	11	99
6.5	Perception 1-year	6.0	6.0	2.3	2.4	0	6	7	8	12	69

NOTE.—The table presents the distribution of economists' perception of the prevailing equity premia forecast. The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviations after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

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TABLE 5 Statistics for Economists' Arithmetic Equity Premia Consensus Estimates

	Univariate Statistics, Common				$\hat{A}_i - \hat{A}_i = \alpha_0 + \alpha_1(\hat{C}_i - \hat{C}_i) + e_i$			
Description	Mean_A (%)	SD_A (%)	Mean_C (%)	SD_C (%)	α_0	α_1	SE (α_1)	N
30-year	7.1	1.9	7.6	1.7	.0	.62	.06	214
30-year (S2)	6.7	2.1	7.4	1.9	.0	.73	.08	111
10-year	7.2	1.8	8.2	1.4	.0	.31	.12	99
5-year	6.7	2.3	7.7	1.7	.0	.28	.14	97
1-year	4.7	4.2	6.0	2.4	.0	.79	.19	67

NOTE.—The left side of the table presents the mean and standard deviation of economists' arithmetic equity premia forecasts (A_i) and their perceptions of the prevailing equity premia consensus forecast (C_i), provided an individual supplied both an equity premium estimate and a consensus estimate for the same horizon. The right side provides ordinary least squares regression output when the demeaned arithmetic forecast ($\hat{A}_i - \hat{A}_i$) is regressed on this economist's demeaned perception of the professional consensus about the same-horizon arithmetic forecast ($\hat{C}_i - \hat{C}_i$). The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A.

In sum, the regressions are consistent with an attempt by economists to provide a forecast that lies between their personal estimate and their perceived consensus belief. If this is the case, the results of this survey may help economists improve their anchoring their own predictions relative to the profession, which would cause a downward revision in the aggregate consensus forecast.

E. Other Statistics

The most interesting remaining question concerns the influence of market movements. Almost all finance professors subscribe to the view that markets follow a random walk in the short run. Updating of equity premia opinions is likely to be a very slow process, and changes in opinion are likely to be marginal only. Still, participants on the second survey were also asked to indicate whether they would be positively, negatively, or not at all influenced by stock market movements on the margin. Coding this feedback rule as $+1$, -1, and 0, respectively, the mean response by 112 participants to this question was -0.367, with a standard deviation of 0.5. Thus, average participants claim that a bull market leads them to predict a lower future equity premium.[15]

Finally, the second survey asked whether financial economists considered themselves to be relatively better informed with respect to the equity premium and whether they have published in the area. Fifty-one respondents indicated no prior relevant publication, 13 of whom considered themselves less qualified (mean arithmetic 30-year equity premium: 6.6%), three of whom considered themselves better qualified (mean: 7.3%), and 35 of whom considered themselves equally qualified (mean: 7.3%). Of the 17 individuals who indicated a relevant publication, six considered themselves better qualified (mean: 6.4%) and 11 considered themselves equally qualified (mean: 6.6%). Thus, lower forecasts tend to be either by individuals who had published related work or by individuals who felt ill-qualified to answer the survey.

IV. Questions Debated in Academic Finance

The first survey took the opportunity to add a set of questions that asked respondents' views on issues that are commonly debated in the academic literature and on which most researchers who attend finance

15. Respondents indicating that they follow a positive feedback rule are also more optimistic about the market. Sixty-six individuals indicate they are not influenced by stock market movements on the margin and provide 7.3% as their equivalent average; 43 individuals follow a negative feedback rule, with 5.7% as their equivalent average; and only two individuals follow a positive feedback rule (with 4% and 8% as their average arithmetic 30-year equity premium estimates). The fact that there is a correlation between the indicated feedback rule and the forecast should not be surprising, given the stellar recent stock market performance.

conferences and seminars are likely to have an interest in (or at least an opinion on). Answers could range from 1 (strongly disagree) to 3 (neither agree nor disagree) to 5 (strongly agree). Table 6 lists both the questions and the received responses (see also app. B).

The first question asked whether the stock market is more likely to follow a random walk or more likely to have long-horizon negative autocorrelation. It turns out that more professors have an opinion (''agree'' or ''disagree'') than no opinion (''neither agree nor disagree''), but when they do, this opinion is roughly evenly split. The jury is still out.

The second question concerned the use of the capital asset pricing model (CAPM) for capital budgeting purposes. Although a sizable minority of professors do not believe that it is ''good enough'' to be used for capital budgeting purposes, a majority feels that it is.

The third question asked whether size and book-market values are more likely to be characteristics (in the Daniel and Titman [1997] sense) or more likely to be risk factors (in the Fama and French [1993] sense). The respondents mildly favored the view that they are characteristics.

The fourth question asked whether the risk factors or characteristics (size, book-market, price-earnings, or momentum) are likely to be useful for portfolio selection in the future. The profession does not have a strong view on this issue. The ambivalent view is remarkable, given the large number of publications and strong ongoing interest in detecting past ''anomalies.'' Prior to conducting this survey, it had seemed to me that the common working hypothesis in finance is that at least the major anomalies are universally viewed to represent persistent phenomena. This survey does not confirm this hypothesis.

The fifth and sixth questions asked whether markets are basically efficient and arbitrage-free. There was much agreement here: financial economists feel that, by and large, financial markets are efficient. The sixth question asked whether economists believe in arbitrage opportunities—an ability to make money without risk. Apparently, the respondents did pay attention and also marked a strong view in favor of absence of arbitrage.

The only question that elicited more support than absence of arbitrage was the question about whether governments should intervene more in financial markets. The profession strongly feels that this would be counterproductive.

Finally, there are two questions related to corporate finance. The eighth question asked whether large Fortune 500 firms have too little debt in the capital structure and whether share repurchases dominate dividends as a means of payout. The profession has no views on whether large Fortune 500 firms would be better off with more debt

TABLE 6 Questions on Issues Debated in Academic Finance

	Question	Univariate Statistics		Response Count					
		Mean	SD	1	2	3	4	5	Total
Q1	I believe that the true stock-market index's 3–5-year return autocorrelations are zero (random walk [à la Richardson, choose agree]), rather than negative (à la Fama-French, Shiller, choose disagree).	2.85	1.1	7	42	17	31	5	102
Q2	I believe that the CAPM is a good enough approximation of reality to deserve use in capital budgeting contexts.	3.41	1.1	5	22	19	51	13	110
Q3	I believe that size/book-market/price-earnings/momentum power can explain cross-sectional returns primarily because they are **risk** factors (in the Fama-French sense) and not just firm **characteristics** (in the Daniel-Titman sense).	2.64	1.2	18	33	19	20	7	97
Q4	I believe that size/book-market/price-earnings/momentum factors are **stationary** enough, so that they will work well in the future in explaining cross-sectional expected return differences.	2.77	1.0	9	37	24	26	3	99
Q5	I believe that, by and large, public securities market prices are efficient.	3.84	.8	1	9	13	71	16	110
Q6	I believe that, by and large, public securities market prices offer arbitrage opportunities.	2.16	.9	22	60	17	8	2	109
Q7	I believe that, by and large, government regulation and intervention in public securities markets should be increased. (Please select **middle** if intervention should be held steady, and **strongly disagree** if intervention should be decreased.)	2.13	.8	29	39	40	0	1	109
Q8	I believe that Fortune-500 U.S. corporations, by-and-large, have too little debt in their capital structure.	3.09	1.0	4	26	23	30	6	89
Q9	I believe that Fortune-500 U.S. corporations, by-and-large, should use share repurchases instead of dividends as payout means.	3.68	1.0	4	7	21	42	18	92

NOTE.—''Response Count'' tallies number of respondents selecting each number on a 1–5 scale, where 1 = disagree and 5 = agree; see app. B for details.

in their capital structure. But they perceive dividends to be an unwise mechanism for corporations to disburse funds relative to share repurchases.

In sum, it is remarkable how weak the views of financial economists are, even on issues, such as absence of arbitrage, that are typically seen as relatively uncontroversial: about one-quarter of the participants responded with a value between ''strongly disagree'' and ''neither agree nor disagree.'' On most questions, there was neither strong agreement nor strong disagreement by many participants, even when central issues in finance and stark positions were concerned.

V. Conclusion

This article presents the results of the first comprehensive survey of financial economists. Two hundred and twenty-six finance professors shared their forecasts and perspectives on the equity premium and some related issues. The primary findings are as follows.

1. The average arithmetic 30-year equity premium consensus forecast hovers around 7%. On the one hand, this is not as high as the current historical 9.4% arithmetic average quoted by Ibbotson or even as high as the Brealey and Myers (1996, p. 146) quoted average of 8.4% per year. Practitioners who would prefer to base their estimates on the perceived academic consensus should thus use a lower 7% arithmetic premium instead.

On the other hand, the 7% equity premium consensus forecast seems too high for comfort among macroeconomists, who argue that stock prices have risen because rational, informed investors now require and expect lower future equity rates of return. These rational, informed investors are not the finance professors surveyed here. Indeed, the 1%–3% theoretical estimate is roughly the academic consensus for a worst-case (one in 20) 30-year scenario.

2. There is a term structure of equity premia forecasts: short-term forecasts are lower than long-term forecasts. (Unfortunately, this consensus also prevailed on the first survey in early 1998!)

3. There is evidence for a ''false-consensus effect.'' On average, finance professors believe that their consensus is about 0.5%–1% higher than it actually is, especially on shorter horizons; there is also a strong correlation between researchers' perceptions of the consensus and their own estimate. This is evidence that participants anchored their own responses on their perceptions of the professional consensus—and it may indicate that the publication of this article may shade down the equity premium consensus forecast among financial economists.

4. On average, financial economists claim to revise their forecast down as markets increase (''negative feedback'').

5. There is strong agreement among financial economists that the government ought to decrease its intervention and regulation of public securities markets and that markets are by and large efficient and arbitrage-free. They also would mildly recommend to corporations to use more share repurchases and fewer dividends. And they have no strong views, one way or another, whether the stock market follows a random walk, whether firms can reasonably use the CAPM for capital budgeting, whether large firms should use more debt financing, whether size and book-market are risk factors or characteristics, or even whether size and book-market will continue to predict stock returns in the future.

Appendix A

Adjustments

The first survey considered the request for an average, paired with the well-known Brealey and Myers/Ibbotson 8% estimate, to mean ''arithmetic''; it also considered the use of a long-term bond for long-horizon premia (rather than short-term bonds) to be the relevant definition. Because neither is a standard in this literature, this introduced ambiguities in the first (but not second) survey.

Geometric versus arithmetic averages. A Taylor approximation yields

$$\frac{[(1+r)^T - 1] - T \cdot r}{T} \sim \left(\frac{T-1}{2}\right) r^2 + \left[\frac{(T-1)\cdot(T-2)}{6}\right] r^3 + O(r)^4, \quad \text{(A1)}$$

where r is the rate of return and T is the horizon, which can be used to adjust geometric and arithmetic averages. Because market returns are not perfectly serially uncorrelated (see Roll 1983), the historical 1926–97 differences provide a better adjustment.

	Number of Holding Years						
	1	2	3	4	5	10	30
Equity premium (%)	.0	1.0	1.4	1.7	1.8	1.9	1.8

To correct the casual distinction between geometric versus arithmetic averages, I e-mailed participants of the survey with a request for clarifications of answers generated by the first survey. This revealed that about a third of respondents had originally quoted a geometric average. To adjust answers to the first survey, for the 25 individuals who indicated that their answer was for a geometric average (out of 85 who responded to the request for clarification), the historically appropriate adjustment of 1.8% was added to 5-year, 10-year, and 30-year estimates. For the 31 individuals who did not respond to the request for clarification, the following adjustment was computed. Among the 85 received clarification responses, a regression was fitted with the dependent variable being a dummy indicating whether the response was geometric (G_i) and the independent variable being the quoted 30-year forecast (Q_i):

$$G_i = 0.823 - 0.0877 \cdot Q_i + \text{noise}_i. \tag{A2}$$

The fitted estimate was used as a ''probability'' adjustment ($p_g(Q_i) \equiv \hat{G}_i$) to translate the original answers by the 31 participants who had not responded to the request for clarification into arithmetic averages (a_i):

$$a_i = Q_i + p_g(Q_i) \cdot 1.8\% \tag{A3}$$

for 5-year, 10-year, and 30-year forecasts. Of course, no adjustment was necessary for 1-year forecasts.

Bonds versus bills. Historically, over the 1926–98 period, long-term bonds offered a geometric return of about 5.3% (arithmetic: 5.8%), whereas short-term bills offered a return of about 3.8%. However, these averages can be deceptive. The return on both instruments over the 1926–81 period was identical; the long-term bond has been a much better performer only since 1981. Over the sampling period (October 1997–May 1999), the quoted yield difference between the short-term and long-term bond was about 1.1%. (Other bond features, e.g., the value of a long-term call feature, reduce this figure.)

The first survey asked for the difference between the equity premium and the long bond, whereas the second survey asked for the difference between the equity premium and short-term treasuries. To translate all quoted first-survey forecasts into bill-adjusted equity premia, a reasonable adjustment into Treasury bill–adjusted rates was added (1% for the 5-year, 10-year, and 30-year forecasts, and 0.5% for the 1-year forecasts).[16] A reader interested in using an equity premium forecast relative to a bond rather than a bill should subtract about 0.5% to the 1-year bill-quoted equity premia and about 1% to the longer-term bill rates. These adjustments were applied to all quoted figures from the first survey: long-horizon and short-horizon equity premia, optimistic and pessimistic scenarios, and consensus estimates.

Other adjustments. In addition, there were five extreme outliers on the first survey, in which the respondent quoted either 12% or 1,500%. I sent e-mails to these respondents to ask them if this was their correct estimate of the per annum equity premium. All five respondents replied that they had misread the survey, either assuming that I had asked for the market expected return (not net of the risk-free rate) or that I had asked for a compound figure. Although it is possible that they meant to say 12% and I unduly influenced them, this is unlikely—these particular finance professors happened to have made their relevant views on this issue publicly known in other venues. In four cases, the answer in the survey was corrected. In one case, the respondent indicated that his numbers were wrong but that he was too busy to fill out the survey again. This answer has been removed from the survey. The second survey had some automatic checks to alert respondents to extremely large or small estimates, which were primarily useful for catching individuals quoting total rather than average returns.

Perceived clarity. The second survey also gathered some descriptive statis-

16. This is lower than the historical 1.5% difference because some participants may have assumed a definition of equity premia without reading the question more carefully. (This adjustment adds 112/226*1.0% $\sim$ 0.5% to the overall average.) The closeness of results from the first survey and the second survey, especially after adjusting for the rising equity market, further indicates that this issue has been dealt with appropriately.

tics. For 110 responses, the average time spent on the survey was about 3.5 minutes. On a scale of 1–10, with 1 indicating perfect clarity and 10 indicating perfect opacity, the mean was 1.8. There was a small negative correlation between perceived clarity and equity premia mean estimates, and a small positive correlation between time spent and equity premia mean estimates. In a regression, the coefficients indicate that an individual who felt one point more confused and an individual who spent about 2 minutes less indicated an arithmetic equity premium mean of about 0.25% less.

Other adjustments. Residual adjustment error is likely to play only a small role. Sampling variation and the bull market of 1998 probably account for much of the 0.4% difference between the overall survey figures and the second survey figures. This difference is well within the range of disagreement among economists' answers.

Appendix B

The First Survey

Market Risk Premium (E R_m - r_f) Survey

Dear Colleague:

Please take 5 minutes to answer the questions in this survey. The first set of questions concern the market risk premium. It should take about 3 minutes of your time. The second set of questions concern such issues as "will the size/book-market/etc. characteristics continue to predict expected return characteristics?," and should take another 3 minutes. All survey questions pertain exclusively to the U.S. market.

I hope the consensus view on these questions will be of great interest to the finance profession. I am planning to publish an academic paper that summarizes the results of this survey.

Market Risk Premium

(**Background Information:** As of October 6, 1997, the S&P-500 stood at 965, the DJ stood at 8,040, the 30-year T-bond stood at 6.3%, the 3-month T-bill stood at 4.9%.)

Define the so-called "market risk premium" as *your* expected return on the SP500 minus the equivalent treasury bond, please give *your* opinion on the *expected* (forward-looking) annualized market risk premium. (Note: use this definition, even if this spread reflects factors other than risk. The famous Ibbotson "historical" equivalent is 8.2%.) I would like your estimate of the future market risk premium, conditional today, i.e., beginning on the day on which you fill out the survey.

Market-Risk-Premium-Survey

Per-Annum Market Risk Premium: Exp. Return on SP500 *MINUS* Risk-Free Bond

	1-year	5-year	10-year	30-year
Total Return Translation Table	not necessary	click here	click here	click here
Your Expectation (Mean, Per-Annum)				
Your "Worst Case" (<5% prob), **Per-Annum**				
Your "Best Case" (<5% prob), **Per-Annum**				
Guess the academic finance profession's mean e.g., as expressed on this survey by other finance professors				

What percentage of their new retirement contributions would you advise a new finance colleague to put into stocks (rather than bonds)? %

I permit publication of my name as one in many in a list of participants **with identification of my name with the risk premium choices above**: yes no

I permit publication of my name as one in many in a list of participants, but I do not permit publication of my choices together with my name. yes no

Additional Questions

The following are 9 "optional" questions. Please answer them. They concern basic debates in finance today. If you do not like a particular question, or do not have a view on it, just leave it blank. Remember: I am asking for your personal view, not whether a null hypothesis can be rejected with 95% probability!

I permit publication of my name as one in many in list of participants on the following questions: ◉ yes ○ no
(Unlike answers to the above questions, for which I requested permission to identify the respondent, the answers to the questions below will be strictly anonymous and confidential.)

	Question	Strongly Agree	Agree	Middle	Disagree	Strongly Disagree	No View
1	I believe that the true stock-market index's 3-5-year return autocorrelations are zero (random walk [ala Richardson, choose agree]), rather than negative (ala Fama-French, Shiller, choose disagree).	○	○	○	○	○	○
2	I believe that the CAPM is good enough an approximation of reality as to deserve use in capital budgeting contexts.	○	○	○	○	○	○
3	I believe that size/book-market/ price-earnings/momentum power can explain cross-sectional returns primarily because they are **risk** factors (in the Fama-French sense) and not just firm **characteristics** (in the Daniel-Titman sense).	○	○	○	○	○	○
4	I believe that size/book-market/ price-earnings/momentum factors are **stationary** enough, so that they will work well in the future in explaining cross-sectional expected return differences.	○	○	○	○	○	○
5	I believe that, by and large, public securities market prices are efficient.	○	○	○	○	○	○
6	I believe that, by and large, public securities market prices offer arbitrage opportunities.	○	○	○	○	○	○
7	I believe that, by and large, government regulation and intervention of public securities markets should be increased. (Please select **middle** if intervention should be held steady, and **strongly disagree** if intervention should be decreased.)	○	○	○	○	○	○
8	I believe that Fortune-500 U.S. corporations, by-and-large, have too little debt in their capital structure.	○	○	○	○	○	○
9	I believe that Fortune-500 U.S. corporations, by-and-large, should use share repurchases instead of dividends as payout means.	○	○	○	○	○	○

Identification

Date (Fill in only if printed, not if filled out via WWW)		
Your Email Address:		
Your Name:		
Professional Status:	○ Professor ○ PhD Student ○ MBA Student	○ PhD Graduate ○ MBA Graduate ○ Other ;
Area	○ Finance ○ Accounting	○ Economics ○ Other ;
Primary specialization:	○ Asset-Pricing - Empirical ○ Asset-Pricing - Theory ○ Asset-Pricing - Both ○ Asset-Pricing - Derivatives ○ Asset-Pricing - Fixed Income	○ Corporate Finance ○ Market Microstructure ○ Other Empirical ○ Other Theoretical ○ Other

Feel free to comment, but please note that you should instead send me email about this survey if you think I have made a mistake (or that I could do the survey better). I will not see these comments until I tabulate the surveys.

Submit Survey Answers | Reset Survey Answers

Please do not forget to check your own WWW and email entries in the directory:
http://linux.agsm.ucla.edu/dir/ (or to look up anyone of your choice).
For feedback about this website, please send email to ivo.welch@anderson.ucla.edu. To get back to the home page, click homepage.

Appendix C

The Second Survey

Ivo Welch, UCLA
January 1999

[The intent of this survey is to gauge consensus estimates of the equity premium from academic and academically oriented finance and economics professionals, e.g., members of the AFA, WFA, AEA, or ASSA. If you have difficulties filling out this survey, please send an email to Ivo Welch.]

equity-survey

Dear Colleague:

Please take a moment to answer the 5 primary questions in this survey (and to input your email address). After you have filled out the form, please press the "submit" button at the end of the page.

The distribution of answers to this survey will be published in an academic paper, possibly in the Journal of Finance. Your identity will be strictly confidential, i.e., it will not be released or published anywhere, much less jointly with your estimates.

The following 5 questions revolve around 30-year forecasts of the equity premium and the stock market. For your convenience, equivalent historical averages, published by Ibbotson, for the 1926-1997 period are in the right-most column of the table. Please enter percentages without "%". PLEASE send email if you encounter difficulties.

	Please Fill In	Requested (30 year forecast)	Long Definition all over the next 30 years	Historical Ibbotson
1	____ % per-annum	**Stock Market** (S&P) *Arithmetic* Per-Annum Rate of Return, Nominal	*Your* expected arithmetic per-annum return on the stock market (e.g., the S&P500) over the next 30 years. if unclear, click for mathematical definition.	13.0% *
2	____ % per-annum	**Equity Premium**, *Arithmetic* Per-Annum Average Rate	*Your* expected arithmetic per-annum average return over the next 30 years on: the stock market (S&P500) return minus the arithmetic per-annum average return on rolled-over 30-day T-bills. if unclear, click for mathematical definition.	9.2% *
3	____ % per-annum	Equity Premium, **Geometric** Per-Annum Average Rate	*Your* expected *geometric* per-annum average return over the next 30 years on: the stock market (S&P500) return net of the *geometric* per-annum average return on rolled-over 30-day T-bills. if unclear, click for mathematical definition.	6.9% *
4	____ % per-annum	Other Economists' Forecasts of Equity Premium, Arithmetic Average, 30 Years	What do you think will be the average answer of other economists to this survey's Question 2?	
5	○ Decrease it very slightly (neg feedback) ○ Not even the slightest epsilon change ○ Increase it very slightly (pos feedback)		◉ Presume that the stock market closed up much higher today, while interest rates remained constant. On the margin, how would today's positive stock market return influence your forecast of the 30-year arithmetic equity premium tomorrow?	

Identity Information

The identity information on this page will be held strictly confidential.

Background ◉	○ Finance/Econ Professor ○ Other Professor ○ Finance/Econ PhD or PhD Student ○ Other
Please fill in your email address:	
Please fill in the date:	used to infer current stock price level
How much time did you spend on this survey?	
Was this survey clear? ◉	Very Clear 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ Not Clear at All

◉ This is my first submission to this survey.
○ This is an update of my earlier submission, indicating how my views have changed.
○ This entry supersedes an earlier erroneous entry.

○ I would likely participate in a future survey.
◉ I would not object to receiving a very short email request for a future survey.
○ I would never participate in such a survey again. Please do not email me any such requests.

After the results of this survey will have been written up in a working paper, and posted on the WWW.

◉ Don't bother sending me a copy---I already have too many papers on my desk.
○ I would like to receive a short email alert with the URL pointing to the paper.
○ I would like to receive a printed copy of the paper by U.S. mail.
Postal Address:

Optional Questions

Please answer any of the following 10 questions, omit what you do not want to answer, then press the submit button below:

	Please Fill In	Requested	Long Definition
6	____% per-annum to ____% per-annum	95% Confidence Range for Your *Arithmetic* Equity Premium Forecast, **30-Years** (Q2)	*Your* 95% confidence interval around *your* 30-year arithmetic equity premium per-annum rate forecast (i.e., your answer to Question 2). if unclear, click for mathematical definition.
7	○ Same ○ Different	◉ Would your answer to question 2 (your equity premium forecast) be the same if the time frame was 1, 5, 10, or 100 years, instead of 30 years? (If different, please fill in differing choices below in questions 8 through 11.)	
8	____% per-annum	Equity Premium, Arithmetic Mean, **1 Year**	*Your* expected forecast of the arithmetic equity premium over the next 1 year. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
9	____% per-annum	Equity Premium, Arithmetic Mean, **5 Years**	*Your* expected forecast of the arithmetic equity premium over the next 5 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
10	____% per-annum	Equity Premium, Arithmetic Mean, **10 Years**	*Your* expected forecast of the arithmetic equity premium over the next 10 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
11	____% per-annum	Equity Premium, Arithmetic Mean, **100 Years**	*Your* expected forecast of the arithmetic equity premium over the next 100 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
12	• ○ The equity market is essentially a random walk. • ○ There may or may not be mean reversion in equity premia, but the statistical significance thereof is so low that these changing means have almost no influence on my asset allocation decision. • ○ The term structure of (my expected) equity premia has (or should have) a significant influence on my asset allocation decisions. • ◉ No Answer.		
13	○ Above Average ○ About The Same ○ Below Average	◉ How do you consider your ability to forecast the equity premium, relative to the average finance professor?	
14	○ Yes ○ No	◉ Have you published on the subjects of this survey (the equity premium or aggregate stock returns)?	
15	____% per-annum	30-Year Inflation, Expected Arithmetic Average	The arithmetic average of the annual CPI inflation rates over the next 30 years. (The historical average from 1926 to 1997 was 2.5%.) if unclear, click for mathematical definition.

Submit Survey Answers | Reset Survey Answers

Your help is highly appreciated.

* Ibbotson data are computed from 1926 to 1997 means, and provided only for calibration purposes---these numbers clarify comparables to finance professors familiar with the basic series. They are not guaranteed to be correct---please contact Ibbotson Associates for definite and up-to-date numbers.

Mathematical Definitions of Requested Expectations

Question 1: Stock Market Return, Nominal, Arithmetic Average, 30 Year Horizon

Your expectation for the arithmetic stock market return (ASMR):

$$\mathrm{ASMR}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} \mathrm{mr}_y,$$

where mr_y is the (unknown) one-year stock market return in y years. (Note also that all stock market related questions do not request the performance of stocks as constituted in the current S&P index, but the performance of stocks in the then-prevailing S&P in the future.) click here for more details on requested time frame.

Question 2: Equity Premium, Arithmetic Average, 30 Year Horizon

Your expectation for the arithmetic equity premium (AEQP):

$$\mathrm{AEQP}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} (\mathrm{mr}_y - \mathrm{tbr}_y),$$

where mr_y is the (unknown) one-year stock market return in y years, and tbr_y is the (unknown) one-year return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Question 3: Equity Premium, Geometric Average, 30 Year Horizon

Your expectation for the **geometric** equity premium (GEQP):

$$\mathrm{GEQP}(30) = \frac{\mathrm{GSMR}(30)}{\mathrm{GTBR}(30)},$$

$$\mathrm{GSMR}(P) = \sqrt[P]{\prod_{y=1}^{P}(1+\mathrm{mr}_y)} \qquad \mathrm{GTBR}(P) = \sqrt[P]{\prod_{y=1}^{P}(1+\mathrm{tbr}_y)}$$

where mr_y is the (unknown) one-year stock market return in y years, and tbr_y is the (unknown) one-year return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Questions 7-10: Equity Premium, Arithmetic Average, Different Horizons

Your expectation for

$$\mathrm{AEQP}(P) = \left(\frac{1}{P}\right) \cdot \sum_{y=1}^{P} (\mathrm{mr}_y - \mathrm{tbr}_y),$$

where P=1 in question 7, P=5 in question 8, P=10 in question 9, and P=100 in question 10. As above, mr_y is the (unknown) annual stock market return in y years, and tbr_y is the (unknown) annual return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Question 13: 30-Year Inflation, Arithmetic Average

Your expectation for

$$\mathrm{AIR}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} i_y,$$

where i_y is the (unknown) annual inflation rate "in y years." click here for more details on requested time frame.

Timing Details

The 30-year questions ask you for your forecasts from tomorrow through 30 years after tomorrow. Thus, if you answered this questionaire on 12/31/1998, the 30-year questions asks you for annualized forecasts using returns from 1/1/1999 to 12/31/2028--i.e., from 1999 (inclusive) through 2028 (inclusive). Note also that *within* each year, the returns are compounded (not averaged), even if the requested average is arithmetic.

Similarly, if you answered this questionaire on Dec 31, 1998, the 1-year forecast question 7 asks you for your forecast for 1999, and the 100-year forecast question 10 asks you for your forecast from 1999 (inclusive) through 2028 (inclusive).

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MDU-003

Regarding: Direct Testimony of John Wilson
Witness: John W. Wilson

Please provide electronic files in Excel format, with formulas intact for Exhibit Nos. JWW-7 and JWW-8.

RESPONSE:

See attachments provided in Response to PSC-073.

MDU-004

Regarding: Direct Testimony of Albert Clark
Witness: Clark

a. Referring to Exhibit No.___ (AEC-2), pages 1 through 3; Miscellaneous Revenues, Column (B) includes a reduction to Taxes Other Than Income. Please confirm that amount should not have been included and is a duplicate of the adjustment provided in the next column, MCC/MPSC Tax Rates.

b. Referring to Exhibit No.___ (AEC-2), pages 1 through 3; Decommissioning Expense, Column (H), provides a decrease to expense but does not have an associated increase in income taxes, current or deferred. Please provide the adjustment which included the associated tax impact or explain why no tax impact would be required.

c. Referring to Exhibit No.___(AEC-2), pages 1 through 3, Post Test Year Plant Related, Column (AA), please explain the reduction in deferred tax and provide support for the associated revenue or expense adjustment. If it is related to depreciation expense on current year additions, explain why the tax impact would not have been properly reflected in the Depreciation Expense, Column (R).

RESPONSE:

a. Confirmed.

b. The formula that calculates the income tax impact should have included the cell which contains the adjustment to decommissioning expense. The income tax impact is 39.875% of the adjustment to decommissioning expense.

c. The adjustment to deferred income taxes is calculated in Exhibit No.___(AEC-2), page 25 of 29. The adjustment is not related to depreciation expense – all adjustments to depreciation expense are included in Column (R). The adjustment to taxes other than income taxes is for reduced property taxes and is calculated in Exhibit No.___(AEC-2), page 26 of 29.

MDU-005

Regarding: Direct Testimony of Albert Clark
Witness: Clark

To the extent the items in MDU-004 change the revenue requirement provided in Exhibit No.___(AEC-1), provide an updated Exhibit in its entirety.

RESPONSE:

See attached Exhibit AEC-1 Updated.

Attachment

Data Response – MDU-005

D2015.6.51

Montana-Dakota Utilities

December 18, 2015

MONTANA-DAKOTA UTILITIES, CO.
INCOME STATEMENT
ELECTRIC UTILITY - MONTANA
TWELVE MONTHS ENDED DECEMBER 31, 2009
PRO FORMA

	Per Books	Company Pro Forma Adjustments	Pro Forma Per Company	MCC Pro Forma Adjustments	Pro Forma Per MCC
	(A)	(B)	(C)	(D)	(E)
Operating Revenues					
Sales	$55,454,440	$150,374	$55,604,814	$0	$55,604,814
Sales for Resale	232,169	(232,169)	0	0	0
Other	2,506,951	(284,667)	2,222,284	10,760	2,233,044
Total Revenues	58,193,560	(366,462)	57,827,098	10,760	57,837,858
Operating Expenses					
Operation and Maintenance					
Fuel and purchased power	22,311,650	(1,803,587)	20,508,063	$0	20,508,063
Other O&M	15,814,581	3,447,455	19,262,036	(1,855,576)	17,406,460
Total O&M	38,126,231	1,643,868	39,770,099	(1,855,576)	37,914,523
Depreciation and amortization	6,901,084	4,608,077	11,509,161	(2,856,764)	8,652,397
Taxes Other Than Income	4,080,303	617,219	4,697,522	(245,723)	4,451,799
Current Income Taxes	(4,064,984)	(13,304,337)	(17,369,321)	1,114,584	(16,254,737)
Deferred Income Taxes	5,966,982	7,080,844	13,047,826	719,719	13,767,545
Total Expenses	51,009,616	645,671	51,655,287	(3,123,760)	48,531,527
Operating Income	$7,183,944	($1,012,133)	$6,171,811	$3,134,520	$9,306,331
Average Rate Base	$87,013,106	$87,944,242	$174,957,348	($1,828,247)	$173,129,101
Rate of Return	8.256%		3.528%		5.375%

MONTANA-DAKOTA UTILITIES, CO.
AVERAGE RATE BASE
ELECTRIC UTILITY - MONTANA
TWELVE MONTHS ENDED DECEMBER 31, 2014
PRO FORMA

	Actual Average	Company Pro Forma Adjustments	Pro Forma Per Company	MCC Prof Froma Adjustments	Pro Forma Per MCC
	(A)	(B)	(C)	(D)	(E)
Electric Plant in Service	$236,462,751	$104,374,441	$340,837,192	-$3,335,703	$337,501,490
Accumulated Reserve for Depreciation	123,710,867	8,209,219	131,920,086	-1,583,609	130,336,477
Net Electric Plant in Service	112,751,884	96,165,222	208,917,106	(1,752,094)	207,165,013
CWIP in Service Pending Reclassification	0		0		0
Total Electric Plant in Service	112,751,884	96,165,222	208,917,106	(1,752,094)	207,165,013
Additions					
Materials and Supplies	2,956,360	(59,974)	2,896,386	424,558	3,320,944
Cash working capital requirement	0	0	0		0
Fuel stocks	1,258,391	(51,222)	1,207,169	61,661	1,268,830
Prepayments	40,434	120,008	160,442	13,524	173,966
Unamortized loss on debt	893,137	(98,461)	794,676		794,676
Decommissioning of retired plants	(121,716)	16,984	(104,732)		(104,732)
Prov. For pensions & benefits	3,382,275	491,293	3,873,568		3,873,568
Prov. For injuries & benefits	10,876	50,168	61,044	-22,710	38,334
Total Additions	8,419,757	468,796	8,888,553	477,033	9,365,586
Total Before Deductions	$121,171,641	$96,634,018	$217,805,659	($1,275,060)	$216,530,599
Deductions					
Accumulated deferred income taxes	32,840,906	9,148,165	41,989,071	553,187	42,542,258
Accumulated ITCs	0	0	0	0	0
Personal injury & property damage	0	0	0		0
Customer Advances	1,317,629	(458,389)	859,240	0	859,240
Total Deductions	34,158,535	8,689,776	42,848,311	553,187	43,401,498
Total Rate Base	$87,013,106	$87,944,242	$174,957,348	($1,828,247)	$173,129,101

MONTANA-DAKOTA UTILITIES, CO.
PROJECTED OPERATING INCOME AND RATE OF RETURN
REFLECTING ADDITIONAL REVENUE REQUIREMENTS
ELECTRIC UTILITY - MONTANA

	Before Additional Revenue Requirements 1/	**Additional Revenue Requirements**	Reflecting Additional Revenue Requirements
Operating Revenues			
Sales	$55,604,814	**$4,210,077**	$59,814,891
Sales for Resale	0		0
Other	2,233,044		2,233,044
Total Revenues	57,837,858	4,210,077	62,047,935
Operating Expenses			
Operation and Maintenance			
Cost of Fuel and Purchased Power	20,508,063		20,508,063
Other O&M	17,406,460		17,406,460
Total O&M	37,914,523		37,914,523
Depreciation	8,652,397		8,652,397
Taxes Other Than Income	4,451,799	12,209	4,464,008
Current Income Taxes	(16,254,737)	1,653,435	(14,601,301)
Deferred Income Taxes	13,767,545		13,767,545
Total Expenses	48,531,527	1,665,645	50,197,171
Operating Income	$9,306,331	$2,544,433	$11,850,764
Rate Base	$173,129,101		$173,129,101
Rate of Return	**5.375%**		**6.845%**

1/ See Page 1.

MDU-006

Regarding: Direct Testimony of Jacob Pous
Witness: Pous

Please provide electronic files in Excel format, with formulas intact supporting for Exhibit No. JP-1.

RESPONSE:

See attached CD for Exhibit JP-1.