income return The capital appreciation component of the large-cap stock total return is the change in the S&P 500 index as reported by S&P Dow Jones Indices from March 1928 to December 2017, and in Standard & Poor's *Trade and Securities Statistics* from January 1926 to February 1928. From February 1970 to December 2017, the income return was calculated as the difference between the total return and the capital appreciation return. From January 1926 to January 1970, quarterly dividends were extracted from rolling yearly dividends reported quarterly in S&P's *Trade and Securities Statistics*, then allocated to months within each quarter using proportions taken from the 1974 actual distribution of monthly dividends within quarters.

[7] "Small Stock" in this context refers to a specific data series created by Ibbotson Associates to represent smaller market capitalization (i.e., small-cap) stocks. "Small-cap" stocks can be represented in a variety of ways, including the aforementioned Ibbotson Associates "small stock" series, or the CRSP 10th decile (as is done later in this article).

[8] The small stock premium is calculated arithmetically here. Arithmetic calculation of premia is typically done when developing forward-looking long-term inputs for MVO analyses, wealth forecasting, or discount rates. The small stock premium can also be calculated on a geometric basis as (1+Small Stock Total Return) ÷ (1+Large Stock Total Return) –1. See: *2018 Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook*, Chapter 4, "Description of the Derived Series", page 4-2. To learn more about or purchase the *Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook,* visit: duffandphelps.onfastspring.com/books.

[9] Small-cap companies do not always outperform large-cap companies. However, as the holding period is increased, small-cap companies tend to outperform large-cap companies to an increasingly greater degree. In other words, the *longer* small-cap companies are given to "race" against large-cap companies, the greater the chance that small-cap companies outpace their larger counterparts. For a detailed discussion of this concept, see the Cost of Capital Navigator "Resources" section, *2018 Valuation Handbook—U.S. Guide to Cost of Capital*, Chapter 4, "Basic Building Blocks of the Cost of Equity Capital – Size Premium". Duff & Phelps © 2018. Available at dpcostofcapital.com.

[10] The result of this calculation can vary dependent on the series selected to represent large-cap and small-cap stocks. For example, later in this article a small stock premium is calculated over the same time horizon (1926–2017) using the same measure of large-cap stocks (the S&P 500 total

return index), but a different measure of small-cap stocks (the CRSP 10th decile). The result of that calculation yields a result of 8.13% (see section entitled "Calculating a Small Stock Premium (i.e., a Non-Beta-Adjusted Size Premium) Using CRSP Decile 10".

[11] "Premia" is the plural of "premium".

[12] For a detailed discussion of the CRSP Size Premia Study, and the Risk Premium Report Study, see the Cost of Capital Navigator "Resources" section, *2018 Valuation Handbook—U.S. Guide to Cost of Capital*, Chapter 7, "The CRSP Decile Studies and the Risk Premium Report Studies—A Comparison". Duff & Phelps © 2018. Available at dpcostofcapital.com.

[13] Finance professionals use the term equity risk premium interchangeably with market risk premium (MRP, or RP_m) and equity market risk premium (EMRP).

[14] The Center for Research in Securities Prices (CRSP) constructs 10 market-capitalization-weighted deciles that are then sorted by market cap. CRSP decile 1 is comprised of the largest companies, and CRSP decile 10 is comprised of the smallest companies. The CRSP deciles are comprised of publicly traded U.S. companies from the NYSE, the NYSE MKT, and the NASDAQ exchanges. To learn more about CRSP, visit www.CRSP.com. The CRSP standard market-capitalization-weighted deciles were used to calculate size premia in Ibbotson Associates/Morningstar *SBBI® Valuation Yearbook* (1999–2013), the Duff & Phelps *Valuation Handbook—U.S. Guide to Cost of Capital* (2014–2017), and now in the online Cost of Capital Navigator (2018 and subsequent years) at dpcostofcapital.com.

[15] Difference due to rounding. Using two decimals of precision (as shown here), the result is 9.83% (1.39 x 7.07%). However, using full precision (i.e., all decimals), this result is 9.84%. We note this because "9.84%" is the actual value used as of December 31, 2017 in these calculations as published in the Cost of Capital Navigator at dpcostofcapital.com.

[16] Difference due to rounding. Using two decimals of precision (as shown here), the difference is 5.36% (15.20% – 9.84%). However, using full precision (i.e., all decimals), the difference is 5.37%. We note this because "5.37%" is the actual size premia calculated for CRSP Decile 10 as of December 31, 2017, as published in the Cost of Capital Navigator at dpcostofcapital.com.

[17] See: Roger J. Grabowski (*2018*) The Size Effect Continues to Be Relevant When Estimating the Cost of Capital. *Business Valuation Review: Fall 2018*, Vol. 37, No. 3, pp. 93-109. See also: Roger G. Ibbotson and Daniel Y.-J. Kim, "Risk and Return within the Stock Market: What Works Best?" working paper, January 8, 2016. Available at www.zebracapital.com.

[18] The *SBBI® Yearbook* has been published for over 30 years. The *SBBI® Yearbook* does not provide extensive valuation data or methodology. The *SBBI® "Classic" Yearbook* was published by Morningstar, Inc. from 2007 through 2015, and by Ibbotson Associates in years prior to 2007. Starting with the 2016 edition, the *Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook* has been produced by Duff & Phelps (the word "Classic" was dropped from the book's title). To learn more about or purchase the *Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook,* visit: duffandphelps.onfastspring.com/books.

[19] Our previous discussion of the small stock premium was in the context of the traditional way this statistic has been calculated in the *Stocks, Bonds, Bills, and Inflation (SBBI) "Classic" Yearbook*, and so the Ibbotson Associates Small Company Stock total return index was used as the proxy for small-cap stocks for that calculation, as is done in that book. In this section, however, we are discussing the small stock premium and beta-adjusted size premia in the context of the CRSP deciles, and so a different proxy for small stocks is necessarily being used (CRSP decile 10).

[20] An equivalent calculation can be accomplished using any of the ten CRSP deciles; for the examples in this section we will develop a small stock premium for CRSP decile 10 to facilitate easy comparison to our earlier development of a beta-adjusted size premium for CRSP decile 10.

[21] Roger, G. Ibbotson, *1995 Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook* (Ibbotson Associates, 1995), Chapter 8, "Estimating the Cost of Capital or Discount Rate", page 155.

Roger G. Ibbotson is Professor in the Practice Emeritus of Finance at Yale School of Management. He is also chairman and CIO of Zebra Capital Management, LLC, an equity investment and hedge fund manager. He is founder, advisor and former chairman of Ibbotson Associates, now a Morningstar Company. He has written numerous books and articles including Stocks Bonds Bills and Inflation with Rex Sinquefield (updated annually) which serves as a standard reference for information and capital market returns.

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METHODOLOGY FOR ESTIMATES

A GUIDE TO UNDERSTANDING THOMSON REUTERS METHODOLOGIES, TERMS AND POLICIES FOR THE FIRST CALL AND I/B/E/S ESTIMATES DATABASES

OCTOBER 2009

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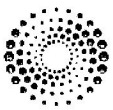

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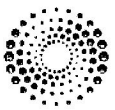

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INTRODUCTION

About Thomson Reuters

Thomson Reuters is the most complete source for integrated information and technology applications in the global financial services industry. Working in partnership with our clients, we develop individual workflow solutions that answer their specific data and analysis needs. Among those needs, clients would like insight on future earning prospects of publicly traded companies. As a result, Thomson Reuters tracks the reported and forecast earnings of these firms globally. *Earnings Per Share* is a key metric, and one most commonly utilized in two ways: to measure performance gains and to gauge companies' results versus expectations.

About This Document

This document provides an in depth look at the methodologies Thomson Reuters uses for estimates. The purpose of this document is to outline, describe and provide reference for the different policies that affect Thomson Reuters estimates data.

ACCOUNTING REGULATIONS

International Financial Reporting Standards (IFRS)

The European Union has passed a regulation that requires listed European companies to comply with International Financial Reporting Standards (IFRS) in 2005 for their consolidated financial statements. There is a limited exception for certain companies to delay implementation until 2007. Generally, the regulation applies to consolidated financial statements for accounting periods starting on or after January 1, 2005. Thus for those companies with 12-month accounting periods covering the calendar year, IFRS will first apply to periods ending on December 31, 2005. As a result, companies will first publish IFRS financial information as at March 31, 2005 (if they report quarterly) or as at June 30, 2005 (if they report semi-annually).

Estimates collected by Thomson Reuters will reflect the adoption of this ruling on a majority basis. The transition period to IFRS is visible for companies in Europe effective April 25, 2005. In addition to countries in Europe, IFRS will be adopted by parts of Asia, including Australia and New Zealand. The transition period to IFRS is visible for companies in Australia and New Zealand effective September 12, 2005.

Dedicated company level footnotes are used to label the majority accounting basis for the company, as well as estimate level footnotes to label and exclude minority accounting basis estimates.

Instrument Level Footnote Code (Majority)	Footnote Text
3	Earnings on a fully adjusted basis
4	Accounting differences exist: Estimate on a Fully-Reported/GAAP basis
W	Estimates based on IFRS

Estimate Level Footnote Code (Minority)	Footnote Text
3	Earnings on a fully adjusted basis
4	Earnings on a fully reported basis
W	Estimates based on IFRS

FAS123(R)

On December 16, 2004, The Financial Accounting Standards Board (FASB) issued FAS123(R). This ruling requires companies to calculate the fair value of stock options granted to employees, and amortize that amount over the vesting period as an expense through the income statement. FAS123(R) is currently effective for fiscal years beginning after June 15, 2005, with company transition choices of: modified prospective, modified retrospective or early adoption. The effective date of the ruling was then extended from quarterly to annual periods beginning after June 15, 2005.

Thomson Reuters will treat the expensing of stock options on a company-by-company basis. Stock option expenses will only be included in the primary EPS mean when the majority of the contributing analysts have included the expenses in their estimates. Estimates will be footnoted describing whether estimates include or exclude the options expense. Once the majority of the analysts are including stock option expenses in their estimates, the remaining estimates that do not include the expenses will be footnoted, filtered, and excluded from the primary EPS mean calculation. In the event that a contributing analyst provides two sets of EPS estimates for a given company (one including options expenses and one excluding), the majority basis estimate will appear under the EPS field and the alternative estimate will appear under the EPX field.

The GAAP EPS measure (GPS) will however, include option expenses per FAS123(R) for periods where GAAP requires the inclusion of option expenses in reported results, and when the impact is known. When available, estimates from contributing analysts on a GAAP basis appear under the GPS measure.

For periods where GAAP requires the inclusion of stock options expense, estimates excluding stock options expense will be filtered and footnoted once the impact of stock options expense is known for that period, as determined by any of the following:

- company issued guidance,
- a quarterly report,
- the presence of a GAAP estimate including options expense from a single contributor.

For example, if 10 brokers provide a GPS estimate that excludes stock options expense, but 1 broker provides an estimate that includes stock options expense for a period where GAAP requires inclusion, the 10 brokers excluding options will be filtered and footnoted and the 1 broker will remain unfiltered and comprise the GPS mean.

Dedicated company level footnotes are used to label the majority accounting basis for the company, as well as estimate level footnotes to label and exclude minority accounting basis estimates.

Company Level Footnote Code (Majority)	Footnote Text
E	Estimates reflect adoption of FAS123(R)
F	Estimates do not reflect adoption of FAS123(R)
I	Estimates have always reflected adoption of FAS123(R)
N	No known impact from FAS123(R) on estimates

Estimate Level Footnote Code (Minority)	Footnote Text
5	Estimate includes stock option expenses
6	Estimate excludes stock option expenses

FASB APB 14-1

On May 9, 2008 The Financial Accounting Standards Board (FASB) issued FASB APB 14-1. This ruling requires companies to change how they account for convertible debt in their financial statements - specifically, debt that can be converted into cash. Companies will be required to amortize the excess of the principal amount of the liability component over its carrying amount. This will result in higher interest costs. The effective date of the change will be the first fiscal year that begins after December 15, 2008, and will impact 2009 fiscal year estimates for most companies. For US traded companies carrying this type of debt, GAAP earnings will be negatively affected starting with 2009.

Thomson Reuters will treat estimates impacted by FASB Staff Position APB 14-1 on a company-by-company basis. Post-FASB APB 14-1 estimates will only be included in the EPS mean when the majority of the contributing analysts have adopted this accounting change in their estimates. Estimates will be footnoted describing whether estimates reflect or do not reflect the accounting change. Once the majority of analysts reflect FASB APB 14-1 in their estimates, the remaining estimates that do not include the expenses will be footnoted, filtered, and excluded from the EPS mean calculation.

The GAAP EPS (Fully Reported) measure will be post FASB APB 14-1 for periods where GAAP requires the amortization of cash-convertible debt in reported results and when the impact is known. When available, estimates from contributing analysts on a GAAP basis appear under the GAAP EPS measure on Thomson Reuters products.

Dedicated company level footnotes are used to label the majority accounting basis for the company, as well as estimate level footnotes to label and exclude minority accounting basis estimates.

Company Level Footnote Code (Majority)	Footnote Text
8	Estimates reflect FASB APB 14-1
9	Estimates do not reflect FASB APB 14-1

Estimate Level Footnote Code (Minority)	Footnote Text
8	Estimate reflects FASB APB 14-1
9	Estimate does not reflect FASB APB 14-1

ACTUALS

Evaluation

Thomson Reuters Market Specialists enter both quarterly period and annual actuals where analyst estimates exist on a real-time global basis - as sourced from multiple newswire feeds, press releases, company websites and public filings. When a company reports their earnings, the data is evaluated by a Market Specialist to determine if any Extraordinary or Non-Extraordinary Items (charges or gains) have been recorded by the company during the period. If no items have been recorded during the period the reported value is entered. If one or more items have been recorded during the period, actuals will be entered based upon the estimates majority basis at the time of reporting. The Market Specialist will still review each item in relation to the estimate submissions and how similar items have been treated in past periods. If after review it is determined that majority basis is to be changed, Thomson Reuters will update the actual and corresponding surprise values accordingly.

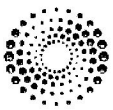
Certain differences exist across regions pertaining to prioritization, coverage, and timeliness. Companies in Asia-Pacific, North America and Latin America are updated the same day of reporting. In the EMEA region, Tier1 companies (445 companies including FTSE 100 and other major indices) are also updated the same-day of reporting, with the Tier 2 companies updated within 15 days.

Please note that Thomson Reuters collects actuals only for periods and measures where current analyst estimates exist.

Majority Basis

Thomson Reuters goal is to present actuals on an operating basis, whereby a corporation's reported earnings are adjusted to reflect the basis that the majority of contributors use to value the stock. In many cases, the reported figure contains unusual or one-time items that the majority of analysts exclude from their actuals. The majority accounting basis is determined on a quarter-by-quarter basis. Typical adjustments are for the effects of extraordinary and non-extraordinary items.

Thomson Reuters examines each reported item, and includes or excludes the item from the actual based on how the majority of contributing analysts treat the item for that period. Once the Thomson Reuters Market Specialist determines



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whether the item is being included or excluded by the majority of contributors, they will enter the actual and a footnote detailing the type of the item, whether it is included or excluded, the size of the item, and the period affected.

If after the comparable actual for the period is saved for a company and a go-forward majority is established on a different accounting basis, that actual will be replaced to reflect the change and footnoted to indicate the majority basis change. The announce and activation dates of the original comparable actual will remain.

Any submission of an estimate by a contributing analyst using a non majority actual or on a non majority basis results in a call from a Thomson Reuters Market Specialist requiring the contributing analyst to adjust to the majority basis or have their estimates footnoted for an accounting difference and excluded from the mean calculation for the fiscal years in question. In all cases, appropriate footnotes are added to the estimate to denote what items are included or excluded. In some cases, a company's actuals number will be temporarily withheld so that analysts may be contacted and additional research conducted.

Elimination of Held-Out Actuals Practice (September 2009)

Thomson Reuters made changes to the collection of actuals to provide increased data timeliness. As companies report, values will be adjusted to the estimates majority basis for the period, then entered into the database without a "hold out" period.

- Previously, when a company reported results, actuals were collected according to the estimates majority basis for the period at the time of report. If however, unexpected charges or gains were reported, actuals would temporarily be "held out" from products to see if the majority basis would change going forward.
    - This process introduced possible timeliness issues whilst the sell-side analyst community reacted to the company news and issued reports, and subsequently Thomson Reuters re-evaluated the majority basis.
- Going forward, this "hold out" period will be eliminated in cases where unexpected charges or gains are reported. Actuals will be entered strictly based upon the estimates majority basis at the time of report – significantly increasing timeliness of actuals under these scenarios.
    - The review of analyst reaction will still be done by Thomson Reuters, however only after the actual was already saved to the database and available on products.
    - If the analyst majority basis changes after the fact, Thomson Reuters will update the actual and corresponding surprise values accordingly, and footnote the reason.

BASIC VS. DILUTED ESTIMATES

Dilution occurs when a company issues securities that are convertible into common equity. Such issues can take the form of convertible bonds, rights, warrants or other instruments. When Thomson Reuters refers to "fully diluted" earnings estimates it means that the forecasts assume that all eligible shares are converted. Fully diluted earnings per share are, by definition, less than basic EPS (which is based solely on common shares outstanding).

- To be an eligible convertible security, the contributing analyst must predict that the share price will be greater than the strike price.

- If the contributing analyst predicts that the convertible security will be eligible, the convertible shares are included in the analyst's share count, and the interest expense associated with the conversion is included in their EPS estimate. If the contributing analyst does not predict the convertible security will be eligible, the share count does not include the convertible shares, and there is no interest expense associated with the convertible. (Interest expense is associated with the conversion and this scenario has no conversion.)

Thomson Reuters determines whether a company is followed on basic versus diluted shares based on the majority rule. If a contributor is on the minority basis, the estimate is filtered, footnoted and excluded from the mean calculation using the estimate level footnotes listed below.

Estimate Level Footnote Code (Minority)	Footnote Text
B	Accounting differences exist: Estimate on a basic share count basis
E	Accounting differences exist: Estimate on a diluted share count basis

North America

Thomson Reuters defaults to using diluted shares in North America, as this is the most widely used valuation method. Estimates are displayed on a diluted basis taking into account all eligible convertible securities. The only circumstances where basic shares would be the default for a company would be when a company reports a loss, as basic is the more conservative valuation method.

International

For international companies, Thomson Reuters determines whether a company is followed on basic vs. diluted shares based on the majority rule, due to the high amount of variance in which companies are followed. In cases where an analyst follows a company on a basis that is different from the mean, filters/footnotes are applied to their estimates, which are then excluded from the mean calculation.

CORPORATE ACTIONS

Corporate actions are defined as any event which can bring material change to a stock, which include the following:

- Mergers
- Acquisitions
- Spin-offs
- Stock splits

Thomson Reuters obtains information on corporate actions via real-time news feeds as well as information received directly from companies. Thomson Reuters Market Specialists then process corporate actions on a real-time basis. Thomson Reuters Market Specialists verify the corporate action announcement by using original press releases from companies. Corporate action announcements are then footnoted in the appropriate tables (see examples below):

Estimate Level Footnote Code (Minority)	Footnote Text
L	Accounting differences exist: Estimate reflecting corporate action
V	Contributor update pending: Estimate not reflecting corporate action
A	Accounting Differences Exist

Example:

St. Paul Travelers Cos Inc. (ticker STA)

Corporate Action Announcement: 17-Nov-03 announced merger with Travelers Property Casualty Corp.

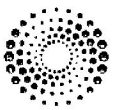
Mergers, Acquisitions and Spin Off's

Thomson Reuters will reflect estimates on the post-event basis, reflecting the completion of a merger/acquisition/spin-off, when the first of two events occur:

- The majority of analysts covering the company submit estimates on a post-event basis or;
- The event itself actually closes/completes (usually signified by a press release on or around the closure date).

When a corporate action occurs, before Thomson Reuters makes any data changes, all of the following action details are thoroughly researched:

- **All information must be confirmed,** including the action, the date, and how current and historical estimates will be treated going forward. For example, to which company estimates will be attached.
- Great importance is also placed on how the company will be treating its financial statements going forward. This research is done by using Datastream, the company's website, or by contacting the company's IR group directly.
- The corporate action is always treated in the database in accordance with the company's guidelines (who will be the surviving entity, etc.).



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Policies involved with introducing the Merger/Acquisition include:

- Footnotes will be added describing the announced merger/acquisition to all publicly traded companies involved that we have established in our database.
- All Thomson Reuters mean estimates will reflect a merger/acquisition according to how the majority of analysts covering the company treat the action. The mean will follow this majority policy up until the date the merger/acquisition closes. An additional footnote will be added to the database detailing how the mean is treating the action that will remain present until the action closes. Once the merger/acquisition is closed and finalized, the estimates must reflect the full affects of the action.
- Upon the date of closing several actions may need to be taken on the part of Thomson Reuters depending on the type of merger/acquisition that has occurred. All of the possible actions performed are to update the Thomson Reuters estimates database to reflect all effects of the closed corporate action. Below are some broader steps taken but more specific instructions are listed with each possible scenario below:
- The closing of the merger/acquisition is footnoted. All records and consensus data for surviving or newly formed companies affected by the merger/acquisition must now fully reflect the effects of the completed corporate action. This may involve company name or identifier changes of the acquiring company or the creation of a completely new entity in our database formed through a merger. It will involve making sure all estimate data included in consensus for these companies reflects the completed action. Historical estimates for the surviving company, normally the company doing the acquiring, will remain.
- If a company has been acquired or merges with another and no longer exists as a separate entity, the estimates/recommendations/price targets associated with that ticker must be stopped and the ticker end-dated upon closing of the action. Since the company will no longer exist, there will be no visible outstanding or active records on our products or database. Please note that when estimates are stopped, the user will not have a link between the former company and the newly created one. Thomson Reuters does, however, keep a record of the movement of companies in the central estimates database.

The policies Thomson Reuters follows in the case of Spin-Off/De-Merger include:

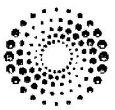
- Footnotes are added describing the announced spin-off/demerger to all publicly traded companies involved that are established in the Thomson Reuters database.
- All mean estimates will reflect a spin-off/demerger according to how the majority of analysts covering the company treat the action. The mean will follow this majority policy up until the date the spin-off/demerger closes. An additional footnote will be added to the database detailing how consensus is treating the action that will remain present until the action closes. Once the spin-off/demerger is closed and finalized, the estimates must reflect the full effects of the action.
- Upon the date of closing several actions may need to be taken on the part of Thomson Reuters depending on the type of spin-off/demerger that has occurred. All of the possible actions performed are to update the estimates database to reflect all effects of the closed corporate action. Below are some broader steps taken but more specific instructions are listed with each possible scenario below:
- The closing of the spin-off/demerger is footnoted. All records and consensus data for surviving or newly formed companies affected by the spin-off/demerger must now fully reflect the effects of the completed corporate action. This may involve the creation of a completely new entity in the estimates database formed through the spin-off/demerger. This will involve making sure that all estimate data included in consensus for these companies reflect the completed action.
- If a previously existing company will no longer exist or no longer trades publicly, all estimates, recommendations and price targets must be stopped and the ticker end-dated upon closing of the transaction.

Stock Splits & Stock Dividends

A security begins trading on a post-split or post-stock dividend basis the day after the payment date (date the declared split or dividend is paid). Thomson Reuters enters a footnote that indicates the size of the stock split or stock dividend and the effective date (the day after the payment date).

After the market closes on the day before the stock begins trading on the new basis, all estimates data in Thomson Reuters – both current and historical - will be adjusted for the new shares. If a contributing analyst submits estimates on an adjusted basis prior to the effective date or unadjusted basis after the effective date, Thomson Reuters will contact that analyst to request properly adjusted estimates.

Please note that Thomson Reuters does not make adjustment factors for corporate actions *which do not affect the number of shares.* This document describes the actions taken when a company's share count changes. This could include, but is not limited to, spin offs, mergers or cash payments / special payments.



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Example of Stock Split:

Meritage Homes Corp [MTH]

Footnote: 20-Dec-04 2 for 1 Split Effective 10-Jan-05

Thomson Reuters does not adjust estimates for cash payments. The effect of cash payments on estimates is treated as a revision by the contributing analyst. On the effective date of the cash payment, a Thomson Reuters market specialist will contact all contributing analysts to request updated figures that include the cash payment. Estimates that are not updated to reflect the cash payment are footnoted as update pending, and will be filtered from the mean until they are updated by the contributing analyst.

Example of Stock Split with Cash Payment:

United Business Media PLC [UBM]
14 for 17 share consolidation
Special cash dividend of 89p per share

Thomson Reuters will apply a split factor of 1.214 reflecting the share consolidation. It is expected that contributors will revise their models to reflect the 89p cash dividend. Contributors that do not revise their estimates to reflect the cash dividend will be footnoted as update pending and filtered from the mean estimate.

Rights Issues

Rights Issues are treated in the following manner:

- When rights issues becomes effective, like stock splits, the ex date triggers all current and historical adjustments for price, shares and earnings.
- Even before the majority of analysts switch to post rights issue estimates, estimates will be collected and displayed on products prior to the ex-date, but will be excluded from the mean with a new estimate level footnote type:

Estimate Level Footnote Code (Minority	Footnote Text
7	Accounting differences exist: Estimate reflecting rights issue prior to ex-date

- Once the ex-date occurs, footnotes of excluded estimates will be automatically end-dated and will be then added back into the mean calculation where appropriate.

CONTRIBUTOR REQUIREMENTS

In order to maintain a quality, professional standard for all contributing analysts, Thomson Reuters Contributor Relations requires a candidate to pass a strict set of guidelines before being enlisted as a contributor. A potential contributor must provide information to establish that they are a reputable firm. This process includes providing example research reports, three references from institutional clients, three references from company investor relations, detail on the number of companies covered per analyst in the firm, and background information on the director of research. Thomson Reuters currently collects and analyzes the research, ratings and forecasts from many different sell-side or independent contributors.

Please reference the Thomson Reuters Contributor Approval Policy document for further details.

CURRENCY

The default currency displayed on Thomson Reuters is generally the currency in which the company reports*. Thomson Reuters will however, accept estimates in any currency.

The following describes the treatment of non-default currency conversions on Thomson Reuters products: (Please note that product update schedules vary for currency conversions.)

- All estimates revisions received in a non-default currency are updated using the prior day's currency conversion rate.
- All non-default estimates have the currency conversion recalculated on Friday night using Friday's end of the day conversion rate.
- When a contributing analyst confirms a default currency estimate, there is no change in the raw value estimate stored in the database.
- Thomson Reuters provides normalized Summary and Detail history offerings which provide a smooth historical view for companies that have had a currency change over time and it is intended to simplify clients' workflow.

A confirmation of a non-default currency estimate however, does result in a reconverted estimate being sent to products. This estimate will represent the conversion rate as of the day prior to the confirmation.

Please note one exception: the per-share data measures of United Kingdom companies are always covered in BPN (pence) and the values for non-per share data measures are displayed in GBP (pounds). The label for all estimates, regardless of per share or non-per share measure type however are BPN.

Treatment of Currency Changes

Thomson Reuters follows companies based on their reporting currency. In some cases however, where the reporting currency does not reflect the clear majority of estimate submissions, Thomson Reuters may exercise the option to set the default based on the currency of the majority of estimate submissions. In cases where companies report in multiple currencies, Thomson Reuters will set the default currency based on the majority of estimate submissions.

Occasionally, companies will change the currency in which they report and/or the majority of analysts covering a company will change the currency of their estimates. As a result, Thomson Reuters will change the default currency of a company in order to align with the reporting company or majority of contributing analysts as part of the operational process.

Normalized Summary & Detail History (Currency)

Thomson Reuters provides normalized summary and detail history in addition to regular summary and detail history, providing a smooth historical view for companies that have had a currency change over time and it is intended to simplify clients' workflow. Whereas the regular summary and detail history offering provides a clear time series of when a company changes reporting currencies, the normalized offering will provide all historical estimates for a company in the current reporting currency of that company.

ENTITLEMENTS INFORMATION

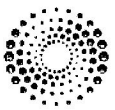
Thomson Reuters is recognized for providing the most timely and accurate estimates data available to investment professionals. This is made possible in part by an agreement with our contributing analysts which restricts the distribution of individual analyst's estimates to certain parties.

The following policy is strictly adhered to:

- Individual estimates with the associated contributor names are provided exclusively to institutional 'buy-side' investors and the research departments of the contributing analysts.
- Institutional investors are defined as users who are involved in executing trades through multiple brokerage firms.
- Investment banking, corporate finance and trading firms are not considered institutional investors as they do not have a trading relationship with any of the contributing firms and in effect, are competitors of those contributing analysts. Therefore, these firms are not privy to seeing individual analyst's earnings estimates.
- Analyst's research is considered proprietary information, unlike news articles or SEC filings. Detailed earnings estimates are also considered a part of an analyst's research and therefore proprietary in nature.

Examples of disentitlement views by product would be:

- Thomson ONE — Broker and analyst names are displayed while displaying estimate value as "PERMISSION DENIED"
- First Call — Blank records for entire entry are sent with the detail record – no broker or analyst name or estimate value are displayed.



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- I/B/E/S — Estimator and Analyst Name will be replaced by a numeric code, effectively meaning "Permission Denied" while displaying estimate value.

In order to gain access to the research reports of a broker with 'Prior Approval' status, a client need only speak with their Thomson Reuters ***Relationship Manager*** or ***Sales Representative*** directly. Thomson Reuters will contact those brokers in question and seek approval to access their reports on behalf of the client. If approved, the client will have access to view the research reports within 24-48 hours.

ESTIMATES COLLECTION

Process

Thomson Reuters gathers earnings forecasts and other data from hundreds of brokerage and independent analysts who track companies as part of their investment research work. Thomson Reuters calculates a mean consisting of estimates utilizing the same accounting standards (basis).

Majority Policy

Most institutional clients prefer to view estimates on an "operating" basis, reflecting the majority of the analysts covering a security. Consequently, Thomson Reuters follows a 'majority' policy, where the accounting basis of each company estimate is determined by the basis used by the majority of contributing analysts.

Once the majority basis has been established, contributing analysts in the minority may keep their original estimates, or are also given the opportunity to adjust to the majority basis. On rare occasions, the majority basis may be revised as additional analysts are heard from or as some change their opinion. In all cases, appropriate footnotes are added to the Thomson Reuters database stating the appropriate basis of each estimate, and if the item has been included or excluded from the mean estimate.

Adoption of Post-Event Mean (as of September 2009)

As of September 21, 2009, Thomson Reuters adopted more stringent updating rules for analyst's estimates which are not reflecting current company events, such as:

- **Issuance of Company Guidance**
  Detail estimates which have not been updated or confirmed following the issuance of guidance and do not fall within the guidance range (e.g. "$1.00 - $1.10") will be filtered / excluded from the mean at the time of guidance. In those cases where single-point guidance is issued (e.g. "about $1.00"), estimates not within 5% of the guidance will be footnoted and excluded from the mean. The aforementioned guidance filter will only apply to the specific measure and period.

  Those estimates that are excluded will be labeled with a (N) estimate level footnote. Then, excluded estimates that are updated or confirmed will have the footnote end-dated and added back into the mean calculation.

- **Actual(s) Reporting**
  Detail estimates for unreported periods which are not updated or confirmed within 10 business days of a prior-period reported actual will be excluded from the mean, based on the reporting of the EPS actual for that/their specified period(s).

  Those estimates that are excluded from the mean will be labeled with a type (P) estimate level footnote. The reported actual(s) filter will be applied to all measures and subsequent periods for that fiscal year. Then, excluded estimates that are updated or confirmed will have the footnote end-dated and added back into the mean calculation.

Estimate Level Footnote Code (Minority)	Footnote Text
N	Contributor update pending: Estimate not reflecting recent company guidance
P	Contributor update pending: Estimate not reflecting recent reported actual

Please note that all other scenarios, including corporate actions, will continue with the original policy of waiting for the full majority of analyst treatment however they will be enhanced with new descriptive footnotes, illustrated below in the Footnotes section of this document.

Extraordinary Items

Extraordinary items are defined by the accounting conventions of the Financial Accounting Standards Board. Companies are required to present extraordinary items as a separate item in their financial statements. Thomson Reuters will always exclude them from the reported figures, since the majority of contributing analysts always choose to exclude extraordinary items. Thomson Reuters uses the word "extraordinary" in the most limited sense as defined by accounting convention (some analysts have the habit of applying the word "extraordinary" to any unusual charges or gains).

The most common extraordinary items are:

- Cumulative Effect of FASB Accounting Changes
- Tax Loss Carry forwards
- Discontinued Operations
- Early Retirement of Debt

Please note that as each quarter is treated independently of each year, any exclusion from a given quarter would result in an exclusion from the annual estimate

Example:	*Q1*	*Included*
	Q2	*Excluded, minority basis*
	Q3	*Included*
	Q4	*Included*
	FY	*Excluded, due to Q2 exclusion*

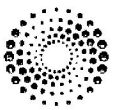
Non-Extraordinary Items

Non-extraordinary and non-operating items are charges or gains that may or may not be seen as pertinent to ongoing operations, depending on the industry and the opinion of the majority of contributing analysts. In contrast to the uniform recognition of extraordinary items, there is a great deal more variance within the analyst community concerning the treatment of non-extraordinary/non-operating items.

When submitting estimates, contributors are encouraged to include or exclude any non-extraordinary items they deem non-recurring and/or non-operating. Once a non-extraordinary or non-operating item is recognized, a Thomson Reuters Market Specialist will poll all contributor's estimates covering a particular company, to establish if the majority of them are including or excluding the event. If there is no clear majority, then the charge or gain is included in the mean. If at any point the majority basis cannot be determined, the Thomson Reuters Market Specialist will further research the affected estimates, including potentially contacting the contributing analysts, to determine the majority basis.

Examples of Non-Extraordinary items include:

- Restructuring charges - larger ones are usually excluded
- Asset sale gains or losses - larger ones are usually excluded
- Inventory adjustments - included in the majority of cases
- Currency adjustments - included in the majority of cases; always included in the Oil industry
- Realized securities gains or losses - always excluded in the Insurance industry; always included in the Banking industry
- Acquisition expenses or gains from acquisition - larger ones are usually excluded
- Litigation charges or gains from litigation
- Tax settlements or adjustments
- Write-offs



Majority Basis Footnotes

A new series of valuable company and estimate level footnotes is now available for enhanced transparency of estimate accounting basis and rationale for exclusions.

COMPANY LEVEL FOOTNOTE

Footnote Code	Footnote Text
M	Majority Basis includes/excludes… (freeform criteria utilized to define specific accounting scenario of the mean calculation)

This new company level footnote is designed for flexibility, and as such it will be edited to reflect any specific company scenario. Just a few possible examples of what this new freeform footnote will label include, but are not limited to, the following:

- Majority Basis excludes restructuring charge
- Majority Basis includes tax adjustment gain
- Majority Basis includes currency adjustment gain
- Majority Basis excludes litigation charge

ESTIMATE LEVEL FOOTNOTES

In addition to labeling a company's majority accounting basis, Thomson Reuters also introduced new estimate level footnotes to clarify the specific reasoning of why an estimate was excluded from the mean. Both the company and estimate level footnotes work in tandem in the event of a change in basis (e.g. if a company's basis changes, both sets of footnotes will be 'flipped' to account for the new majority basis).

New / Modified footnotes to be used are as follows:

Footnote Code	Footnote Text
4	Accounting differences exist: Estimate on a Fully-Reported/GAAP basis
7	Accounting differences exist: Estimate reflecting rights issue prior to ex-date
B	Accounting differences exist: Estimate on a basic share count basis
E	Accounting differences exist: Estimate on a diluted share count basis
G	Accounting differences exist: Excludes charge(s)
H	Accounting differences exist: Includes charge(s)
I	Accounting differences exist: Excludes gain(s)
J	Accounting differences exist: Includes gain(s)
L	Accounting differences exist: Estimate reflecting corporate action
M	Accounting differences exist: Estimate on a non-GAAP basis
X	Accounting differences exist: Estimate on a Cash EPS basis
N	Contributor update pending: Estimate not reflecting recent company guidance
O	Contributor update pending: Estimate failed freshness policy
P	Contributor update pending: Estimate not reflecting recent reported actual
V	Contributor update pending: Estimate not reflecting corporate action

Existing footnotes which will continue to be used where appropriate are as follows:

Footnote Code	Footnote Text
3	Earnings on a fully adjusted basis
5	Estimates Include Stock Options Expense
6	Estimates Exclude Stock Options Expense
8	Estimate reflects FASB APB 14-1
9	Estimate does not reflect FASB APB 14-1
A*	Accounting Differences Exist
C	Estimate Received directly from Analyst

D	Est rec'd in currency other than default
F	Freeform Footnote
K	Forecast estimate not a 12-month figure
S	Estimate Confirmed in analysts notes.
T	Accounting basis unknown - contributor contacted
U*	Contributor Update Pending
W	Estimates based on IFRS

Please note that whenever possible, the newly created granular footnotes above will be used, but the existing "A" and "U" footnotes will still continue to be utilized when multiple minority basis scenarios exist.

ESTIMATES TO RESEARCH LINKING (JUMP-TO)

Through use of the Thomson ONE platform, clients subscribing to both Detail-Estimates and Real-Time Research reports have the capability to click from a sell-side analyst's estimate to the exact research document from which it was sourced. This will provide greater transparency to identify the details around estimate movements and pinpoint the exact reasons why a contributor is revising or confirming an estimate.

Estimates sourced directly from a research report contain a link to the exact report from where the estimate was first received (identified on the platform as any underlined estimate value in blue). If the estimate was confirmed more recently, an additional link will display to take the user to the most recent confirmation document.

These links are offered for current or previous estimates available on the detail estimates, full year, all measures and revision analysis pages of Thomson ONE.

Note that a user must be entitled to Real-Time Research to be able to see the Estimates to Research (Jump-To) functionality. Additionally the page will only contain links to contributor's documents the user is entitled to view.

Please note: If Estimates were received through automated feeds or files, the value will display without a link.

FISCAL YEAR

The fiscal year displayed on Thomson Reuters products is determined by the calendar year the last month of the fiscal year falls in. For example, if a company reports fiscal year results ending in January 2007, they are reporting Fiscal Year 2007. If a company reports fiscal year results ending in October 2006, they are reporting Fiscal Year 2006.
Thomson ONE platforms contain estimate data for up to five annual fiscal periods, four quarterly fiscal periods and long-term growth. (Analysts typically do not make forecasts for periods beyond the third fiscal year and fourth quarter.) Since not all companies have the same fiscal year end, Thomson Reuters uses the familiar FY1, FY2... convention to identify estimates for each unique period.

The following is a description of how this labeling technique works:

- The most recently reported earnings number is denoted as time slot **0 (** can be FY, Q, or SAN).
- A company's last reported annual earnings is referred to as FY0, the most recently reported quarter is Q0 and the most recent semiannual reported earnings is SAN0.
- Using these periods as a base, the period end dates for all estimated periods are easily found.
- If FY0 corresponds to the December 2006 year-end, the FY1 mean estimate is for December 2007 and the FY2 mean estimate is for the period ended December 2008. The same holds true for the interim periods.
- If Q0 refers to the period ended March 2007 (the last reported quarter), then the Q1 estimate is for the June quarter. A frequent misunderstanding is that Q1 refers to the first fiscal quarter instead of the first estimated quarter.

Fiscal Year-End Changes:

- If a company decides to change their fiscal period end, stops will be inserted in the database for all existing estimates on the company with the previous fiscal period end.
- New estimates data will then be collected under the new fiscal period end going forward.

- For example if a company changed from an October year end to December year end, all 10-2007Y estimates would be stopped, then only 12-2007Y estimates would collected on the effective date of the change.

FOOTNOTES

Footnotes are attached to estimates to alert clients as well as Thomson Reuters Market Specialists of special actions or situations affecting estimates. There are three distinct types of footnotes that can be entered: Company, Instrument and Estimate Level Footnotes.

Company-Level Footnotes

Company-level footnotes are footnotes that apply to estimates received from all contributors in a specific measure for a specific period. All company level footnotes apply to the majority EPS accounting basis, which translates down to all related data measures as well. Thomson Reuters Market Specialists use company-level footnotes to relay the majority basis of a table to clients. For example, if the analysts covering a company are including/excluding a specific charge or gain, a Company-level footnote would be attached to clearly identify this.

The footnotes below show the types of Company-level footnotes available:

Footnote Code	Purpose	Footnote Text
8	Accounting	Estimate reflects FASB APB 14-1
9	Accounting	Estimate does not reflect FASB APB 14-1
A	Accounting	Quarters may not add to annual due to changes in shares outstanding
B	Accounting	Estimates reflect adoption of SFAS 142
C	Accounting	Stock Carries Goodwill Amortization
D	Accounting	No Goodwill Amortization Present In Stock
E	Accounting	Estimates reflect adoption of FAS123(R)
F	Accounting	Estimates do not reflect adoption of FAS123(R)
G*	Accounting	Free Form Extraordinary Event Footnote
I	Accounting	Estimates have always reflected adoption of FAS123(R)
M*	Accounting	Majority basis Includes / Excludes <text>
N	Accounting	No Known impact from FAS123(R) on estimates

Footnote utilizes free-form criteria to define specific accounting scenarios of the mean calculation.

Instrument-Level Footnotes

Instrument-level footnotes are footnotes without a time frame or specific measure. These footnotes apply to all estimates entered on a particular ticker across every year and every measure.

For example, if the company tracks FFO instead of EPS, an Instrument-level footnote would be attached to clearly identify this.

Footnote Code	Purpose	Footnote Text
3	Accounting	Earnings on a fully adjusted basis
4	Accounting	Earnings on a fully reported basis
8	Accounting	Estimate reflects FASB APB 14-1
9	Accounting	Estimate does not reflect FASB APB 14-1
A*	Accounting	Accounting Alert. Free Form
C	Accounting	Accounting Alert, Company followed on a Cash Earnings basis
E	Accounting	Estimates reflect adoption of FAS123(R)
F	Accounting	Estimates do not reflect adoption of FAS123(R)
G	Accounting	Accounting Alert, Company earnings before goodwill amortization
I	Accounting	Estimates have always reflected adoption of FAS123(R)
M*	Accounting	Majority basis Includes / Excludes <text>

N	Accounting	No known impact from FAS123(R) on estimates
W	Accounting	Estimates based on IFRS

Footnote utilizes free-form criteria to define specific accounting scenarios of the mean calculation

Estimate-Level Footnotes

Estimate-level footnotes are attached to a specific contributor, ticker, year, measure, and/or period estimate.

The footnotes below show the types of Estimate-level footnotes available. The purpose of Estimate-level footnotes is to exclude estimates from the mean calculation, and give a label as to the reason why it is excluded. Footnotes in *italics* however do not automatically exclude estimates from being part of the mean (C, D, F and S).

Footnote Code	Purpose	Footnote Text
3	Accounting	Earnings on a fully adjusted basis
4	Accounting	Accounting differences exist: Estimate on a Fully-Reported/GAAP basis
5	Accounting	Estimate includes stock option expenses
6	Accounting	Estimate excludes stock option expenses
7	Accounting	Accounting differences exist: Estimate reflecting rights issue prior to ex-date
8	Accounting	Estimate reflects FASB APB 14-1
9	Accounting	Estimate does not reflect FASB APB 14-1
A	Accounting	Accounting differences exist
B	Accounting	Accounting differences exist: Estimate on a basic share count basis
E	Accounting	Accounting differences exist: Estimate on a diluted share count basis
G	Accounting	Accounting differences exist: Excludes charge(s)
H	Accounting	Accounting differences exist: Includes charge(s)
I	Accounting	Accounting differences exist: Excludes gain(s)
J	Accounting	Accounting differences exist: Includes gain(s)
K	Accounting	Forecast estimate not a 12-month figure.
L	Accounting	Accounting differences exist: Estimate reflecting corporate action
M	Accounting	Accounting differences exist: Estimate on a non-GAAP basis
T	Accounting	Accounting basis unknown - contributor contacted
W	Accounting	Estimates based on IFRS
X	Accounting	Accounting differences exist: Estimate on a Cash EPS basis
N	Freshness	Contributor update pending: Estimate not reflecting recent company guidance
O	Freshness	Contributor update pending: Estimate failed freshness policy
P	Freshness	Contributor update pending: Estimate not reflecting recent reported actual
U	Freshness	Contributor update pending.
V	Freshness	Contributor update pending: Estimate not reflecting corporate action
C	*Supplemental*	*Estimate received directly from analyst*
D	*Supplemental*	*Est rec'd in currency other than default*
F	*Supplemental*	*Freeform Footnote*
S	*Supplemental*	*Estimate confirmed in analysts notes.*

GLOBAL ESTIMATES FRESHNESS POLICIES

Thomson Reuters strives to provide the freshest estimates content possible to clients and consequently, contributors are asked to regularly send confirmations of their existing estimates. Thomson Reuters maintains active policies on the 'freshness' of estimates provided by contributing analysts. All forecasted data measures are accompanied by original announce and confirmation dates (in Eastern Time) and are subject to policies designed to prevent stale data:

Estimates

If an estimate has not been updated for 105 days, the estimate is filtered, footnoted with the following estimate level footnote and excluded from the mean. (Estimates are updated by a contributing analyst sending a confirmation, revision or drop in coverage.)

Footnote Code	Footnote Text
O	Contributor update pending: Estimate failed freshness policy

- When Q4 is the current reporting period, Q4 and FY1 estimates are an exception to this rule: Q4 and FY1 estimates will be filtered when they have not been updated for 120 days. (This allows extra time for companies to report year-end results.)

If an estimate is not updated for a total of 180 days, the estimate is stopped.

Note:

- All non-updated estimates are auto-filtered at 105 days. If an estimate is later confirmed as current, the filter/footnote/exclusion will be end-dated and the estimate will be confirmed.
- All non-updated estimates are auto-stopped at 180 days. If an estimate is later re-sent by a contributor, it will be treated as a new estimate initiation.

Recommendations

If a recommendation is not updated for a total of 180 days, the recommendation is stopped. (Recommendations are updated by a contributing analyst sending a confirmation, revision or drop in coverage.)

Price Targets

Price target data is stopped at the expiration of it's time horizon (For example, a 12-month price target would be stopped 12 months after it was last revised by a contributing analyst).

GUIDANCE

Guidance is any forward-looking expectation issued directly by a company regarding its future financial performance. Most importantly, guidance is used by company management to manage investor expectations and by investors to evaluate the company and predict future performance. Under current full disclosure regulations, guidance is the only legal method a company can utilize to communicate its expectations to investors.

Thomson Reuters StreetEvents obtains guidance information via real-time news feeds as well as information received directly from companies. Thomson Reuters Market Specialists analyze estimates and guidance together on a real-time basis. Thomson Reuters Market Specialists verify the guidance by using original press releases from companies; comments made by analysts are not used as guidance. Guidance will be evaluated and compared with the earnings estimates mean before reflecting on product.

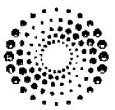
Issuance of Company Guidance

Detail estimates which are not updated in a timely fashion after the issuance of guidance will be excluded in order to create a post-event mean value. Detail estimates which have not been updated or confirmed following the issuance of guidance and do not fall within the guidance range (e.g. "$1.00 - $1.10") will be excluded from the mean at the time of guidance. If a single-point guidance is issued (e.g. "about $1.00"), estimate(s) not within 5% of the guidance would be excluded from the mean with appropriate addition of footnotes (see below). Once excluded estimates are updated or confirmed, they will have the footnote end-dated and added back into the mean calculation.

Footnote Code	Footnote Text
N	Contributor update pending: Estimate not reflecting recent company guidance

Product Views

In Q307, Thomson Reuters began offering a "Mean/Guidance Comparison" page on **Thomson ONE**, which is separate from the standard StreetEvents guidance offering. This enhancement allows clients to view mean estimates, actuals and guidance on the same accounting basis side-by-side to ensure a consistent analysis. Additionally, guidance and estimates not on the same accounting basis are indicated with a footnote. This comparable guidance data is fielded and adjusted for corporate actions. Most importantly it is normalized and adjusted to match the accounting basis of estimates; percentages are translated into values, extraordinary items are included/excluded to adhere to estimates majority.



THOMSON REUTERS

Thomson Reuters offers estimates-comparable guidance on 14 data measures for over 2,350 companies globally, with history for the S&P500 back to January 2006.

Thomson Reuters also offers **Thomson Reuters Guidance Datafeed**, bringing I/B/E/S Estimates and Guidance together into one consistent format allowing clients to perform true comparisons. Thomson Reuters Guidance is a unique, intra-day datafeed that offers quantitative (numeric) company expectations from press releases and transcripts of corporate events and plots them alongside the I/B/E/S mean estimate at the time of the release. This offering enables investment professionals to access company expectations alongside earnings forecasts in a single feed, and most importantly, direct from the market-leading source including the benefits of:

- Global coverage
- Historical content dating back to 1994
- Available for fiscal quarters and years
- Announcement dates and timestamps

Estimates Comparable Guidance is available for the following 14 data measures:

Code	Data Measure
CPX	Capital Expenditure
DPX	Dividends Per Share
EBS	EBITDA Per Share
EBT	EBITDA
EPS	Earnings Per Share
FFO	Funds From Operations Per Share
GPS	Fully Reported Earnings Per Share
GRM	Gross Margin
NET	Net Income
OPR	Operating Profit
PRE	Pre-Tax Income
ROA	Return On Assets (%)
ROE	Return On Equity (%)
SAL	Sales

HISTORY

Thomson Reuters I/B/E/S historical earnings database is revision-based. Therefore, a new 'record' is not written into history unless the current estimate changes (referred to as "revised"). In the event that a contributing analyst is confident in the current estimate and does not wish to revise the estimate, a confirmation is requested. Confirmations add integrity to the estimates (a 30-day old estimate, although in-line with all other estimates, is not regarded as confidently as a day-old estimate). Confirmations are easily identifiable in the database in that the announce (effective) date remains unchanged while the confirmation date is updated to the date of the confirmation.

Error-Corrected History

Thomson Reuters has traditionally made error corrections to historical data if it can be substantiated through published research documentation. While there are certain types of estimate data that contain "As published" information (e.g., Surprise values), the majority of the data is error corrected. Policies on historical corrections are defined by data item. In general, historical corrections are made upon request/review and are granted based on: corresponding documentation and if necessary, after the basis is verified.

There are two main types of data items:

- Earnings forecasts and other period-specific data items
- Recommendations or Target Prices

For each of the types, the following factors are taken into consideration when making historical changes:

How long ago did the error occur?

- Within the last six months: Changes are made to the database. History is captured in the recalculated mean figures.
- Prior to the past six months: These changes are made but do not automatically result in recalculated mean figures. This is due to the need to adjust history products and tables, or else detail data will not match mean data. As a result, summary history may not match detail history due to such error corrections.

How was the data received?

- Data can be received via: Notes, PDF Research, or Universe Files.

Types of changes made to historical data:

- Value, Effective Date (and Activation Date for Actuals), Analyst Coverage, Deletion, Addition of Missed Revision

  Historical corrections are made to ensure the highest quality data. Errors are minimized; however it is possible that discrepancies exist due to contributing analysts never sending Thomson Reuters the data originally, or that it was sent incorrectly. As a general rule, corrections are only made, if the contributing analyst can support the value through published research. This policy has been in effect for the treatment of both recent and older history - regardless of whether or not the company reported.

As-Was Summary History

In addition to the traditional 'error-corrected' history offering, Thomson Reuters has recently made a new historical summary-level dataset available, which is unaltered in any way. The As-Was historical daily mean estimates dataset provides daily mean values as they appeared on a particular day; regardless if the underlying detail estimates have since been corrected or not.

Daily Historical Mean is a collection of detail estimates from analysts calculated on a daily basis. The mean is the average of the detail estimates as reported by the analyst at that particular point in time, without making any revisions or corrections to the data once it's published. Quantitative researchers utilize "as was" data to analyze the market impact on the actual day the official record was released. Subscribers of this data set will have the ability to view over 20 financial measures, including 5 types of per share data for US and International companies.

- This powerful data set is *extremely* important to quantitative portfolio managers wishing to see historic data free from modifications due to error corrections.
- As-was history enables clients to see a true snapshot of the *exact* information available to the market at a given point in time - to see the effect that the company's estimates had on market events.

****Note that Thomson Reuters presently only offers summary-level daily as-was history. As-was detail-level estimates history will be a future enhancement to this offering.**

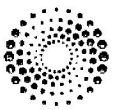
Differences between 'Error-Corrected' and 'As-Was' History

There are certain circumstances when Thomson Reuters needs to adjust or correct a historical detail estimate that has been stored in the database. This happens when brokers go back to Thomson Reuters to correct a previously provided estimate, or when an estimate was missed from an update. In these cases, Thomson Reuters will change the detailed estimate which may or may not cause the mean to change. If the mean changes, it is no longer an "as-was" figure. Instead, the mean becomes "error-corrected" because it is recalculated based on a corrected detail.

Example:

Company ABC has 10 estimates from 10 different brokers. As of 11-01-2006, the mean for the 12-06 quarter is $2.15. One of the brokers covering Company ABC is Broker XYZ who provided Thomson Reuters with an estimate of $2.20 for the same time period.

On November 30, 2006, Broker XYZ told Thomson Reuters that their $2.20 should have been $2.26. Broker XYZ provides documented proof that the estimate that was sent to Thomson Reuters via a feed was incorrect, and that their research reports support that the estimate is actually $2.26. Thomson Reuters will apply the correct value to the detail estimate for the applicable quarter, on the date that the estimate was effective. Because of the change, the mean will change to $2.17. In this scenario, the "as-was" mean is $2.15 and the "error-corrected" mean is $2.17.



In summary, all traditional estimates history products offer 'error-corrected' history in which any time an incorrect value is found, it is then corrected – on either a summary or detail estimate level. Thomson Reuters new 'as-was' history offers historical mean estimates, free of any modification, and shows any given mean estimate value as it appeared in that particular day.

History is also available for Normalized Summary & Detail History (Currency) and is detailed in the Currency section above.

INDUSTRY CLASSIFICATIONS SOURCE / SCHEMA

The sector/industry classification schema for I/B/E/S and Thomson ONE products presently are based upon:

- For U.S. companies follow the S&P scale for sector/industries/groups
- For international companies the MSCI schema is used.

Future products will adopt the new proprietary Thomson Reuters Business Classification schema.

KEY PERFORMANCE INDICATORS

Thomson Reuters offers Key Performance Indicators (KPIs) to quickly identify and retrieve analyst forecast information on key drivers within the retail, restaurant and pharmaceutical industries. These key performance indicators are industry-specific measures that facilitate comparisons among similar peer groups. Consensus and detail forecasts are available for Same Store Sales and Pharmaceutical Sales, including business segment and product breakdowns, enabling efficient comparisons between analysts' expectations on these indicators and your own.

Thomson Reuters collects and displays forecasted and reported industry-specific Key Performance Indicators on products including Thomson ONE Analytics and Thomson ONE Investment Management (under Security -> Estimates -> Detail – Single Period). Estimates data is available on both a detail analyst as well as summary mean level.

Thomson Reuters also offers a Key Performance Indicators (KPI) datafeed collection of current detail and summary level estimates as well as actuals information.

See "Glossary of Estimates Data Measures" section under "Product-Level Measures" for all KPIs collected.

MULTI LISTED SECURITIES

Companies may enlist to trade on multiple exchanges or may have more than one share type trade on a common exchange. The Thomson Reuters estimates database will store forecast information for all listings covered by analysts. The primary listing is referred to as an "S" type Security (Instrument Type: S). This type of security's I/B/E/S ticker will usually reflect the ticker used for trading on the local exchange, such as MSFT for Microsoft Corporation based in the US and traded on the NASDAQ exchange. It is usually the most liquid share class with the highest trading volume.

In addition to the primary listing, companies may also have other listings including:

- Multiple Shares (Instrument Type M)
- Multiple Listings/Inter-listed Securities (Canada Only) (Instrument Type D)
- American Depository Receipts - ADR's (Instrument Type A)
- Combination of all Security Types
- Dual Listed Companies

Multiple Share Classes (Instrument Type M)

Please note: Presently, multiple share listings - indicated by Instrument Type M and having I/B/E/S Tickers with a slash "/" - are not displayed on Thomson Reuters platforms nor included in datafeeds such as I/B/E/S QFS & History.

Multiple share classes of a company occur when more than one share class is traded for that company on the same exchange within the same country. The additional shares are referred to as multiple shares of the same equity. Multiple shares for companies are usually issued because:

- Different levels of voting rights are attached to each share class
- There is a restriction within the market on foreign ownership and a secondary class is created for foreigners
- The company wishes to increase the liquidity of its shares by adding share classes with small nominations
- Other reasons as determined by the company

A multiple share of a company is added to the estimates database as a Multi Share listing (I/B/E/S Type: M). This type of security's I/B/E/S ticker will always be the I/B/E/S ticker of the S type listing, with a slash "/" and a numeric digit suffix. For example, if the ticker for the S type listing of a company is @ALZ, the ticker for the M type listing will be @ALZ/1. If the numeric digit is greater than 9, then a letter is used in place of a numeric, for example: @ALZ/A.

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange
Royal Dutch Shell	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam
Royal Dutch Shell	RDSB.NL	@RDN/1	M	NETHERLANDS	Euronext Amsterdam

Royal Dutch Shell plc has two classes of shares, "A" and "B" shares. "A" shares and "B" shares have identical rights except in relation to the source of dividend income where "A" shares have a Dutch source and "B" shares are intended to have a UK source.

Source: www.unification.shell.com

- Unique tickers are created in the database for each share class – the primary share as type S and the additional share classes as type M (with a slash "/" in the ticker).
- All estimates forecasts (with the exception of price targets, DPS, and recommendations) are stored and displayed under the type S listing regardless of the listing sent by the contributor. Minority data are stored under the share class for which it was received and then copied over to the primary listing with the exception of Price targets, DPS, and recommendations.

Multi-listed Securities/Inter-listed Securities/Dual Listed Securities (Instrument Type D)

A multi-listed/inter-listed security has the same class of shares listed on two different exchanges. Multi-listed securities are an additional listing of any security of the company, but are typically related to the primary listing. In this case, the company's shares are listed on more than one stock exchange in two different geographic locations. Inter-listed securities are those listed on both Toronto Stock Exchange (TSX) and a US exchange, including the NASDAQ, AMEX or NYSE. Each inter-listed security has one CUSIP, is fungible, and can therefore be traded and cleared in either Canada or the US.

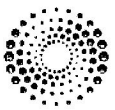
A multi-listed/inter-listed security is added to the database as a D Type security under the same issuer name as the primary S type listing. The primary ticker is setup as an S type security and the secondary listing as a D type security.

Example:

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange	Share Class
Royal Dutch Shell	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam	A Shares
Royal Dutch Shell	RDSA.GB	@SHE	D	UNITED KINGDOM	London Stock Exchange	A Shares

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange
Barrick Gold	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam
Barrick Gold	RDSA.GB	@SHE	D	UNITED KINGDOM	London Stock Exchange

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange
Barrick Gold	ABX.US	ABXF	S	Canada	TSX
Barrick Gold	ABX.CN	ABX3	D	USA	NYSE



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- Unique tickers are created for each listing -- the listing on the local exchange as type S and the multi-listed/inter-listed as type D.
- Estimates are stored and displayed under the listing provided by the contributing broker.
- Thomson Reuters platforms display both types of securities and feed files include data on both types of securities.

A dual-listed security is a Canadian company that trades on both the US and Canadian stock exchanges. In order to increase granularity of its data, Thomson Reuters uses the following method to capture estimate, recommendation and price target data for Canadian dual-listed companies.

- Thomson Reuters adds a secondary instrument or ticker for Canadian dual-listed companies when estimate data is received for both listings. In order to link the tickers, there are two types of securities: The primary security is denoted as type 'S' and the dual-listed security is denoted as type 'D'.
- Duplicate identifiers (CUSIPS) exist since Canadian companies that trade both in Canada and the US share the same CUSIP, but carry a separate SEDOL for each exchange on which they trade. A CUSIP is a number identifying all stocks and registered bonds – *C*ommittee on *U*niform *S*ecurities *I*dentification *P*rocedures. A SEDOL is a code which identifies a foreign stock that has a CUSIP number but does not trade in the U.S. – *S*tock *E*xchange *D*aily *O*fficial *L*ist.
- Thomson Reuters implements this process in a two-step approach in order to accommodate clients who currently use CUSIP as the identifier to load data. A second dual listed instrument is added and data is captured as received from contributing analysts. An artificial CUSIP is attached, which is the first seven digits of the primary listing and "X" as the last digit eg. 3748593X. The unique SEDOL for each listing is captured in the database in order to maintain correct pricing information.
- The second step requires that data file products be amended in order to adequately support duplicate CUSIPS. Once implemented, Thomson Reuters will continue to maintain the dual listed instruments by properly capturing data and attaching the correct CUSIP for both instruments. The correct digit will replace the artificial "X" once the long-term approach is implemented. At least three months notification will be provided to clients preceding any changes to the ID files.
- Thomson Reuters publishes estimates on whichever security a contributor provides estimates. If an analyst supplies forecasts under both securities then estimates/coverage will be made viewable on both securities. If the analyst supplies forecasts for one security, estimates will be displayed under that particular security and no other.
- Target Price will be the basis for determining which security is covered. For example, if an analyst sends their Target Price under the CAD listing yet supplies US estimates, Thomson Reuters will display coverage under the CAD security. Analyst's have the ability to cover both listings as long as both target prices are supplied. The currency of estimates will have no determining factor on which listing an analyst covers. Dual-listed securities are shown in the exchange opposite of the primary security. For example, if the primary security is listed on the Canadian Exchange, the newly created security would be listed under the US Exchange.

Example of Dual-Listed Company:

Canadian National Railway

Local Tickers:	U.S. – CNI Canada – CNR
I/B/E/S Tickers:	U.S. – CNI Canada – CN2

Thomson Reuters uses this policy on dual-listed companies due to the request of analysts. Analysts wish to show coverage with specific security. These methods allow analysts to forecast price targets for one or both securities. Having two separate securities increase granularity of data and allow for correct pricing information. It also allows for proper analyst ranking for each security.

American Depository Receipts – ADR's (I/B/E/S Type A)

American Depository Receipts are listings for a foreign traded company on an American exchange. An ADR is a negotiable certificate issued by a U.S. bank representing a specified number of shares (or one share) in a foreign stock that is traded on a U.S. exchange. ADR's are denominated in U.S. dollars, with the underlying security held by a U.S financial institution overseas, and help to reduce administration and duty costs on each transaction that would otherwise be levied. ADR's make it easier for Americans to invest in foreign companies, due to the widespread availability of dollar-denominated price information, lower transaction costs, and timely dividend distributions.

ADR's are treated the same as US companies. If an ADR is covered by one of the Thomson Reuters contributing analysts, estimates are collected as well as actuals, and mean data is created based off the number of analysts included in the mean calculation. ADR's are grouped, however, with US companies, and not by the countries of their local security.

An ADR security is added to the I/B/E/S database as an A type security under the same issuer name as the primary S type listing. The primary ticker is setup as a type S and the secondary listing as a type A security.

Example:

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange	Share Class
Royal Dutch Shell	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam	A Shares
Royal Dutch Shell	RDS/A.US	RD	A	USA	NYSE	A Shares

- Unique I/B/ES tickers are created for each listing - the listing on the local exchange as type S and the ADR as type A.
- Estimates are stored and displayed under the listing provided by the contributing broker.
- All platforms display both types of securities and feed files include data on both types of securities.

Combination of All Security Types

Some companies have a combination of different listing types including dual listings, multiple share classes and ADR's, as is the case for Royal Dutch Shell PLC.

Example:

Company Name	Market Symbol	I/B/E/S Tickers	I/B/E/S Type	Exchange Country	Exchange	Share Class
Royal Dutch Shell	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam	A Shares
Royal Dutch Shell	RDSB.NL	@RDN/1	M	NETHERLANDS	Euronext Amsterdam	B Shares
Royal Dutch Shell	RDSA.GB	@SHE	D	UNITED KINGDOM	London Stock Exchange	A Shares
Royal Dutch Shell	RDSB.GB	@SHE/1	M	UNITED KINGDOM	London Stock Exchange	B Shares
Royal Dutch Shell	RDS/A.US	RD	A	USA	NYSE	A Shares
Royal Dutch Shell	RDS/B.US	RD/1	M	USA	NYSE	B Shares

Thomson Reuters publishes estimates on whichever security a contributor provides estimates. If an analyst supplies forecasts under both securities then estimates/coverage will be made viewable on both securities. If the analyst supplies forecasts for one security, estimates will be displayed under that particular security and no other.

- Target Price will be the basis for determining which security is covered. For example, if an analyst sends their Target Price under the CAD listing yet supplies US estimates, Thomson Reuters will display coverage under the CAD security. Analyst's have the ability to cover both listings as long as both target prices are supplied. The currency of estimates will have no determining factor on which listing an analyst covers. Dual-listed securities are shown in the exchange opposite of the primary security. For example, if the primary security is listed on the Canadian Exchange, the newly created security would be listed under the US Exchange.

PARENT / CONSOLIDATED INDICATOR

Indicates whether the estimates of a company are carried (by Thomson Reuters) on a parent or consolidated basis. The way a company appears on the database is based on the majority of the earnings estimates received. Contributors are free to provide either parent or consolidated estimates for any given company. Using sales estimates as an example, consolidated sales estimates would be under SAL, whereas sales for parent company would be under SALPAR. The primary basis (either P or C) is determined by whichever is the majority basis.

Consolidated Companies

Companies are classified as consolidated when the earnings of the investee companies where the parent holds a 20% voting stake or more are combined with the earnings of the parent company, after elimination of inter-company transactions.

Parent Companies

Companies are classified as parent when only the earnings of the reporting entity, including dividends, interest, royalties, etc. received from its investee companies, are presented as net income.

Companies Without Subsidiaries

Companies without subsidiaries are classified as consolidated by default since a great majority of the markets adhere to the consolidated basis.

Consolidated / Parent Companies

If companies are carried in two-basis (Consolidated and Parent) and use a different calculation, a review and shifting of the affected measures are necessary to ensure that the majority and minority of broker submissions are stored in the right primary measures (Primary Parent/ Primary Consolidated) and secondary measures (Secondary Parent/ Secondary Consolidated). Switching the primary basis from secondary and vice versa is imperative when there is a significant drop or increase in either broker submission.

Shifting Company Indicators

The reason for the need to shift is that there are two main data products that are dependent on current collection:

- History- The detail history product only includes primary basis. Due to constraints it is imperative that the primary basis includes the majority of contribution.
- Global Aggregates- This product also offers history. If EPS history for primary basis is deleted/ removed/ relabeled calculations that includes these companies will be affected.

The switch from consolidated primary to parent primary or vice versa should be based on two main factors:

- Change in reporting standards/ actual availability - Availability of actual data for the basis identified as primary. When company does not have subsidiaries and no earnings to consolidate.
- Change in broker submission- when there is a shift in majority of basis brokers is sending their data.

When a significant number of brokers are shifted to a different basis, the primary measure is shifted to the basis where the majority of the brokers are sending. The basis where the minority of the brokers are sending will be the new secondary measure. All measures for the same basis will be shifted all together.

When equal contribution is submitted for both bases, the deciding factor should be the availability of the actuals for that company/market based on proposed/ reviewed and approved by the accounting board.

When equal contributions are submitted for both bases and there is an actuals available for both bases as well, the company basis should remain as of the day of the review. When companies have minimal (1 or 2 contributor in the P/C status) difference in contribution and majority have shifted to a different basis, the current measures remain until a significant number of contributors have shifted. Significant number is considered as 60% if company has fewer than 8 estimates & 40% if it is has 9 estimates up.

PERIODICITY

Periodicity is the frequency for which a company reports their full financial results. A company will have either a quarterly (QTR) periodicity, a semi annual (SAN) periodicity, or an annual (ANN) periodicity once it is established with the database and data is collected.

Quarterly (QTR) periodicity is used when:

- Company reports full financial results quarterly;

- Company reports full financial results semi annually, and contributors are making quarterly EPS or FFO estimates; and;
- Company reports full financial results annually and there are no contributors making interim estimates.

Semi-Annual (SAN) periodicity is used when:

- Company reports full financial results semi annually, and contributors are not making quarterly EPS or FFO estimates. There are cases where contributors will supply quarterly sales estimates for companies that only report full financials semi annually. These sales estimates should not be used to determine the periodicity since it is not a shifting measure; and
- Company reports full financial results semi annually, and there are no contributors making interim estimates.

Annual (ANN) periodicity is used when:

- Company reports full financial results every 12 months, and a period year consists of one annual.
- A company's periodicity should be set to the most frequent time interval based on one of the following:
- The company report; or
- EPS or FFO estimates periodicity supplied by contributors

Please note that quarterly periodicity is the most frequent interval used as the default periodicity when setting up new companies.

PRELIMINARY ESTIMATES

When Thomson Reuters receives a contributor's estimate, it goes through an extensive and thorough verification process prior to delivery to all estimates products to ensure accuracy and consistency. This value-added quality control process ensures estimates are of the highest quality and estimates are delivered to products in the quickest time possible, however there are times where this added level of process may affect the timeliness of estimates.

As a solution for the most time-sensitive clients, Preliminary Estimates are available which combine real-time estimate availability, with an automated quality screening process. A Preliminary Estimate bypasses the manual portion of Thomson Reuters value-added quality control checks and verification tests – and is only subjected to limited automated verification tests. This data is then available in true real-time, enabling clients to view a contributor's updated forecasts prior to the Thomson Reuters full verification, filtering and footnoting process. The majority of Preliminary Estimates will be followed by a 'fully-verified' estimate, which are subjected to all of Thomson Reuters quality control checks.

- Preliminary Estimates enable true real-time delivery to clients.
- Preliminary Estimates are useful to any customers making investment decisions based on estimate revisions and related time sensitive activity.
- Preliminary estimates are currently being offered via the First Call Datalink feed, as well as Thomson ONE Analytics and Thomson ONE Investment Management platforms.
- First Call Datalink offers Preliminary Estimates for the following data measures: EPS, Sales, Cash Flow per Share, Recommendations and Price Target.
- Thomson ONE Analytics and Thomson ONE Investment Management offer Preliminary Estimates for all 26 data measures.

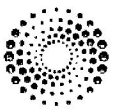
Please note that Preliminary Estimates are available in real-time after fielded receipt of estimate values from analysts (either once automated feeds/files are received from brokers, or once Thomson Reuters Market Specialists extract estimate values from PDF research documents.

PRICE FORECASTS

In addition to publically traded companies, Thomson Reuters also collects forecasts on the price levels of commodities, as well as both bottom-up and top-down price forecasts on select indices.

Commodity Price Forecasts

Commodities are something that are relatively easily traded, that can be physically delivered, and that can be stored for a reasonable period of time. A common characteristic of commodities is that their prices are determined on the basis of an active market. Examples of commodities include metals, minerals, and energy sources such as crude oil, natural gas,



aluminum, gold, diamonds, or silver. Sales and purchases of commodities are usually carried out under future contracts on exchanges, which standardize both the quantity and minimum quality of the commodity being traded.

Commodity price forecasts are collected by Thomson Reuters if available from contributing analysts. Unique I/B/E/S tickers are created for each commodity with sell-side analyst estimates coverage and are set up as a Type "O" Instrument type. For a complete listing of all available commodity price forecasts, please reference the document *"Thomson Reuters Top-Down Index & Commodity Price Forecasts"*.

Actuals

Commodity price actuals are entered within 15 days of the end of the period by using the calculated average price of the preceding three (3) months period. Please note that this method is also used by the contributing analysts, who take the average closing price of the quarter to determine actuals, not the closing price at the end of the quarter.

Estimates

Commodity price forecasts are based off spot prices and are entered using the same majority basis policy as estimates on companies. These estimates are sourced from the same sell-side analysts covering companies and related industries.

Index Price Forecasts

Thomson Reuters collects and calculates price forecasts for a handful of US stock indices, most notably including the S&P500 and Dow Jones Industrial Average (DJIA). Unique I/B/E/S tickers are created for each index with sell-side analyst estimates coverage and are set up as a Type "I" Instrument type. For a complete listing of all available index price forecasts, please reference the document *"Thomson Reuters Top-Down Index & Commodity Price Forecasts".*

Two types of index price forecasts are available on Thomson Reuters; top-down, which are an average of market strategists' forecasts, and bottom-up, which are aggregations of all analyst mean forecasts for each individual company in an index.

Top-Down Estimates

Index price forecasts are based off index prices and are entered using the same majority basis policy as estimates on individual companies. These detail estimates are sourced from sell side industry analysts, as well as market strategists who forecast based upon macroeconomic conditions, rather than individual company performance. All of these individual estimates are then averaged to create a mean (consensus) top down forecast.

Bottom-Up Estimates

In addition to Thomson Reuters collecting top-down forecasts from sell-side contributors, bottom-up forecasts are calculated as well. These forecasts are sourced from aggregating all of the individual mean estimates for each individual company in an index, and then weighted by market cap. The explicit bottom-up index forecasts calculation used by Thomson Reuters is as follows:

Avg_eps = spi * total_cons_shares / total_price_shares

Where:

Avg_eps =	bottom-up index estimate displayed on products
spi =	price index value
total_cons_shares =	consensus eps * shares of each company of the Index
total_price_share =	price * shares of each company of the index

Actuals

The current policy for updating actuals for index estimates is to enter the bottom up calculated figure two quarters after the end of the period. Bottom-up estimates and actuals are calculated on a calendarized basis, in order to account for different fiscal year ends for companies and allow for comparison of companies regardless of fiscal period. The calendar quarter end is taken along with the month before and the month after to create a quarter number that allows companies with different fiscal periods to be compared against each other.

Actuals Entry Schedule:

Quarter	Period Ending	Enter Actual Value on
Q1	March 31	July 1
Q2	June 30	October 1
Q3	September 30	January 1
Q4	December 31	April 1

Calendarization Methodology:

Quarter	Period Ending
Q1	February, March, April
Q2	May, June July
Q3	August, September, October
Q4	November, December, January (of next calendar year)

PRIORITIZATION

Estimates and recommendations are researched and reviewed by Thomson Reuters Market Specialists to insure accuracy – prior to becoming available on products. Every revision is subject to a stringent quality control process – both before and after the data is available on products. If the accuracy or accounting basis cannot be verified by the data source alone, Thomson Reuters Market Specialists will further research the affected estimates/recommendations, by contacting the contributing analysts directly for clarification. It is however Thomson Reuters goal to deliver accurate and reliable estimate revisions as timely as possible.

During peak times such as earning seasons, the added revision volume can sometimes cause slight delays. Thomson Reuters uses a rolling 'priority scheme' which gives higher priority to market movers, index constituents, higher market cap companies, companies in the news/reporting etc. – to ensure that estimate revisions for these types of companies are the first to be updated.

All of the following would be considered as higher priorities when updating estimates; surprising earnings news, pre-announcements, reported earnings, S&P companies, market capitalization, major merger announcements/ completions and post-market prior day events (e.g., companies in the news to which the market has yet to react). Index Constituents tend to be considered market movers and therefore given priority over lesser-followed companies. For that reason, the mechanism is in place to highlight an index as a priority grouping.

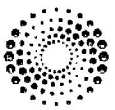
Please note that Preliminary Estimates are available in real-time after fielded receipt of estimate values from analysts – prior to the manual verification process. See Preliminary Estimates section for more details.

REASONS FOR CONTACT WITH CONTRIBUTING ANALYSTS

All phone calls between Thomson Reuters Market Specialists and Contributors/IR Representatives are logged in a phone call database.

Cases that would typically trigger Thomson Reuters to contact a contributor include but are not limited to:

- Quarterly estimates within the published research document do not add to the annual provided (indicating use of non-majority prior period actual).
- Quarterly or annual estimates received from a contributor (either via research or feed) which fail quality control tests and validations for accuracy, such as standard deviations, decimalization errors, etc.
- An accounting basis issue is identified within a contributor's estimate or reported actual – contributor contacted and communicated what the 'majority' basis is using.
- A company issues guidance, and the contributor either does not update/confirm their estimate or it is outside of the guidance range.
- An estimate fails the Thomson Reuters Freshness Policy and a contributor is contacted to confirm/revise their estimates.
- A company announces a merger/acquisition/spinoff – a contributor is contacted for their post-event estimate.



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- A contributor's estimates are not updated after a company reports their quarterly/annual results.
- Pre-split estimates are provided in research, after a company has gone through a stock dividend or split of their stock.
- A company goes through a FYE change and the contributor sends numbers on the old FYE.

RECOMMENDATIONS

Recommendation Mapping: Thomson Reuters I/B/E/S 1-5 Scale

The Thomson Reuters I/B/E/S recommendation scale is as follows:

1 - Strong Buy
2 – Buy
3 – Hold
4 – Underperform
5 – Sell

Each contributor determines how their individual recommendation scale maps to the Thomson Reuters I/B/E/S 5-point scale. Every firm, no matter if they have a 3-point scale or a dual-tiered system, must map their scale to the normalized 1-5 scale utilized by Thomson Reuters. The only stipulation being that the mapping requested must allow for negative to negative ratings, positive to positive ratings and neutral to neutral ratings when mapping to Thomson Reuters I/B/E/S 1-5 scale. A contributor using a 3-point scale of BUY, HOLD, SELL would not be allowed to have a mapping of 1,2,3 on the 1-5 Thomson Reuters Scale. Contributors are made aware that the 1-5 value will be calculated to create a mean and displayed across Thomson Reuters products.

Please note that while contributors may have elaborate multi-tier recommendation scales, including both company and industry/sector ratings, all points in their scale must map back to the standardized Thomson Reuters I/B/E/S scale is 1-5. In cases of broker scales being greater than 5 points, multiple points in a broker's scale may map back to a single point in the Thomson Reuters I/B/E/S scale.

Recommendation Mapping: Impact on Products

Clients viewing the Recommendations data measure, depending upon the product, can view analyst recommendations in multiple versions:

- Contributor Text format – the actual text provided by the contributor
- Normalized Text format – the corresponding text on Thomson Reuters normalized scale
- Normalized Code format – the corresponding code on Thomson Reuters normalized scale

Contributor Text format is the exact recommendation language used by that specific contributing firm. Normalized Text and Code make the Contributor Text more consistent, by mapping the Contributor Text to Thomson Reuters standard 1-5 recommendation scale. It is the Normalized Codes which are used to calculate the Thomson Reuters Mean Recommendation.

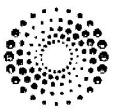
Recommendation Scale Changes

If a contributor changes their recommendation scale, stops must be applied to the database to prevent false revisions, followed directly by new recommendations applied on the same day. When recommendation scale changes occur, Thomson Reuters Market Specialists work closely with the contributor to outline the implications, and make decisions on how the change should be represented, based on the guidelines Thomson Reuters uses in mapping contributor scales to the normalized scale.

Note: Recommendation scale change requests received from contributors will be processed on a go-forward basis

Recommendation Drops

If a contributor drops coverage of a company, a stop is applied to the recommendation field. Additionally, if a contributor is "restricted" on the stock or has suspended their recommendation, a stop would be applied to the recommendation field.



RESTATEMENT POLICY (ACTUALS)

Thomson Reuters actuals restatement policy addresses the needs of two distinct sets of end users: those who prefer the actual data as it was initially reported and those who wish to view the company as it is constituted today.

- Thomson Reuters can restate actuals for any available measures; however the ones most commonly restated are EPS, Sales and FFO.
- Thomson Reuters will restate the quarterly figures for the current fiscal year, as well as the prior year's actuals data to provide comparability. Thomson Reuters will not restate actual data for more than one year back.
- All other actuals data will be left as originally entered, to allow historical examination.
- In all cases, footnotes will be entered to explain the basis of the modified figures.
- Once a restatement has taken place, any existing estimates or new estimate submissions must use the restated actual data: this ensures a proper apples-to-apples comparison among contributing analysts. If a contributor is not using the restated figure, a Thomson Reuters Market Specialist will contact the analyst to adjust to the restated basis, or will have their estimates footnoted and excluded from the mean for the fiscal year in question.

Examples of events that would require restatement include:

- Changes in the accounting basis
- Classification of certain operations as discontinued
- Sales and acquisitions of business lines

Example of company with restated actuals:

Integrated Circuit Systems (ticker ICST)

Restated EPS Actual: Q105 = 0.24R

Accompanying Footnote: 11-Nov-04 SEP04Q Restated from 0.23 upward for accounting change

Thomson Reuters will only restate actuals after a company has officially made the restatement, and can be documented via a press release, or by confirmation of all the contributing analysts.

SHARE CLASS

Default share class is determined by the majority of estimates submitted. Policies differ slightly for the US and International companies.

U.S.

1. Determined by majority of coverage.
2. If there is not a majority of coverage, then defer to liquidity.
3. If liquidity is comparable then defer to the share class with the most voting rights.

International

1. Determined by majority of coverage.
2. If there is not a majority of coverage, then defer to the share class with voting rights.

Only recommendations and target prices are affected by share class; all other estimates are generally available under the primary share class.

Shares Outstanding Data

Number of Shares Outstanding (NOSH)
Current number of shares outstanding (NOSH) data is provided as a supplemental data item in I/B/E/S datafeeds as well as on Thomson ONE (Security->Overview->Snapshot). This data provided is based on the NOSH for the specific security (SEDOL-specific), and not on the consolidated/company level.

Shares Outstanding Used in Per-Share Estimates
The shares outstanding data, for per-share data measures, which is utilized in individual analyst's detail estimates, and subsequently the summary level mean data, are all consolidated/company-specific data (it is not share class specific, like the NOSH data displayed on products is).

- *The above is only for per-share measures. Exclusions would be Dividend Per Share and Price Targets, which would be based upon NOSH for the particular share class.*

Example
To illustrate, here is an example using Viacom:

- NOSH data would display 549.503m for VIAB, and VIAB/1 has 57.364m number of shares outstanding; each security showing security-specific shares outstanding.
- Analyst research reports, and subsequently estimates data, would show 607m number of shares outstanding; showing consolidated/company level shares outstanding.

STOP, FILTER AND DELETION SCENARIOS

***Stop* - Results in a contributing analyst's estimates no longer being displayed on products.**

- The contributing analyst has dropped coverage.
- The contributing analyst is "restricted" on the stock.
- Estimate/recommendation has not been updated (confirmed or revised) for 180 days or more.
- Recommendation / Target Price under review

***Filter* - Contributing analyst's estimates are still displayed on products but are footnoted and excluded from the mean calculation.**

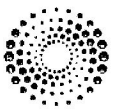
- Estimate is on a different accounting basis than the majority of contributing analysts.
- Estimate has not been confirmed or revised at the issuance of a company's earnings guidance and it is either outside of the guidance range or >5% of a single-point guidance value; applying only to the specific measure and period issued.
- Estimate is not on the majority basis pertaining to a corporate action or the estimate has not been updated to reflect a corporate action after the effective date.
- Quarterly estimates revised without a corresponding adjustment to the annual estimate (all other period estimates for the same year are filtered).
- Annual estimate revised without a corresponding adjustment to the quarterly estimates (all quarterly estimates for the same year are filtered).
- A Thomson Reuters Market Specialist has requested data verification and no response was received for more than 48 hours.
- Estimate is under review by the contributing analyst.
- Estimate has not been updated (confirmed or revised) for 105 days or more.
- After an actual is reported, an estimate is excluded from the mean if it is not or confirmed within 10 business days of a prior-period reported actual.
- Estimate is updated for post-Rights Issue prior to the ex-date.

***Deletion* - Estimate is removed from the database and history. The previous estimate becomes the current estimate.**

- Incorrect estimate was entered into the database (only if verified by published research).

TAX RATES

A quarterly estimate is only considered to be on a different basis with respect to taxes if some analysts are taxing the estimates and others are not. For example, if an analyst is not taxing their estimates and the other analyst is using a tax rate of 30%, those two estimates are on a different basis and one of them needs to be excluded from the mean calculation. On the other hand, if one analyst is using a tax rate of 20% and the other is using a tax rate of 33%, and there are no other basis issues, those estimates are on the same basis and should both be included in the mean.



THOMSON REUTERS

This holds true for an annual estimate as long as the analyst is using the same tax rate for the actuals that we are using. If the analyst is using a different tax rate for a reported period (different actual), then the annual estimate should be filtered. Any future quarters should remain unfiltered if they do not violate the quarterly rule above.

TREATMENT OF SMALL ESTIMATES REVISIONS

Thomson Reuters accepts data from contributors to varying degrees of precision. Most contributors provide estimates to 2 or 3 decimal places. The following are scenarios under which small estimates revisions would be treated:

Second Decimal Place

- An estimate revision that is less than 0.01, which *does not result* in a new value after rounding to the **second decimal place**, is treated as a confirmation of the existing estimate (i.e., it is not recorded in the Thomson Reuters I/B/E/S collection database as a revision and is not fed to products as a revision).
- An estimate revision that is less than 0.01 which *does result* in a new value after rounding to the **second decimal place** is treated as a revision and is fed to products as a revision.

Third Decimal Place *(in effect since June 15, 2009)*

- All estimates revisions that impact the **third decimal place** after rounding will now be recorded and fed to products as a revision, for select currencies, in order to provide additional estimates granularity for markets that are regularly impacted by very small revisions:
  - Australian Dollar (AUD)
  - Japanese Yen (JPY)
  - Malaysian Ringgit (MYR)
  - New Zealand Dollar (NZD)
  - Singapore Dollar (SGD)
  - South African Rand (ZAR)
  - South Korean Won (KRW)

Scenario 1: New estimate differs from the current estimate by less than 0.01, but *does not impact* the second decimal place after rounding.

Example 1 – Not Impacting Second Decimal Place

	ANALYST'S ESTIMATE		3+ DECIMAL PLACE PRODUCTS (I/B/E/S QFS, I/B/E/S HISTORY, REUTERS KNOWLEDGE, 3000 XTRA)			2 DECIMAL PLACE PRODUCTS (THOMSON ONE, FIRST CALL DATALINK)		
	Estimate	Revision Date	Estimate	Revision Date	Confirmation Date	Estimate	Revision Date	Confirmation Date
Existing	0.241	05-May-2009	0.241	05-May-2009	05-May-2009	0.24	05-May-2009	05-May-2009
New	0.244	03-Jun-2009	0.241	05-May-2009	03-Jun-2009	0.24	05-May-2009	03-Jun-2009

In Example 1, the new estimate is treated as a confirmation on all products since the change does not impact the second decimal place after rounding. No subsequent revision dates change, but confirmation date is updated.

Example 2 – Impacting Third Decimal Place - Select Currencies

	ANALYST'S ESTIMATE		3+ DECIMAL PLACE PRODUCTS (I/B/E/S QFS, I/B/E/S HISTORY, REUTERS KNOWLEDGE, 3000 XTRA)			2 DECIMAL PLACE PRODUCTS (THOMSON ONE, FIRST CALL DATALINK)		
	Estimate	Revision Date	Estimate	Revision Date	Confirmation Date	Estimate	Revision Date	Confirmation Date
Existing	0.241	05-May-2009	0.241	05-May-2009	05-May-2009	0.24	05-May-2009	05-May-2009
New	0.244	03-Jun-2009	0.244	03-Jun-2009	03-Jun-2009	0.24	03-Jun-2009	03-Jun-2009

In Example 2, the new estimate is treated as a revision on products displaying 3 decimal places since it is for one of the select currencies and it impacts the third decimal place after rounding. On products with 2 decimal places it appears as the same value since the second decimal place is not impacted, however the revision and confirmation dates are updated.

Scenario 2: new estimate differs from the current estimate by less than 0.01, but does impact the second decimal place after rounding.

Example 3 – Impacting Second Decimal Place

	ANALYST'S ESTIMATE		3+ DECIMAL PLACE PRODUCTS (I/B/E/S QFS, I/B/E/S HISTORY, REUTERS KNOWLEDGE, 3000 XTRA)			2 DECIMAL PLACE PRODUCTS (THOMSON ONE, FIRST CALL DATALINK)		
	Estimate	Revision Date	Estimate	Revision Date	Confirmation Date	Estimate	Revision Date	Confirmation Date
Existing	0.244	05-May-2009	0.244	05-May-2009	05-May-2009	0.24	05-May-2009	05-May-2009
New	0.246	03-Jun-2009	0.246	03-Jun-2009	03-Jun-2009	0.25	03-Jun-2009	03-Jun-2009

In Example 3, the new estimate is treated as a revision on all products since it impacts the second decimal place after rounding.

GLOSSARY OF ESTIMATES DATA MEASURES

Product-Level Measures

Key Performance Indicator Description	Relevant Industries	Measure Code	Measure Abbreviation
Pharmaceutical Sales	Drug Manufacturers	SAL	PS
Same Store Sales	Retailers, Restaurants, Lodging	SSS	SS

Pharmaceutical Sales

Pharmaceutical Sales represents the revenue associated with individual pharmaceutical drug unit products.

- Thomson Reuters collects reported company results and forecasted sales estimates on a quarterly and annual basis for pharmaceutical companies globally.
- Estimates data available on both a detail analyst as well as summary mean level.

- Thomson Reuters links these drugs on multiple levels depending on the business relationship, chemical ingredients and purpose associated with each - allowing not only specific forecast data for each separate drug but also aggregate sales of generic ingredients and instances where global revenues are shared as a joint venture between companies.

Same Store Sales

Same Store Sales represents a percentage sales growth for retail stores and restaurants that have been open for more than one year. Same Store Sales allows investors to decipher what portion of sales growth is due to true retail growth and what portion is due to new store openings.

- Thomson Reuters collects reported company results and sales growth forecasts on a monthly, quarterly and annual basis for North American companies.
- Estimates available on a store line as well as consolidated basis, where available.
- Estimates data available on both a detail analyst as well as summary mean level.
- Companies followed include discount retailers, department stores, specialty retailers, casual dining, quick serve restaurants and more.

Company-Level Measures

Data Measure Description	Primary Consolidated Code	Secondary Consolidated Code	Primary Parent Code	Secondary Parent Code
Book Value Per Share	BPS	SBP	BPSPAR	SBPPAR
Capital Expenditure	CPX	SPX	CPXPAR	SPXPAR
Cash Flow Per Share	CPS	SCP	CPSPAR	SCPPAR
Dividend Per Share	DPS			
Earnings Before Interest & Taxes (EBIT)	EBI	SBI	EBIPAR	SBIPAR
Earnings Before Interest, Taxes, Depreciation & Amortization (EBITDA)	EBT	SBT	EBTPAR	SBTPAR
Earnings Per Share	EPS	SEP	EPSPAR	SEPPAR
Earnings per Share - Alternate	EPX			
Earnings per Share - Before Goodwill	EBG	SBG	EBGPAR	SBGPAR
Earnings per Share - Cash	CSH	SCS	CSHPAR	SCSPAR
Earnings per Share - Fully Reported / GAAP	GPS	SGP	GPSPAR	SGPPAR
EBITDA Per Share	EBS	SEB	EBSPAR	SEBPAR
Enterprise Value	ENT	SNT	ENTPAR	SNTPAR
Funds From Operations Per Share	FFO	SFO	FFOPAR	SFOPAR
Gross Profit Margin	GRM	SGM	GRMPAR	SGMPAR
Long Term Growth Rate (%)	LTG			
Net Asset Value	NAV	SAV	NAVPAR	SAVPAR
Net Debt	NDT	SND	NDTPAR	SNDPAR
Net Income	NET	SNI	NETPAR	SNIPAR
Operating Profit	OPR	SOP	OPRPAR	SOPPAR
Pre-tax Profit	PRE	SPR	PREPAR	SPRPAR
Price Target	PTG			
Recommendation	REC			
Return on Assets (%)	ROA	SOA	ROAPAR	SOAPAR
Return on Equity (%)	ROE	SOE	ROEPAR	SOEPAR
Revenue	SAL	SSA	SALPAR	SSAPAR

**While EPS, Revenue, Price Target and Recommendations are the most popular measures contributed, analysts are free to contribute forecasts for any or all of the collected data metrics specified above. Thomson Reuters doesn't require any minimums in terms of collected data measures, and is willing to accept all metrics a broker provides.*

**For companies followed on both a parent and consolidated basis (see the Parent/Consolidated Indicator section), both Primary and Secondary data measures are available. The markets where two-basis measures are usually available include India, Japan, South Korea, Taiwan, and Thailand.*

Book Value per Share (BPS)

A company's common stock equity as it appears on a balance sheet equal to total assets minus liabilities, preferred stock, and intangible assets such as goodwill, divided by the weighted average number of total shares outstanding for the year. This is how much the company would have left over in assets per share after all debts are paid, if it went out of business immediately. Thomson Reuters provides both expected and actual BPS data (where available).

Capital Expenditure (CPX)

Funds used by a company to acquire or upgrade physical assets such as property, industrial buildings, or equipment or the amount used during a particular period to acquire or improve long term assets such as property, plant, or equipment. Thomson Reuters provides both expected and actual CPX data (where available).

Cash Flow per Share (CPS)

Cash Flow per Share is a corporation's cash flow from operations, before investing and financing activities, divided by the weighted average number of common shares outstanding for the year. Investing includes the sale or purchase of land, factories, buildings etc.

- Financing includes dividend payments, loan proceeds and sale of stock. Thomson Reuters provides both expected and actual CPS data (where available).
- Interest payments are an operating activity.
- Thomson Reuters CPS is a company's Operating Cash Flow. The basic formula is Operating Cash flow less maintenance capital = Distributable Cash flow per unit.
- CPS is generally calculated after-tax.
- Thomson Reuters does not have DCFPU (Distributable Cash Flow per Unit) as a measure. This is something to consider as an industry specific measure as well as payout ratio. If the company does not provide operating cash flow, Thomson Reuters will collect the DCFPU estimate and place it in the CPS filtered with "A" for accounting difference.

Dividend per Share (DPS)

DPS are a corporation's common stock dividends on an annualized basis, divided by the weighted average number of common shares outstanding for the year. In the US dividend per share is calculated before withholding taxes (though for some non-US companies DPS is calculated after withholding taxes). Thomson Reuters provides both expected and actual DPS data (where available).

- Thomson Reuters DPS is equivalent to Cash Distribution (not the same as Distributable Cash Flow per Unit.)
- For DPS estimates a "0" is a valid estimate, indicating no expected dividend payment for a company. The absence of any estimate or a "stopped" estimate indicates that a contributor does not have any DPS estimate.

Earnings per Share (EPS)

Valuation earnings per share, defined as the EPS that the contributing analyst considers to be that with which to value a security. This figure may include or exclude certain items depending on the contributing analyst's specific model. Estimates that are not on the majority basis for a given security are displayed on certain Thomson Reuters products but filtered from the mean calculation. Thomson Reuters provides both expected and actual EPS data where available.

Earnings per Share - Alternate (EPX)

Alternate EPS is a corporation's net income from continuing operations, divided by the weighted average number of shares outstanding. This measure tracks the estimates of contributing analysts who wish to forecast EPS on the non-majority basis. This alternate basis is not included in the mean calculation; it is filtered from the main EPS data measure. This data measure therefore, will not have corresponding Summary-Level (mean), nor actuals data.

Earnings per Share - Before Goodwill (EBG)

EBG measures a company's per share earnings before the amortization of goodwill. In some countries (France, for example) goodwill is treated as a part of ordinary income for companies and the amortized component of goodwill is added back to yield earnings before goodwill amortization. EBG is a corporation's net income from continuing operations before goodwill amortization divided by the weighted average number of shares outstanding. Thomson Reuters provides both expected and actual EBG data (where available).

- Due to the implementation of International Financial Reporting Standards (IFRS) in various European countries, goodwill will no longer be amortized but instead written off as an impairment charge and will be treated as an exceptional item. This change eliminates the necessity for a separate EBG measure for companies residing in those countries. In such markets, Thomson Reuters will only collect and display EPS and GPS (valuation EPS and fully-reported EPS).

Earnings per Share - Cash (CSH)

Cash Earnings Per Share is a company's net income, plus depreciation, amortization of goodwill, intangibles, and prepaid assets (non-cash items); divided by weighted average number of shares outstanding. Thomson Reuters provides both expected and actual CSH data (where available).

Earnings per Share – Fully Reported / GAAP (GPS)

Statutory or reported earnings per share, defined as net profit (on continuous activities) divided by the weighted average number of shares outstanding during the period. Where a company carries exceptional items or goodwill amortization, this measure is post-exceptional, post-goodwill. Thomson Reuters provides both expected and actual GPS data (where available).
In North America this figure is referred to as GAAP Earnings per Share and is calculated according to Generally Accepted Accounting Principles (GAAP), which is reported in SEC filings. The mean estimate for the GPS data measure will only reflect the strict adaptation of GAAP basis estimates. Estimates from contributors on an adjusted GAAP basis will be displayed but footnoted and filtered from the mean, even if the adjusted basis is the majority. A-type footnotes will include as much information as possible regarding the difference in accounting basis from the strict GAAP basis. This policy may result in the majority of estimates being filtered under GPS if the majority basis is an adjusted GAAP basis.

In countries that have adopted International Financial Reporting Standards (IFRS) this figure will include all items according to IFRS rules.

EBIT / Earnings Before Interest & Taxes (EBI)

EBIT represents the earnings of a company before interest expense and income taxes paid. As such, EBIT is a gauge of corporate earnings before any debt servicing to creditors (including bondholders) and the payment of corporate taxes. It is calculated in general form by taking the pretax corporate income of a company, adding back interest expense on debt, and subtracting any interest capitalized. Thomson Reuters provides both expected and actual EBIT data (where available).

- Displayed in whole number terms (millions).
- In certain European and Asian markets, EBIT is calculated as total sales and subtracting total costs and operating expenses. In these cases EBIT will be similar to Operating Profit.

EBITDA / Earnings Before Interest, Taxes, Depreciation & Amortization (EBT)

EBITDA gauges the raw earnings power of a company before debt servicing, corporate taxes, and any allowances made for depreciation and amortization costs the company faces. It is calculated in general form by taking the pretax corporate income of a company, adding back any depreciation and amortization costs charged, plus any interest expense on debt (subtracting any capitalized interest). Thomson Reuters provides both expected and actual EBITDA data (where available).

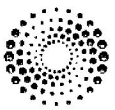
- Displayed in whole number terms (millions).
- In the United Kingdom, the general market standard is to include royalties as part of gross revenue, net of royalty tax. This tax portion would be included as part of the royalties, and would therefore be deducted before EBITDA, rather than as part of the income taxes lower down the income statement.

EBITDA per Share (EBS)

EBITDA per share represents EBITDA divided by the weighted average number of shares outstanding. Thomson Reuters provides both expected and actual EBS data (where available).

Enterprise Value (ENT)

Enterprise Value is calculated as market capitalization plus debt, minority interest and preferred shares, minus total cash and cash equivalents. Cash equivalents are defined as an item on the balance sheet that reports the value of a



company's assets that can be converted into cash immediately. Examples of cash and equivalents are bank accounts, marketable securities and Treasury bills. An Enterprise Value actual is calculated using the closing price at the end of the fiscal period. Thomson Reuters provides both expected and actual ENT data (where available).

Funds from Operations per Share (FFO)

A measure used by real estate and other investment trusts to define the cash flow from trust operations. It is earnings with depreciation and amortization added back. A similar term increasingly used is Funds Available for Distribution (FAD), which is FFO less capital investments in trust property and the amortization of mortgages. Thomson Reuters provides both expected and actual FFO data (where available).

Gross Margin (Gross Profit Margin) (GRM)

A company's total sales revenue minus cost of goods sold, divided by the total sales revenue, expressed as a percentage. Thomson Reuters provides both expected and actual GRM data (where available).

Long Term Growth Rate (%) (LTG)

The long term growth rate represents an expected annual increase in operating earnings over the company's next full business cycle. These forecasts refer to a period of between three and five years, and are expressed as a percentage.

Long term growth rate forecasts are received directly from contributing analysts; they are not calculated by Thomson Reuters. While different analysts apply different methodologies, the Long Term Growth Forecast generally represents an expected annual increase in operating earnings over the company's next full business cycle. In general, these forecasts refer to a period of between three to five years. Due to the variance in methodologies for Long Term Growth calculations, Thomson Reuters recommends (and uses as its default display) the median value for Long Term Growth Forecast as opposed to the mean value. The median value (defined as the middle value in a defined set of values) is less affected by outlier forecasts.

Net Asset Value (NAV)

Net Asset Value is the total book value of a company's securities. It is calculated in general form by taking the total assets of a company and subtracting the value of the company's intangible assets (goodwill, patents, etc.) minus current and long-term liabilities. NAV is helpful in determining under-priced equities by indicating the ultimate value of a company's securities in the event of their liquidation. Thomson Reuters provides both expected and actual NAV data (where available).

- Displayed in whole number terms (millions).
- As NAV is not a measure companies generally report in filings or press releases, Thomson Reuters calculates NAV actual data as total shareholders equity including minority share or total assets minus total liabilities.

Net Debt (NDT)

Net Debt is calculated as short and long term interest bearing debt minus cash (and equivalents). Thomson Reuters provides both expected and actual NDT data (where available).

Please note the examples below:

Rule: If debt is greater than cash, the value collected will be a positive number in the database.
From the balance sheet.

Cash and Equivalents	$175
Short and Long Term Debt	$400
Net Debt =	$400 – 175
NDT =	$225

Rule: If debt is less than cash then the value collected will be a negative number in the database.
From the balance sheet.

Cash and Equivalents	$300
Short and Long Term Debt	$250
Net Debt =	$250 – 300
NDT =	($50)

Net Income (NET)

Net income is defined as a corporation's after-tax income. This item varies significantly from market to market as regards the inclusion or exclusion of non-recurring items. In most markets, non-recurring items are backed out of net income and this measure is restricted to income from continuing operations only (also referred to as normalized income). Some markets (Japan, for example) apply reported net income, including any and all extraordinary items. Recent accounting changes in still other markets (particularly Southeast Asia) have resulted in a reclassification of extraordinary versus exceptional items, bringing many formerly extraneous items above the net income line. Thomson Reuters provides both expected and actual NET data (where available).

Operating Profit (OPR)

Operating Profit is the difference between a company's revenues and its costs and expenditures arising directly out of a company's regular operations. Operating Profit is calculated before any deductions in income owing to non-operating activities (generally such items as interest expense, corporate tax payments, material gains or losses arising from changes in accounting policy, and the like) and excludes any income derived from outside the firm's regular activities. Thomson Reuters provides both expected and actual OPR data (where available).

- Displayed in whole number terms (millions).
- In certain European and Asian markets, EBIT is calculated as total sales and subtracting total costs and operating expenses. In these cases EBIT will be similar to Operating Profit.

Pre-Tax Profit (PRE)

Pre-tax profit is a company's net income before tax expense. Where applicable, extraordinary items and non-recurring charges are subtracted from net income. Thomson Reuters provides both expected and actual PRE data (where available).

- In Japan, companies compliant with Japan Accounting Standards use Recurring Profit.

Price Target (PTG)

Price target is the projected price level forecasted by the analyst within a specific time horizon. Note that while detail-level data can be collected for various time horizons, Thomson Reuters summary-level mean data is only calculated for targets with 12-month time horizons.

Recommendation (REC)

The recommendation value reflects the contributing analyst's rating for a particular company.

Return on Assets (ROA)

Return on Assets is a profitability ratio and as such gauges the return on investment of a company. Specifically, ROA measures a company's operating efficiency regardless of its financial structure (in particular, without regard to the degree of leverage a company uses) and is calculated by dividing a company's net income prior to financing costs by total assets. Thomson Reuters provides both expected and actual ROA data (where available).

- **Displayed as a percentage.**

Return on Assets is calculated as follows:

$$\text{ROA (Return on Assets)} = \frac{\text{Net Income}}{\text{AverageTotalAssets}}$$

Return on Equity (ROE)

Return on Equity is another profitability ratio, which gauges return on investment by measuring how effectually the company is employing stockholder money. ROE is calculated by dividing a company's net income by total equity of common shares. Unlike ROA, ROE does consider the degree to which a company uses leveraging, as interest expense paid to creditors is generally deducted from earnings to arrive at Net Income. Thomson Reuters provides both expected and actual ROE data (where available).

- **Displayed as a percentage.**

Return on Equity is calculated as follows:

$$\mathrm{ROE(ReturnonTotal\,Equity)} = \frac{\mathrm{Net\ Income}}{\mathrm{AverageTotalEquity}}$$

Revenue (Sales) (SAL)

The Revenue measure is a corporation's net revenue, generally derived from core business activities. For non-financial companies, the calculation of net revenue (or net turnover) in most markets generally involves subtracting transportation and related operational costs from gross revenue/sales. Revenue recognition practices vary significantly from market to market, though generally the recording of revenue is based upon sales invoices issued (or anticipated for forecast purposes) during the accounting period.

For banks, revenue is generally defined as net interest income plus net non-interest income. Net interest income is defined as interest income minus interest expenses. Net interest income components generally include net interest earned on loans, reserve deposits and deposits with other banks, and net interest earned from inter-bank money market operations (IMMO) and marketable securities. Net non-interest income components generally include net income from fees and commissions, net gains from capital market and foreign exchange operations, and net income earned from participations.

For insurance companies, revenue is generally defined as net technical income plus net financial income. Net technical income is generally defined as technical income minus technical expenses. Technical income components generally include income from premiums and commissions received, re-insurer's share of claims paid, transferred net technical reserves, and re-insurer's share of technical reserves. Net financial income is generally defined as financial income minus financial expenses. Net financial income components generally include net interest income, net dividend income, and net foreign exchange gains. Thomson Reuters provides both expected and actual SAL data (where available).

Expected Returns on Stocks and Bonds

Investors must moderate their expectations.

Antti Ilmanen

The equity-bond risk premium—the long-run expected return advantage of stocks over government bonds—is one of the biggest questions in financial markets. The extent of the premium is widely debated, but it is reasonably clear that it declined in the last quarter of the 20th century, to partly rebound in the first years of the 21st century.

Our review provides a road map to the complex literature on the topic. We explain the key drivers of the risk premium and varying assumptions about them, letting investors themselves assess the long-run prospects for stocks versus bonds. Long-term government bond yields are known, while prospective equity returns are inherently less transparent and thus more open to question.

There is an ongoing shift in opinion about expected returns. Long-term equity premiums have traditionally been predicted from historical average asset performance assuming a constant risk premium, but today they are increasingly predicted with the help of dividend discount models, assuming time-varying expected returns.

We first review the historical average returns of major asset classes and explain why these are misleading guides for the future. Essentially, the double-digit returns of the 20th century were due to equities starting cheap and getting richer over time. Many investors extrapolated this past performance and expected (at least) as high future returns. Investors thus missed, first, the fact that a part of realized returns was unexpected windfalls from rising equity valuation multiples, and, second, that when starting from high valuation levels it is not reasonable to

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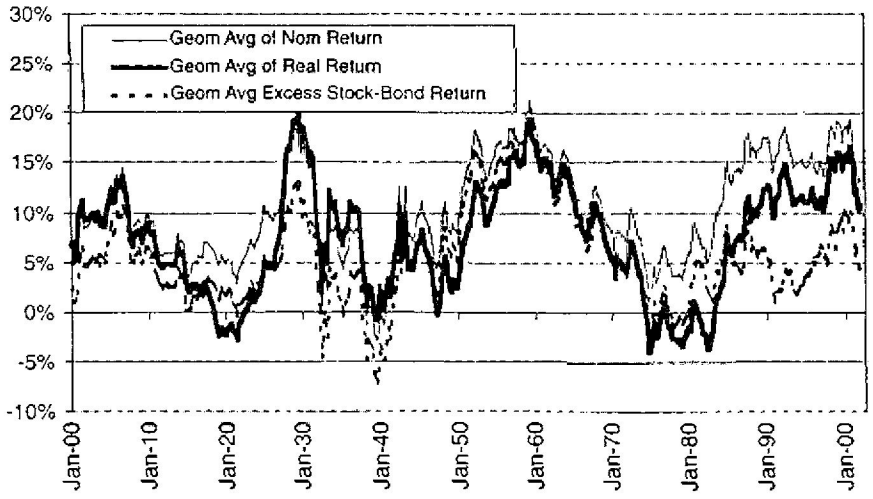
EXHIBIT 1
Road Map to Equity Risk Premiums—Alternative Means for Assessing Levels

	Historical Ex Post Excess Returns	Surveys	Ex Ante Models and Market Data
Means of Assessing the Equity-Bond Risk Premium	Historical average is a popular proxy for the ex ante premium – but likely to be misleading.	Investor and expert surveys can provide direct estimates of prevailing expected returns/premiums.	Current financial market prices (simple valuation ratios or DDM-based measures) can give most objective estimates of feasible ex ante equity-bond risk premiums.
Problems/ Debated Issues	Time-variation in required returns and systematic selection and other biases have boosted valuations over time, and have exaggerated realized excess equity returns compared with ex ante expected premiums.	Limited survey histories and questions of survey representativeness. Surveys may tell more about hoped-for expected returns than about objective required premiums due to irrational biases such as extrapolation.	Assumptions needed for DDM inputs, notably the trend earnings growth rate, make even these models' outputs subjective. Range of views on this growth rate (plus debates on relevant stock and bond yields) => range of premium estimates.

EXHIBIT 2
Moving Average of 10-Year Stock Market Performance 1900–2001



Sources: Ibbotson Associates, Arnott (private correspondence), Shiller website, and Schroder Salomon Smith Barney.

expect as high returns as in the past.

The painful lessons of the recent bear market have made investors more aware of forward-looking expected return measures; the starting price matters. Since market yields give good proxies for the expected returns of long-term bonds, the question of the ex ante equity-bond premium boils down to the ex ante equity return. The dividend discount model (DDM) shows that in the absence of predictable valuation changes (often a good base case), feasible long-run equity return is the sum of dividend yield and a long-run earnings growth rate.[1]

We stress the distinction between two types of expected returns—objectively feasible long-run returns, and subjective return expectations—as well as the balance between them. Objectively high feasible returns are bullish for equities, while excessive subjective investor expectations are bearish, because high hopes make future disappointment more likely.

Neither expected return can be directly observed, but we attempt to estimate them by analyzing historical returns, investor surveys, and market valuation indicators (*see Exhibit 1*). Surveys provide direct estimates of changing return expectations, but they may reflect hoped-for returns as much as required returns.[2]

As of the time of writing in mid-2002, long-term bond yields are 4%–5%, and the DDM suggests feasible long-run equity returns between 5% and 8% (depending on input assumptions). There may still be an imbalance between the objective return prospects and subjective expectations that we put between 8% and 10%. The gap has narrowed significantly from the year 2000 when feasible returns were even lower (due to higher valuation multiples), while subjective return expectations were well into double-digits.[3]

PITFALLS OF BACKWARD-LOOKING RETURNS

The 20th century was the century of equities. Dimson, Marsh, and Staunton [2002] review the 1900-2000

asset returns in 16 countries, and conclude that in all markets stocks handily outperformed bonds and cash. We extend the data to include the 2001 experience, and discuss primarily the U.S. market history.

Even after large losses in the last two years, U.S. equities' average real returns over the 1900–2001 period are 6.5%, with excess return over long-term government bonds of 4.8 percentage points.[4] Looking at just the 1950–1999 period, stocks did even better, outperforming bonds by 7.7 percentage points per year. For comparison, the excess return of equities over bonds was much slimmer (0.5 percentage point) in the 19th century (1802–1899), while the realized average real equity return was similar (6.2%) (see Siegel [1998] and Arnott and Bernstein [2002]).[5]

Exhibit 2 plots the ten-year average compound returns of stocks since 1900—comparing nominal returns, real returns, and excess returns over bonds. In some studies, equity performance is expressed in raw returns, while in others the inflation rate or long-term bond return (or short-term bill return) is subtracted from it. Another distinction is between compound (geometric) average returns and simple (arithmetic) average returns.

Given that the United States has been the world's most successful economy of the past two centuries, it is not surprising that real equity returns have been somewhat lower in most other markets. For example, the average real equity returns for the other G-5 markets over the 1900–2001 period range between 3.4% (Germany) and 5.6% (the United Kingdom). Hyperinflation experiences make excess stock returns versus government bonds harder to gauge.

Did Realized Returns Exaggerate Expected Returns?

A consensus is emerging that the high long-term returns on equities, relative to bonds, are unlikely to persist. The 20th century was favorable to stocks and unfavorable to bonds. Improved valuations boosted ex post equity returns, while rising inflation expectations and real yields hurt bonds. Thus, the realized return gap almost surely exaggerates the expected return gap investors actually required (in the past, let alone after the decline in required returns).

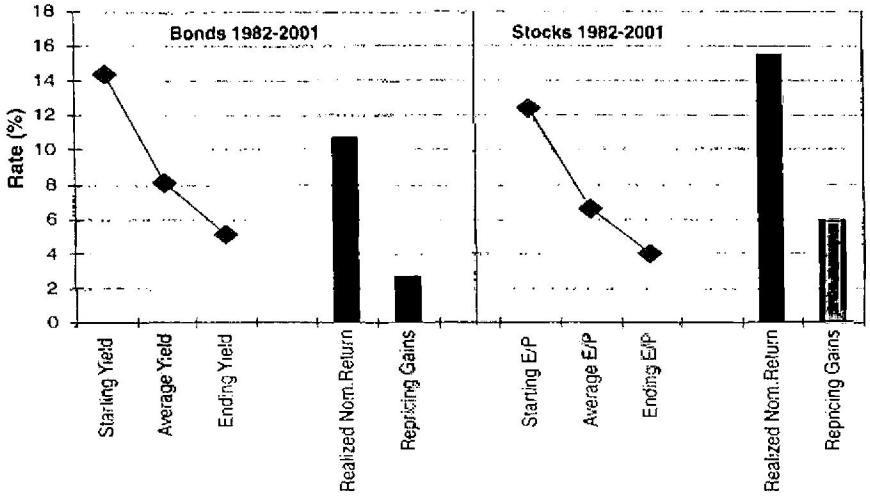
- Various systematic biases make it likely that the publicized realized equity market returns from historical studies exceed the returns that were anticipated—notably survivorship bias, easy data bias, and the so-called peso problem (see Dimson, Marsh, and Staunton [2002] and Fama and French [2002], among others).
- Survivorship bias raises the odds that we examine countries that have had good capital market performance (say, the current G-5 as opposed to Russia, Austria-Hungary, India, Turkey, or Argentina).
- Easy data bias makes it likely that we start samples after unusual events (war, hyperinflation, market closure), which often means that assets are cheap at the start of the period and that no comparable turmoil occurs again during the period.
- The peso problem literature recognizes that past U.S. market pricing was influenced by what could have happened but did not.[6] With hindsight we know that the United States and its market economy survived two world wars, the Cold War, and the Great Depression, and did not suffer the hyperinflation, invasion, or other calamities of many other countries. This was not a forgone conclusion at the time, so it is little wonder that realized equity returns have been boosted by a repricing effect.

Despite these arguments, it is common to use historical excess returns as a proxy for the ex ante risk premium; indeed this is the approach taken in most investment textbooks. Historical average returns equal expected returns, however, only if expected returns are constant, and if unexpected returns from trendwise valuation changes do not distort the within-sample results. Such valuation changes can materially impact average realized returns even over long sample periods—and indeed they have done so in the 20th century. Thus the crucial distinction between realized (ex post) average excess returns and expected (ex ante) risk premiums.

Bond investors understand better than equity investors the folly of extrapolating expected returns from past average returns drawn from a time when valuation levels have trended up or down. A rally—high realized returns—caused by falling discount rates will reduce future yields (feasible expected returns), rather than raise them.

The example in Exhibit 3 shows that between 1982 and 2001 ten-year Treasury yields averaged 8.1%, but the realized annual return was 10.7% because the downtrend in yields (from 14.4% to 5.1%) added almost 3 percentage points of annual capital gains to the yield income. Using the 10.7% realized annual return or even the 8.1% average yield as an expected return proxy makes little sense

EXHIBIT 3
Bond and Stock Market Repricing Gains Due to Falling Discount Rates Between 1982 and 2001



Source: Schroder Salomon Smith Barney.

now that the yield is 5%. The transparency of market yields prevents bondholders from harboring excessive return expectations after a long bull market.

Exhibit 3 shows that the revaluation effect was even greater for equities. The earnings-to-price (E/P) ratio fell from 12.4% to 4.0% in 20 years; that is, the market paid 3.1 times more for a given amount of dollar earnings at the end of 2001 than at the end of 1981. This repricing explains almost 6 percentage points of the S&P 500's 15.5% realized annual return (11.8% real). Again the realized average return clearly exceeds the forward-looking return that was feasible in the 1980s, let alone now. Unfortunately, most equity investors may have focused more on historical returns than on forward-looking returns.

Repricing: Valuation-Neutral Sample or Adjusted Realized Returns

If required returns vary over time, past average returns may be poor predictors of future returns. We try to recover the past average expected returns using two approaches—by selecting a sample period when valuation changes were minimal, and by adjusting realized returns for the estimated repricing impact.

We first focus on a relatively valuation-neutral subperiod—1960-2001. Realized average returns can be dominated by unexpected capital gains/losses even over long sample periods if markets undergo significant valuation changes. Indeed, starting from 1900 or 1950, D/P and E/P ratios have fallen dramatically, while bond yields have risen. These within-sample changes are much smaller between 1960 and 2001, which means that future expected return extrapolations from this subperiod should be less distorted.

The 3.3 percentage point excess return in the United States falls short of the 4.8 percentage points for the 1900-2001 period. During the same period, the excess returns in Germany and Japan (1.1 and 0.0 percentage points) are even slimmer as real equity returns have been lower and real bond returns higher than in the U.S.

These average returns conceal significant time variation in market performance. Besides the equity correction of 2000-2002, these numbers show that equities can underperform long bonds over a period as long as a decade (Germany in the 1970s, Japan in the 1990s). In Japan, the realized excess return over the past 30 years is now negative. Because such a sustained underperformance did not take place in the United States in the last century, many investors took the idea of equities' long-run superiority too far, and believed that equities will always beat bonds over a 20- to 30-year horizon.

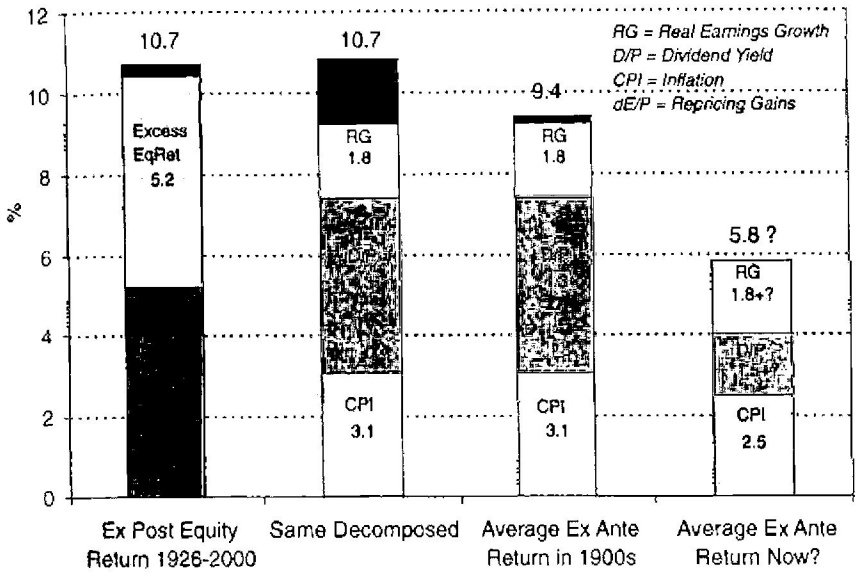
By now it is clear that all statements about the probability of stocks beating bonds were distorted by the favorable sample period, and that the outperformance odds are much slimmer now, given the narrower equity-bond premium.

Alternatively, we can pick any sample period and adjust the returns for unexpected capital gains. Several recent studies take this approach, notably Dimson, Marsh, and Staunton [2002], Fama and French [2002], and Ibbotson and Chen [2002]. Each study uses a slightly different way to remove the impact of unexpected capital gains to recover the typical expected equity risk premium over the sample period. All three studies find (adjusted) expected equity-bond risk premium near 4 percentage points in the United States, averaged over very long histories.

Moving Toward Forward-Looking Expected Returns

Exhibit 4 shows how Ibbotson and Chen [2002] decompose the realized 75-year average compound stock

EXHIBIT 4
Decomposition of 1926–2000 Equity Market Returns



Sources: Ibbotson-Chen [2002], Schroder Salomon Smith Barney.

market return of 10.7% into demanded or supplied parts. The total return is split either into:

- A sum of demanded returns on the assumption that sample averages capture required returns well (5.2% nominal Treasury bond return + 5.2% ex post equity risk premium + small interaction/reinvestment terms), or into:
- A sum of supplied returns (3.1% inflation + 4.3% dividend yield + 1.8% real earnings growth rate + 1.3% repricing effect + small interaction/reinvestment terms).

The third column in Exhibit 4 removes from the supplied returns the unexpected repricing effect (1.3%, the annualized impact of the within-sample change in E/P ratio). The study concludes that investors required a nominal equity market return of 9.4% between 1926 and 2000, on average.

Analysis of *past average* levels can be a misleading guide for the future when current dividend yields and inflation expectations are much lower than the sample average. It misses the point that if expected returns and valuations vary over time, historical averages incorporate limited information about medium-term market prospects. Using strictly the dividend yield and inflation expectations from mid-2002 together with the historical real earnings growth rate, in the spirit of the DDM, the prospective long-term equity market return is below 6%. The implicit equity-bond premium is about 1 percentage point.

The question marks in the last column in Exhibit 4 are related to debates that we review below.

The ongoing shift from constant risk premiums and rational investors to time-varying risk premiums and partly irrational investors means that forward-looking (ex ante) returns are gaining ground over historical (ex post) returns. This change is moderating experts' and investors' perceptions of prospective long-run equity returns and equity-bond premiums, given that the fourth column in Exhibit 4 (ex ante return) is much lower than the first column (ex post return).

Survey Evidence on Subjective Return Expectations

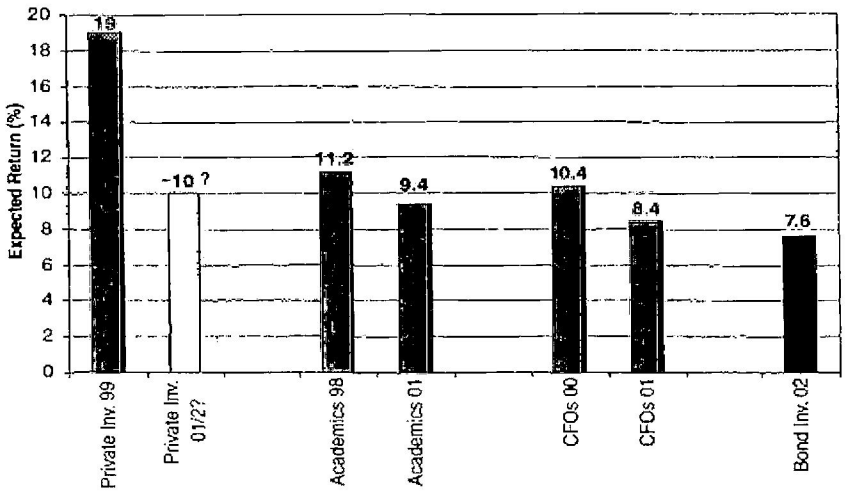
There is a dichotomy between *objectively feasible* return prospects and less rational *subjective* expectations. To provide direct evidence on subjective return expectations, Exhibit 5 summarizes survey views on nominal long-term equity returns from various sources.[7]

Private investors' subjective return expectations were especially high in the late 1990s. Poterba [2001] quotes a broad Gallup poll from 1999 when the consensus of private investors expected 19% annual returns over the long term. Presumably these were deemed moderate expectations after five years of 20%–40% annual returns.

No follow-up surveys tell us how much these excessive expectations have fallen, but we would guess to around 10%. Consensus forecasts in one-year-ahead surveys seem to center around 10% (but dropped in summer 2002 below 8%), while many U.S. pension funds continue to budget well over 10% annual equity returns.

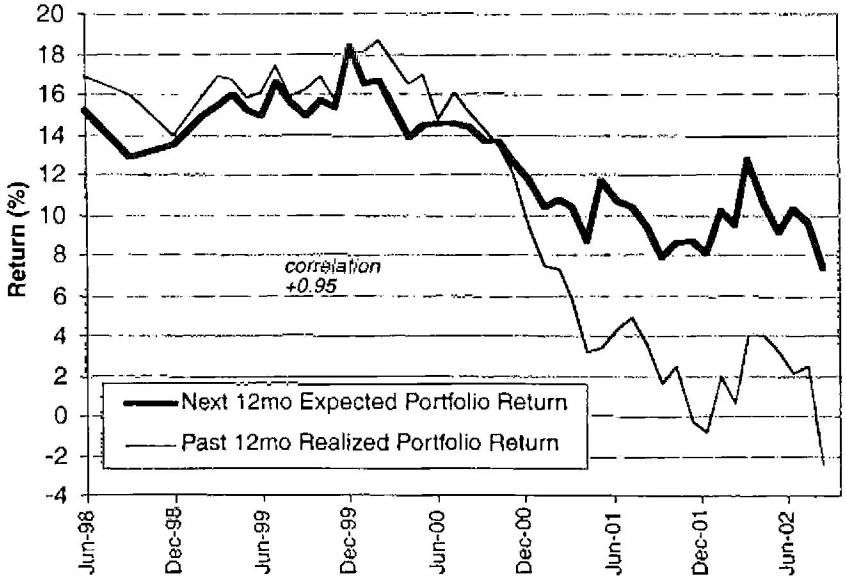
Two surveys of different U.S. experts—finance and economics professors by Welch [2000, 2001] and CFOs and treasurers by Graham and Harvey [2001]—imply long-run equity returns of 8%–9% and stock-bond risk premium estimates of 3.5 to 4.5 percentage points. The equity return forecast in the CFO survey has stabilized at around 8.2% to 8.3% in 2002.

EXHIBIT 5
Survey Forecasts of Long-Term Nominal Expected Returns of U.S. Equities



Sources: Graham and Harvey [2001], Peterba [2001], Welch [2001], and Schroder Salomon Smith Barney.

EXHIBIT 6
Individual Investor Extrapolative Return Expectations—June 1998–August 2002



Sources: Gallup/UBS Paine Webber Survey of Index of Investor Optimism.

Our own survey in April 2002 of global bond investors comes up with the most cautious views on future equity market returns. The mean forecast for next-decade average equity market return is 7.6% for the United States. Compared with bond yields of around 5.2%, these forecasts imply a stock-bond risk premium of 2.4 percentage points.

Are these survey-based risk premium estimates useful proxies for the equity risk premium that the market requires? One can always question how representative any survey is of market views. More important, because of behavioral biases, survey-based expected returns may tell us more about hoped-for returns than about required returns.

Private investor surveys appear especially prone to extrapolation (high hopes after high returns); witness the striking 95% correlation between the past year's returns and next year's expected returns in Exhibit 6. Even the expert surveys are not free from this bias, as consensus views of future risk premiums have edged lower amid poor market performance.[8]

Given the tendency of investors to extrapolate from past returns, the danger of exaggerated expectations and the scope for subsequent disappointment were especially high after two decades of double-digit returns. To quote Dimson, Marsh, and Staunton [2002, p. 4]:

> The most fundamental question of all is: Do investors realize that returns are likely to revert to more normal levels, or do current valuations embody exaggerated expectations based on imperfect understanding of history?

Survey data indicate that investor expectations have corrected lower in the past two years—but it is not possible to say whether the adjustment has gone far enough.

How High Should the Equity-Bond Risk Premium Be?

There is also a normative question about the appropriate size of the equity risk premium, but academic theories provide limited guidance. In the context of the capital asset pricing model, the required market risk premium

should reflect the *price* of risk (market risk aversion) and the *amount* of risk (stock market volatility). Other asset pricing models relate the required risk premium to asset return covariances with consumption; intuitively, the risk premium should be high for assets that perform poorly in bad states of the world when losses hurt most (economic downturns with high marginal utility and low consumption).

Given the low observed correlations between equity returns and consumption data, popular utility functions need extremely high risk aversion coefficients to justify the high observed equity risk premium; see Mehra and Prescott [1985]. Academics have proposed various solutions to this equity premium puzzle—alternative utility functions and market imperfections—but there is little agreement on the topic.

While the academic consensus has been shifting from constant risk premiums to time-varying expected returns, opinions vary about the source of the variation: rational time variation in required risk premiums or irrational fluctuations in market sentiment. We believe that both matter.

Because stock prices can be viewed as discounted values of expected future cash flows, it is an accounting identity that higher stock prices and realized returns reflect higher earnings growth expectations or lower required returns. Both factors likely contributed to the run-up in stock prices in the 1990s. The growth optimism was based on a range of factors from real evidence on higher productivity to irrational hopes about the Internet and the new economy (see Asness [2000a] and Shiller [2000]).

Here we focus on a host of possible reasons for the 1990s fall in required equity returns:

- Declines in riskless Treasury yields that contribute to equity discount rates.
- Changing risk—Output volatility and earnings volatility have fallen during past decades; recessions are less frequent (as well as shorter and shallower); monetary and fiscal policies are more stable; improved regulatory and legal infrastructures arguably make transactions safer; and world wars and the Cold War are history.
- Changing risk aversion—Consumer surveys reveal a fall in perceived risk aversion that may be attributed to wealth-dependent risk tolerance or demographic developments. Lower risk and risk aversion are intertwined in many arguments.
  —Higher realized volatility and market losses may remind investors of their risk aversion. Many authors contrast investor caution about equities after the depression of the 1930s with the market-dips-are-buying-opportunities mentality in the 1990s. The optimistic spin is that investors learned in the 1980s–1990s about the consistency of equity long-horizon outperformance, and that this learning enhanced investors' risk tolerance and thereby slimmed equities' required return cushion over less risky assets.
  —Lower trading costs, better market access, greater global diversification opportunities, and negative stock-bond correlations enabled investors to reduce the systematic risk in their portfolios, which in turn raised investors' willingness to take risks.

Some of these factors have reversed since 2000. Although macroeconomic volatility remains low by historical standards, financial market volatility has been extremely high, and perceived risks have risen since September 11, 2001, and various corporate scandals. Sharp falls in share prices certainly have reminded investors of the innate riskiness in equity investing and brought investors closer to their subsistence levels, thereby raising the risk aversion level. If investors perceived, say, a 2 percentage point equity-bond premium sufficient three years ago, we suspect they would now require twice as high compensation for bearing equity risks. Finally, the latest declines in government bond yields appear related to bonds' safe-haven characteristics and should not help reduce the equity discount rates.[9]

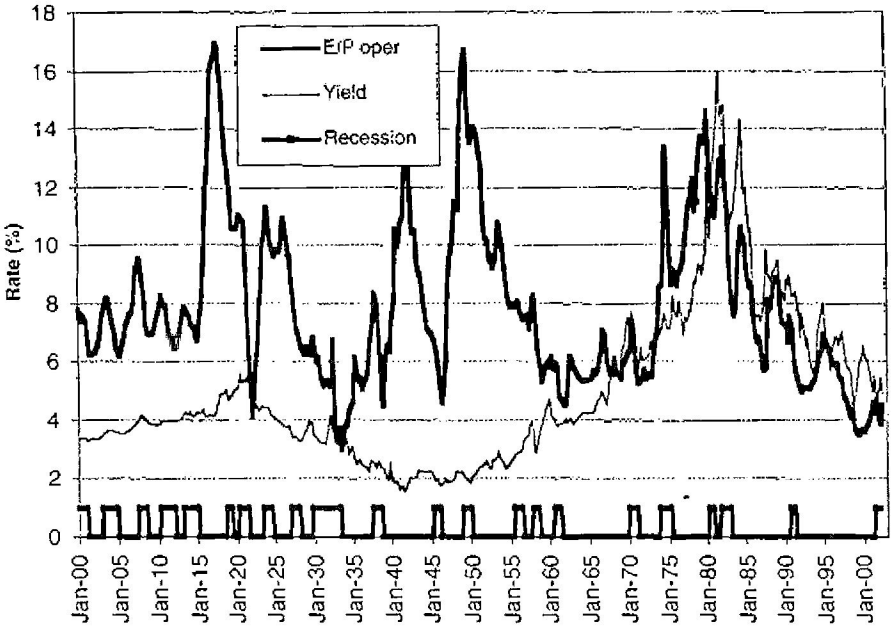
SIMPLE VALUATION RATIOS AS EQUITY-BOND PREMIUM PROXIES

A stock market's price-earnings (P/E) ratio is the most popular pure-equity valuation indicator. Similarly, the ratio of government bond yield (Y) over earnings yield (E/P) is the most popular relative valuation measure for the two major asset classes and thus a shorthand for the equity-bond premium. (Sometimes the earnings yield spread is used instead of the yield ratio, but the broad patterns tend to be similar.)

Lower Bond Yields Explain Lower Earnings Yields

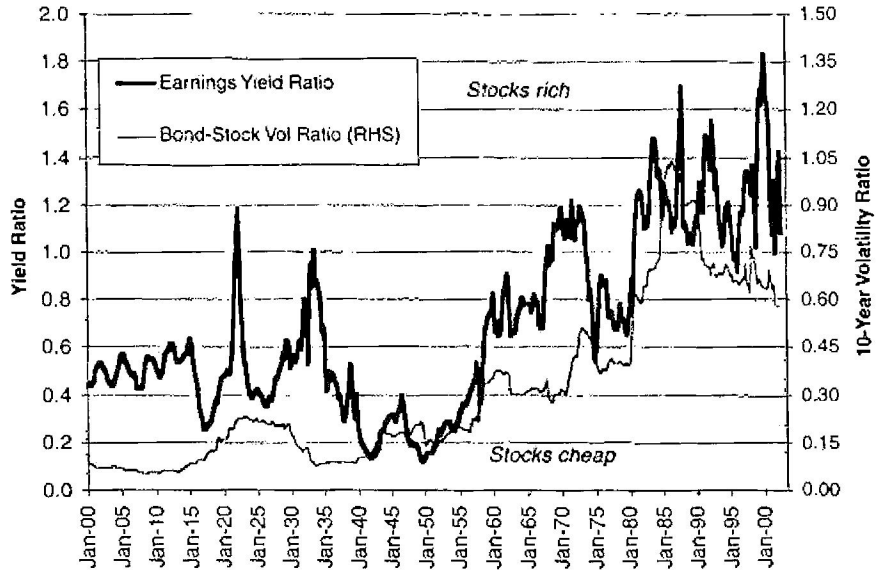
Exhibit 7 shows the history of earnings yield and the ten-year government bond yield for over one century. We focus on the earnings yield rather than its reciprocal

EXHIBIT 7
Earnings Yield of S&P 500 (Operating Earnings) and 10-Year Treasury Yield, 1900–June 2002



Sources: Ibbotson Associates, NBER, Arnott, Shiller website, and Schroder Salomon Smith Barney.

EXHIBIT 8
Bond-Earnings Yield Ratio and Bond-Stock Volatility Ratio 1900–June 2002



Sources: Ibbotson Associates, NBER, Arnott, Shiller website, and Schroder Salomon Smith Barney.

(P/E), because the former is a rate of return measure, akin to a bond yield. Unless otherwise stated, our earnings yield refers to the trailing one-year operating earnings per share of the S&P 500 index and its predecessors.[10]

The broad picture is that the earnings yield has ranged between 4% and 16%, but has been near historical lows for the past few years. Bond yields traded between 2% and 6% for the first 70 years, then hit a 16% peak in the early 1980s, followed by a decline to 4%–5% in 2002. Bond yields traded systematically below earnings yields for most of the century, but traded above them for the last two decades. The measures at the foot of the graph show the timing of the increasingly rare official recessions.

While earnings yields and bond yields were hardly related until 1960, since then they have shared common uptrends and downtrends. Exhibit 8 plots the yield ratio of the Treasury yield over the earnings yield. This ratio is high when stocks are expensive versus bonds, in the sense that bond yields exceed earnings yields.

For the last 20 years, this ratio has been neatly mean-reverting, providing good relative-value signals for asset allocation trades between stock and bond markets. Over this period, we can say that lower bond yields explain lower earnings yields (higher equity market valuations). This is not surprising, because bonds are the main competing asset class for equities, and the bond yield constitutes the riskless part of equities' discount rate.

But what are we to make of the long-run trends in the yield ratio? If we cannot explain them, we may deem the last 40 years' close relation between stock and bond yields as spurious, perhaps related to the broad rises and falls in inflation.

Lower Relative Risk of Stocks versus Bonds Explains the Long-Run Puzzle

The yield ratio series was relatively trendless in the first half of the 20th century but clearly upward-trending in the second, signaling relative richening of stocks versus bonds. Asness [2000b] proposes an appealing explanation for the long upward trend in the yield ratio: The relative risk of bonds versus stocks has grown over time.

The thin line in Exhibit 8 shows the relative return volatility of ten-year government bonds and the stock market index, measured by ten-year moving standard deviations. In the first half of the century, stock market returns were about seven times as volatile as bond returns. By the 1980s, relative volatilities were virtually equal—although subsequent disinflation has reduced bond volatility to about half of stock market volatility.

The trend increase in the volatility ratio reflects an increase in bond volatility, particularly in the 1970s-1980s, and a decline in stock volatility since the 1930s. The related underlying macroeconomic trends are:

- Growing inflation uncertainty associated with the persistent rise in inflation until the early 1980s.
- More stable real growth, as evidenced by lower volatilities in real output and earnings growth rates and by less frequent, shorter, and shallower recessions.[11]

Changing relative risk between asset classes is a structural change that undermines the usefulness of valuation signals like the yield ratio. This ratio will serve well as a mean-reverting signal within any one regime, but it typically gives a wrong value signal when a structural change occurs.

How to watch out for those structural changes? One guidepost is the relative importance of long-run inflation and growth risks.

- If central bank credibility and other arguments, for example, convince people of future inflation stability, and thus of relatively higher real growth risks, relative bond-stock volatility may again shift lower. Such a change should favor bonds and perhaps move the yield ratio back below unity in the medium term. Exhibit 8 shows a reversal in the volatility ratio in the past 15 years but not yet any trend reversal in the yield ratio. (In third quarter 2002, the yield ratio did fall below unity, however.)
- As a more current example, we think that in the world after September 11, 2001, with heightened security concerns and policy uncertainties, both growth and inflation risks have increased. It is less clear which has increased more, making the impact on the yield ratio debatable.
- Deflation would arguably reduce the required bond risk premium and raise the required equity risk premium. Thus, incipient deflation should systematically reduce the yield ratio.

Drivers of Earnings Yields

Since stock prices reflect the discounted values of expected future cash flows, it is an accounting identity that low earnings yields (high P/E ratios) reflect some combination of low discount rates and/or high expected earnings growth rates.

Like many others, we find that various growth indicators are only loosely related to earnings yield fluctuations and that P/E ratios have only a modest ability to predict subsequent earnings growth. Discount rate effects may reflect the riskless yield component or the required equity-bond risk premium. The sensitivity of earnings yields to nominal bond yields can be traced back to expected inflation rates or required real bond yields. Historical analysis suggests that earnings yields have been more closely related to inflation than to any other series, including nominal or real bond yields.

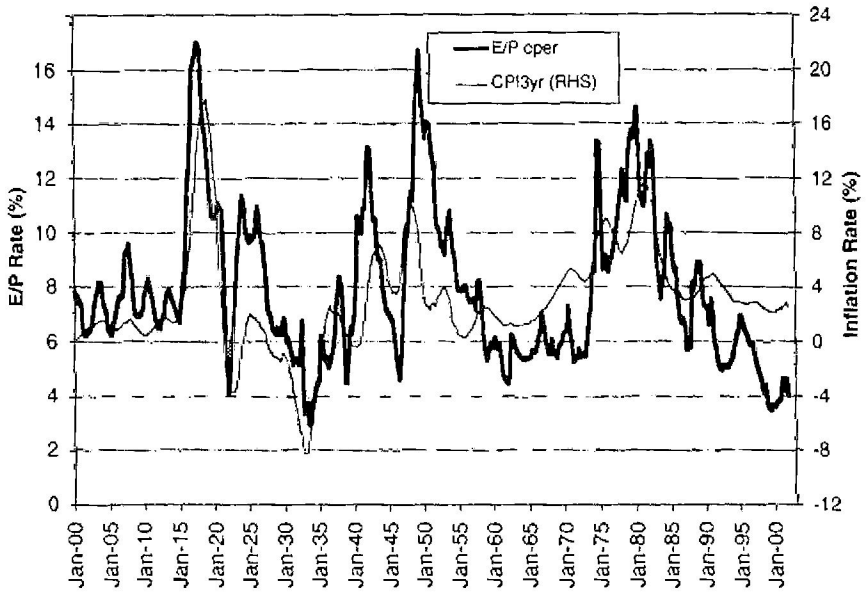
Exhibit 9 depicts the relation between U.S. earnings yields and the previous three years' average inflation. There is a similarly close relationship in other countries, including Japan.[12]

A high correlation between earnings yields and inflation rates may be surprising, because the E/P is supposed to be a real variable. The textbook view is that stocks are real assets since higher inflation should be fully compensated by higher nominal earnings growth rate, with little impact on the stock price or the D/P or E/P ratios.

What explains this anomalous correlation? Here are the main candidates, all of which may contribute:

- Inflation may impact real earning growth prospects —steady low-but-positive inflation appears to be the optimal environment for real growth.
- Inflation may raise prospective real returns because irrational money illusion makes equity markets undervalued (overvalued) when inflation is high (low).[13]

EXHIBIT 9
Dependence of Earnings Yields on Inflation Level—1900–2001



Sources: Shiller website, Schroder Salomon Smith Barney.

- Inflation may raise required real returns on bonds *and* equities (rational inflation-related risk premium).

We can explain the bulk of the past 50 years' variation in earnings yields by just two factors: inflation level, and output volatility (see Bernstein [1999], Wieting [2001], and Ilmanen [2002]). The rise and fall in inflation explains the humped shape (20-year rise in earnings yields before 1980 and 20-year fall thereafter), while the trailing volatility of GDP growth rates (or earnings growth rates) explains the general downtrend.

By the end of the century, equity markets benefited from low levels in both factors, in addition to a record-long expansion, productivity optimism, and high risk tolerance after a persistent bull market. No wonder that irrational exuberance and overshooting valuations followed.

The good news is that at least part of the multiple expansion is fundamentally justified. Above-average P/E levels may then be sustainable (as long as inflation stays at the apparently optimal level for equities, near 2%–4%, and macroeconomic stability rather than equity volatility drives equity investors' risk aversion). Yet many observers appear to forget that sustainably high P/E still means low E/P and low long-term equity returns; sustainability would just remove the need for further cheapening in the near term (as the P/E falls to the historical mean).

EXPECTED EQUITY PREMIUMS BASED ON DDM

While the yield ratio is a useful shorthand for the equity-bond premium, the dividend discount model gives us directly what we really want to see: the difference between stocks' and bonds' expected long-run returns.[14] In the basic version of the DDM, equity cash flows (dividends) are assumed to grow at a constant annual rate G. A feasible long-run return on equities is then the sum of the cash flow yield (D/P) and the trend cash flow growth rate (see the appendix). The required return on equities, or the discount rate, can be viewed as a sum of the riskless long-term government yield (Y) and the required equity-bond risk premium (ERP).

Intuitively, markets are in equilibrium when the equity market return that investors require (Y + ERP) equals the rationally feasible expected return (D/P + G). This equality can be reshuffled to express the ex ante equity-bond risk premium in terms of three building blocks:

Equity-Bond Risk Premium ≡
Expected Stock Return −
Expected Bond Return

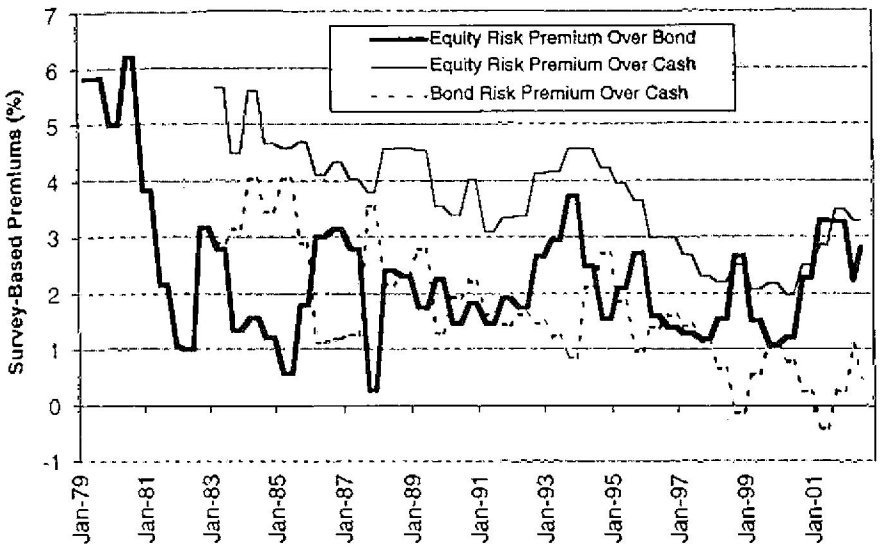
or

$$ERP = D/P + G_{nom} - Y_{nom}$$

The appendix shows how this model can be extended to real (inflation-adjusted) terms or to discounted earnings terms. The DDM framework is simple, but there is a wide disagreement about the inputs to the equity premium calculation. There are two main unobservables, ERP and G. One can either infer ERP for a given G assumption, as we do, or one can reshuffle the equation to infer G (implied growth rate) for a given ERP assumption.

Even the observable inputs—dividend yield and bond yield—are ambiguous. It may be debated whether to include share repurchases in dividend yield and whether to use a ten-year or longer-maturity Treasury yield. The

EXHIBIT 10
Survey-Based Asset Class Premiums—Using Consensus Forecasts of Long-Term GDP Growth, Inflation, and Short-Term Rates—1979–June 2002



Sources: Best and Byrne [2001], Blue Chip Economic Indicators, IBES, and Schroder Salomon Smith Barney.

main source of contention, though, is the assumed trend profit growth rate G.

Instead of assuming a constant profit growth rate, we may allow G to vary over time according to survey forecasts or statistical estimates. Before we explore the various debates, we present equity-bond premium estimates based on survey forecasts of long-term GDP growth rate, motivated by the widely held idea that corporate profit trends are somehow tied to output trends.

Best and Byrne [2001] examine risk premium estimates that use consensus forecasts of next-decade average real GDP growth and inflation as inputs for nominal G. Exhibit 10 shows that the estimated equity-cash risk premium and bond risk premium together trended downward between 1983 and 2000, while the ex ante equity-bond risk premium ranged between 0.5 and 3.5 percentage points.[15]

Debates on Inputs for Statistical Risk Premium Estimates

There will never be full agreement about the equity-bond premium, because there are a wide range of views about DDM inputs. Here we simply summarize the key questions.

Long-Run Growth Rate (G). This is the main debate. Since G is the least-anchored DDM input, differing views on it can shift risk premium estimates by several percentage points, while disagreements about dividend yields and bond yields are worth about 1 percentage point, at most.

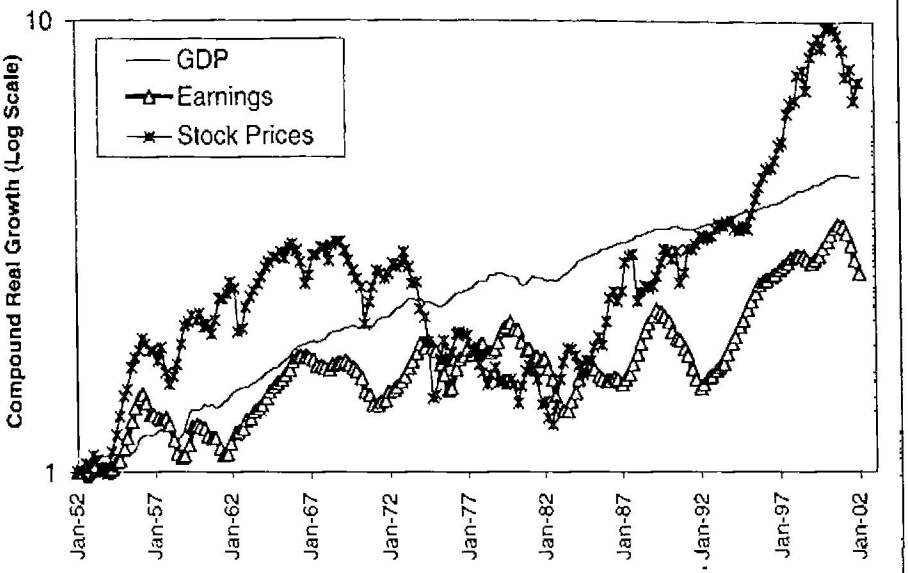
Earnings or dividend data? In historical analyses, some authors use earnings data, others dividend data, and yet others gross domestic product data to proxy for cash flows. While earnings data have their own shortcomings, we use them. Historical dividend growth is arguably understated by the declining trend in dividend payout rate since the late 1970s, partly related to firms' shift from dividend payments toward share repurchases.

Nominal or real G? Many observers refer to historical earnings growth rates in nominal terms (perhaps even using arithmetic averages), thereby overstating future prospects now that inflation rates are quite low. We prefer to assess expected inflation and real earnings growth separately. We do concede that assuming stable nominal earnings growth rates over time could work surprisingly well, because inflation may be inversely related to real earnings growth.

Relation to GDP growth? It is useful to first assess the trend GDP growth rate and then the gap between earnings and GDP growth.

- The long-run productivity growth is important because it determines the potential earnings growth rate, and because persistent changes influence stock prices much more than cyclical changes. If the recent extraordinary productivity growth is sustained, it could be quite bullish for long-run profits and share valuations.
- Historical evidence on the gap between earnings (or dividends) and GDP growth is less encouraging—indeed, recent findings are shocking to many market participants. Several recent studies show that per share earnings and dividends have over long histories lagged the pace of GDP growth and in many cases even per capita GDP growth. Focusing on our past-century sample period (1900–2001), U.S. GDP growth averaged 3.3% in real terms, compared with 1.9% GDP per capita growth, 1.5% earnings growth, and 1.1% dividend growth.

EXHIBIT 11
Cumulative Real Growth of GDP, S&P 500 Operating Earnings, and Stock Prices—1952–2001



Sources: Arnott, Shiller website, and Schroder Salomon Smith Barney.

Exhibit 11 shows that cumulative real growth of earnings has consistently lagged GDP growth in the past 50 years, while stock prices beat GDP only because of the multiple expansion. International evidence in Arnott and Ryan [2001] is hardly more encouraging, and Dimson, Marsh, and Staunton [2002] show that real dividend growth has lagged real GDP per capita growth between 1900–2000 in 15 of the 16 countries they examine.

- What explains these disappointing results? Arnott and Bernstein [2002] attribute them to the dynamic nature of entrepreneurial capitalism. New entrepreneurs and labor (perhaps especially top management) capture a large share of economic growth at the expense of current shareholders. Stock market indexes (made up of listed stocks) do not participate in all growth, and indeed may miss the most dynamic growth of yet-unlisted start-up ventures. Arnott and Bernstein argue that aggregate earnings growth of the corporate sector (listed and unlisted firms) should better keep pace with aggregate GDP growth, and this conjecture seems to hold in the national accounts data.

Siegel [1999] adds that real output growth related to technological progress may have been largely labor-augmenting and wage-enhancing rather than the capital-enhancing type that would spur EPS growth (also see discussion in Nordhaus [2002] and "Proceedings of Equity Risk Premium Forum" [2002]).

Can we do better than using historical averages? Empirical studies find limited predictability in long-term earnings growth rates (see Fama and French [2002]). No predictability implies that the historical sample average may be the best estimate of future earnings growth.

How long a sample? The compound average real earnings growth rate over very long periods is around 1.5%. Others argue that the world has changed, and that the future should be more like the 1990s' experience, with its 4.3% average real earnings growth, and unlike the preceding decades (0.4% in the 1980s and 1.8%–2.9% in the 1950s, 1960s, and 1970s).

Payout rates appear to have some ability to predict future growth, but the results are debatable. Ibbotson and Chen [2002] argue on theoretical grounds that low dividend payout rates are a sign of high growth prospects. Arnott and Asness [2002] show that the empirical experience has been exactly opposite. Low dividend payout rates have preceded low subsequent earnings growth. If this pattern holds, it is a bad omen for the coming years, given the low payout rates of the boom years.[16]

On a positive note, there are some signs that real earnings growth is higher when the trend productivity growth is higher, when the inflation rate is lower (but positive), and when earnings volatility is lower. Lower inflation and volatility drags may have boosted real earnings in the last 15 years and, if sustained, could keep future trend earnings growth more in line with the GDP growth (see Wieting [2001]).

Dividend Yield (D/P). Dividend yields in the United States fell even faster in the 1980s and 1990s than earnings yields. The declining propensity to pay dividends partly reflects a shift toward more tax-efficient share repurchases; by the late 1990s, U.S. firms disbursed cash flows more in share repurchases than in dividends (see Wadhwani [1999], Fama and French [2001], and Jagan-

nathan, McGrattan, and Scherbina [2001]). Adding up dividends and gross buy-backs, however, exaggerates sustainable cash flow yields. One reason is that gross buy-backs should be adjusted for related share issuance (buy-backs are often linked to employee stock options); another is that share repurchase programs are less permanent (easier to discontinue) than dividend payments.

While gross buy-backs added perhaps 2 percentage points and net repurchase payouts 1.5 percentage points to U.S. cash flow yields during the late 1990s peak buy-back years, Liang and Sharpe [1999] argue that adding 0.5 percentage point to dividend yields is a more realistic medium-term estimate. Even this adjustment may be questioned because the 1990s share buy-backs never exceeded new share issuance.

Bond Yield (Y). It is common to use the ten-year government bond yield in equity-bond premium calculations, mainly for data availability reasons. In fact, the "duration" of equities is much longer. Using a longer-maturity yield may thus be appropriate.[17]

Yield curves tend to be upward-sloping, so the use of a longer yield typically reduces the equity-bond premium. But when the yield curve was inverted in the early 1980s, the reverse was true.

Inputs for Ex Ante Asset Returns and Premiums—and Resulting Outputs

Arnott and Bernstein [2002] carefully create a time series of ex ante real long-term stock and bond returns since the early 1800s that would have been realistic to expect, given the information available at the time. Roughly speaking, their inputs include the historical average real dividend growth rate to proxy for the real G (averaging previous 40 years and full-sample experience), a regression-based proxy for expected future inflation, and dividend yield and long-term Treasury yield.[18] These plausible inputs give rise to recently low equity-bond risk premium estimates: near-zero average since the mid-1980s, and negative values between 1997 and 2001.

We propose an alternative set of plausible input assumptions that are somewhat more optimistic for stocks and thus give rise to higher risk premium estimates.[19]

Exhibit 12 summarizes our selections, and Exhibit 13 shows the histories of our inputs (except for yields).

D/P: Since raw dividend yields arguably underestimate recent equity market cash flow yields due to share buy-backs, and since we do not have long histories of net buy-back-adjusted dividend yields, we prefer to use earnings data that have not undergone such a structural change as dividends. We use smoothed earnings yields multiplied by a constant payout rate (0.59) as a proxy for sustainable dividend yields.[20]

G_{real}: As we find limited predictability in long-term real earnings growth, we assume that investors take historical average real earnings growth as a proxy for future G_{real}. The geometric average growth rate is more relevant than the arithmetic average if investors are interested in a long-run wealth accumulation rate.[21]

The historical window length is ambiguous, and we prefer to take an average of the past 10, 20, 30, 40, and 50 years' average growth rates; this choice gives more weight to more recent decades and implies shorter windows than in Arnott and Bernstein [2002]. This approach hopes to capture some slow-moving variation in trend earnings growth rates that may be associated with changing productivity trends and changing inflation or volatility drags.

Since these historical averages are quite unstable over time—the extremes of their range (from −4% to +6%) appear unreasonable for long-run ex ante G views—we take an average of these averages and a 2% anchor for the G_{real} proxy. This admittedly ad hoc approach succeeds in giving a plausible ex ante G_{real} series (a range between 0 and 4% most of the time), while allowing slow variation over time (*see Exhibit 13*). The latest value is 2.5%.

Y: We use the longest available Treasury yield (Ibbotson Associates' roughly 20-year bond until 1951, Salomon Brothers' 20-year or 30-year on-the-run series thereafter), and annualize it. These long bonds' durations are roughly double the ten-year maturity bonds' durations (near seven), and thus are closer to equity durations, although still shorter.

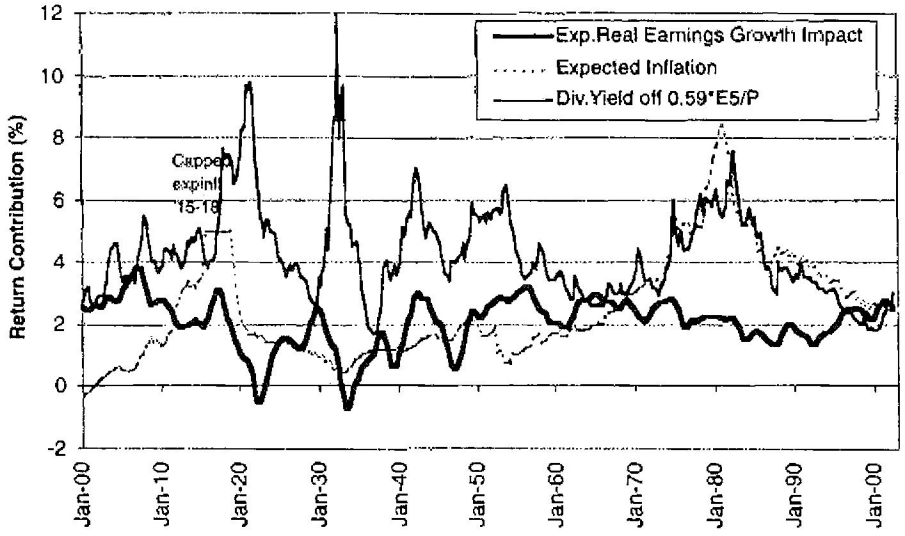
Ex Ante Inflation: We follow Arnott and Bernstein [2002] in regressing each quarter the next-decade inflation on the previous three years' inflation and using the fitted value as a quasi-out-of-sample prediction of the long-term inflation outlook.[22] The regression window length is arbitrary. We use a moving 30-year window and full sample since 1870, averaging the two. We make one exception around World War I; we cap the 1915–1918 expected inflation at 5%, even though our regression proxy rose above it, peaking above 9%.[23]

When survey-based inflation forecasts become available, we incorporate them. After 1951, we use the Livingston survey's median forecast of one-year-ahead inflation as a third component in the average that proxies for expected inflation. And from 1979 when ten-year-ahead

EXHIBIT 12
Estimates of Expected Asset Class Returns and Underlying Input Assumptions

	Input/Assumption:	Mid-2002	*End-99*	(50yr Avg)
Ex Ante Real Stock Return:		*5.5%*	*4.0%*	(6.2%)
D/P	0.59(5-Year Operating) Earnings Yield	3.0	*1.8*	(3.9)
+ Real Growth (G_{real})	Average of 2% and past 10/20/30/40/50yr real earnings growth adjusted for volatility	2.5	*2.2*	(2.3)
Ex Ante Real Bond Return:		**3.0**	*3.9*	(3.3)
Long Govt Yield	30- or 20-Year Treasury Yield (annualized)	5.6	*6.6*	(6.7)
– Ex Ante Inflation ($E\pi$)	Consensus forecast of decade-ahead inflation since 1979; earlier regression-based long-run inflation forecasts	2.6	*2.7*	(3.4)

EXHIBIT 13
Three Components of Ex Ante Nominal Stock Return—1900–June 2002



Sources: Blue Chip Economic Indicators, FRB Philadelphia, Ibbotson Associates, Arnott, and Schroder Salomon Smith Barney.

survey forecasts are available, we use them as our expected inflation proxy.[24]

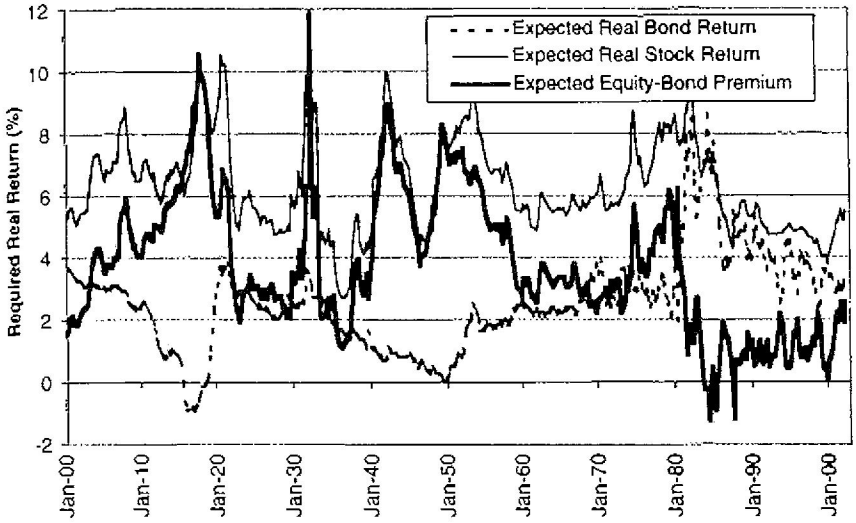
This set of inputs results in the feasible ex ante real long-term stock and bond return series shown in Exhibit 14. The estimated real stock returns varied between 4% and 9% most of the century, sweeping from the top of this range to the bottom between 1982 and 1999. The estimated real bond returns varied between 0% and 5% except for the 1980–1985 period, when ex ante real returns occasionally exceeded 8%. Overall, the post-Second World War pattern of a long upward trend (pre-1982) and a long downward trend (post-1982) in inflation is matched in required real bond returns, although with a short lag.

Bernstein [2002] notes that the great variation in required bond and stock returns in recent decades makes the use of historical returns either irrelevant or, worse, misleading for any kind of future projections.

The equity-bond premium (the difference between the other two series) experienced a clear downward shift 20 years ago. Before 1982, the premium ranged between 2 and 10 percentage points most of the time, while since 1982 the range has mostly been 0 to 2 percentage points.

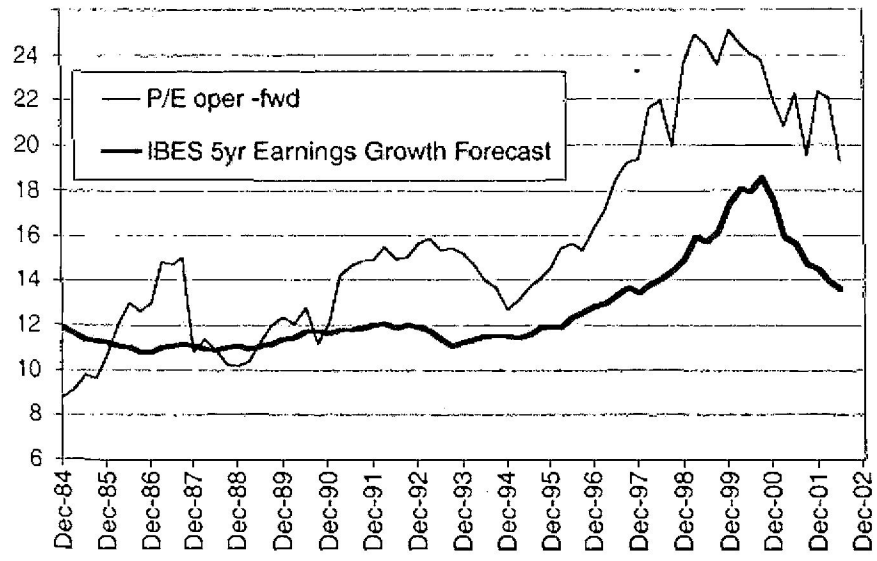
The lowest equity-bond premiums—June 1984, September 1987, and December 1999—coincided with temporary peaks in bond risk premiums. On all three occasions, a Fed tightening triggered a heavy bond market sell-off (year-on-year rises in ten-year yields of 310bp, 220bp, and 180bp, respectively), while equity markets had not yet suffered much. Over

EXHIBIT 14
Estimated Long-Term Real Stock and Bond Returns and their Difference (Ex Ante Premium)—1900–June 2002



Source: Schroder Salomon Smith Barney.

EXHIBIT 15
Forward-Looking P/E Ratio and Analysts' Medium-Term Earnings Growth Forecasts—1985–June 2002



Sources: IBES and Schroder Salomon Smith Barney.

the following year, stocks underperformed bonds by 5, 25, and 26 percentage points, respectively.

It is counter-intuitive that the ex ante equity-bond premium was averaging just 1 percentage point during the great bull market, while realized equity returns between 1982–2001 were 16% per year (*see Exhibit 3*). Using the more conservative Arnott and Bernstein estimates, the ex ante premium was actually negative most of this period.

How could equities outperform bonds by 5 percentage points per year with such a slim ex ante premium? The first answer that comes to mind, a falling equity-bond premium, is not valid for this period; the premium already had shrunk by 1982 and actually edged a bit wider during the 20-year period. A better answer is that discount rates fell (ex ante real returns for stocks fell by 3.5 percentage points, and expected long-run inflation fell even more), and the longest-duration asset class, equities, reaped the greatesr windfall gains from falling rates.

This analysis assigns almost all of the equity outperformance and P/E multiple expansion to lower discount rates rather than greater growth optimism. But recall that our series of feasible ex ante equity returns is based on pretty rational real earnings growth forecasts (that rose just by 1% in the 1990s; see Exhibit 13). Actual subjective growth forecasts probably were much less rational during the Internet boom. Indeed, analysts' medium-term earnings growth forecasts rose from their normally overoptimistic 11%–12% level (of nominal annual growth) to a heady 18%–19% level in 2000, before tailing off (*see Exhibit 15*).

EXHIBIT 16
Forecasting Ability of Various Predictors—Predictive Correlations Based on Quarterly Data

Forecast Horizon and Data Window =>	10yr Return 1900-2001	5yr Return 1900-2001	5yr Return 1960-2001	1yr Return 1900-2001	1yr Return 1983-2001
Predict Real Equity Return Using:					
Trailing Earnings Yield	0.58	0.27	0.17	0.06	0.33
Ex Ante Real Equity Return Estimate	0.40	0.31	0.03	0.25	0.26
Past 5yr Real Equity Return	-0.13	-0.13	0.26	-0.14	-0.40
Predict Real Bond Return Using:					
Nominal Bond Yield	0.54	0.42	0.65	0.29	0.50
Ex Ante Real Bond Return Estimate	0.54	0.61	0.77	0.60	0.62
Past 5yr Real Bond Return	0.08	0.17	0.10	0.04	0.23
Predict Equity-Bond Excess Return Using:					
Earnings Yield Gap (EarnY – GovtY)	0.53	0.32	0.19	0.20	0.56
Ex Ante Equity-Bond Premium Estimate	0.51	0.32	0.05	0.26	0.47
Past 5yr Equity-Bond Excess Return	-0.03	-0.22	-0.28	-0.21	-0.32

Sharpe [2002] uses these growth forecasts, without prejudging their rationality, and estimates that about half of the late-1990s P/E expansion reflects lower discount rates and half greater growth optimism. Thus, part of the late-1990s decline in feasible real equity return in Exhibit 14 likely should be attributed to irrational growth forecasts.

How robust are these estimates of ex ante asset class returns? Details are sensitive to the input assumptions, but the broad contours of such estimates tend to be similar (compare Exhibits 10 and 14), because all are anchored by market yields on equities and bonds.[25] The long-term growth forecasts can vary more widely, and in the basic DDM these forecasts translate one-on-one into higher or lower estimated equity returns or premiums.

Predictive Ability of Equity-Bond Premium Estimates

To assess the usefulness of our ex ante expected return estimates, we use these measures to predict real stock return and real bond return and their difference (excess return) over ten-year, five-year, and one-year horizons. Exhibit 16 displays for each trade the predictive ability of our ex ante expected return measure and two alternative predictors, a simpler yield proxy and a past-return measure.

In all cases, our estimates exhibit reasonable forecasting ability, but they are clearly better predictors than the simple yield measures only at the short (one-year) horizon. The long-horizon correlations are typically higher than short-horizon correlations, mainly because the realized returns are smoother at longer horizons.

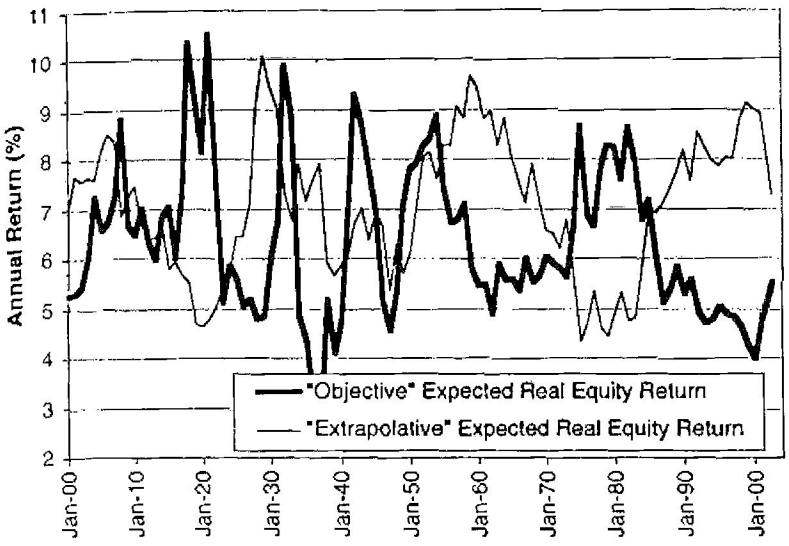
For example, the correlations between the ex ante equity-bond premium and subsequent realized outperformance of equities over bonds are 0.51 for the ten-year horizon, 0.32 for the five-year horizon, and 0.26 for the one-year horizon. In a scatterplot of ex post long-run equity-bond premiums on the ex ante premiums, the 1998-2000 observations show up as major outliers.

Past five-year equity returns (real and excess) have generally been negatively correlated with future returns, consistent with a mild mean-reversion tendency. This pattern underscores the extrapolation risk following an extended period of above-average market returns. Past bond returns on the contrary have been positively related to future returns, consistent with slow-moving variation in required returns.

WHERE DO WE STAND?

While our analysis cannot unambiguously reveal the current extent of the equity-bond premium, our framework does clarify the assumptions needed for various risk premium estimates. Moreover, we argue that

EXHIBIT 17
Gap Between Objectively Feasible (Rational) and Extrapolative (Irrational) Return Expectations—1900–June 2002



Source: Schroder Salomon Smith Barney.

"how high are objectively feasible future stock returns?" is not the only critical question for equity markets' medium-term prospects. Acknowledging the role of irrational expectations, another key question is: "How high returns do investors subjectively expect?" If objective and subjective return expectations are not in balance, equity markets remain vulnerable to disappointments.

There are no directly observable proxies for either return, but we have tried to provide evidence on both. As an illustration only, Exhibit 17 contrasts our estimate of feasible ex ante real equity return with a simple proxy of extrapolative subjective return expectations (75% of a long-run anchor, 7% real equity return, plus 25% of past-decade average real equity return).

Clearly a wide gap arose between the two series in the late 1990s. Just when rising valuations reduced feasible future returns, many investors confused recent windfall gains as a sign of permanently higher equity returns. This gap has narrowed from both sides since the end-1999 peak, but at least in this illustration the gap has not yet been closed.

At a minimum, our framework should give structure to the dialogue about future equity returns. Aggressive return forecasts must be explained by something: high dividend yield, high trend real earnings growth, high inflation, or further multiple expansion. Low dividend yields remain a reality, and from the current above-average valuation levels, further multiple expansion is unlikely.[26]

Since inflation is also likely to remain low, high returns need to be earned the hard way—by very high real profit growth rates.

The mega-bullish equity market view requires throwing away the history books and fully embracing the "this time is different" idea. For example, technology-related arguments might be used to justify a tripling of long-run G_{real} to 4%–5%, which would enable long-run nominal equity returns near 9%–10%. (The finding that the trend earnings growth lags the trend GDP growth does challenge the credibility of such assumptions, given the consensus view of next-decade real GDP growth at 3.1%.)

A moderately constructive case is that feasible and subjectively expected long-run equity returns are in balance near 7%–8%. The deliberately optimistic assumptions we use in Exhibit 12 give rise to 8% feasible (nominal) return, almost as high as the CFO survey forecasts. Stable inflation, low macroeconomic volatility, reduced trading costs, and better diversification opportunities may help sustain the above-average P/E levels. And, given the fall in bond yields, equities again offer more than a negligible risk premium.[27]

A moderately bearish view is that the feasible long-run nominal equity return is closer to 5%–6% than 7%–8%. Such estimates simply follow from using (unadjusted) dividend yields and historical average dividend growth rates.

The most bearish view involves further declines (mean reversion) in the market's P/E multiples. Below-average earnings growth and higher risk aversion are plausible scenarios (see Campbell and Shiller [2001] and Arnott and Asness [2002]). Unwarranted investor optimism, a remnant of the 1990s bull market returns, can also be bad news. Refusal of investors to reconcile themselves to the moderate feasible long-run returns is not sustainable in the medium term.

APPENDIX

Dividend Discount Models and Equity-Bond Premiums

Dividend discount models analyze stocks as if they were perpetual (consol) bonds, with the twist that their coupon rate is expected to grow over time. We describe here the basic Gordon [1962] model with a constant dividend growth rate. Given a constant discount rate R (which can be viewed as a sum of riskless component Y and an equity-bond risk premium com-

ponent ERP), the stock price can be expressed as the sum of expected discounted future cash flows:

$$P_t = E_t[\sum_{j=1}^{\infty}(\frac{1}{1+R})^j(D_{t+j})]$$

where $R \equiv Y + ERP$.

If we assume a constant growth rate G:

$$E_t(D_{t+j}) = (1+G)E_t(D_{t+j-1}) = (1+G)^jD_t$$

we can express the stock price simply as

$$P_t = E_t(D_{t+1})/(R-G) = (1+G)D_t/(R-G)$$

Thus:

$$E(D_{t+1})/P_t = R - G$$

or as an approximation of the dividend yield:

$$D/P = R - G = Y + ERP - G$$

In equilibrium the equity return that investors require ($R = Y + ERP$) must equal the rationally feasible long-run return ($D/P + G$).

Earnings Discount Model: To express the equation in terms of the E/P ratio, we assume a constant dividend payout rate $k \equiv D/E$. With a constant dividend payout rate, dividend growth rate and earnings growth rate are equal. Then

$$D/P = (E/P)(D/E) = Y + ERP - G$$

Thus:

$$E/P = (Y + ERP - G)/k$$

Real or Nominal: The DDM can be expressed in real terms or in nominal terms. Mechanically, a rise in expected inflation rate raises both the dividend growth rate and the bond yield, without having an impact on the stock price. Empirically, however, the correlation between inflation rates and earnings yields suggests that either real growth rates, payout rates, or equity risk premiums are related to inflation.

Dynamic Models: It is not necessary to assume a constant growth rate. Practical implementations often involve multistage models where growth rate varies over the horizon (see Cornell [1999] and Jagannathan, McGrattan, and Scherbina [2001]). Sharpe [2002] uses a dynamic version of the growth model that allows growth rates and required returns to vary over time. It still follows that low earnings yields are related to high growth prospects or low required returns.

ENDNOTES

The author thanks Robert Arnott, Clifford Asness, Peter Bernstein, Alistair Byrne, and Steven Wieting for helpful discussions and for help in acquiring historical data. This article is largely based on research reports written for Schroder Salomon Smith Barney in May and June 2002. The original disclaimer there applies.

[1]If the payout rate is constant, dividend growth rate and earnings growth rate are equal. We use the latter because payout rates fell in the 1980s and 1990s, and many observers argue that share buy-backs have replaced dividend payments.

[2]The distinction between objective and subjective expectations implies that the subjective expectations can be irrational. In fully rational markets, there is just one expected return that clears the market. The feasible asset return that investors can rationally expect is, by assumption, equal to the required asset return.

[3]Most of our data analysis focuses on U.S. markets because the literature has concentrated on them, partly because of better data availability and reliability. The global leading role of the U.S. economy and asset markets and higher valuation ratios than in most other major equity markets also make the U.S. experience the most interesting topic.

[4]All returns are expressed as annual compound returns, unless otherwise stated.

[5]One reason is that U.S. government bonds were not perceived to be riskless until the 20th century. In addition, yield trends were more favorable for bonds as the 19th century ended with extended deflation. Long yields were then halved from 1802's near-6% level to near 3% at the beginning of 1900, and then doubled back by the end of 2001. Of course, equity and bond markets also were less developed in the 1800s, making data less comprehensive and reliable.

[6]The peso problem refers to infrequent, unlikely events such as currency devaluation that may influence market pricing (e.g., forward bias in peso-dollar pricing) but may not show up, even in a long historical sample.

[7]The CFO survey and our bond investor survey asked for views on the expected annual return of a major equity index over the next decade. The academic survey required some adjustments because it asked for the 30-year equity-bill-premium (and only an arithmetic average in 1998). We first subtract from the 7% consensus view in 1998 0.8 percentage point (the gap between arithmetic and geometric means in the later survey), then add a 5% expected average bill rate (typical long-run view of economists in 1998 from another survey) to get an 11.2% expected nominal return. In 2001, the survey quotes a 4.7 percentage point geometric mean premium over bills; we add 4.7% expected average bill rate to it to get a 9.4% estimate.

[8]The falling consensus views may partly reflect a real change due to the growing literature on the changing equity risk premium, besides simple extrapolation from recent returns.

[9]Specifically, we have found that the negative correlation between stock and bond returns has made government bonds

the ultimate safe haven. The negative beta feature can even justify a negative risk premium for government bonds when the traditional inflation risk premium has fallen to near zero. All else equal, a low or negative bond risk premium (over cash) makes the current equity-bond premium wider. (See Best, Byrne, and Ilmanen [1998] and Ilmanen [2002].)

[10]We use operating earnings rather than reported earnings since the former became available in the early 1980s. Broadly speaking, operating earnings are earnings from continuous operations, excluding non-recurring items. Operating earnings may give a better picture of trend earnings, as they are less influenced by one-off events and cyclical downturns (see Wieting and Peng [2002]).

Findings of aggressive and even illegal earnings accounting practices, however, have made many investors prefer the reported earnings. Stock option expensing and pension return assumptions are other contentious earnings topics. Any adjustments to recent earnings levels would imply lower earnings yields and lower ex ante equity returns in our empirical analysis.

[11]Improving macro stability has not brought along financial market stability, an unattractive outcome for equity investors. Alan Greenspan, among others, highlighted the contrast between low output volatility and high equity market volatility in his annual Jackson Hole speech in August 2002.

[12]Overall, Japan's experience confirms the inflation-dependence of earnings yields but there is a hint of a leaning J-shape. We conjecture that earnings yields could actually rise in a deflationary environment. Low-but-positive inflation is the optimal environment for equity valuations; both higher inflation and deflation can hurt equities and raise E/P ratios. This also suggests that U.S. equity multiples already reflect all the possible gains from disinflation and that the best they can do now is to hold onto these gains (if inflation remains near 2%–4%).

[13]Modigliani and Cohn [1979] argue that investors and analysts incorrectly discount real dividend streams with nominal discount rates, resulting in too low a price for real fundamentals when inflation is high. For a recent review, see Ritter and Warr [2002]. Sharpe [2002] suggests a variant of inflation illusion: Investors and analysts actually discount nominal cash flows using nominal discount rates, but do not make sufficient inflation adjustments to their extrapolative nominal growth forecasts.

[14]Under certain conditions, the earnings yield equals the ex ante real equity return—for example, if the constant retention rate (1 – payout rate) matches the constant dividend growth rate. Intuitively, earnings yield understates expected return because it excludes dividend growth, but it exaggerates expected return because only a part of earnings are paid out as dividends. Unless the two extra terms just balance, the DDM should provide a better ex ante real return measure than the earnings yield.

[15]The equity-cash premium is the difference between the ex ante equity return and the expected average Treasury bill rate over the next decade. The bond risk premium is the difference between the ten-year Treasury yield and the expected average Treasury bill rate over the next decade. The equity-bond premium is the difference between the ex ante equity return and the ten-year Treasury yield.

The nominal ex ante equity return is estimated as a sum of the dividend yield (proxied by a forward-looking earnings yield times a constant assumed payout rate), expected long-run real GDP growth rate, and expected inflation. The main raw material is economists' consensus forecasts of next-decade average real GDP growth, inflation, and Treasury bill rates from the semiannual Blue Chip Economic Indicators survey.

Note that using the current Treasury bill yield in equity premium calculations could be quite misleading when short rates are exceptionally low (or high) and expected to revert to normal levels. For example, the current three-month rate is near 2%, while the expected next-decade average short rate is above 4%.

[16]The theoretical argument is in the "Modigliani-Miller spirit," based on the idea that management retains a greater share of earnings when it sees greater future profit opportunities. The empirical finding that high retention rates predict low earnings growth may reflect management's exuberance or inefficient empire building (see Arnott and Asness [2002]). Alternatively, management may be concerned with dividend smoothing, and will pay higher dividends only when it can afford (or dares) to do so, given its expectation of strong future profit growth.

[17]In the DDM context, the equity market can be viewed as a consol bond with a growing coupon rate. It follows from simple algebra that the modified duration of equities is $1/(R - G)$, which is just the inverse of the dividend yield. For D/P of 2.5%, this duration is 40, but this result is model-dependent; recall that the basic model assumes constant R and G. More generally, equities really are long-duration assets, that is, very sensitive to *permanent* discount rate changes—and more so when dividend yields are low.

[18]Arnott and Bernstein present the real dividend growth rate component in two parts: the predicted long-run growth rate of GDP per capita, and the predicted dilution of dividend growth versus GDP per capita growth.

[19]Our exercise follows in the same spirit as the Arnott-Bernstein study—trying to come up with reasonable views on each of the DDM inputs (say, what long-term real growth rate and what inflation rate investors could have expected at the time). There is sufficient uncertainty about these inputs that both sets of assumptions can be deemed plausible. Our assumptions are deliberately more optimistic than those of Arnott and Bernstein, to see how much expected returns rise if we add an implicit adjustment for share buy-backs to dividend yields, and if we use higher, but not outrageous, earnings growth estimates.

[20]Recall that $D/P = (D/E)(E/P)$. Since one-year trailing earnings yields are volatile, we use smoother five-year average earnings.

[21]We do not use geometric averages but rather a closely related procedure proposed in Fama and French [2002]. We reduce arithmetic averages by half the variance difference

between the earnings growth rate and dividend growth rate.

[22]The simple approach we use captures both the past average as an anchor and the varying sensitivity of future expectations to current inflation; this sensitivity increased during the 20th century once inflation became more persistent. We explored other inflation forecasting models with yield and growth indicators. The results were not robust, perhaps because forecasting decade-ahead developments leaves us with few independent observations.

[23]War-related inflations had typically been temporary before the First World War. More generally, inflation had not been persistent in the past, so investors had little reason to raise long-run inflation expectations sky-high (and would have been right, as a deflation soon followed). The 5% cap actually may be too high, given that the 1800s experienced mild net deflation, and given that bond yields stayed below 5% through the 1915–1918 period.

[24]Our proxy series and the consensus forecast are closely related during the overlapping period, and there is no large jump when moving from one series to another.

[25]As we have noted, even these yields are subject to debate about the impact of share buy-backs on dividend yields and about the appropriate Treasury maturity. Our current D/P estimate of 3.0% in Exhibit 12 is especially high, virtually double the raw number. This high level is partly offset in the equity-bond premium by our use of the 30-year Treasury yield (1 percentage point higher than the 10-year yield).

[26]Our analysis ends in mid-2002, but even during the third-quarter 2002 equity sell-off the dividend yield rose only to 2%. The long duration of equities means that feasible returns rise painfully slowly; a 15%–20% price decline may increase the feasible long-term return by about 0.5 percentage point. Yet the 1% fall in long-term Treasury yields in the third quarter had a greater impact on the equity-bond premium, raising our estimate to nearly 4 percentage points. Greater attractiveness versus bonds can benefit equities in the near term, but a wide cushion does not make the absolute level of feasible equity return any higher. It is unclear whether absolute or relative return prospects matter more.

Further disinflation or yield declines are unlikely to boost P/E ratios, because they likely would reflect bad deflation. Moreover, there appears little chance that the late-1990s growth optimism, exuberant sentiment, and risk tolerance will reappear any time soon. Observed empirical patterns (mean reversion, low payout rates) point rather to lower P/E multiples in the future. A cyclical upturn supported by easy monetary policy can of course raise equity valuations and realized returns over a shorter horizon.

[27]Siegel [1999] and Carlson, Pelz, and Wohar [2002] review these arguments. Jones [2002] provides specific evidence of falling trading costs during the past century and notes that the gross equity premium may have fallen by 1 percentage point as a result.

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Note

Biases in Arithmetic and Geometric Averages as Estimates of Long-Run Expected Returns and Risk Premia

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The empirically documented presence of negative autocorrelation in long-horizon common stock returns magnifies the upward (downward) bias inherent in the use of arithmetic (geometric) averages as estimates of long-run expected returns and risk premia. Failure to account for this autocorrelation can lead to incorrect project accept/reject decisions. Through simulations, we show that a horizon-weighted average of the arithmetic and geometric averages contains a smaller bias and is a more efficient estimator of long-run expected returns.

■ Consider an investment project with an average life (duration) of N months. What rate should be used to discount this project's expected cash flows? In particular, suppose the required return on the N-month investment project is based on a *market* equity-risk premium, that is, the difference between the future expected return on the market index and the risk-free rate of interest. Since risk premia are not constant (Brigham, Shome, and Vinson, 1985; Harris, 1986; Harris and Marston, 1992; Maddox, Pippert, and Sullivan, 1995; and Brennan, 1997) and can depend on the choice of measurement period, averaging method, or portfolio weighting (Carleton and Lakonishok, 1985), how should the historical monthly market return data be used to compute the risk premium? In practice, the arithmetic and geometric average of monthly returns are used as a proxy for determining the future expected N-month market return.[1]

Brealey and Myers (1991) argue that if monthly returns are identically and independently distributed, then the arithmetic average of monthly returns should be used to estimate the long-run expected return. However, the empirical evidence from Fama and French (1988a, 1988b), Lo and MacKinlay (1988), and Poterba and Summers (1988) suggests that there is significant long-term negative autocorrelation in equity returns and that historical monthly returns are not independent draws from a stationary distribution. Based on this evidence, Copeland, Koller, and Murrin (1994) argue that the geometric average is a better estimate of the long-run expected return. Thus, as noted by Fama (1996), when expected returns are autocorrelated, compounding a sequence of one-period returns is problematic for project valuation.

In this paper, we examine the biases obtained by using the arithmetic or geometric sample averages of single-period returns to assess the long-run expected rates of return when there is both a time-varying and a stationary component in those returns. To do this, we adopt the analytical framework outlined in Blume (1974). We find that for long-run expected return and risk premium, the arithmetic average produces an

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[1]Alternatively, in deriving the cost of equity estimates, Harris (1986) and Harris and Marston (1992) employ the Discounted Cash Flow (DCF) model, which uses a consensus measure of financial analysts' forecasts of earnings growth as a proxy for investor expectations. Although this alternative is appealing, Timme and Eisemann (1989) caution that it requires a judicious choice of the weight assigned to each forecast to construct the consensus forecast. Otherwise, the DCF model can generate a risk-adjusted discount rate that contains estimation risk and requires an adjustment such as that outlined in Butler and Schachter (1989).

estimate that is too high relative to the true mean, and that the geometric average produces an estimate that is too low. The magnitude of upward and downward bias is proportional to the total variance underlying the asset's return, and to the length of the investment horizon (N months) relative to the length of the historical sample period ($T \geq N > 1$). In addition, we confirm Blume's finding that there are significant biases associated with the use of the arithmetic and geometric averages, even when returns are independently and identically distributed each period. Finally, simulation results show that the horizon-weighted average of the arithmetic and geometric averages proposed by Blume is less biased and more efficient than alternative estimates.

I. The Bias in the Arithmetic and Geometric Averages

Here, we describe the return generating process and derive the biases in the arithmetic and geometric averages.

A. Return Generating Process

Let R_t denote a one-period total return over a time interval of length dt. Specifically,

$$R_t = 1 + r_t dt = 1 + \mu_t dt + \varepsilon_t \sqrt{dt} \quad (1)$$

where $r_t dt$ is the net return for period $t = 1,2,....,T$; $\mu_t dt$ is the conditional mean, and the deviations from the conditional mean, $\varepsilon_t \sqrt{dt}$ are independently and identically distributed over time with mean zero and variance $\sigma_\varepsilon^2 dt$. Further, assume that the conditional mean $\mu_t dt$ is distributed as follows. For $t = 1$, the conditional mean is

$$\mu_1 dt = \mu dt + \eta_1 \sqrt{dt} \quad (2)$$

where μdt is the unconditional mean. For $t = 2,3,....,T$, the conditional mean follows a mean-reverting process around the unconditional mean:

$$\mu_{t+1} dt = \mu dt + \rho(\mu_t dt - \mu dt) + \eta_{t+1}\sqrt{dt} = (1 - \rho)\mu dt + \rho\mu_t dt + \eta_{t+1}\sqrt{dt} = \mu dt + \sum_{j=1}^{t+1} \rho^{t-j+1} \eta_j \sqrt{dt} \quad (3)$$

where the single-period autocorrelation between conditional means, $\rho \leq 0$, captures the time variation in expected returns, and $\eta_t \sqrt{dt}$ are independently and identically distributed random variables with mean zero and variance $\sigma_\eta^2 dt$. From Equations (1) through (3) it follows that

$$r_t dt = \mu dt + \varepsilon_t \sqrt{dt} + \sum_{i=1}^{t} \rho^{t-i} \eta_i \sqrt{dt} = \mu dt + v_t \sqrt{dt} \quad (4)$$

for all t. The return generating process described by Equation (4) is consistent with that used by Fama and French (1988a) to document significant negative autocorrelations in long-horizon returns.[2] The unconditional mean, $E(r_t dt)$, is μdt. The unconditional variance, $Var(r_t dt)$, is $[(1-\rho^{2T})/(1-\rho^2)]\sigma_\eta^2 dt + \sigma_\varepsilon^2 dt$ for a finite T, and $[1/(1-\rho^2)]\sigma_\eta^2 dt + \sigma_\varepsilon^2 dt$ as $T \to \infty$.

B. The Bias in the Arithmetic Average

From a sample of T observations, we compute the arithmetic average, R_A, as:

$$R_A = 1 + r_A dt = 1 + \mu dt + T^{-1} \sum_{t=1}^{T} v_t \sqrt{dt} \quad (5)$$

and the estimated N-period return, $R_A^N = (1 + r_A dt)^N$,

$$R_A^N = (1 + \mu dt + T^{-1} \sum_{t=1}^{T} v_t \sqrt{dt})^N \quad (6)$$

In addition, applying the expected value operators to Equation (6) yields:

$$E(R_A^N) = E(1 + \mu dt + T^{-1} \sum_{t=1}^{T} v_t \sqrt{dt})^N \quad (7)$$

Since $(1 + \mu dt + T^{-1} \sum_{t=1}^{T} v_t \sqrt{dt})^N$ is a convex function of $T^{-1} \sum_{t=1}^{T} v_t \sqrt{dt}$, it follows by Jensen's inequality that for $N > 1$, the arithmetic average is biased upward:

$$E(R_A^N) > (1 + \mu dt + E(T^{-1} \sum_{t=1}^{T} v_t \sqrt{dt}))^N > (1 + \mu dt)^N \quad (8)$$

Further, by taking a Taylor series expansion of $E(R_A^N)$ around $(1 + \mu dt)$, the extent of the bias is given by:[3]

$$E(R_A^N) = (1 + \mu dt)^N \left[1 + \frac{N(N-1)}{2} (1 + \mu dt)^{-2} \sigma_\xi^2 dt\right] + O(dt^2) \quad (9)$$

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[2]Specifically, in Fama and French (1988a), p(t), the natural log of a stock price at time t, is the sum of a random walk, q(t), and a stationary component, z(t):

$$p(t) = q(t) + z(t) \text{ and } q(t) = q(t-1) + \mu + \varepsilon(t) \quad (3a)$$

where μ is expected drift and $\varepsilon(t)$ is white noise. z(t) follows a first-order autoregression (AR1) process:

$$z(t) = \phi z(t-1) + \eta(t) \quad (3b)$$

where $\eta(t)$ is white noise and ϕ is less than 1. From Equations (3a) and (3b), we compute a continuously compounded return:

$$p(t) - p(t-1) = [q(t) - q(t-1)] + [z(t) - z(t-1)] = \mu + \varepsilon(t) + \eta(t) + (\phi - 1)z(t-1) \quad (3c)$$

Through successive substitutions for $z(\cdot)$ from Equations (3b) into (3c), the consistency between our formulation and that of Fama and French (1988a) follows from a comparison of Equations (3c) and (3).

[3]Derivations of the extent of biases in the arithmetic and geometric averages are available from the authors on request.

where $O(dt^2)$ denotes an order of no greater than dt^2, $\lim O(dt^2) \to 0$ as $dt \to 0$. From Equation (5), $\xi\sqrt{dt} = T^{-1}\Sigma_{t=1}^{T}\nu_t\sqrt{dt}$, and

$$\sigma_\xi^2 dt = E[(\xi\sqrt{dt})^2] = T^{-2}(T\sigma_\eta^2 dt + \Sigma_{i=1}^{T}(T - i)\rho^{2i}\sigma_\eta^2 dt) + T^{-2}(T\sigma_\xi^2 dt) = T^{-1}(\sigma_\eta^2 dt + \sigma_\varepsilon^2 dt) + T^{-1}\left(\frac{(T+1)}{2}\right)\rho^{2\tau}\sigma_\eta^2 dt \quad (10)$$

since by the mean value theorem there exists a τ, $T > \tau > 1$ such that $\Sigma_{t=1}^{T}(T - i)\rho^{2i} = \Sigma_{t=1}^{T}(T - i)\rho^{2\tau}$.

For $\rho = 0$ and fixed N, it is clear that the estimator R_A^N is asymptotically unbiased and consistent as $T \to \infty$, but for a finite and small T, is upward-biased for $N > 1$ by an amount proportional to the number of periods, $[N(N-1)/2]$, and variance, $T^{-1}(\sigma_\eta^2 dt + \sigma_\varepsilon^2 dt)$. Furthermore, for $\rho < 0$ and fixed N, the estimator R_A^N is asymptotically unbiased and consistent only for $N = 1$. For $N > 1$, the amount of upward bias is proportional to the number of periods, $[N(N-1)/2]$, and either the variance $\frac{1}{2}\rho^{2\tau}\sigma_\eta^2 dt$ for $T \to \infty$, or the variance $T^{-1}(\sigma_\eta^2 dt + \sigma_\varepsilon^2 dt) + T^{-1}[(T+1)/2]\rho^{2\tau}\sigma_\eta^2 dt$ for a finite and small T. Compounding the single-period arithmetic return tends to produce an estimated long-run return, and thus a risk premium, that is too high relative to the true mean $(1 + \mu dt)^N$.

C. The Bias in the Geometric Average

From a sample of T observations, the geometric average, R_G, is computed as:

$$R_G = \left(\Pi_{t=1}^{T} R_t\right)^{1/T} \quad (11)$$

and the estimated N-period return, R_G^N, as:

$$R_G^N = \left(\Pi_{t=1}^{T} R_t\right)^{N/T} = \exp\left\{\frac{N}{T}\Sigma_{t=1}^{T}\ln R_t\right\} \quad (12)$$

Hence, for a fixed N and $T \to \infty$, it is clear from Equation (12) that

$$p\lim R_G^N = \exp\left\{p\lim\frac{N}{T}\Sigma_{t=1}^{T}\ln R_t\right\} = \exp\{NE[\ln R_t]\} < \exp\{N \ln [E(R_t)]\} < 1 + \mu dt) \quad (13)$$

The geometric average is asymptotically biased downwards and thus is an inconsistent estimator of the long-run expected return.

To examine the bias for a fixed N and finite T, we rewrite the geometric average as:

$$R_G^N = \left(\Pi_{t=1}^{T} R_t\right)^{N/T} = \Pi_{t=1}^{T}(1 + \mu dt + \nu_t\sqrt{dt})^{N/T} = [(1 + \mu dt)^T + \zeta\sqrt{dt}]^{N/T} \quad (14)$$

where

$$\zeta\sqrt{dt} = \Pi_{t=1}^{T}(1 + \mu dt + \nu_t\sqrt{dt}) - (1 + \mu dt)^T \quad (15)$$

Taking the expectation of Equation (14) and a Taylor series expansion around $(1 + \mu dt)^T$ yields:

$$E(R_G^N) = E[(1 + \mu dt)^T + \zeta\sqrt{dt}]^{N/T} = (1 + \mu dt)^N + \left(\frac{N}{T}\right)(1 + \mu dt)^{N-T}E(\zeta\sqrt{dt}) + \left(\frac{N}{T}\right)\left(\frac{N}{T} - 1\right)(1 + \mu dt)^{N-2T}E(\zeta\sqrt{dt})^2 + O(dt^2) \quad (16)$$

where

$$E(\zeta\sqrt{dt}) = (1+\mu dt)^{T-2}[\Sigma_{i=1}^{T-1}\rho^{2i-1}\Sigma_{j=1}^{T-i} j\rho^{T-i-j}]\sigma_\eta^2 dt + O(dt^2) \quad (17)$$

and

$$E(\zeta\sqrt{dt})^2 = (1+\mu dt)^{2(T-1)}[T(\sigma_\varepsilon^2 dt + \sigma_\eta^2 dt) + \rho^2\sigma_\eta^2 dt \Sigma_{i=1}^{T-1}(T-i)\rho^i + 2\sigma_\eta^2 dt \Sigma_{i=1}^{T-1}\rho^{2i-1}\Sigma_{j=1}^{T-i} j\rho^{T-i-j}] + O(dt^2) \quad (18)$$

Observe that for $\rho=0$,

$$E(R_G^N) = (1 + \mu dt)^N\{1 + (1 + \mu dt)^{-2}\left(\frac{N}{T} - 1\right)[T(\sigma_\varepsilon^2 dt + \sigma_\eta^2 dt)]\} \quad (19)$$

the geometric average is downward-biased for $N < T$ but unbiased as $N \to T$. For $\rho < 0$,

$$E(R_G^N) = (1 + \mu dt)^N\{1 + \left(\frac{N}{T}\right)(1 + \mu dt)^{-2}[E(\zeta\sqrt{dt}) + \left(\frac{N}{T} - 1\right)E(\zeta\sqrt{dt})^2]\} \quad (20)$$

By definition, $E(\zeta\sqrt{dt})^2 = \mathrm{Var}(\zeta\sqrt{dt}) > 0$, and it can be shown that $E(\zeta\sqrt{dt}) \le 0$ for $\rho \le 0$.[4] Hence, from Equation (20), the geometric average is always biased downward for $\rho < 0$, even as $N \to T$. It is also clear from Equation (20) that an increase in the stationary variance $\sigma_\varepsilon^2 dt$ raises the magnitude of the downward bias. The effect on the bias of changes in the parameters governing the temporal variation in expected returns, namely, ρ and $\sigma_\eta^2 dt$, is generally ambiguous. However, when $N \to T$,

$$E(R_G^N) = (1 + \mu dt)^N\{1 + (1 + \mu dt)^{-2}[1 + (T - 2)\rho]\rho\sigma_\eta^2 dt + O(\rho^3)\sigma_\eta^2 dt\} \quad (21)$$

the downward bias at the limit is an increasing function of ρ and $\sigma_\eta^2 dt$.

[4]The sketch of the proof is as follows. Let $T = 5$. Compute and sum the five variances and ten covariances of $\nu_t\sqrt{dt}$. Examining the covariance sum for $\rho \le 0$ results in $E(\zeta\sqrt{dt}) \le 0$. The general result is obtained by induction. The formal derivation is available from the authors on request.

II. Simulation Results

We use simulations to assess the severity of the biases in the arithmetic and geometric averages. In addition, we present two other estimates of expected return, as suggested in Blume (1974): a weighted average and an overlapping average.

We calculate the weighted average as a horizon-weighted average of the arithmetic and geometric averages:

$$E(W^N) = \frac{T-N}{T-1} R_A^N + \frac{N-1}{T-1} R_G^N \qquad (22)$$

where the weights sum to one. When N=1, the arithmetic average receives all the weight. As $N \rightarrow T$, more weight is given to the geometric average.

We construct the overlapping average as follows. We compute an N-period total return, T-N+1 in number, by multiplying the first through the N^{th} one-period total returns together, the second through the $(N+1)^{st}$ one-period returns together, and so on. We then average the overlapped total returns.

To examine the empirical properties of each estimator, we use the return generating process described in Equation (3). For a benchmark monthly return, $\mu = 0.01$, and alternative values of autocorrelations $\rho = 0, -0.05, -0.25$, we draw a total of 250,000 random values of $\varepsilon_t\sqrt{dt}$ and $\eta_t\sqrt{dt}$ from zero mean normal variates with variances ranging from zero to 0.0081 for σ_ε^2 and zero to 0.0045 for σ_η^2, respectively. We then partition the 250,000 returns into 1,000 samples of 250 observations (T =250), and calculate the values of the four estimators for horizons N = 12,24,60,84,120.

Table 1 presents the simulation results when the autocorrelation and time-varying variance components are absent, i.e., $\rho = 0$ and $\sigma_\eta^2 = 0$. Simulation results in the presence of both time-varying and stationary variance as well as negative autocorrelation components appear in Table 2 (ρ =-0.05) and Table 3 (ρ = -0.25).

For the four estimators, the patterns of bias (direction and magnitude) and efficiency (standard deviation or the 0.05-0.95 fractile values) that appear in Table 1 are similar to those found in Blume (1974). Notice from Table 1 that for any investment horizon and stationary variance, the geometric average is always biased downward. For longer horizons N (=60,84,120), the arithmetic average is upward-biased, regardless of the stationary variance. For shorter horizons, N (=12,24), the arithmetic average is downward-biased for a small value of stationary variance, σ_ε^2 (= 0.0036), but upward-biased for a large value of stationary variance, σ_ε^2 (= 0.0081). For a small value of stationary variance, σ_ε^2 (= 0.0036), the overlapping estimator is downward-biased for any horizon, but for a large value of stationary variance, σ_ε^2 (= 0.0081), the estimator is upward-biased for shorter horizons, N (=12,24), and downward-biased for longer horizons, N (=60,84,120). Finally, for any horizon, the weighted average estimator is downward-biased for a small value of stationary variance, σ_ε^2 (= 0.0036),and upward-biased for a large value of stationary variance, σ_ε^2 (= 0.0081).

The magnitude of the bias is the largest for the geometric average. In addition, observe that for the smaller value of stationary variance, σ_ε^2 (= 0.0036), the arithmetic average has the least bias for shorter horizons, N (= 12,24), and the overlapping average the least bias for longer horizons, N (= 60,84,120). For the large value of stationary variance, σ_ε^2 (= 0.0081), and any horizon, the weighted and overlapping averages have less bias than the arithmetic and geometric averages. Overall, the geometric average is the most efficient estimator, and the overlapping average is the least efficient. The weighted average is consistently more efficient than the arithmetic and overlapping averages.

If we compare both Panel A's in Tables 1 and 2, we see that the arithmetic and geometric averages are more upward- and less downward-biased, respectively, and that both averages are less efficient. This represents the combined effect of a small negative autocorrelation (ρ = -0.05) and time-varying variance (σ_ε^2 = 0.0036),which is greater than that of σ_ε^2 alone. Moreover, although the bias for all estimators increases with N, the weighted average is not only the least biased, but is also more efficient than the overlapping average.

Similarly, if we compare Panels A and B of Table 2, introducing σ_ε^2 (= 0.0045) to a small negative autocorrelation (ρ = -0.05) and time-varying variance (σ_ε^2 = 0.0036) magnifies the magnitude of bias for all estimators. The overlapping average is the least biased, but least efficient, estimator. The weighted average is only slightly more biased, but is more efficient than the overlapping average.

Finally, the relative impact of σ_ε^2 and σ_η^2 is evident when we compare Panels B and C of Table 2. When $\sigma_\eta^2 > \sigma_\varepsilon^2$, the weighted average contains consistently smaller biases than when $\sigma_\eta^2 < \sigma_\varepsilon^2$, and its efficiency improves as N increases. Although the overlapping average is still the least biased, it is also the least efficient estimator. The weighted average is only slightly more biased, but is more efficient, than the overlapping average.

In general, the direction and magnitude of the biases reported in Table 2 are also observed in Table 3. In the majority of the cases reported in Table 3, however, the weighted average is the least biased of all estimators, although this improvement is achieved at the expense of efficiency. If we compare Panels A and C, we also

Table 1. Simulation Results in the Absence of Autocorrelation and Time-Varying Variance, $\rho = 0$ and $\sigma_\eta^2 = 0$

Monthly benchmark return is 1%. Horizon is stated in the number of months. Wt. Ave. is the horizon-weighted average of the arithmetic and geometric averages. Overlap is the overlapping average.

Panel A. $\rho = 0$, $\sigma_\eta^2 = 0, \sigma_\varepsilon^2 = 0.0036$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1254	0.0507	1.0427	1.1246	1.2076
Geometric			1.1018	0.0499	1.0209	1.1013	1.1831
Wt. Ave.			1.1243	0.0507	1.0417	1.1237	1.2064
Overlap			1.1251	0.0516	1.0427	1.1248	1.2090
Arithmetic	24	1.2697	1.2691	0.1146	1.0872	1.2648	1.4582
Geometric			1.2165	0.1104	1.0422	1.2128	1.3998
Wt. Ave.			1.2640	0.1142	1.0831	1.2604	1.4526
Overlap			1.2657	0.1191	1.0786	1.2610	1.4682
Arithmetic	60	1.8167	1.8422	0.4198	1.2325	1.7990	2.5677
Geometric			1.6575	0.3796	1.1088	1.6198	2.3181
Wt. Ave.			1.7966	0.4098	1.2036	1.7567	2.5050
Overlap			1.8022	0.4725	1.1562	1.7383	2.6531
Arithmetic	84	2.3067	2.3858	0.7693	1.3400	2.2752	3.7442
Geometric			2.0580	0.6672	1.1556	1.9645	3.2448
Wt. Ave.			2.2719	0.7337	1.2796	2.1701	3.5650
Overlap			2.2851	0.8909	1.1991	2.1236	3.9425
Arithmetic	120	3.3004	3.5698	1.6822	1.5190	3.2362	6.5931
Geometric			2.8912	1.3714	1.2295	2.6239	5.3736
Wt. Ave.			3.2319	1.5270	1.3830	2.9328	5.9712
Overlap			3.2528	1.9440	1.2160	2.7965	6.8591

Panel B. $\rho = 0$, $\sigma_\eta^2 = 0, \sigma_\varepsilon^2 = 0.0081$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1306	0.0760	1.0079	1.1284	1.2583
Geometric			1.0774	0.0730	0.9599	1.0745	1.2022
Wt. Ave.			1.1281	0.0758	1.0059	1.1261	1.2556
Overlap			1.1283	0.0780	1.0047	1.1260	1.2605
Arithmetic	24	1.2697	1.2839	0.1727	1.0159	1.2734	1.5833
Geometric			1.1662	0.1581	0.9214	1.1544	1.4452
Wt. Ave.			1.2726	0.1713	1.0071	1.2624	1.5697
Overlap			1.2703	0.1791	0.9944	1.2607	1.5759
Arithmetic	60	1.8167	1.9316	0.6610	1.0403	1.8298	3.1544
Geometric			1.5195	0.5241	0.8149	1.4320	2.5107
Wt. Ave.			1.8299	0.6269	0.9857	1.7356	2.9926
Overlap			1.8074	0.6846	0.8913	1.6954	3.1078
Arithmetic	84	2.3067	2.5929	1.2706	1.0569	2.3301	4.9944
Geometric			1.8540	0.9167	0.7508	1.6531	3.6284
Wt. Ave.			2.3363	1.1471	0.9532	2.1020	4.5182
Overlap			2.2787	1.2826	0.7824	2.0096	4.7529
Arithmetic	120	3.3004	4.1676	3.0671	1.0823	3.3482	9.9503
Geometric			2.5834	1.9241	0.6640	2.0506	6.3036
Wt. Ave.			3.3788	2.4961	0.8798	2.7156	8.1821
Overlap			3.2201	2.7834	0.6314	2.4351	8.7221

Table 2. Simulation Results with a Small Autocorrelation ρ = -0.05

Monthly benchmark return is 1%. Horizon is stated in the number of months. Wt. Ave. is the horizon-weighted average of the arithmetic and geometric averages. Overlap is the overlapping average.

Panel A. $\rho = -0.05$, $\sigma^2_\eta = 0.036$ $\sigma^2_\varepsilon = 0$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1269	0.0515	1.0446	1.1237	1.2166
Geometric			1.1032	0.0506	1.0246	1.1003	1.1917
Wt. Ave.			1.1258	0.0515	1.0437	1.1226	1.2156
Overlap			1.1236	0.0527	1.0383	1.1221	1.2165
Arithmetic	24	1.2697	1.2724	0.1171	1.0913	1.2627	1.4801
Geometric			1.2195	0.1125	1.0499	1.2107	1.4201
Wt. Ave.			1.2674	0.1167	1.0872	1.2574	1.4748
Overlap			1.2621	0.1216	1.0743	1.2546	1.4707
Arithmetic	60	1.8167	1.8556	0.4393	1.2440	1.7918	2.6651
Geometric			1.6687	0.3962	1.1294	1.6127	2.4032
Wt. Ave.			1.8095	0.4286	1.2159	1.7476	2.6018
Overlap			1.7869	0.4676	1.1393	1.7179	2.6344
Arithmetic	84	2.3067	2.4123	0.8214	1.3575	2.2626	3.9446
Geometric			2.0793	0.7102	1.1858	1.9524	3.4127
Wt. Ave.			2.2966	0.7826	1.2986	2.1572	3.7665
Overlap			2.2608	0.8839	1.1510	2.1064	4.0036
Arithmetic	120	3.3004	3.6361	1.8669	1.5475	3.2106	7.1027
Geometric			2.9415	1.5153	1.2756	2.6007	5.7753
Wt. Ave.			3.2902	1.6915	1.4119	2.9204	6.4632
Overlap			3.2330	1.9575	1.1754	2.7698	6.8499

Panel B. $\rho = -0.05$, $\sigma^2_\eta = 0.036$, $\sigma^2_\varepsilon = 0.0045$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1319	0.0748	1.0164	1.1283	1.2568
Geometric			1.0786	0.0720	0.9662	1.0763	1.1971
Wt. Ave.			1.1294	0.0747	1.0143	1.1259	1.2544
Overlap			1.1278	0.0771	1.0077	1.1238	1.2610
Arithmetic	24	1.2697	1.2867	0.1713	1.0331	1.2732	1.5796
Geometric			1.1686	0.1571	0.9335	1.1585	1.4330
Wt. Ave.			1.2754	0.1669	1.0239	1.2617	1.5668
Overlap			1.2720	0.1819	1.0056	1.2590	1.6056
Arithmetic	60	1.8167	1.9412	0.6685	1.0847	1.8290	3.1359
Geometric			1.5266	0.5307	0.8419	1.4446	2.4583
Wt. Ave.			1.8388	0.6343	1.0243	1.7300	2.9745
Overlap			1.8159	0.7385	0.9271	1.6760	3.1844
Arithmetic	84	2.3067	2.6111	1.3023	1.1206	2.3285	4.9536
Geometric			1.8663	0.9401	0.7859	1.6736	3.5227
Wt. Ave.			2.3524	1.1760	1.0025	2.0926	4.4684
Overlap			2.3005	1.4391	0.8698	1.9396	4.7906
Arithmetic	120	3.3004	4.2146	3.2132	1.1767	3.3451	9.8342
Geometric			2.6119	2.0128	0.7088	2.0869	6.0431
Wt. Ave.			3.4166	2.6141	0.9468	2.6988	7.9694
Overlap			3.3191	3.4287	0.7108	2.3538	8.5702

Table 2. Simulation Results with a Small Autocorrelation ρ = -0.05 (*Continued*)

Panel C. $\rho = -0.05$, $\sigma_\eta^2 = 0.0045$ $\sigma_\varepsilon^2 = 0.0036$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1306	0.0749	1.0085	1.1289	1.2550
Geometric			1.0779	0.0720	0.9603	1.0771	1.1963
Wt. Ave.			1.1282	0.0747	1.0064	1.1265	1.2522
Overlap			1.1266	0.0779	0.9985	1.1242	1.2583
Arithmetic	24	1.2697	1.2839	0.1701	1.0172	1.2744	1.5750
Geometric			1.1670	0.1559	0.9223	1.1602	1.4312
Wt. Ave.			1.2727	0.1687	1.0084	1.2632	1.5609
Overlap			1.2689	0.1828	0.9850	1.2568	1.5954
Arithmetic	60	1.8167	1.9297	0.6472	1.0435	1.8333	3.1133
Geometric			1.5206	0.5141	0.8168	1.4500	2.4503
Wt. Ave.			1.8287	0.6141	0.9896	1.7368	2.9461
Overlap			1.8123	0.7192	0.8688	1.6657	3.1331
Arithmetic	84	2.3067	2.5865	1.2395	1.0614	2.3363	4.9036
Geometric			1.8538	0.8962	0.7533	1.6824	3.5067
Wt. Ave.			2.3320	1.1197	0.9580	2.1085	4.4085
Overlap			2.2913	1.3224	0.7811	1.9445	4.7278
Arithmetic	120	3.3004	4.1422	2.9827	1.0888	3.3611	9.6930
Geometric			2.5764	1.8779	0.6672	2.1025	6.0039
Wt. Ave.			3.3626	2.4308	0.8854	2.7379	7.8210
Overlap			3.2489	2.8583	0.6348	2.3838	8.1933

Table 3. Simulation Results with a Large Autocorrelation ρ = -0.25

Monthly benchmark return is 1%. Horizon is stated in the number of months. Wt. Ave. is the horizon-weighted average of the arithmetic and geometric averages. Overlap is the overlapping average.

Panel A. $\rho = -0.25$, $\sigma_\eta^2 = 0.00108$ $\sigma_\varepsilon^2 = 0.00252$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1262	0.0487	1.0448	1.1266	1.2077
Geometric			1.1021	0.0478	1.0213	1.1024	1.1816
Wt. Ave.			1.1251	0.0486	1.0437	1.1254	1.2065
Overlap			1.1225	0.0494	1.0386	1.1221	1.2011
Arithmetic	24	1.2697	1.2708	0.1097	1.0915	1.2692	1.4585
Geometric			1.2169	0.1054	1.0431	1.2152	1.3962
Wt. Ave.			1.2656	0.1092	1.0869	1.2638	1.4527
Overlap			1.2603	0.1136	1.0728	1.2567	1.4536
Arithmetic	60	1.8167	1.8458	0.3996	1.2447	1.8149	2.5689
Geometric			1.6565	0.3602	1.1113	1.6280	2.3034
Wt. Ave.			1.7991	0.3898	1.2134	1.7704	2.5056
Overlap			1.7895	0.4342	1.1623	1.7311	2.5611
Arithmetic	84	2.3067	2.3891	0.7302	1.3586	2.3035	3.7467
Geometric			2.0536	0.6308	1.1592	1.9784	3.2159
Wt. Ave.			2.2726	0.6955	1.2935	2.1953	3.5686
Overlap			2.2606	0.7989	1.1846	2.1236	3.7313
Arithmetic	120	3.3004	3.5665	1.5918	1.5493	3.2937	6.5994
Geometric			2.8738	1.2908	1.2349	2.6504	5.3055
Wt. Ave.			3.2216	1.4415	1.3994	2.9794	5.9669
Overlap			3.2091	1.6643	1.1889	2.8265	6.4095

Table 3. Simulation Results with a Large Autocorrelation ρ = -0.25 (*Continued*)

Panel B. $\rho = -0.25$, $\sigma_\eta^2 = 0.000405$ $\sigma_\varepsilon^2 = 0.007695$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1299	0.0785	1.0006	1.1268	1.2676
Geometric			1.0768	0.0756	0.9512	1.0737	1.2076
Wt. Ave.			1.1275	0.0783	0.9980	1.1244	1.2646
Overlap			1.1264	0.0812	0.9936	1.1230	1.2652
Arithmetic	24	1.2697	1.2829	0.1789	1.0011	1.2696	1.6069
Geometric			1.1652	0.1643	0.9049	1.1528	1.4583
Wt. Ave.			1.2715	0.1775	0.9908	1.2584	1.5910
Overlap			1.2679	0.1898	0.9755	1.2511	1.5983
Arithmetic	60	1.8167	1.9326	0.6969	1.0028	1.8162	3.2732
Geometric			1.5208	0.5546	0.7788	1.4267	2.5679
Wt. Ave.			1.8309	0.6615	0.9445	1.7202	3.0817
Overlap			1.8186	0.7458	0.8661	1.6569	3.2862
Arithmetic	84	2.3067	2.6022	1.3673	1.0040	2.3058	5.2596
Geometric			1.8619	0.9902	0.7047	1.6447	3.7447
Wt. Ave.			2.3451	1.2358	0.8964	2.0758	4.6840
Overlap			2.3242	1.4276	0.7842	1.9571	5.1075
Arithmetic	120	3.3004	4.2200	3.4602	1.0057	3.2985	10.7135
Geometric			2.6200	2.1793	0.6066	2.0356	6.5943
Wt. Ave.			3.4233	2.8210	0.8030	2.6675	8.5390
Overlap			3.3601	3.1676	0.6356	2.3754	9.7576

Panel C. $\rho = -0.25$, $\sigma_\eta^2 = 0.00243$ $\sigma_\varepsilon^2 = 0.00567$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1294	0.0721	1.0199	1.1252	1.2561
Geometric			1.0753	0.0694	0.9690	1.0721	1.1970
Wt. Ave.			1.1269	0.0719	1.0174	1.1225	1.2533
Overlap			1.1200	0.0738	1.0113	1.1146	1.2504
Arithmetic	24	1.2697	1.2808	0.1641	1.0403	1.2661	1.5779
Geometric			1.1611	0.1505	0.9390	1.1493	1.4329
Wt. Ave.			1.2693	0.1628	1.0296	1.2543	1.5632
Overlap			1.2529	0.1700	1.0132	1.2368	1.5553
Arithmetic	60	1.8167	1.9141	0.6252	1.1038	1.8038	3.1274
Geometric			1.4987	0.4957	0.8545	1.4161	2.4576
Wt. Ave.			1.8115	0.5930	1.0404	1.7044	2.9563
Overlap			1.7524	0.6358	0.9180	1.6407	2.9633
Arithmetic	84	2.3067	2.5532	1.1906	1.1483	2.2839	4.9347
Geometric			1.8140	0.8578	0.8024	1.6276	3.5213
Wt. Ave.			2.2965	1.0745	1.0309	2.0482	4.4316
Overlap			2.1744	1.1431	0.8366	1.9151	4.4332
Arithmetic	120	3.3004	4.0541	2.8088	1.2184	3.2539	9.7808
Geometric			2.4915	1.7562	0.7301	2.0054	6.0396
Wt. Ave.			3.2761	2.2832	0.9765	2.6212	7.8862
Overlap			2.9808	2.3220	0.6750	2.2822	7.5861

Table 3. Simulation Results with a Large Autocorrelation ρ = -0.25 (*Continued*)

Panel D. $\rho = -0.25$, $\sigma_\eta^2 = 0.0036$ $\sigma_\varepsilon^2 = 0.0045$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles 0.05	0.50	0.95
Arithmetic	12	1.1268	1.1275	0.0709	1.0146	1.1272	1.2492
Geometric			1.0730	0.0684	0.9633	1.0725	1.1877
Wt. Ave.			1.1250	0.0708	1.0125	1.1247	1.2467
Overlap			1.1158	0.0724	1.0008	1.1168	1.2410
Arithmetic	24	1.2697	1.2762	0.1605	1.0295	1.2705	1.5606
Geometric			1.1560	0.1474	0.9280	1.1503	1.4107
Wt. Ave.			1.2646	0.1592	1.0207	1.2593	1.5468
Overlap			1.2446	0.1662	0.9894	1.2401	1.5459
Arithmetic	60	1.8167	1.8947	0.6019	1.0754	1.8196	3.0423
Geometric			1.4809	0.4767	0.8296	1.4190	2.3638
Wt. Ave.			1.7925	0.5707	1.0183	1.7202	2.8760
Overlap			1.7249	0.6193	0.8986	1.6286	2.9045
Arithmetic	84	2.3067	2.5137	1.1352	1.1072	2.3119	4.7477
Geometric			1.7816	0.8146	0.7699	1.6323	3.3347
Wt. Ave.			2.2595	1.0233	0.9959	2.0773	4.2567
Overlap			2.1478	1.1423	0.8072	1.8783	4.4142
Arithmetic	120	3.3004	3.9518	2.6400	1.1565	3.3109	9.2557
Geometric			2.4201	1.6346	0.6883	2.0137	5.5876
Wt. Ave.			3.1891	2.1377	0.9301	2.6705	7.4157
Overlap			2.9632	2.3759	0.6444	2.2599	7.7379

observe that when σ_ε^2 and σ_η^2 both increase by the same proportion, the weighted average experiences a smaller bias relative to the other three estimators. Furthermore, we see from Panels B and C that a reduction in σ_ε^2 that is offset by a corresponding increase in σ_η^2 improves the weighted average's efficiency.

The effect of higher negative autocorrelation is evident when we compare Panel D in Table 3 with Panel B in Table 2. Even though we obtain a higher efficiency for all estimators, a higher negative autocorrelation ρ leads to a smaller bias in the arithmetic and weighted averages, but a larger bias for the geometric and overlapping averages. Moreover, although Table 3 shows that the weighted average is the second most efficient estimator, it is overall the least biased when negative autocorrelation, time-varying, and stationary variance components are all present.

III. Concluding Remarks

We show that both the arithmetic and geometric averages are biased estimates of long-run expected returns, and the bias increases with the length of the investment horizons. The existence of negative autocorrelation in long-horizon returns documented by Fama and French (1988a, 1988b), Lo and MacKinlay (1988), and Poterba and Summers (1988) exacerbates the bias. The implication is that without making an adjustment, we are likely to obtain an estimate of long-run expected return (and risk premium) that is either too high or too low, and this can result in an inappropriate decision to reject a good project or accept a bad project.

The horizon-weighted average of the arithmetic and geometric averages, proposed by Blume (1974), is an alternative estimate of long-run expected returns. Our simulation results indicate that in general, the horizon-weighted average contains the least bias. It is also more efficient than other estimators in the presence of negative autocorrelation, time-varying, and stationary variances. This conclusion contrasts with Blume's conjecture that "...if one cannot assume independence of successive one-period relatives or if there is even a slight chance that these relatives are dependent, the simple average of *N*-period relatives would appear preferable to the nonlinear estimators which, even under ideal conditions, yield only a modest increase in efficiency." ■

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Invesco

2023 Long-Term Capital Market Assumptions

Invesco Investment Solutions | United States Dollar (USD)

1

Executive Summary

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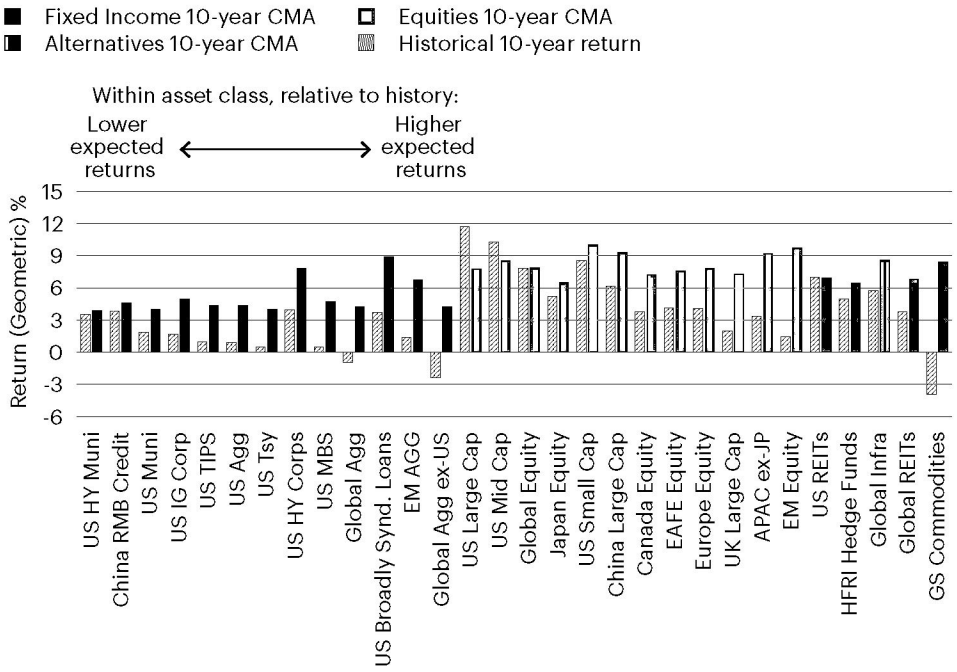
Invesco Investment Solutions provides forecasts for 170+ assets in over 20 currencies, including 10 private assets. For additional CMA data, views, or analysis, please reach out to your Invesco representative.

- Our team at Invesco Investment Solutions remains quite positive on our long-term capital market assumptions (CMAs). Most of the 170+ assets we cover are expected to return more in the coming decade than the last decade.
- As central banks have begun to unwind years of excess liquidity through quantitative tightening and rapid rate hikes, only one thing is certain, cash has become more valuable. Investors can now be prudent in their risk taking and, in nominal terms, the risk-free rate actually returns something for savers.
- Fixed income assets, particularly long duration government bonds, have corrected meaningfully in 2022, and while major economies have yet to register a technical recession, cash flows have been discounted by higher interest rates resulting in drawdowns within overvalued portions of equity markets.

Figure 1: Expectations relative to historical average (USD)



Source: Invesco, estimates as of September 30, 2022. Proxies listed in **Figure 8**. These estimates are forward-looking, are not guarantees, and they involve risks, uncertainties, and assumptions. Please see page 9 for information about our CMA methodology. These estimates reflect the views of Invesco Investment Solutions, the views of other investment teams at Invesco may differ from those presented here.

2

Asset Allocation Insights

Jacob Borbidge
Senior Portfolio Manager,
Head of Investment Research,
Invesco Investment Solutions

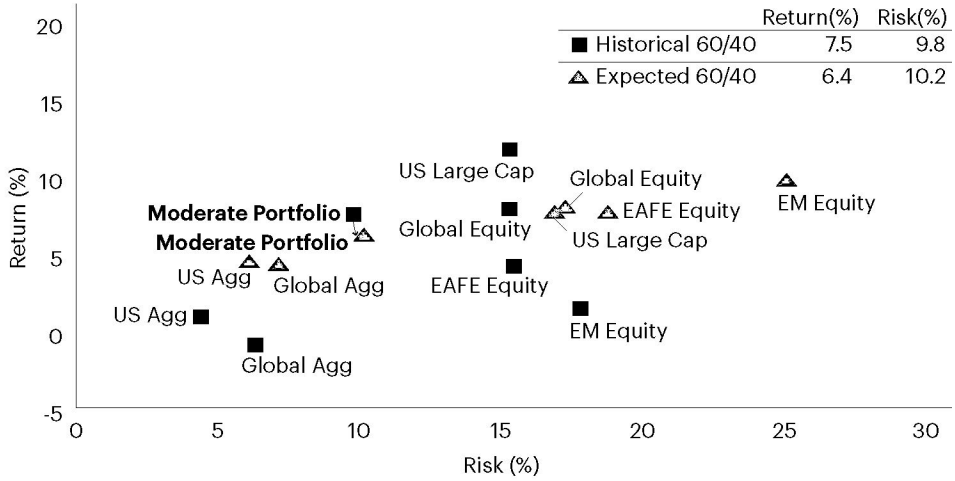
For further details on our process for defining scenarios and adjustments, please refer to our CMA Methodology paper.

Strategic perspective

2022 has been a year for the record books, at least for most investor's professional careers, and not in a good way. Since 1928, we have yet to register a year in which both equities and long duration treasuries experience double digit declines simultaneously. It is not an exaggeration to say that even moderate investors have had one of worst calendar year investment periods, ever. And after accounting for persistently high inflation, 2022 may be the worst year the 60/40 portfolio has ever seen. At least the simple mix of assets had little exposure to meme stocks or cryptocurrencies.

How did we get here? Rampant inflation from reopening stimulus and supply shocks have been a thorn in the side of policy makers. As central banks have begun to unwind years of excess liquidity through quantitative tightening and rapid rate hikes, only one thing is certain, cash has become more valuable. Investors can now be prudent in their risk taking and the risk-free rate actually returns something for savers. Fixed income assets, particularly long duration government bonds, have corrected meaningfully, and while major economies have yet to register a technical recession, cash flows have been discounted by higher interest rates resulting in drawdowns within overvalued portions of equity markets. Outside of the US, growth prospects have been diminished in other regions due to COVID-lockdowns, food and energy crises, and the war in the Ukraine. It has been a long time since a global 60/40 has looked this attractive on a forward-looking basis.

Figure 2: Historical returns for the 60/40 have fallen amid recent selloff while expected returns are improving (USD)



Source: Invesco Investment Solutions, as of September 30, 2022. Proxies listed in **Figure 8**. These estimates are forward-looking, are not guarantees, and they involve risks, uncertainties, and assumptions. Please see page 9 for information about our CMA methodology. These estimates reflect the views of Invesco Investment Solutions, the views of other investment teams at Invesco may differ from those presented here. The 60/40 Portfolio is a blend of 60% S&P 500 Index and 40% Bloomberg Barclays US Aggregate Index.

Despite most forecasters predicting a recession in 2023 due to the lagged effects of rate hikes, our team at Invesco Investment Solutions remains quite positive on our long-term capital market assumptions (CMAs). Most of the 170+ assets we cover are expected to return more in the coming decade than the last decade. This is a dramatic shift felt throughout the CMAs and particularly within fixed income. While our goal is not to predict when the next business cycle will begin, when examining the spread of our shorter-term forecasts (5 years) and longer-term ones (10 years), cyclical assets tied with an accelerating economy like broadly syndicated loans, small cap equities, value factor-oriented strategies, and emerging markets (EM) seem to be front-loading returns, an indication that growth prospects may be positive going forward. We anticipate sharpe ratios of portfolios will increase and the value of diversification will return as correlations between assets normalize.

3Q22 CMA Observations (10Y, USD):

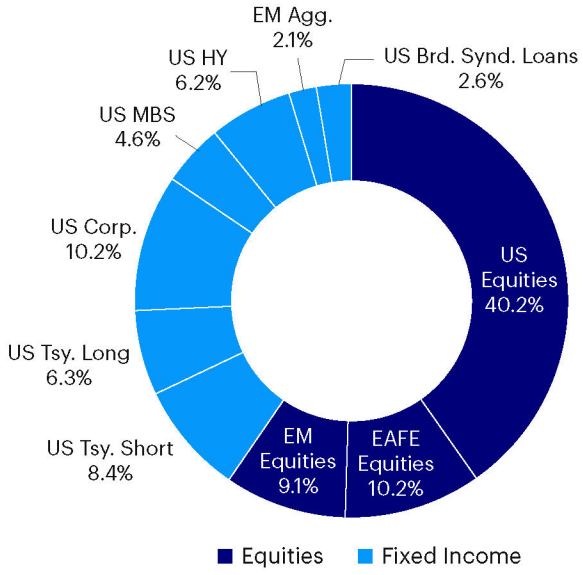
Equities: Nominal growth is very high, and earnings have not yet collapsed but are expected to moderate. Thus far in 2022, inflation has been a life raft for nominal earnings but when the support of inflation recedes we expect nominal earnings to struggle in the short term. However, our global equity CMAs are still approaching 8% nominal returns with some assets, like US small caps and EM equities are close to 10%. Developed market (DM) equity CMAs outside of the US continue to lag due to a challenging growth environment and we have manually adjusted the earnings growth building block of our forecast down for these regions due to persistent issues stemming from the war in the Ukraine. Quarter over quarter, the largest shift in expected return has been in our currency adjustment building block as countries begin to normalize their interest rates. Year over year, the largest detractor to our equity CMAs has been the earnings growth component as a period of high growth is expected to slow.

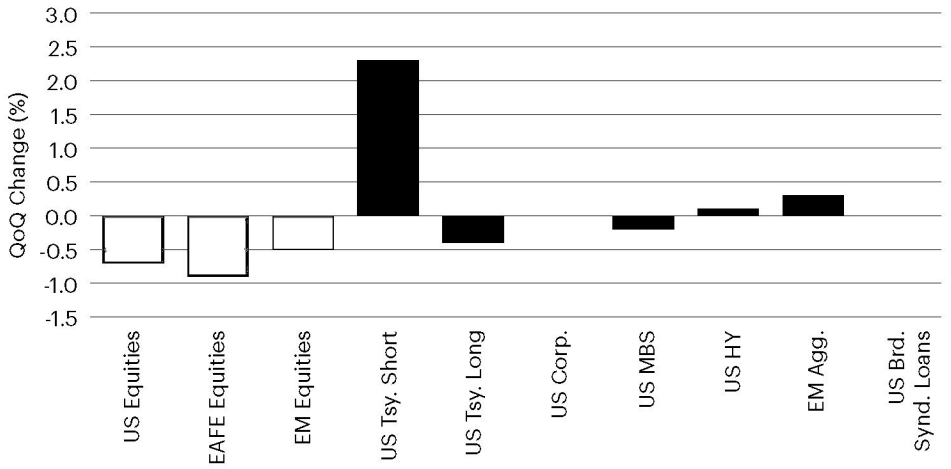
Fixed Income: Sharpe ratios of fixed income assets typically hover around 1, while equity assets are on average closer to .5. Artificially low interest rates over the past few years created an investment environment where the opposite was true. Today's Sharpe ratios are closer to normal, providing opportunities for multi-asset investors to increase allocations to fixed income instruments. US Treasury CMAs are 4%, a 2.5% increase over the past year. The forecasts for most fixed income assets have improved as current yields have risen. Expected yields are slightly lower than present yield curves resulting in an improvement to valuation change, however curves are flatter and thus detracting from roll return. Credit assets like loans and high yield are up almost 5% this past year as higher credit spreads are anticipated to revert to their long-term average.

Alternatives: Private market CMAs have been mixed this past year as interest rate sensitive assets like core real estate have suffered, going from 12.7% last year to around 9%, while shorter duration private credit has improved to 12.5% for our levered first lien forecast. Private assets remain a strategic decision based on liquidity needs and investor goals, be it improved returns, enhanced income, or diversification.

Strategic Asset Allocation Trends:

Figure 3: 2022 Q3 SAA Rebalance (USD)





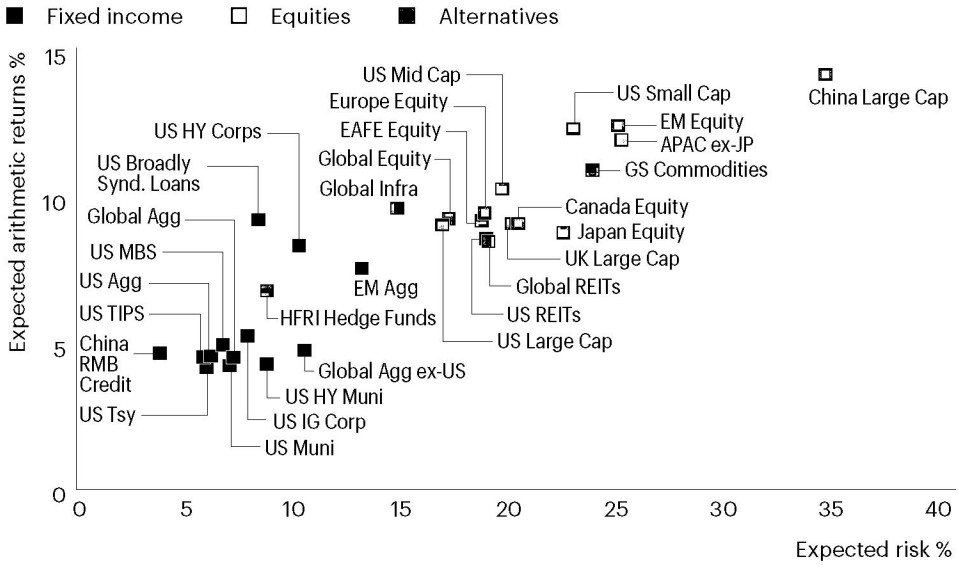
Source: Invesco Investment Solutions, as of September 30, 2022. Proxies listed in **Figure 8**. These estimates reflect the views of Invesco Investment Solutions, the views of other investment teams at Invesco may differ from those presented here. References to overweights and underweights are relative to a 60% global equity and 40% global aggregate fixed income benchmark.

- **Portfolio level:** Compared to a global 60/40 benchmark, our strategic portfolio (5-10Y) is slightly overweight fixed income relative to equities.
- **Within equities:** We are overweight EM and US large cap equities while underweight DM ex-US equities. We have further reduced our exposure in DM ex-US equities amid growth concerns.
- **Within fixed income:** Presently overweight both treasuries and risky credit. Presently we have a neutral duration compared to our benchmark and have recently added to short term treasuries.

3

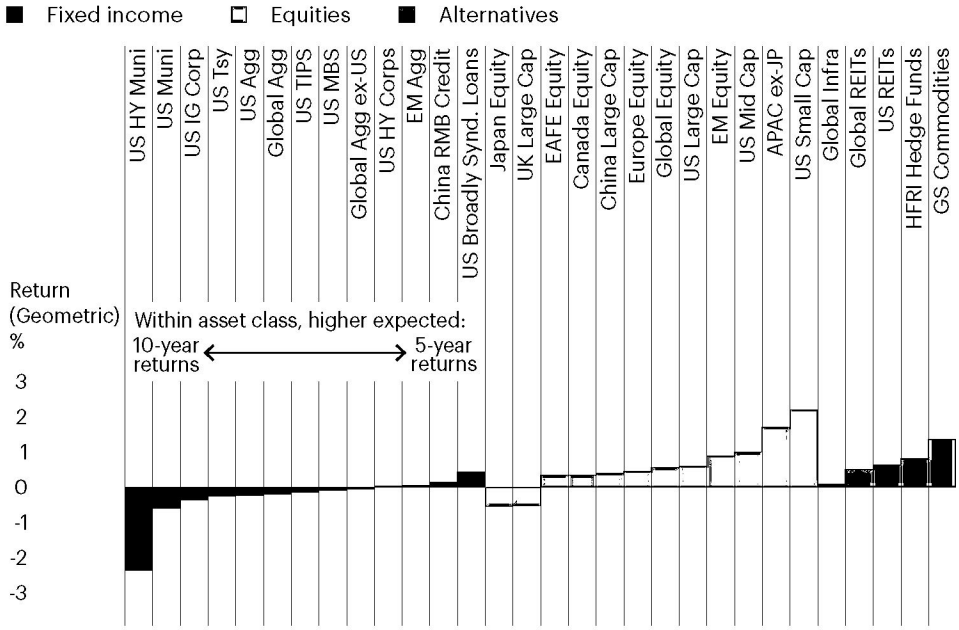
2023 Capital Market Assumptions

Figure 4: 10-year asset class expectations (USD)



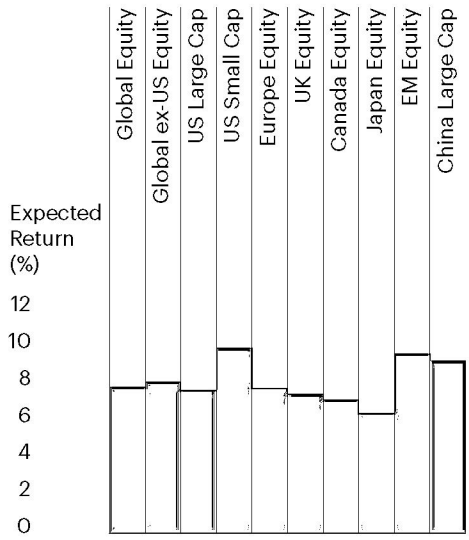
Source: Invesco, estimates as of September 30, 2022. Proxies listed in **Figure 8**. These estimates are forward-looking, are not guarantees, and they involve risks, uncertainties, and assumptions. Please see page 9 for information about our CMA methodology. These estimates reflect the views of Invesco Investment Solutions, the views of other investment teams at Invesco may differ from those presented here. **Performance, whether actual or simulated, does not guarantee future results.**

Figure 5: CMA difference: 5-year minus 10-year assumptions (USD)



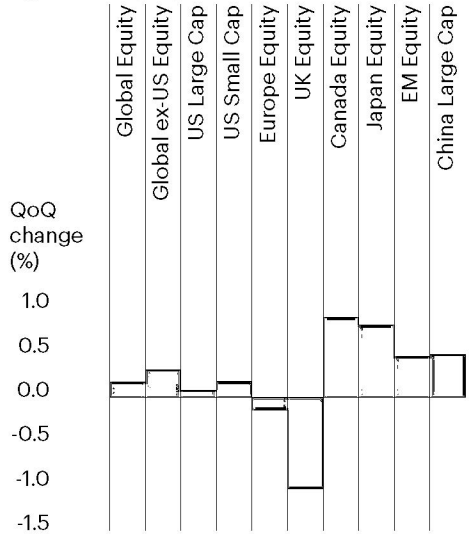
Source: Invesco, estimates as of September 30, 2022. Proxies listed in **Figure 8**. These estimates are forward-looking, are not guarantees, and they involve risks, uncertainties, and assumptions. Please see page 9 for information about our CMA methodology. These estimates reflect the views of Invesco Investment Solutions, the views of other investment teams at Invesco may differ from those presented here. **Performance, whether actual or simulated, does not guarantee future results.**

Figure 6a: Equity CMA and building block contribution (USD) (%)



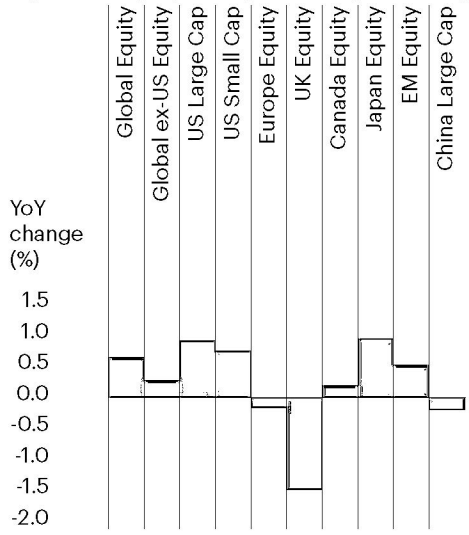
	Dividend Yield	Buyback Yield	LT Earnings Growth	Expected Inflation	Valuation Change	Currency Adj. (IRP)
Global Equity	2.32	0.79	1.90	2.18	0.35	0.34
Global ex-US Equity	3.29	0.00	1.85	1.90	0.22	0.91
US Large Cap	1.72	1.27	1.93	2.35	0.43	0.00
US Small Cap	1.56	0.80	3.31	2.35	1.95	0.00
Europe Equity	3.37	0.00	1.38	1.99	-0.09	1.18
UK Equity	4.02	0.00	1.76	2.45	-0.38	-0.34
Canada Equity	2.93	0.00	1.76	2.02	-0.16	0.63
Japan Equity	2.65	0.00	1.01	-0.44	-0.28	3.55
EM Equity	3.33	0.00	2.91	2.74	1.07	-0.40
China Large Cap	2.34	0.00	3.82	1.37	0.73	1.02

Figure 6b: Equity CMA quarter-over-quarter change and building block contribution (USD) (%)



	Dividend Yield	Buyback Yield	LT Earnings Growth	Expected Inflation	Valuation Change	Currency Adj. (IRP)
Global Equity	0.16	0.03	-0.17	-0.06	0.14	0.08
Global ex-US Equity	0.25	0.00	-0.25	-0.12	0.22	0.22
US Large Cap	0.13	0.02	-0.12	-0.03	0.09	0.00
US Small Cap	0.09	-0.02	-0.18	-0.03	0.32	0.00
Europe Equity	0.12	0.00	-0.16	-0.03	0.12	-0.19
UK Equity	0.04	0.00	-0.21	-0.06	0.23	-1.01
Canada Equity	0.21	0.00	-0.19	-0.05	0.06	0.87
Japan Equity	0.16	0.00	-0.28	-0.08	0.21	0.80
EM Equity	0.47	0.00	-0.39	-0.26	0.43	0.24
China Large Cap	0.49	0.00	-0.62	-0.88	0.65	0.88

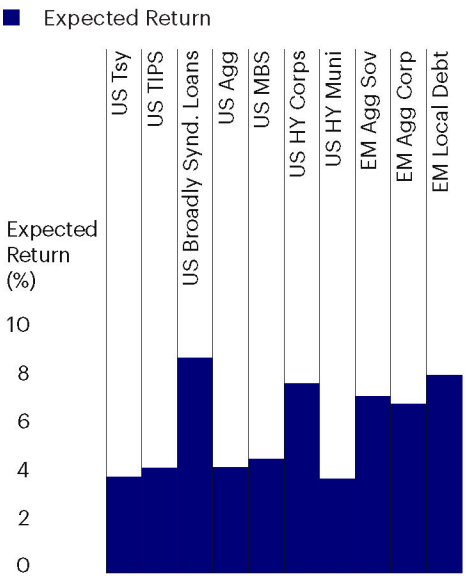
Figure 6c: Equity CMA year-over-year change and building block contribution (USD) (%)



	Dividend Yield	Buyback Yield	LT Earnings Growth	Expected Inflation	Valuation Change	Currency Adj. (IRP)
Global Equity	0.56	0.14	-2.06	0.64	1.29	0.11
Global ex-US Equity	0.85	0.00	-2.21	0.48	0.84	0.34
US Large Cap	0.42	0.18	-1.96	0.72	1.58	0.00
US Small Cap	0.50	0.14	-2.46	0.72	1.87	0.00
Europe Equity	0.79	0.00	-2.18	0.76	0.76	-0.28
UK Equity	0.34	0.00	-1.90	0.68	0.34	-0.92
Canada Equity	0.43	0.00	-2.07	0.70	0.55	0.61
Japan Equity	0.64	0.00	-2.32	-0.28	0.82	2.09
EM Equity	1.02	0.00	-2.28	0.31	1.07	0.44
China Large Cap	0.49	0.00	-2.18	-1.54	0.79	2.37

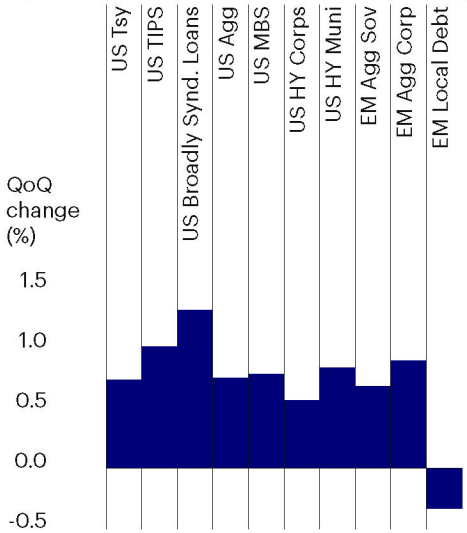
Source: Invesco, estimates as of September 30, 2022. Proxies listed in **Figure 8**. These estimates are forward-looking, are not guarantees, and they involve risks, uncertainties, and assumptions. Please see page 9 for information about our CMA methodology. These estimates reflect the views of Invesco Investment Solutions, the views of other investment teams at Invesco may differ from those presented here. **Performance, whether actual or simulated, does not guarantee future results.**

Figure 7a: Fixed income CMA and building block contribution (USD) (%)



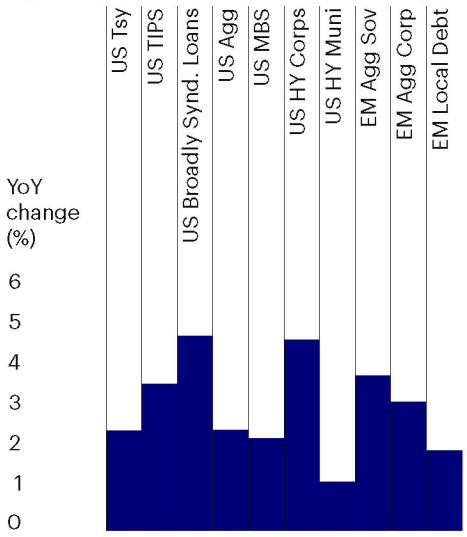
	Average Yield	Roll Return	Valuation Change (Yield Curve)	Valuation Change (OAS)	Credit Loss	Currency Adj. (IRP)
US Tsy	4.26	-0.11	-0.16	0.00	0.00	0.00
US TIPS	4.54	-0.10	-0.08	0.00	0.00	0.00
US Broadly Synd. Loans	9.49	0.00	-0.01	0.35	-0.93	0.00
US Agg	4.86	-0.11	-0.16	0.02	-0.25	0.00
US MBS	4.82	-0.11	-0.16	0.17	0.00	0.00
US HY Corps	9.51	-0.10	-0.05	0.18	-1.70	0.00
US HY Muni	7.01	0.20	-0.65	-1.76	-0.90	0.00
EM Agg Sov	8.13	-0.03	-0.27	0.75	-1.25	0.00
EM Agg Corp	8.58	-0.10	-0.05	0.31	-1.73	0.00
EM Local Debt	7.57	0.54	-0.26	0.00	0.00	0.35

Figure 7b: Fixed income CMA quarter-over-quarter change and building block contribution (USD) (%)



	Average Yield	Roll Return	Valuation Change (Yield Curve)	Valuation Change (OAS)	Credit Loss	Currency Adj. (IRP)
US Tsy	0.93	-0.33	0.14	0.00	0.00	0.00
US TIPS	1.00	-0.31	0.32	0.00	0.00	0.00
US Broadly Synd. Loans	1.22	0.00	0.02	0.07	0.00	0.00
US Agg	0.86	-0.35	0.23	0.04	-0.03	0.00
US MBS	0.83	-0.33	0.14	0.14	0.00	0.00
US HY Corps	0.71	-0.25	0.17	-0.07	0.00	0.00
US HY Muni	0.66	0.06	0.11	-0.02	0.02	0.00
EM Agg Sov	0.76	-0.15	0.25	-0.18	0.00	0.00
EM Agg Corp	0.97	-0.25	0.17	0.00	0.00	0.00
EM Local Debt	0.13	-0.07	0.12	0.00	0.00	-0.52

Figure 7c: Fixed income CMA year-over-year change and building block contribution (USD) (%)



	Average Yield	Roll Return	Valuation Change (Yield Curve)	Valuation Change (OAS)	Credit Loss	Currency Adj. (IRP)
US Tsy	2.77	-0.83	0.53	0.00	0.00	0.00
US TIPS	3.54	-0.90	0.99	0.00	0.00	0.00
US Broadly Synd. Loans	3.99	0.00	0.03	0.81	0.00	0.00
US Agg	2.69	-0.83	0.53	0.22	-0.12	0.00
US MBS	2.37	-0.74	0.41	0.25	0.00	0.00
US HY Corps	3.72	-0.60	0.46	1.17	0.00	0.00
US HY Muni	2.26	-0.43	-0.08	-0.30	-0.26	0.00
EM Agg Sov	3.08	-0.75	0.60	1.02	-0.10	0.00
EM Agg Corp	3.19	-0.73	0.52	0.42	-0.21	0.00
EM Local Debt	1.65	-0.16	0.39	0.00	0.00	0.10

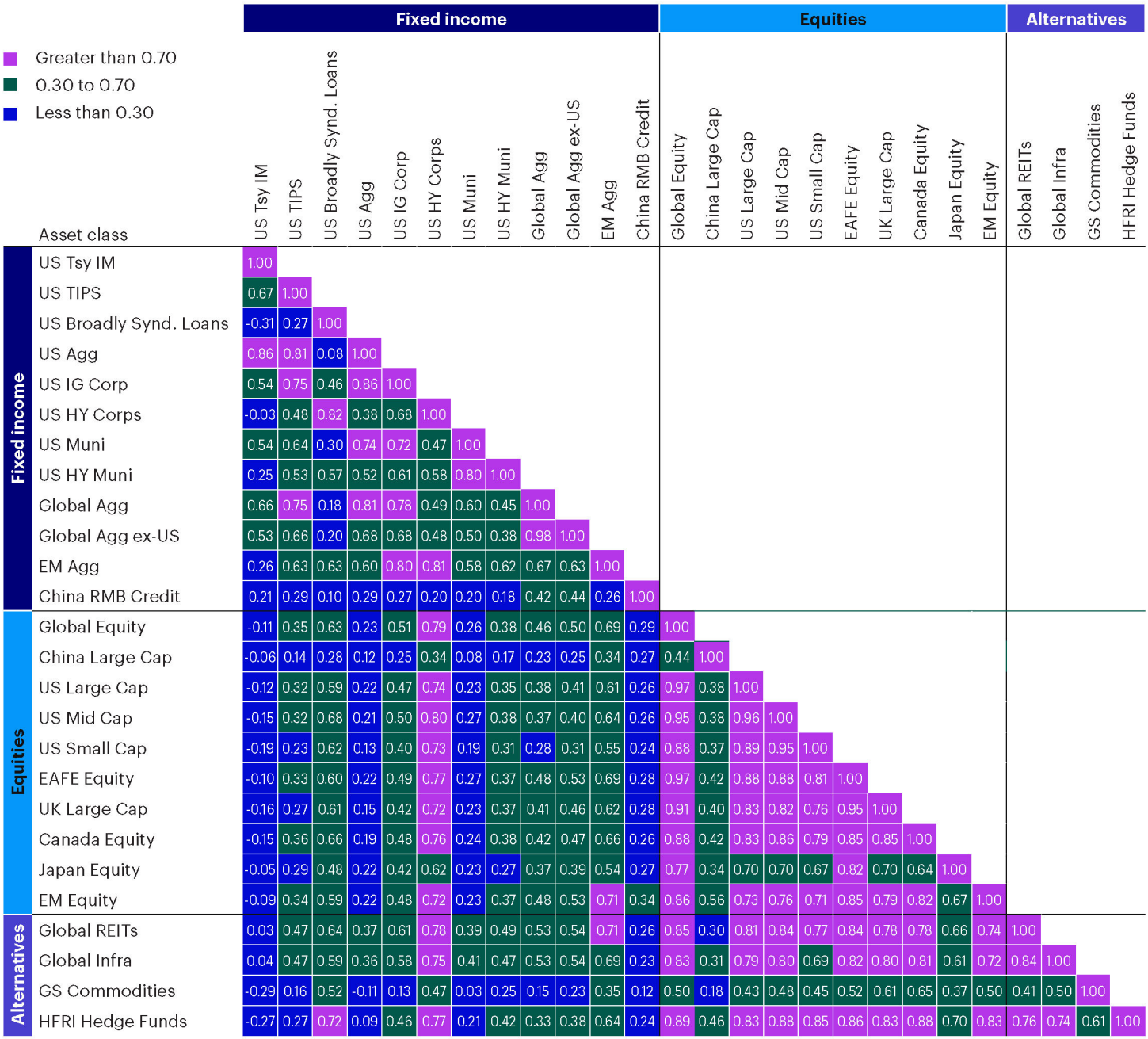
Source: Invesco, estimates as of September 30, 2022. Proxies listed in **Figure 8**. These estimates are forward-looking, are not guarantees, and they involve risks, uncertainties, and assumptions. Please see page 9 for information about our CMA methodology. These estimates reflect the views of Invesco Investment Solutions, the views of other investment teams at Invesco may differ from those presented here. **Performance, whether actual or simulated, does not guarantee future results.**

Figure 8: 10-year asset class expected returns, risk, and return-to-risk (USD)

	Asset class	Index	Expected geometric return %	Expected arithmetic return %	Total Yield %	Expected risk %	Arithmetic return to risk ratio
Fixed income	US Tsy Short	BBG US Tsy Short	3.7	3.7	3.5	1.5	2.44
	US Tsy IM	BBG US Tsy IM	4.1	4.2	4.2	4.6	0.91
	US Tsy Long	BBG US Tsy Long	3.0	3.7	4.0	12.1	0.30
	US TIPS	BBG US TIPS	4.4	4.5	4.5	5.8	0.78
	US Broadly Synd. Loans	CSFB Leverage Loan	8.9	9.2	9.8	8.3	1.11
	US Agg	BBG US Agg	4.4	4.5	4.8	6.1	0.74
	US IG Corp	BBG US IG	4.9	5.2	5.7	7.8	0.67
	US MBS	BBG US MBS	4.7	4.9	4.8	6.7	0.74
	US Preferred Stocks	BOA ML Fixed Rate Pref Securities	5.2	5.9	6.9	12.4	0.48
	US HY Corps	BBG US HY	7.8	8.3	9.7	10.2	0.81
	US Muni	BOA ML US Muni	4.0	4.2	4.1	7.0	0.60
	US Muni (Taxable)	ICE BOA US Taxable Muni Securities Plus	4.6	4.9	5.2	8.1	0.60
	US HY Muni	BBG Muni Bond HY	3.9	4.3	6.0	8.7	0.49
	Global Agg	BBG Global Agg	4.3	4.5	4.6	7.2	0.63
	Global Agg ex-US	BBG Global Agg ex-US	4.2	4.7	4.6	10.5	0.45
	Global Tsy	BBG Global Tsy	4.2	4.5	4.3	8.6	0.52
	Global Sov	BBG Global Sov	4.5	4.8	5.2	8.0	0.59
	Global Corp	BBG Global Corp	5.0	5.3	5.8	8.0	0.66
	Global IG	BBG Global Corp IG	5.0	5.4	5.9	8.2	0.65
	Eurozone Corp	BBG Euro Agg Credit Corp	5.2	6.1	5.9	13.5	0.45
	Eurozone Tsy	BBG Euro Agg Gov Tsy	4.3	5.1	4.4	12.8	0.40
	Asian Dollar IG	BOA ML AC IG	5.1	5.4	5.8	8.3	0.65
	EM Agg	BBG EM Agg	6.8	7.6	8.2	13.2	0.57
	EM Agg IG	BBG EM USD Agg IG	4.9	5.2	5.8	8.9	0.59
	China Policy Bk & Tsy	BBG China PB Tsy TR	4.2	4.2	3.6	4.3	0.98
	China RMB Credit	BBG China Corporate	4.6	4.6	4.1	3.8	1.24
Equities	Global Equity	MSCI ACWI	7.9	9.2	3.5	17.2	0.54
	Global ex-US Equity	MSCI ACWI ex-US	8.2	9.8	4.2	19.0	0.52
	US Broad Market	Russell 3000	7.9	9.3	3.0	17.7	0.53
	US Large Cap	S&P 500	7.7	9.0	3.0	16.9	0.53
	US Mid Cap	Russell Midcap	8.5	10.3	2.9	19.7	0.52
	US Small Cap	Russell 2000	10.0	12.3	2.4	23.0	0.54
	EAFE Equity	MSCI EAFE	7.6	9.2	4.9	18.7	0.49
	Europe Equity	MSCI Europe	7.8	9.4	4.5	18.9	0.50
	Eurozone Equity	MSCI Euro ex-UK	7.9	9.7	4.8	19.9	0.49
	UK Large Cap	FTSE 100	7.3	9.1	3.7	20.1	0.45
	UK Small Cap	FTSE Small Cap UK	8.7	11.6	3.2	25.9	0.45
	Canada Equity	S&P TSX	7.2	9.1	3.6	20.4	0.44
	Japan Equity	MSCI JP	6.5	8.8	6.2	22.5	0.39
	EM Equity	MSCI EM	9.7	12.4	2.9	25.1	0.50
	APAC ex-JP	MSCI APXJ	9.2	11.9	2.7	25.2	0.47
	China Large Cap	CSI 300	9.3	14.3	3.4	34.7	0.41
Alternatives	US REITs	FTSE NAREIT Equity	6.9	8.6	4.0	19.0	0.45
	Global REITs	FTSE EPRA/NAREIT Developed	6.8	8.5	4.7	19.0	0.44
	HFRI Hedge Funds	HFRI HF	6.4	6.8	-	8.7	0.78
	GS Commodities	S&P GSCI	8.4	10.9	-	23.9	0.46
	Agriculture	S&P GSCI Agriculture	4.0	6.1	-	21.5	0.28
	Energy	S&P GSCI Energy	11.2	16.7	-	37.1	0.45
	Industrial Metals	S&P GSCI Industrial Metals	7.5	10.1	-	24.2	0.42
	Precious Metals	S&P GSCI Precious Metals	5.3	6.9	-	18.5	0.37

Source: Invesco, estimates as of September 30, 2022. These estimates are forward-looking, are not guarantees, and they involve risks, uncertainties, and assumptions. Please see page 9 for information about our CMA methodology. These estimates reflect the views of Invesco Investment Solutions, the views of other investment teams at Invesco may differ from those presented here. Agg = Aggregate, Infra = Infrastructure, Corp = Corporate, DJ = Dow Jones, HY = High Yield, Muni = Municipals, Tsy = Treasury, IM = Intermediate, ML = Merrill Lynch, Sov = Sovereign, EM = Emerging Markets, IG = Investment Grade, APAC = Asia Pacific, Gov = Government, MBS = Mortgage Backed Securities, TIPS = Treasury Inflation Protected Securities.

Figure 9: 10-year correlations (USD)



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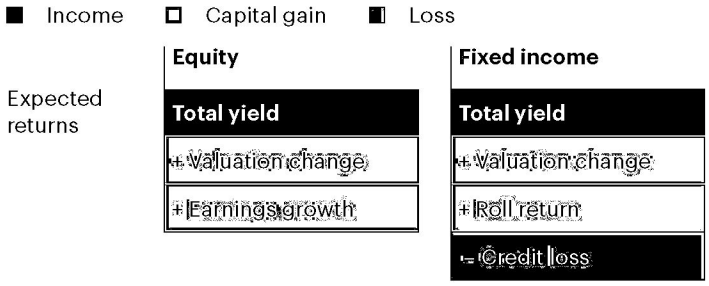
About our capital market assumptions methodology

We employ a fundamentally based "building block" approach to estimating asset class returns. Estimates for income and capital gain components of returns for each asset class are informed by fundamental and historical data. Components are then combined to establish estimated returns (Figure 10). Here we provide a summary of key elements of the methodology used to produce our long-term (10-year) estimates. Five-year assumptions are also available upon request. Please see Invesco's capital market assumption methodology whitepaper for more detail.

Figure 10: Our building block approach to estimating returns



For illustrative purposes only.

Fixed income returns are composed of:

- **Average yield:** The average of the starting (initial) yield and the expected yield for bonds.
- **Valuation change (yield curve):** Estimated changes in valuation given changes in the Treasury yield curve.
- **Roll return:** Reflects the impact on the price of bonds that are held over time. Given a positively sloped yield curve, a bond's price will be positively impacted as interest payments remain fixed but time to maturity decreases.
- **Credit adjustment:** Estimated potential impact on returns from credit rating downgrades and defaults.

Equity returns are composed of:

- **Dividend yield:** Dividend per share divided by price per share.
- **Buyback yield:** Percentage change in shares outstanding resulting from companies buying back or issuing shares.
- **Valuation change:** The expected change in value given the current Price/Earnings (P/E) ratio and the assumption of reversion to the long-term average P/E ratio.
- **Long-term (LT) earnings growth:** The estimated rate in the growth of earnings based on the long-term average real GDP per capita and inflation.

Currency adjustments are based on the theory of Interest Rate Parity (IRP) which suggests a strong relationship between interest rates and the spot and forward exchange rates between two given currencies. Interest rate parity theory assumes that no arbitrage opportunities exist in foreign exchange markets. It is based on the notion that, over the long term, investors will be indifferent between varying rate of returns on deposits in different currencies because any excess return on deposits will be offset by changes in the relative value of currencies.

Volatility estimates for the different asset classes, we use rolling historical quarterly returns of various market benchmarks. Given that benchmarks have differing histories within and across asset classes, we normalise the volatility estimates of shorter-lived benchmarks to ensure that all series are measured over similar time periods.

Correlation estimates are calculated using trailing 20 years of monthly returns. Given that recent asset class correlations could have a more meaningful effect on future observations, we place greater weight on more recent observations by applying a 10-year half-life to the time series in our calculation.

Arithmetic versus geometric returns. Our building block methodology produces estimates of geometric (compound) asset class returns. However, standard mean-variance portfolio optimisation requires return inputs to be provided in arithmetic rather than in geometric terms. This is because the arithmetic mean of a weighted sum (e.g., a portfolio) is the weighted sum of the arithmetic means (of portfolio constituents). This does not hold for geometric returns. Accordingly, we translate geometric estimates into arithmetic terms. We provide both arithmetic returns and geometric returns given that the former informs the optimisation process regarding expected outcomes, while the latter informs the investor about the rate at which asset classes might be expected to grow wealth over the long run.

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- By putting analytics into practice, we develop investment approaches specific to your needs.
- We work as an extension of your team to engage across functions and implement solutions.

The foundation of the team's process is the development of capital market assumptions — long-term forecasts for the behavior of different asset classes. Their expectations for returns, volatility, and correlation serve as guidelines for long-term, strategic asset allocation decisions.

Assisting clients in North America, Europe and Asia, Invesco's Investment Solutions team consists of over 75 professionals, with 20+ years of experience across the leadership team. The team benefits from Invesco's on-the-ground presence in 25 countries worldwide, with over 150 professionals to support investment selection and ongoing monitoring.

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Invesco Investment Solutions develops CMAs that provide long-term estimates for the behavior of major asset classes globally. The team is dedicated to designing outcome-oriented, multi-asset portfolios that meet the specific goals of investors. The assumptions, which are based on 5- and 10-year investment time horizons, are intended to guide these strategic asset class allocations. For each selected asset class, we develop assumptions for estimated return, estimated standard deviation of return (volatility), and estimated correlation with other asset classes. This information is not intended as a recommendation to invest in a specific asset class or strategy, or as a promise of future performance. Estimated returns are subject to uncertainty and error, and can be conditional on economic scenarios. In the event a particular scenario comes to pass, actual returns could be significantly higher or lower than these estimates.

Important information

Unless otherwise stated, all information is sourced from Invesco, in USD and as of September 30, 2022.

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Economic Profit vs. Accounting Profit: What's the Difference?

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Economic Profit vs. Accounting Profit: An Overview

Profit is one of the most widely watched financial metrics in evaluating the financial health of a company. It is the financial gain or revenue generated from any business or investment activity in excess of any expenses, taxes, and any other costs. However, economic profits and accounting profits are two types of profits. Economic profit refers to total revenue from sales minus opportunity costs from all inputs. Accounting profit, on the other hand, represents the total earnings of a company, which includes explicit costs.

KEY TAKEAWAYS

- Profit is the financial metric that indicates an entity's financial gain or revenue from any business or investment activity.
- Economic profit is money earned after taking explicit and implicit costs into account.
- Accounting profit is the net income for a company or revenue minus expenses.
- You can determine economic profit by subtracting total costs from a company or investment's total revenue or return.
- Companies report their accounting profits to investors on their income statements and to the IRS for tax purposes.

Economic Profit

Economic profit is a form of profit that is derived from producing goods and services while factoring in the alternative uses of a company's resources. It deducts explicit costs from

revenue and includes the opportunity costs incurred during that period of time. Implicit costs, which are typically the costs of a company's resources, are also part of the equation.

You can calculate economic profit as long as you know the total amount of revenue earned and the total cost involved using the following formula:

Economic Profit = Total Revenue - (Total Explicit Costs + Total Implicit Costs)

For example, the implicit costs could be the market price a company could sell a natural resource for versus using that resource. A paper company owns a forest of trees. They cut down trees and create paper products. Their implicit costs are the timber, which they could sell for market prices.

Here's another way to think about it. A company may choose Project A over Project B. The profit from Project A after deducting expenses and costs would be the accounting profit. The economic profit would include the opportunity cost of choosing Project A versus Project B. In other words; the economic profit would consider how much more or less profit would have been generated (by using the company's resources) had management chosen Project B.

Economic profit is based on theoretical principles while accounting profit uses accounting principles. As such, accounting profit is the true form of profitability while economic profit is derived from assumptions and estimates.

Accounting Profit

Accounting profit is also known as a company's earned profit, net income, or bottom line. Unlike economic profit, accounting profit is reported on a company's income statement. It's the profit earned after various costs and expenses are subtracted from total revenue or total sales, as stipulated by generally accepted accounting principles (GAAP). Those costs include:

- Labor costs, such as wages and salaries
- Any inventory needed for production
- Raw materials
- Transportation and storage costs
- Production costs and overhead
- Sales and marketing costs

Accounting profit is the amount of money left over after deducting the explicit costs of running the business. Explicit costs are merely the specific amounts that a company pays for those costs in that period—for example, wages. Typically, accounting profit or net income is reported on a quarterly and annual basis and is used to measure the financial performance of a company.

Key Differences

Economic profit is more of a theoretical calculation based on alternative actions that could have been taken. Accounting profit, on the other hand, calculates what actually occurred and the measurable results for the period.

Here's another way to think about it. Accounting profit is the profit after subtracting explicit costs (such as wages and rents). Economic profit includes explicit costs as well as implicit costs (what the company gives up to pursue a certain path). As such, accounting profit represents a company's true profitability while economic profit is indicative of its efficiency.

Companies are only required to report one form of profit to the Internal Revenue Service (IRS) for tax purposes: accounting profit. Economic profit is generally only meant for internal uses. For instance, businesses can use it to determine whether to enter or stay in a particular market. Economic profit also shows how efficiently companies are operating, including whether they're allocating their resources to the best of their ability.

Major Differences Between Economic Profit and Accounting Profit

Economic Profit	Accounting Profit
Earnings after deducting explicit and implicit costs from total revenue	Earnings after deducting explicit costs of running a business
Derived from assumptions and estimates	Measurable and calculated as per GAAP
Not reported	Reported on corporate income statements and to the IRS

Economic Profit vs. Accounting Profit Example

Let's use a hypothetical example to show how economic and accounting principles work in the corporate world. Remember that economic profit is based on estimates and assumptions while accounting profit is the figure that companies report for tax purposes and to investors.

Accounting profits are easy to determine since we already know that this figure can be found on a company's income statement. As noted above, it is reported as a company's net income. For instance, NVIDIA (NVDA) reported total net income or accounting profit of $9,75 billion for the 2022 fiscal year compared to the $4.33 billion it earned in 2021.1

Now let's take a look at an example of economic profit. Unlike accounting profit, you can't get this figure from a corporate financial or income statement. Instead, it requires some calculation. Let's say a company earns revenue of $10,000 on sales of stuffed animals. Explicit costs amount to $5,000. In addition, the company could have produced a different product; by foregoing that opportunity, it declined $2,000 of income. Using the formula above, we can determine that the economic profit of producing these toys is $3,000 ($10,000 - $5,000 - $2,000). The $2,000 is included as an implicit cost that is otherwise not recorded on the financial statements.

What Is the Difference Between Zero Accounting Profit and Zero Economic Profit?

Zero economic profit is also known as normal profit. Like economic profit, this figure also accounts for explicit and implicit costs. When a company makes a normal profit, its costs are

equal to its revenue, resulting in no economic profit. Competitive companies whose total expenses are covered by their total revenue end up earning zero economic profit. Zero accounting profit, though, means that a company is running at a loss. This means that its expenses are higher than its revenue.

How Do You Calculate Economic Profit?

In order to calculate economic profit, add together both explicit and implicit costs. Then subtract that figure from the total amount of revenue earned. Explicit costs include wages, leases, utilities, and the cost of raw materials while implicit costs include any opportunity costs, such as the loss of interest on an investment.

How Do You Calculate Accounting Profit?

You can calculate accounting profit by subtracting explicit costs or expenses from the total amount of revenue earned. Explicit costs include things like raw materials, wages, lease payments, and utilities. Management calculates accounting profit as part of its financial statements, though it may use different approaches for internal analysis.

Is Accounting Profit More Than Economic Profit?

In most cases, accounting profit will be more than economic profit. This is because companies often incur opportunity cost for activities foregone in favor of other activities. For example, imagine a company has $100,000 to invest. If it declines one opportunity for another, the potential income from the declined opportunity is factored into economic profit but not accounting profit. In other words, accounting profit usually has less expenses, though it is possible for an opportunity cost to be a cost avoidance measurement that results in lower accounting profit.

Why Is Economic Profit Better Than Accounting Profit?

Economic profit may be seen as better than accounting profit because it is not restricted by accounting rules. Economic profit reflects all of the decisions of a company, regardless of whether they comply with GAAP or IFRS. Economic profit considers decisions not made or choices foregone, so it is a broader, more encompassing depiction of the positioning of a company.

The Bottom Line

There are a few ways to calculate profit. Most analysts use accounting profit which reflects the revenue less expenses of a company based on accounting rules. These costs are often explicitly defined. On the other hand, economic profit incorporates implicit costs that sometimes not recorded on a general ledger but still impact the net profitability of a decision.

https://www.wsj.com/articles/economists-got-the-decade-all-wrong-theyre-trying-to-figure-out-why-11576346400

JOURNAL REPORTS: DECADE IN REVIEW

Economists Got the Decade All Wrong. They're Trying to Figure Out Why.

The U.S. has enjoyed its longest economic expansion on record without triggering inflation as interest rates remain historically low

Subdued growth and low interest rates have been part of the mix in the longest economic expansion on record for the U.S.
PHOTO: RON ANTONELLI/BLOOMBERG NEWS

By Greg Ip
Dec. 14, 2019 1:00 pm ET

In the fall of 2009, the global financial crisis had only just ended, and interest rates were a mere 0.1%. Peering ahead, economists assumed the recovery would resemble previous recoveries, though a tad slower, and thus rates would start rising the next year and plateau at 4.2% by 2015.

But by the fall of 2010, rates hadn't budged. Like Charlie Brown taking another run at the football, economists gamely made the same forecast that year, and the year after that and the year after that. Rates remained stuck near zero until 2015, a stretch of free money unseen since the 1940s.

When rates started to rise, they didn't come close to levels once considered normal, ending the decade between 1.5% and 1.75%. Private-sector economists now expect them to average 2.4%

they might have guessed high again: Ten-year Treasury note yields are just 1.8%—roughly zero, adjusted for inflation.

How could economists have gotten something so basic so spectacularly wrong? What was it about this past decade that made all their predictions go awry?

Fed Chairman Jerome Powell and former chairmen Janet Yellen and Ben Bernanke. The financial crisis was followed by a stretch of free money unseen since the 1940s. **PHOTO:** JESSICA MCGOWAN/GETTY IMAGES

Economists have been casting around for the answer, a theory to explain their inability to peer accurately into the months ahead, let alone the years. Such a theory must do more than say "The Federal Reserve did it." It must explain why growth was the most subdued of any expansion since the 1940s and inflation consistently ran below the Fed's 2% target, the reasons the Fed kept rates so low.

And, no less difficult, it would have to explain why, in spite of that subdued growth, the U.S. has enjoyed its longest economic expansion on record, one marked by a record-breaking bull market in stocks and unemployment falling to a 50-year low.

One explanation is the "debt hangover"theory popularized by Carmen Reinhart and Kenneth Rogoff, whose history of financial crises, "This Time Is Different: Eight Centuries of Financial Folly," was a sleeper hit in 2009. They found that in the wake of financial crises, households,

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another crisis is around the corner, so they avoid borrowing and investing. This holds down growth, inflation and interest rates.

The U.S. initially tracked this model. It had barely exited its own crisis when another erupted in the eurozone, pushing Greece into default and others to the brink of it.

But as those crises faded from view, low growth, inflation and rates persisted.

So in 2013 Larry Summers, a former top adviser to Presidents Bill Clinton and Barack Obama and now an economist at Harvard University, advanced an alternative explanation: "secular stagnation." He borrowed the phrase from an earlier Harvard economist, Alvin Hansen who used it in 1938 to describe the Great Depression's persistently weak growth and high unemployment. Mr. Hansen tied it to weak investment due to slow population growth: Businesses had less need to invest when there were fewer new workers and customers and when aging households bought fewer big-ticket products like houses.

Slow population growth is once again weighing on growth and interest rates, Mr. Summers noted, and he added several other factors: the fastest-growing businesses, such as social-media platforms, invest little of their rich profits. Higher inequality meant more income flows to the high-saving, low-spending rich.

Though initially skeptical of Mr. Summers's thesis, many economists have since warmed to it, at least for other parts of the world, if not the U.S. In some countries like Germany a persistent excess of savings manifests itself as a trade surplus which flows into other countries' bonds, holding down interest rates around the world.

Secular stagnation has several profound implications. First, with interest rates closer to zero, central banks are less able to combat future recessions. Second, a structural shortage of private borrowing means governments can run big deficits without pushing up interest rates. Indeed, given central banks' lack of ammunition, governments should run deficits, or the economy will stagnate. Reducing entitlements such as future Social Security benefits in the name of fiscal prudence may worsen the problem by encouraging households to save more.

Secular stagnation also increases the risk of protectionism. Any country with too little domestic demand to achieve full employment and 2% inflation will be tempted to foist the problem on its neighbors by cheapening its currency or erecting tariffs so as to export more and import less.

Yet in key respects the past decade doesn't conform to the gloomy prognosis of secular stagnation: The stock market has romped to one record after another, and job growth has remained consistently strong.

As with interest rates, economists have been surprised by unemployment, which peaked at almost 10% in 2010. Year after year, they expected it to bottom out around 5%. It's now down to 3.5%, a 50-year low, and likely headed lower.

The expansion is now the longest since records begin in the mid-1800s. It bears little resemblance to the 1930s, which Mr. Hansen described as "sick recoveries which die in their infancy and...leave a hard and seemingly immovable core of unemployment."

This points to a third possible theory. The so-called natural rate of unemployment, the lowest the U.S. can sustain without running out of workers or pushing up inflation (called u* or "u-star" in economists' equations) is much lower than previously thought. So the recovery has had more ground to cover than many realized, and as a result the economy has spent much of the past decade operating well below capacity.

Jan Hatzius, chief economist at Goldman Sachs, says there isn't a lot of mystery about the behavior of inflation and interest rates: "We fell into a deep hole so we had a lot of spare capacity, and it took a long time to climb out."

The U.S. may have finally climbed out, but until Europe has as well, interest rates may remain low, he says. "How secular is it? How cyclical? Until you've seen economies really normalize

Job seekers and recruiters at a fair in Los Angeles. Economists have been surprised by the continued decline of unemployment.
PHOTO: MONICA ALMEIDA/REUTERS

THE DECADE IN REVIEW

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In other words, it might take the next decade to answer what really happened in the last.

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What is your take on the economy over the past 10 years? Join the conversation below.

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