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In This Issue

Program Report:
Asset Pricing 1

Research Summaries
Strategic Asset Allocation: Portfolio
Choice for Long-Term Investors 8
Capital Flows and Crises in
Emerging Markets 12
Computer and the Internet 15
Globalization and Macroeconomics 18

NBER Profiles 24
Conferences 26
Bureau News 37
Bureau Books 48
Current Working Papers 49

Program Report

Asset Pricing

John H. Cochrane*

As the name suggests, a large part of our effort in this program involves understanding the prices of financial assets — stocks, bonds, options, currencies, and derivatives. Why do prices move? Why do some assets give consistently higher returns than others? What are the underlying macroeconomic risks that balance low prices and attractive returns? Asset pricing researchers also study the economics of financial markets more generally, including the formation and design of securities and security markets, the nature of financial contracting and banking, the trading mechanisms in securities markets, and the regulation of markets and related issues. Asset pricing research is characterized by a lively interplay between theory, empirical work that evaluates theories, and empirical work that focuses on interesting facts.

New Factors, Time-Variation, and Macroeconomics

Average returns are higher and prices are lower for securities that pay off poorly in macroeconomic “bad times.” Our central task is to find the correct measure of “bad times.” A body of empirical and theoretical work now suggests a quite radical change in traditional views of this measure. First, something like a “recession factor” is important in addition to swings in the market as a whole. In fact, the bulk of cross-sectional variation in stock prices and average returns may be attributable to this additional risk factor rather than to a stock’s tendency to move with the market as a whole. Second, mean returns, covariances, and risk premiums all vary through time; the variation is as large as typical values, and also has a suggestive business cycle pattern. Theory, application, and empirical work can be profoundly affected by this fact. For example, almost all variation in the cost of capital is caused by varying risk premiums, not interest rates. Much research on asset pricing

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fleshes out these points, and John Y. Campbell¹ and I² review this literature in depth.

Martin Lettau and Sydney Ludvigson³ find that a conditional capital asset pricing model (CAPM) and a conditional consumption-based model can explain the cross-section of stock returns just as well as the Fama-French model which is based on size and book-to-market portfolios. In "bad times," measured by the consumption-to-wealth ratio, value stocks covary strongly with market return and with consumption growth. This covariance is absent in good times, which is why an unconditional CAPM or a consumption-based model does not work. This striking paper merges both the importance of a conditional approach and the search for additional "recession factors" that drive risk premiums.

Tano Santos and Pietro Veronesi⁴ create an asset pricing model that prices a claim to dividends that is distinct from consumption. The dividend/consumption ratio (also interpreted as the ratio of human capital to market value) becomes a state variable that forecasts returns and drives variation in expected returns and covariances.

George M. Constantinides and Darrell Duffie⁵ show that an increase in cross-sectional risk to labor income during market downturns can, in principle, explain all asset pricing puzzles. Alon Brav, Constantinides, and Christopher C. Geczy⁶ take up the empirical challenge: does cross-sectional risk increase enough in market downturns to be the "recession factor"? They find some preliminary support, but document the troublesome noise in individual income and consumption data.

Campbell and I⁷ focus on the subject of conditioning information. We

examine a model economy in which a *conditional* consumption-based model holds perfectly, but risk aversion varies over time. This model generates predictable returns. We find that the static CAPM is a better approximate model than the static consumption-based model, and that multifactor models beat the static CAPM in their artificial data. This calculation suggests the importance of including conditioning information in evaluating asset-pricing models.

Wayne E. Ferson and Campbell R. Harvey⁸ test conditional asset pricing models. They check Merton's classic idea that bad news also indicates bad times, and thus that returns that are correlated with news variables should carry risk premiums. They find that such information variables are in fact important risk factors. This paper links the new factor question with the time-variation question nicely.

Owen Lamont⁹ provides an intriguing new description of the relation between asset prices and macroeconomic events by constructing "economic tracking portfolios." While it is well known that the market as a whole is correlated with GDP and macroeconomic events, Lamont goes further and constructs portfolios that are correlated maximally with specific macroeconomic events and forecasts. He finds that using tracking portfolio returns as instruments for future economic variables substantially raises the estimated sensitivity of asset prices to news about those economic variables. Furthermore, the tracking portfolios can be used to partially hedge economic risks directly, without creating new securities as Steven J. Davis, Jeremy Nalewaik, and Paul Willen advocate.¹⁰

The high-tech econometric end of empirical asset pricing is similarly engaged with modeling time-varying conditioning information.¹¹

Predictable Returns and the Value Effect

The fact, character, and interpretation of return predictability are still hotly debated. It appears that over the long run, stock returns "mean revert" — high prices relative to dividends, book value, and so on signal that subsequent returns will be low. In fact, this pattern may be thought of in reverse: high prospective returns mean that cash flows are discounted at a higher rate, which in turn lowers current prices. Thus, prices reveal changes in expected returns. This pattern holds across individual stocks — the "value effect" — as well as over time for the market as a whole. That is a sobering thought to holders of recently hot dot-com growth stocks (with very high price-to-anything ratios). In principle, this phenomenon can be explained by slow, business-cycle related variation in risks or risk aversion, but asset pricing researchers are actively exploring the nature of that risk or risk aversion.

Randolph Cohen, Polk, and Tuomo Vuolteenaho¹² examine whether firms that have high market prices relative to book value (Tobin's q) have higher expected cash flows, or lower expected returns. In contrast to the market as a whole, in which such variation is almost entirely driven by variation in risk premiums, Cohen, Polk, and Vuolteenaho find that half or more of the cross-sectional variation in market and book ratios is driven by variation in expected cash flows.

Diversified firms have lower value — lower market value and book value — than do apparently comparable single-segment firms or portfolios of single segment firms. This classic effect gets at the larger question of how and why value ratios can forecast returns. Lamont and Polk¹³ break the diversification discount into

two components: how much of the discount reflects lower subsequent cash flows, and how much represents a higher discount rate, revealed by higher subsequent returns. Interestingly, they find that only half of the diversification discount is attributable to lower profits, leaving half to be explained by higher discount rates and covariation of discount rates with profits. This finding may reflect riskier activities for the diversified firms; perhaps they diversified in order to undertake riskier activities. At any rate, Lamont and Polk show that the classic story of diversified firms simply wasting cash flow opportunities must be substantially revised, and that as elsewhere in finance, risk premiums must play a central role.

In a separate paper, Lamont and Polk¹⁴ directly examine the classic question of whether diversification causes or is caused by lower value. They attack this causality question with a clever identification using the diversity of industry investment, and conclude that diversification does lower value.

Hyun-Han Shin and Rene M. Stulz¹⁵ deconstruct the value effect into systematic and idiosyncratic components. They notice that prices for stocks with more systematic risk — a greater tendency to move up or down with the market as a whole — are *higher* relative to book value than the prices of stocks with more firm-specific risk (which are lower, relative to book value). The first fact runs opposite to the usual value effect that low returns follow high prices. Shin and Stulz argue that this result means that expected cash flows must be higher for riskier firms, and that growth stocks are more sensitive to market movements. Shin and Stulz suggest that this finding stems from the real option nature of equity: options on riskier projects are, with other variables held constant, more

valuable.

Jonathan Berk, Richard C. Green, and Vasant Naik¹⁶ model these interactions between investment, growth options and firm value. Their model reproduces a number of facts, including the time-series and cross-sectional relationship between the book-to-market ratio and asset returns, and the inverse relationship between interest rates and the market risk premium.

Predictable Returns and Momentum

It appears that if you buy a portfolio of stocks that performed best in the last year, and short a portfolio of the worst performers, you will make money over a period of six months and perhaps a year. This is termed "momentum." This short-term effect goes in the opposite direction from the longer-term value or mean-reversion effect, in which past winners lose over the long run. Yet many researchers reconcile the two effects by thinking of a humped-shaped response function for stock values.

Momentum can be generated by the product of slight autocorrelation in returns magnified by their wide dispersion. Since the best tenth of stocks typically went up 80 percent last year, and the worst tenth went down 60 percent, just a mere continuation of this return can generate an expected return of a few percent for the long-short portfolio over the next few months or a year. Momentum thus is concentrated in holding short positions of small losing stocks at the end of the year. This suggests that an explanation is based on frictions, but this has not yet been proven. We could start looking for time-varying risk premiums, but positive short-order autocorrelation, even if small, is much harder to explain as a consequence of slow, business-cycle related variation in risks or risk aversion. Therefore, momentum is much more controversial. In short, momen-

tum remains an anomaly.

Dong-Hyun Ahn, Jacob Boudoukh, Mathew Richardson, and Robert F. Whitelaw¹⁷ show that liquid international equity index futures that can easily be shorted do not show the same momentum pattern as the underlying indexes. In this market, and they suggest in others, momentum in the indexes results from market microstructure effects rather than from irrational investors; it cannot be exploited for trading.

Jonathan Lewellen¹⁸ notes that momentum can occur if a rise in one stock forecasts declines in other stocks, as well as the more traditional interpretation based on positive autocorrelation in individual returns. In fact, he finds that most momentum is driven by negative cross-correlation. This finding spells trouble for the view that momentum is caused by slow information diffusion about the prospects of a single firm.

Narasimhan Jegadeesh and Sheridan Titman¹⁹ survey several explanations for momentum. They report that momentum continues out of its original sample and dismiss the argument that it simply reflects variation in unconditional means across assets in unconditional means (stocks that did better last year are likely to have higher unconditional means, and so do better next year).

Many anomalies, including size and momentum, are concentrated around the end of the year, suggesting that they may result from tax-induced trading. James M. Poterba and Scott J. Weisbenner²⁰ examine how specific changes in the tax code have affected the incentives for year-end trading. Their findings support the role of tax-loss trading in contributing to turn-of-the-year return patterns.

Harrison Hong, Terence Lim, and Jeremy C. Stein²¹ show that momentum strategies work best in small stocks with limited analyst coverage. They also find an interesting asymmetry: the effect of analyst coverage

is stronger for losers than for winners.

Crashes

Joseph Chen, Hong, and Stein²² investigate the determinants of "crashes" which they define as asymmetries in the conditional distributions of stock returns. They find that the negative change in individual stocks and the market as a whole is most pronounced when there is an increase in trading volume over the prior six months and when there are positive returns over the prior 36 months. This interesting paper merges asset pricing researchers' interests in applying modern time-series econometrics to asset pricing data, going beyond traditional linear models of mean and variance, with their interest in "crashes" and information structures behind trading.

David Bates and Roger Craine²³ note that during the October 1987 crash, there were rumors that a major clearinghouse might fail. They assess the probabilities of this event, find it plausible, and suggest that the Federal Reserve's October 20 announcement that it stood ready to supply the necessary liquidity may have acted to eliminate this possibility.

Theory

An evolving strand of theoretical work explains the anomalous behavior of asset markets based on a combination of differences in information, or information processing, together with market frictions. Hong and Stein²⁴ develop a theory of stock-market crashes based on differences of opinion among investors that is then combined with constraints on short sales. Because they cannot sell short, bearish investors' opinions may not be reflected in market prices. However, if other previously bullish investors have a change of heart and bail out of the market, then the originally more-bearish group may become the marginal "support buyers." In this way,

more will be learned about their signals, and the accumulated bearish information tends to come out during market declines.

While asymmetric information has been the most reliable explanation of financial frictions for 30 years, Fernando Alvarez and Urban J. Jermann²⁵ have instead started to apply participation constraints (with symmetric information) as an explanatory factor. Insurance can't be perfect, because you cannot tax the lucky so much that they leave the system. Alvarez and Jermann study the quantitative implications of this type of model and find that it can generate a large equity premium and a large risk premium for long-term bonds.

Average returns are hard to measure since returns are so volatile. The standard formula σ/\sqrt{T} for the uncertainty about a sample mean implies that even twenty to fifty years of data are not enough to nail down the average return on stocks. Therefore, the true probability distribution of returns may differ substantially from "rationally" expected probabilities, even with substantial historical experience. Lewellen and Jay Shanken²⁶ expand on this observation to construct a model based on learning that explains many apparent anomalies, including the predictability of returns and average returns far from the predictions of the CAPM. Kent D. Daniel, David Hirshleifer, and Avanidhar Subrahmanyam²⁷ construct a model that mixes rational and irrational investors to obtain some rational pricing mixed with anomalies.

In an invasion from asset pricing to macroeconomics, I²⁸ show that nominal government debt really is an equity claim to future primary surpluses. Valuing such debt as we do equity, the price level can be determined with no monetary frictions whatsoever.

Robert J. Shiller,²⁹ continuing an important research program on the

design of better risk sharing mechanisms, considers the optimal design of the insurance and risk sharing aspects of a Social Security system. Sensibly starting with a consideration of what barriers limit private risk sharing, he describes optimal government-sponsored systems.

Portfolios

The explosion of portfolio research continues. Luis M. Viceira³⁰ studies portfolios for investors with labor income risks. Where much previous research examined how portfolios should adapt to changing mean returns, George Chacko and Viceira³¹ study how portfolios should adapt to periods of greater and lesser return volatility. Campbell and Viceira³² note that the relevant "risk-free rate" for a long-horizon investor is an indexed perpetuity, a bond with quite long maturity. However, in the absence of indexed bonds, investors may prefer the inflation protection of short-term bonds if inflation is more variable than real interest rates. Campbell and Viceira find large welfare benefits from the introduction of long-term indexed bonds.

Louis K. C. Chan, Jason Karceski, and Josef Lakonishok³³ focus on the crucial question of how to measure covariances between stock returns in forming portfolios. This is an important problem; for example, some of the troubles of Long-Term Capital Management were reported to stem from inaccurate measures of covariance and thus a presumption that investments were much more diversified than they turned out to be. The authors' results support a covariance structure based on a few factors and a heuristic approach based on matching the benchmark's attributes.

Recently, datasets have become available that allow us to study the investment decisions of individual investors and institutions. This work dovetails with a renewed interest in heterogeneity in macroeconomics,

and the new portfolio theory more generally. Do investors behave as our models say they should?

William N. Goetzmann and Massimo Massa³⁴ examine individual accounts in an S&P 500 Index mutual fund to examine the trading and investment behavior of more than 91,000 investors. They identify positive feedback traders as well as contrarians whose activities are conditional on preceding day stock market moves. They find that more frequent traders are typically contrarians, while infrequent traders are more typically momentum investors. They also use the behavior of momentum and contrarian investors to build a measure of "market polarization" or dispersion of investors' beliefs.

James M. Poterba and Andrew Samwick³⁵ analyze portfolio data from the Surveys of Consumer Finances. They find that household portfolio allocations respond strongly to tax incentives. Households with high marginal tax rates hold more tax-advantaged assets including 401(k) plans and IRAs, corporate stock and tax-exempt bonds, and fewer corporate bonds and interest-bearing accounts. This work complements John B. Shoven and Clemens Sialm's³⁶ extension of portfolio theory to include tax effects.

Kenneth A. Froot, Paul G. J. O'Connell, and Mark S. Seasholes³⁷ explore the behavior of daily international portfolio flows into and out of 46 countries from 1994 through 1998, exploiting a dataset that includes over three million institutional trades. They present a number of interesting facts, including that flows are strongly influenced by past returns, investors seem to follow trends, and local stock prices are sensitive to foreign inflows. However, the authors reject the idea that this correlation reflects an information disadvantage on the part of international investors.

Connie Becker, Wayne Ferson, David Myers, and Michael Schill³⁸ examine the market timing attempts of a sample of 400 mutual funds. They find that funds behave like risk-averse investors who care about returns relative to a benchmark. The funds do time the market based on publicly available information, but seem to have no further market timing ability.

Means and Variances

Even so basic a fact as the average return on stocks over bonds is a subject of lively debate. Is the last century of good returns on U.S. stocks a fundamental fact, a constant of nature, or was it a lot of good luck? Philippe Jorion and William N. Goetzmann³⁹ make a strong case for luck. The United States has been the most successful capitalist system in the world; most other countries have been plagued by political upheaval, war, and financial crises. Yet this outcome was not predictable at the start of the century. Comparing the United States to 39 markets with histories going as far back as the 1920s, they find that the United States has the highest uninterrupted real rate of appreciation of all countries, at 4.3 percent annually from 1921 to 1996. For other countries, the median real appreciation rate was 0.8 percent. Perhaps the large equity premium reflects a large selection bias.⁴⁰ also argue that much of the postwar stock return was luck, not unconditional mean.

Campbell, Lettau, Burton G. Malkiel, and Yexiao Xu⁴¹ document the popular impression that stocks have become more volatile. There has been a noticeable increase in *firm-level* volatility, even while *market* volatility has declined, as G. William Schwert documents.⁴² Therefore, correlations among individual stocks have declined, the

explanatory power of a regression of individual stocks on the market has declined, and the number of stocks needed to achieve a given level of diversification has increased. This view is consistent with findings that betas — regression co-efficients of stocks on the market and other indexes — are declining. They note that the volatility measures move together countercyclically and help to predict GDP growth.

Peter F. Christoffersen and Francis X. Diebold⁴³ ask whether the burgeoning literature documenting changes in return volatility over time matters for portfolio problems and risk management. Using a model-free procedure, they find that the ability to forecast volatility decays quickly with the time horizon. Therefore, they conclude that although changes in volatility that can be forecast might be important for risk management at the short horizons that are relevant for trading desks for example, they may not be important for risk management more generally.

Term Structure of Interest Rates

Modeling of the term structure of interest rates is a continuing research activity. David Backus, Silverio Foresi, and Chris Telmer⁴⁴ present an easily readable integration of the daunting finance literature on the term structure of interest rates. Backus, Foresi, Abon Mozumdar, and Liuren Wu⁴⁵ show how popular linear (“affine”) models—in which the expected change in interest rates, volatility, and risk premiums are linear functions of current interest rates—can be adapted to capture the fact that interest rate spreads forecast bond returns. Boudoukh and Richardson⁴⁶ construct a multifactor, nonlinear, continuous-time model of interest rate volatility.

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