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INTRODUCTION

Eric Ghysels is the Bernstein Distinguished Professor of Economics at the University of North Carolina - Chapel Hill and Professor of Finance at the Kenan-Flagler Business School. His main research interests are time series econometrics and finance. He obtained his Ph.D. from the Kellogg Graduate School of Management at Northwestern University. He has been a visiting professor or scholar at several major U.S., European and Asian universities. He gave invited lectures, including at the World Congress of the Econometric Society, the American Statistical Association Meetings, several (EC)2 Conferences, among many others. He serves on the editorial boards of several academic journals and was co-editor of the Journal of Business and Economic Statistics (2000-2003) and is currently co-editor of the Journal of Financial Econometrics. He has published in the leading economics, finance and statistics journals and has published several books. He is a fellow of the American Statistical Association and The Journal of Econometrics. He is also the Founding Co-President of the Society for Financial Econometrics (SoFiE). His most recent research focuses on MIDAS (mixed data sampling) regression models and related econometric methods, Quality Control for Risk Management, and asset pricing with heterogeneous agents and model uncertainty.

The following list is a non-exhaustive, subjective selection of Eric Ghysels’s publications.

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- The address of M. Eric Ghysels’s homepage at: www.unc.edu/~eghysels

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1. **WORKING PAPERS AND ARTICLES**


No abstract available.

*Full text available on-line at:*  
[http://www.unc.edu/~eghysels/papers/Forecasting_chapter_31Jan_new.pdf](http://www.unc.edu/~eghysels/papers/Forecasting_chapter_31Jan_new.pdf)

1.2 Eric Ghysels, Per Mykland and Eric Renault, January 2010, “In-sample Asymptotics and Across-sample Efficiency Gains for High Frequency Data Statistics”.

We revisit in-sample asymptotic analysis extensively used in the realized volatility literature. We show that there are gains to be made in estimating current realized volatility from considering realizations in prior periods. Our analysis is reminiscent of local-to-unity asymptotics.

The weighting schemes also relate to Kalman-Bucy filters, although our approach is non-Gaussian and model-free. We derive theoretical results for a broad class of processes pertaining to volatility, higher moments and leverage. The paper also contains a Monte Carlo simulation study showing the benefits of cross-sample combinations.

*Full text available on-line at:*  

1.3 Xilong Chen and Eric Ghysels, January 2010, “News - Good or Bad - and its impact on volatility predictions over multiple horizons”.

We examine whether the sign and magnitude of intra-daily returns have impact on expected volatility the next day or over longer future horizons. We first let the data ‘speak’, namely with minimal interference we capture the mapping between intra-daily returns and future volatility.
We revisit the concept of news impact curves introduced by Engle and Ng (1993). Overall, we find that moderately good (intra-daily) news reduces volatility (the next day), while both very good news (unusual high intra-daily positive returns) and bad news (negative returns) increase volatility, with the latter having a more severe impact. The asymmetries disappear over longer horizons. We also introduce a new class of parametric models applicable to a mixture of high and low frequency data which feature asymmetries. The new class of models also has close ties to ARCH-type models. Models featuring asymmetries dominate in terms of out-of-sample forecasting performance, especially during the 2007-2008 financial crisis.

Full text available on-line at:


We evaluate the importance of “Limits to Arbitrage” to explain profitability of momentum strategies. Specifically, when the availability of arbitrage capital is in short supply, momentum cycles last longer, and breaks in momentum cycles are shorter. We demonstrate the robustness of our findings with a unique database of stock returns from 1866-1907 London and the CRSP database. Momentum cycle durations are similar in both databases and all other momentum facts documented in the literature using the CRSP database hold for the Victorian period as well, except for the January reversal due to the absence of capital gains taxation.

Full text available on-line at:


We use a sample of option prices, and the method of Bakshi, Kapadia and Madan (2003), to estimate the ex ante higher moments of the underlying individual securities’ risk-neutral returns distribution. We find that individual securities’ volatility, skewness, and kurtosis are strongly related to subsequent returns. Specifically, we find a negative relation between volatility and returns in the cross-
We also find a significant relation between skewness and returns, with more negatively (positively) skewed returns associated with subsequent higher (lower) returns, while kurtosis is positively related to subsequent returns. We analyze the extent to which these returns relations represent compensation for risk. We find evidence that, even after controlling for differences in comoments, individual securities’ skewness matters. As an application, we examine whether idiosyncratic skewness in technology stocks might explain bubble pricing in Internet stocks. However, when we combine information in the risk-neutral distribution and a stochastic discount factor to estimate the implied physical distribution of industry returns, we find little evidence that the distribution of technology stocks was positively skewed during the bubble period – in fact, these stocks have the lowest skew, and the highest estimated Sharpe ratio, of all stocks in our sample.

Full text available on-line at:


We evaluate the importance of “Limits to Arbitrage” to explain profitability of momentum strategies. Specifically, when the availability of arbitrage capital is in short supply, momentum cycles last longer, and breaks in momentum cycles are shorter. We demonstrate the robustness of our findings with a unique database of stock returns from 1866-1907 London and the CRSP database. Momentum cycle durations are similar in both databases and all other momentum facts documented in the literature using the CRSP database hold for the Victorian period as well, except for the January reversal due to the absence of capital gains taxation.

Full text available on-line at:

We study asset pricing in economies featuring both risk and uncertainty. In our empirical analysis, we measure risk via return volatility and uncertainty via the degree of disagreement of professional forecasters, attributing different weights to each forecaster. We empirically model the typical risk-return trade-off and augment these models with our measure of uncertainty. We find stronger empirical evidence for an uncertainty-return trade-off than for the traditional risk-return trade-off. Finally, we investigate the performance of a two-factor model with risk and uncertainty in the cross section.

Full text available on-line at:

1.8 Jennie Bai, Eric Ghysels and Jonathan Wright, May 2009, “State Space Models and MIDAS Regressions”.

We examine the relationship between MIDAS regressions and Kalman filter state space models applied to mixed frequency data. In general, the latter involves a system of equations, whereas in contrast MIDAS regressions involve a (reduced form) single equation. As a consequence, MIDAS regressions might be less efficient, but also less prone to specification errors. First we examine how MIDAS regressions and Kalman filters match up under ideal circumstances, that is in population, and in cases where all the stochastic processes - low and high frequency - are correctly specified by a linear state space model. We characterize cases where the MIDAS regression exactly replicates the steady state Kalman filter weights. In cases where the MIDAS regression is only an approximation, we compute the approximation error and find it to be small (using two different metrics). We also study how MIDAS regressions perform in comparison to the Kalman filter when the latter is subject to specification errors. Our findings favor MIDAS regressions, as their approximation errors are typically small in comparison to the model specification errors of the Kalman filter. The paper concludes with an empirical application comparing MIDAS and Kalman filtering to predict future GDP growth, using monthly macroeconomic series.

Full text available on-line at:
http://www.unc.edu/~eghysels/papers/BGW_Kalman_vs_MIDAS_EG_Jan_02.pdf
1.9 Elena Andreou, Eric Ghysels and Andros Kourtellos, May 2009, “Should macroeconomic forecasters use daily financial data and how?”.

Hundreds of daily financial series contain information about the economy. Can we use all this information for improving and/or updating macroeconomic forecasts? We introduce easy to implement regression-based methods for predicting inflation and real activity that rely either on combinations of MIDAS regressions involving daily series or MIDAS regressions using a small set of daily financial factors. Both share the important features that: (1) they allow us to clearly show the incremental value of daily financial series in terms of forecasting, (2) they provide a succinct summary of huge amounts of daily financial data, (3) they allow for real-time updates of forecasting or so called nowcasting.


1.10 Xilong Chen, Eric Ghysels and Fangfang Wang, April 2009, “The HYBRID GARCH Class of Models”.

We propose a general GARCH framework that allows the use of different frequency returns to model conditional heteroskedasticity. We call the class of models High FrequencY Data- Based PRojection-Driven GARCH models as the GARCH dynamics are driven by what we call HYBRID processes. We study three broad classes of HYBRID processes: (1) parameter free processes that are purely data-driven, (2) structural HYBRIDs where one assumes an underlying DGP for the high frequency data and finally (3) HYBRID filter processes. We develop the asymptotic theory of various estimators and study their properties in small samples via simulations.

Full text available on-line at: http://www.unc.edu/~maguilar/metrics/HYBRID-GARCH_Jan_18_10_EG.pdf

1.11 Eric Ghysels, Antonio Rubia and Rossen Valkanov, March 2009, “Multi-Period Forecasts of Volatility: Direct, Iterated, and Mixed-Data Approaches”.

Selected Readings –April 2010
Multi-period forecasts of stock market return volatilities are often used in asset pricing, portfolio allocation, risk-management and most other areas of finance where long horizon measures of risk are necessary. Yet, very little is known about how to forecast volatility several periods ahead, as most of the focus has been on one-period-ahead forecasts. In this paper, we compare several approaches of producing multi-period ahead forecasts of volatility – iterated, direct, and mixed-data sampling (MIDAS) – as alternatives to the often-used “scaling” method. The comparison is conducted (pseudo) out-of-sample using returns data of the US stock market portfolio and a cross section of size, book-to-market, and industry portfolios. The results are surprisingly sharp. For the market and all other portfolios, we obtain the same ordering of the volatility forecasting methods. The direct approach provides the worse (in MSFE sense) forecasts; it is dominated even by the naive scaling method. Iterated forecasts are suitable for shorter horizons (5 to 10 days ahead), but their MSFEs deteriorate rapidly as the horizon increases. The MIDAS forecasts perform well at long horizons: they dominate all other approaches at horizons of 10-days ahead and longer. At 30-days ahead horizons, the MIDAS MSFE is about 20 percent lower than that of the next best volatility forecast. West (1996) and Giacomini and White (2006) tests show that the difference in predictive ability is statistically significant at conventional levels.

In sum, this study dispels the notion that volatility is not forecastable at long horizons and offers an approach that delivers accurate out-of-sample predictions.

Full text available on-line at:


The idea of component models for volatility is extended to dynamic correlations. We propose a model of dynamic correlations with a short- and long-run component specification. We call this class of models DCC-MIDAS as the key ingredients are a combination of the Engle (2002) DCC model, the Engle and Lee (1999) component GARCH model to replace the original DCC dynamics with a component specification and the Engle, Ghysels, and Sohn (2006) GARCH-MIDAS component specification.
that allows us to extract a long-run correlation component via mixed data sampling. We provide a comprehensive econometric analysis of the new class of models, including conditions for positive semi-definiteness, and provide extensive empirical evidence that supports the model specification.

Full text available on-line at:


We study how heterogeneous beliefs affect returns and examine whether they are a priced factor in traditional asset pricing models. To accomplish this task, we suggest new empirical measures based on the disagreement among analysts about expected earnings (short-term and long-term) and show they are good proxies. We first establish that the heterogeneity of beliefs matters for asset pricing and then turn our attention to estimating a structural model in which we use the forecasts of financial analysts to proxy for agents’ beliefs. Finally, we investigate whether the amount of heterogeneity in analysts’ forecasts can help explain asset pricing puzzles.

Full text available on-line at:


Multi-period forecasts of stock market return volatilities are often used in many applied areas of finance where long horizon measures of risk are necessary. Yet, very little is known about how to forecast variances several periods ahead, as most of the focus has been placed on one-period ahead forecasts. In this paper, we compare several approaches of producing multi-period ahead forecasts: iterated, direct, and mixed data sampling (MIDAS) as alternatives to the often-used scaling-up method. The comparison is conducted (pseudo) out-of-sample using returns data of the US stock market portfolio and a cross section of size and book-to-market portfolios. The comparison results are surprisingly sharp. For the market, size, and book-to-
market portfolios, we obtain the same precision ordering of the forecasting methods. The direct approach provides the worse (in MSFE sense) forecasts; it is dominated even by the naive scaling-up method. Iterated forecasts are suitable for shorter horizons (5 to 10 periods ahead), but their MSFEs deteriorate as the horizon increases. The MIDAS forecasts perform well at long horizons: they dominate all other approaches at horizons of 10-periods ahead and higher. The MIDAS forecasting advantage becomes most apparent at horizons of 30-periods ahead and longer. In sum, this study dispels the notion that volatility is not forecastable at long horizons and offers an approach that delivers accurate pseudo out-of-sample predictions.

*Full text available on-line at:*  


We find that price momentum in stocks was a pervasive phenomenon during the Victorian age (1866-1907) as well. Momentum strategy profits have little systematic risk even at business cycle frequencies; disappear periodically only to reappear later; exhibit long run reversal; and are higher following up markets, suggesting limited availability of arbitrage capital relative to opportunities during those times. Since there were no capital gains taxes during the Victorian age, the long run reversal of momentum profits must have a fundamental component, that is unrelated to tax based trading, identified by Grinblatt and Moskowitz (2004) using CRSP era data.

*Full text available on-line at:*  


We revisit the relation between stock market volatility and macroeconomic activity using a new class of component models that distinguish short run from secular movements. We study long historical data series of aggregate stock market volatility, starting in the 19th century, as in Schwert (1989). We formulate models with the long term component driven by inflation and industrial production growth that are at par in
terms of out-of-sample prediction for horizons of one quarter and are at par or out-
perform more traditional time series volatility models at longer horizons. Hence,
imputing economic fundamentals into volatility models pays off in terms of long
horizon forecasting. We also find that at a daily level, inflation and industrial
production growth, account for between 10 % and 35 % of one-day ahead volatility
prediction. Hence, macroeconomic fundamentals play a significant role even at short
horizons. Unfortunately, all the models - purely time series ones as well as those
driven by economic variables - feature structural breaks over the entire sample
spanning roughly a century and a half of daily data. Consequently, our analysis also
focuses on subsamples - pre-WWI, the Great Depression era, and post-WWII (also
split to examine the so called Great Moderation). Our main findings remain valid
across subsamples.

*Full text available on-line at:*

for Volatility Component Models”.

The volatility component models have received much attention recently, not only
because of their ability to capture complex dynamics via a parsimonious parameter
structure, but also because it is believed that they can handle well structural breaks or
non-stationarities in asset price volatility. The paper studies the distributional
properties of various volatility component models. Sufficient conditions for the
existence or/and uniqueness of (strictly) stationary (ergodic) solutions with mixing
property to the volatility component models are derived. Hence, the paper revisits the
component models from a statistical perspective and attempts to explore the
stationarity and mixing properties of the underlying processes. There is a clear need
for such an analysis, since any discussion about non-stationarity presumes we know
when component models are stationary. As it turns out, this is not the case and the
purpose of the paper is to rectify this. We also look into the sampling behavior of the
maximum likelihood estimates of recently proposed volatility component models and
establish their local consistency and asymptotic normality are established as well.

*Full text available on-line at:*

Our objective is volatility forecasting, which is core to many risk management problems. We provide theoretical explanations for (i) the empirical stylized fact recognized at least since Taylor () and Ding, Granger, and Engle () that absolute returns show more persistence than squared returns and (ii) the empirical finding reported in recent work by Ghysels, Santa-Clara, and Valkanov () showing that realized absolute values outperform square return-based volatility measures in predicting future increments in quadratic variation. We start from a continuous time stochastic volatility model for asset returns suggested by Barndorff-Nielsen and Shephard () and study the persistence and linear regression properties of various volatility-related processes either observed directly or with sampling error. We also allow for jumps in the asset return processes and investigate their impact on persistence and linear regression. Extensive empirical results complement the theoretical analysis.

Full text available on-line at:


The article evaluates the performance of several recently proposed change-point tests applied to conditional variance dynamics and conditional distributions of asset returns. These are CUSUM-type tests for $^2$-mixing processes and EDF-based tests for the residuals of such nonlinear dependent processes. Hence the tests apply to the class of ARCH- and SV-type processes as well as data-driven volatility estimators using high-frequency data. It is shown that some of the high-frequency volatility estimators substantially improve the power of the structural break tests, especially for detecting changes in the tail of the conditional distribution. Similarly certain types of filtering and transformation of the returns process can improve the power of CUSUM
statistics. We also explore the impact of sampling frequency on each of the test statistics.

Full text available on-line at:


It is common practice to use the sum of frequently sampled squared returns to estimate volatility, yielding so called realized volatility. Unfortunately, returns are contaminated by market microstructure noise. Several noise-corrected realized volatility measures have been proposed. We assess to what extend correction for microstructure noise improves forecasting future volatility using the MIxed DAta Sampling (MIDAS) framework. We start by studying the population properties of predictions using various realized volatility measures. We do this in a general regression setting with i.i.d. microstructure noise. Next we study optimal sampling issues theoretically, when the objective is forecasting and microstructure noise contaminates realized volatility. We distinguish conditional and unconditional optimal sampling schemes, as in Bandi and Russell (2005b). We find that conditional optimal sampling seems to work reasonably well in practice.

Full text available on-line at:
http://www.unc.edu/~sinko/pdf/GS_MS.pdf
Detailed Appendix: Forecasting and Microstructure Noise

1.21 Elena Andreou, Eric Ghysels and Andros Kourtellos, November 2007, “Regression Models With Mixed Sampling Frequencies”.

We study regression models that involve data sampled at different frequencies. We derive the asymptotic properties of the NLS estimators of such regression models and compare them with the LS estimators of a traditional model that involves aggregating or equally weighting data to estimate a model at the same sampling frequency. In
addition we provide a new aggregation bias test. We explore the above theoretical aspects and verify them via an extensive Monte Carlo simulation study and an empirical application.

*Full text available on-line at:*


We consider a log-linearized version of a discounted rents model to price commercial real estate as an alternative to traditional hedonic models. First, we verify a key implication of the model, namely, that cap rates forecast commercial real estate returns. We do this using two different methodologies: time series regressions of 21 US metropolitan areas and mixed data sampling (MIDAS) regressions with aggregate REIT returns. Both approaches confirm that the cap rate is related to fluctuations in future returns. We also investigate the provenance of the predictability. Based on the model, we decompose fluctuations in the cap rate into three parts: (i) local state variables (demographic and local economic variables); (ii) growth in rents; and (iii) an orthogonal part. About 30% of the fluctuation in the cap rate is explained by the local state variables and the growth in rents. We use the cap rate decomposition into our predictive regression and find a positive relation between fluctuations in economic conditions and future returns. However, a larger and significant part of the cap rate predictability is due to the orthogonal part, which is unrelated to fundamentals. This implies that economic conditions, which are also used in hedonic pricing of real estate, cannot fully account for future movements in returns. We conclude that commercial real estate prices are better modelled as financial assets and that the discounted rent model might be more suitable than traditional hedonic models, at least at an aggregate level.

*Full text available on-line at:*
1.23 Xilong Chen and Eric Ghysels, July 2007, “News - Good or Bad - and its Impact Over Multiple Horizons”.

It is difficult to define news, and many definitions are model-based since part of what is announced is anticipated. Therefore, news is typically defined as a residual within the context of some type of prediction model, and the prediction model locks in the sampling frequency that is the reference time scale for analyzing propagation mechanisms. We try to accomplish two goals: (1) characterize news as much as possible as a model-free observation, and (2) measure the impact of news over any arbitrary horizon of interest. We revisit the concept of news impact curves introduced by Engle and Ng (1993), in the current high frequency data environment of financial market time series. Instead of taking a single horizon fixed parametric specification, we recast many of the original ideas in a very flexible multi-horizon semi-parametric setting. Technically speaking we introduce semi-parametric MIDAS regressions and study their asymptotic properties. The analysis relates to and extends recent work by Linton and Mammen (2005). In addition we also introduce various new parametric models. We find that moderately good (intra-daily) news reduces volatility (the next day), while both very good news (unusual high positive returns) and bad news (negative returns) increase volatility, with the latter having a more severe impact. The asymmetries we find have profound implications for current volatility prediction models that are based on in-sample asymptotic analysis developed over recent years. In this context we discuss the link between diffusions and news impact curves.

*Full text available on-line at:*

1.24 Elena Andreou and Eric Ghysels, October 2006, “Structural Breaks in Financial Time Series”.

This paper reviews the literature on structural breaks in financial time series. First we discuss the implications of structural breaks in financial time series for statistical inference purposes. In the second section we discuss the relevant asymptotic results and issues involved in general classifications of change-point tests in financial time series such historical versus sequential tests, parametric versus nonparametric tests and single versus multiple break tests. The third section reviews a number of
structural change tests by focusing on certain characteristics or moments of financial time series such as structural break tests in the financial asset returns and volatility, long memory, tails and distribution. In addition, we review change point tests for the co-dependence between financial asset returns processes in the context of multivariate volatility models, copulae and last but not least asset pricing. In concluding we provide some areas of future research in the subject.

*Full text available on-line at:*


Survey of forecasters, containing respondents' predictions of future values of growth, inflation and other key macroeconomic variables, receive a lot of attention in the financial press, from investors, and from policy makers. They are apparently widely perceived to provide useful information about agents' expectations. Nonetheless, these survey forecasts suffer from the crucial disadvantage that they are often quite stale, as they are released only infrequently, such as on a quarterly basis. In this paper, we propose methods for using asset price data to construct daily forecasts of upcoming survey releases, which we can then evaluate. Our methods allow us to estimate what professional forecasters would predict if they were asked to make a forecast each day, making it possible to measure the effects of events and news announcements on expectations. We apply these methods to forecasts for several macroeconomic variables from both the Survey of Professional Forecasters and Consensus Forecasts.

*Full text available on-line at:*

1.26 Eric Ghysels and Eric Jacquier, August 2006, “Market Beta Dynamics and Portfolio Efficiency”.

This paper introduces a new estimation for the dynamics of betas. It combines two previously separate approaches in the literature, data-driven filters and parametric methods. Namely, we show how to estimate the parametric beta dynamics by instrumental variables combined with block-sampling - but not overlapping window filters - of data-driven betas. Instrumental variables are needed because of the
measurement errors in empirical betas. We find that, while betas are very strongly
autocorrelated, neither aggregate nor firm-specific variables explain much of their
quarterly variation. We then compare block-samplers and overlapping window filters
using a criterion of economic significance. Namely, we track the out-of-sample
performance of portfolios optimized subject to target beta constraints. For target betas
of zero, the case of many hedge funds, we show that estimation error results in
systematic overshooting of the target beta. These portfolios benefit from the use of
medium to long term estimation windows of daily returns.

Full text available on-line at:

1.27 Elena Andreou and Eric Ghysels, August 2006, “Quality Control for
Structural Credit Risk Models”.

Over the last four decades, a large number of structural models have been developed
to estimate and price credit risk. The focus of the paper is on a much neglected issue
pertaining to fundamental shifts in the structural parameters governing default. We
propose formal quality control procedures that allow risk managers to monitor
fundamental shifts in the structural parameters of credit risk models. The procedures
are sequential - hence apply in real time. The basic ingredients are the key processes
used in credit risk analysis, such as most prominently the Merton distance to default
process as well as financial returns. Moreover, while we propose different monitoring
processes, we also show that one particular process is optimal in terms of minimal
detection time of a break in the drift process and relates to the Radon-Nikodym
derivative for a change of measure.

Full text available on-line at:

1.28 Eric Ghysels and João Pedro Pereira, May 2006, “Liquidity and
Conditional Portfolio Choice: A Nonparametric Investigation”.

Selected Readings – April 2010
This paper studies the relation between liquidity and optimal portfolio allocations. Given that the portfolio problem of a constant relative risk aversion investor does not have a closed-form solution, we use a nonparametric approach to estimate the optimal allocations. Using a sample of NYSE stocks from 1963-2000, we find that the optimal portfolio weight in small stocks is strongly increasing in liquidity at short daily and weekly horizons. This result is consistent for three different measures of liquidity: price impact, dollar volume, and turnover. However, liquidity does not influence the optimal portfolio choice for large stocks, nor for longer monthly investment horizons.

*Full text available on-line at:*

1.29 Eric Ghysels, Arthur Sinko and Rossen I. Valkanov, February 2006, “MIDAS Regressions: Further Results and New Directions”.

We explore Mixed Data Sampling (henceforth MIDAS) regression models. The regressions involve time series data sampled at different frequencies. Volatility and related processes are our prime focus, though the regression method has wider applications in macroeconomics and finance, among other areas. The regressions combine recent developments regarding estimation of volatility and a not so recent literature on distributed lag models. We study various lag structures to parameterize parsimoniously the regressions and relate them to existing models. We also propose several new extensions of the MIDAS framework. The paper concludes with an empirical section where we provide further evidence and new results on the risk-return tradeoff. We also report empirical evidence on microstructure noise and volatility forecasting.

*Full text available on-line at:*


We study historical and sequential CUSUM change-point tests for strongly dependent nonlinear processes. These tests are used to monitor the conditional variance of asset returns and to provide real-time information regarding instabilities or disruptions in...
We discuss in detail the theoretical underpinnings of applying historical and sequential CUSUM change-point tests to monitor the stability of dynamic variance processes. Data-driven volatility monitoring schemes are investigated that satisfy the FCLT and provide various advantages for sequential analysis. We examine various issues that emerge when using such processes. One such issue is the sampling frequency since the processes can be sampled at alternative frequencies. We study the power of detection as sampling frequencies vary. Analytical relative local power results are obtained for the CUSUM test for monitoring volatility processes at low versus high sampling frequencies. The analytical results provide evidence of some nontrivial trade-offs between relative local power and the role of sampling frequency, persistence and tails of the volatility process. A comprehensive simulation analysis unfolds the finite sample properties of the CUSUM volatility change-point test and provides additional support to the analytical asymptotic results on relative local power.

Full text available on-line at:


We consider various MIDAS (Mixed Data Sampling) regression models to predict volatility. The models differ in the specification of regressors (squared returns, absolute returns, realized volatility, realized power, and return ranges), in the use of daily or intra-daily (5-minute) data, and in the length of the past history included in the forecasts. The MIDAS framework allows us to compare models across all these dimensions in a very tightly parameterized fashion. Using equity return data, we find that daily realized power (involving 5-minute absolute returns) is the best predictor of future volatility (measured by increments in quadratic variation) and outperforms model based on realized volatility (i.e. past increments in quadratic variation). Surprisingly, the direct use of high-frequency (5-minute) data does not improve volatility predictions. Finally, daily lags of one to two months are sufficient to capture the persistence in volatility. These findings hold both in- and out-of-sample.

Full text available on-line at:

Time series are demeaned when sample autocorrelation functions are computed. By the same logic it would seem appealing to remove seasonal means from seasonal time series before computing sample autocorrelation functions. Yet, standard practice is only to remove the overall mean and ignore the possibility of seasonal mean shifts in the data. Whether or not time series are seasonally demeaned has very important consequences on the asymptotic behavior of autocorrelation functions. The effect on the asymptotic distribution of seasonal mean shifts and their removal is investigated and the practical consequences of these theoretical developments are discussed. We also examine the small sample behavior of autocorrelation function estimates through Monte Carlo simulations.

*Full text available on-line at:*


The paper surveys the recent literature on the econometric analysis of option pricing models.

*Full text available on-line at:*


A general estimation approach combining the attractive features of method of moments with the efficiency of ML is proposed. The moment conditions are computed via the characteristic function. The two major difficulties with the implementation is that one needs to use an infinite set of moment conditions leading
to the singularity of the covariance matrix in the GMM context, and the optimal instrument yielding the ML efficiency was previously shown to depend on the unknown probability density function. We resolve the two problems simultaneously in the framework of C-GMM (GMM with a continuum of moment conditions) of Carrasco and Florens (2000a). First, we extend their results to dependent data and provide a reformulation of their estimator that enhances its computational ease. Second, we propose to span the unknown optimal instrument by an infinite basis consisting of simple exponential functions. Since the estimation framework already relies on a continuum of moment conditions, adding a continuum of spanning functions does not pose any problems. As a result, we achieve ML efficiency when we use the values of conditional CF indexed by its argument as moment functions. We also introduce HAC-type estimators so that the estimation methods are not restricted to settings involving martingale difference sequences. Hence, our methods apply to Markovian and non-Markovian dynamic models. Finally, a simulated method of moments type estimator is proposed to deal with the cases where the characteristic function does not have a closed-form expression. Extensive Monte-Carlo study based on the models typically used in term-structure literature favorably documents the performance of our methodology.

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We propose extensions of the continuous record asymptotic analysis for rolling sample variance estimators developed by Foster and Nelson (1996) for estimating the quadratic variation of asset returns, which is also referred to as integrated or realized volatility. The new approach treats integrated volatility as a continuous time stochastic process sampled at high frequencies and suggests rolling sample estimators which share many features with spot volatility estimators. We also discuss asymptotically efficient window lengths and optimal weighting schemes for estimators of the quadratic variation and establish the links between various spot and integrated volatility estimators. Theoretical results are complemented with extensive Monte Carlo simulations and an empirical investigation.

The paper evaluates the performance of several recently proposed tests for structural breaks in conditional variance dynamics of asset returns. The tests apply to the class of ARCH and SV type processes as well as data-driven volatility estimators using high-frequency data. In addition to testing for the presence of breaks, the statistics identify the number and location of multiple breaks. We study the size and power of the new tests for detecting breaks in the conditional variance under various realistic univariate heteroskedastic models, change-point hypotheses and sampling schemes. The paper concludes with an empirical analysis using data from the stock and FX markets for which we find multiple breaks associated with the Asian and Russian financial crises. These events resulted in changes in the dynamics of volatility of asset returns in the samples prior and post the breaks.

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We rely on recently developed general equilibrium asset pricing models, from which we derive some predictions about how heterogeneity of beliefs affects return and volatility dynamics. The first contribution of our paper is the derivation of a simple decomposition of the conditional stock returns and volatility into two components, one component determined by traditional fundamental factors, the other component dependent on the heterogeneity of beliefs. The second contribution of our paper is that we suggest a new empirical measure of heterogeneity of beliefs of agents. We address the practical question of whether we can observe good proxies that capture informational heterogeneity and obey the predictions of theoretical models. It is argued factors that capture the dispersion of analysts' earnings forecasts are such
proxies. We use factor asset pricing models to construct conventional predictions of returns and volatility. First, we determine dispersion is a priced risk factor in traditional asset pricing models. Second, we show dispersion is significantly and positively related to both out-of-sample returns and volatility, which is coherent with the theoretical decomposition.

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We show that using data which are properly available in real time when assessing the sensitivity of asset prices to economic news leads to different empirical findings than when data availability and timing issues are ignored. We do this by focusing on a particular example, namely Chen, Roll and Ross (1986), and examine whether innovations to economic variables can be viewed as risks that are rewarded in asset markets. Our findings support the view that data uncertainty is sufficiently prevalent to warrant careful use of real-time data when forming real-time news measures, and in general when undertaking empirical financial investigations involving macroeconomic data.

Full text available on-line at:


The purpose of this paper is to bridge two strands of the literature, one pertaining to the objective or physical measure used to model an underlying asset and the other pertaining to the risk-neutral measure used to price derivatives. We propose a generic procedure using simultaneously the fundamental price and a set of option contracts. We use Heston's (1993, Review of Financial Studies 6, 327--343) model as an example, and appraise univariate and multivariate estimation of the model in terms of pricing and hedging performance. Our results, based on the S&P 500 index contract
show dominance of univariate approach, which relies solely on options data. A by-
product of this finding is that we uncover a remarkably simple volatility extraction
filter based on a polynomial lag structure of implied volatilities. The bivariate
approach, involving both the fundamental security and an option contract, appears
useful when the information from the cash market reflected in the conditional kurtosis
provides support to price long term.

Full text available on-line at:

1.40 Mikhail Chernov, A. Ronald Gallant, Eric Ghysels and George Tauchen,

The purpose of this paper is to shed further light on the tensions that exist between the
empirical fit of stochastic volatility (SV) models and their linkage to option pricing. A
number of recent papers have investigated several specifications of one-factor SV
diffusion models associated with option pricing models. The empirical failure of one-
factor affine, Constant Elasticity of Variance (CEV), and one-factor log-linear SV
models leaves us with two strategies to explore: (1) add a jump component to better
fit the tail behavior or (2) add an additional (continuous path) factor where one factor
controls the persistence in volatility and the second determines the tail behavior. Both
have been partially pursued and our paper embarks on a more comprehensive
examination which yields some rather surprising results. Adding a jump component to
the basic Heston affine model is known to be a successful strategy as demonstrated by
Andersen et al. (1999), Eraker et al. (1999), Chernov et al. (1999), and Pan (1999).
Unfortunately, the presence of a jump component introduces quite a few unpleasant
econometric issues. In addition, several financial issues, like hedging and risk factors
become more complex. In this paper we show that a two-factor log-linear SV
diffusion model (without jumps) appears to yield a remarkably good empirical fit. We
estimate the model via the EMM procedure of Gallant and Tauchen (1996) which
allows us to compare the non-nested log-linear SV diffusion with the affine jump
specification. Obviously, there is one drawback to the log-linear SV models when it
comes to pricing derivatives since no closed-form solutions are available. Against this
cost weights the advantage of avoiding all the complexities involved with jump
processes.

The purpose of this paper is to propose a new class of jump diffusions which feature both stochastic volatility and random intensity jumps. Previous studies have focused primarily on pure jump processes with constant intensity and log-normal jumps or constant jump intensity combined with a one factor stochastic volatility model. We introduce several generalizations which can better accommodate several empirical features of returns data. In their most general form we introduce a class of processes which nests jump-diffusions previously considered in empirical work and include the affine class of random intensity models studied by Bates (1998) and Duffie, Pan and Singleton (1998) but also allows for non-affine random intensity jump components. We attain the generality of our specification through a generic Levy process characterization of the jump component. The processes we introduce share the desirable feature with the affine class that they yield analytically tractable and explicit option pricing formula. The non-affine class of processes we study include specifications where the random intensity jump component depends on the size of the previous jump which represents an alternative to affine random intensity jump processes which feature correlation between the stochastic volatility and jump component. We also allow for and experiment with different empirical specifications of the jump size distributions. We use two types of data sets. One involves the S&P500 and the other comprises of 100 years of daily Dow Jones index. The former is a return series often used in the literature and allows us to compare our results with previous studies. The latter has the advantage to provide a long time series and enhances the possibility of estimating the jump component more precisely. The non-affine random intensity jump processes are more parsimonious than the affine class and appear to fit the data much better.
1.42 Charles Cao, Eric Ghysels and Frank Hatheway, July 1999, “Price Discovery without Trading: Evidence from the Nasdaq Pre-opening”.

This paper studies Nasdaq market makers' activities during the one-and-half hour pre-opening period. Price discovery during the pre-opening is conducted via price signaling as opposed to the auction used to open the NYSE or the continuous market used during trading. In the absence of trades, Nasdaq dealers use crossed and locked inside quotes to signal to other market makers which direction the price should move. Furthermore, we find evidence of price leadership among market makers that bears little resemblance to their IPO/SEO lead underwriter participation.

*Full text available on-line at:*


The paper complements the reviews on the stochastic volatility models and option pricing. We discuss recent advances in modeling and estimation techniques which allow investigating models with latent factors and non-unique risk-neutral probability measures. The issues related to the optimal data utilization and volatility filtering are highlighted. We also discuss some of the future research in this area.

*Full text available on-line at:*


In this paper, we study stochastic volatility models with time deformation. Such processes relate to the early work by Mandelbrot and Taylor (1967), Clark (1973), Tauchen and Pitts (1983), among others. In our setup, the latent process of stochastic volatility evolves in an operational time which differs from calendar time. The time deformation can be determined by past volume of trade, past returns, possibly with an
asymmetric leverage effect, and other variables setting the pace of information arrival. The econometric specification exploits the state-space approach for stochastic volatility models proposed by Harvey, Ruiz and Shephard (1994) as well as the matching moment estimation procedure using SNP densities of stock returns and trading volume estimated by Gallant, Rossi and Tauchen (1992). Daily data on returns and trading volume of the NYSE are used in the empirical application. Supporting evidence for a time deformation representation is found and its impact on the behavior of returns and volume is analyzed. We find that increases in volume accelerate operational time, resulting in volatility being less persistent and subject to shocks with a higher innovation variance. Downward price movements have similar effects while upward price movements increase the persistence in volatility and decrease the dispersion of shocks by slowing down market time. We present the basic model as well as several extensions; in particular, we formulate and estimate a bivariate return-volume stochastic volatility model with time deformation. The latter is examined through bivariate impulse response profiles following the example of Gallant, Rossi and Tauchen (1993).

Full text available on-line at:


There is now considerable evidence suggesting that estimated betas of unconditional CAPM models exhibit statistically significant time variation. Therefore, many have advocated the use of conditional CAPM models. If we succeed in capturing the dynamics of beta risk, we are sure to outperform constant beta models. However, if the beta risk is inherently misspecified there is a real possibility that we commit serious pricing errors, potentially larger than with a constant traditional beta model. In this paper we show that this is indeed the case, namely that pricing errors with constant traditional beta models are smaller than with conditional CAPM models.

Full text available on-line at:
In this paper we propose a generic procedure for estimating and pricing options in the context of stochastic volatility models using simultaneously the fundamental price and a set of option contracts. We appraise univariate and multivariate estimation of the model in terms of pricing and hedging performance. Our results, based on the S&P 500 index contract, show that the univariate approach only involving options by and large dominates. A by-product of this finding is that we uncover a remarkably simple volatility extraction filter based on a polynomial lag structure of implied volatilities. The bivariate approach involving both the fundamental and an option appears useful when the information from the cash market provides support via the conditional kurtosis to price options. This is the case for some long term options. Moreover, having estimated separately the risk-neutral and objective measures allows us to appraise the typical risk-neutral representations used in the literature. Using Heston's (1993) model as example we show that the usual transformation from objective to risk neutral density is not supported by the data.

Full text available on-line at:

Simulation-based estimation methods have become more widely used in recent years. We propose a set of tests for structural change in models estimates via Simulated Method of Moments (see Duffie and Singleton (1993)). These tests extend the recent work of Andrews (1993) and Sowell (1996a, b) which covered Generalized Method of Moments estimators not involving simulation. We derive the asymptotic distributions of various tests. We show that the number of simulations does not affect the asymptotic distribution nor the asymptotic local power of tests for structural change. A Monte Carlo investigation of the finite sample size and power reveals, however, that simulation uncertainty does affect the properties of tests. Nevertheless, even a relatively small number of simulations suffice to obtain tests with desirable small sample size and power properties.

Subordinated stochastic processes, also called time deformed stochastic processes, have been proposed in a variety of contexts to describe asset price behavior. They are used when the movement of prices is tied to the number of market transactions, trading volume or the more elusive concept of information arrival. The aim of the paper is to present a comprehensive treatment of the stochastic process theory as well as the statistical inference of subordinated processes. Numerous applications in finance are provided to illustrate the use of the processes to model market behavior and asset returns.

Full text available on-line at:

1.49 Mark Broadie, Jerome Detemple, Eric Ghysels and Olivier Torres, November 1996, “American Options with Stochastic Dividends and Volatility: A Nonparametric Investigation”.

In this paper, we consider American option contracts when the underlying asset has stochastic dividends and stochastic volatility. We provide a full discussion of the theoretical foundations of American option valuation and exercise boundaries. We show how they depend on the various sources of uncertainty which drive dividend rates and volatility, and derive equilibrium asset prices, derivative prices and optimal exercise boundaries in a general equilibrium model. The theoretical models yield fairly complex expressions which are difficult to estimate. We therefore adopt a nonparametric approach which enables us to investigate reduced forms. Indeed, we use nonparametric methods to estimate call prices and exercise boundaries conditional on dividends and volatility. Since the latter is a latent process, we propose several approaches, notably using EGARCH filtered estimates, implied and historical volatilities. The nonparametric approach allows us to test whether call prices and exercise decisions are primarily driven by dividends, as has been advocated by
Harvey and Whaley (1992a, b) and Fleming and Whaley (1994) for the OEX contract, or whether stochastic volatility complements dividend uncertainty. We find that dividends alone do not account for all aspects of call option pricing and exercise decisions, suggesting a need to include stochastic volatility.

Full text available on-line at:


In one of the early attempts to model stochastic volatility, Clark [1973] conjectured that the size of asset price movements is tied to the rate at which transactions occur. To formally analyze the econometric implications, he distinguished between transaction time and calendar time. The present paper exploits Clark's strategy for a different purpose, namely, asset pricing. It studies arbitrage-based pricing in economies where: (i) trade takes place in transaction time, (ii) there is a single state variable whose transaction-time price path is binomial, (iii) there are risk free bonds with calendar-time maturities, and (iv) the relation between transaction time and calendar time is stochastic. The state variable could be interpreted in various ways. E.g., it could be the price of a share of stock, as in Black and Scholes [1973], or a factor that summarizes changes in the investment opportunity set, as in Cox, Ingersoll and Ross [1985] or one that drives changes in the term structure of interest rates (Ho and Lee [1986], Heath, Jarrow and Morton [1992]). Property (iv) generally introduces stochastic volatility in the process of the state variable when recorded in calendar time.

The paper investigates the pricing of derivative securities with calendar-time maturities. The restrictions obtained in Merton [1973] using simple buy-and-hold arbitrage portfolio arguments do not necessarily obtain. Conditions are derived for all derivatives to be priced by dynamic arbitrage, i.e., for market completeness in the sense of Harrison and Pliska [1981]. A particular class of stationary economies where markets are indeed complete is characterized.

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Selected Readings –April 2010 33

Much of the research describing the cross-sectional and time series behavior of asset returns can be characterized as a search for the relevant state variables and also a search for the relevant model specification. Ultimately the scope of such efforts is to find a satisfactory and stable asset pricing structure. In this paper we discuss various methods to accomplish this and appraise the success of two recently proposed classes of asset pricing models in tracking predictable patterns in risk and return trade-offs. The two classes are the conditional CAPM and the nonlinear APT. The parameters of both models are estimated via a set of moment conditions using the GMM estimator and the model fit is judged on the basis of the overidentifying restrictions. The fundamental problem is that overidentifying restrictions tests are not designed to diagnose whether a model provides a stable relationship between the return series and the risk factors. We use a set of recently developed tests for structural stability of parameter estimates for the GMM estimator to diagnose which factor structures appear stable through time in the context of the two aforementioned classes of models. In the course of trying to sort out whether there is systematic mispricing we also try to determine what type of model looks most promising for further development. In that regard we find the nonlinear APT more satisfactory than the conditional CAPM and APT. The paper covers several empirical examples ranging from international asset pricing to the pricing of size-sorted and industry classified portfolios of stocks listed on the NYSE.

Full text available on-line at:

1.52 Tim Bollerslev and Eric Ghysels, March 1994, “Periodic Autoregressive Conditional Heteroskedasticity”.

High frequency asset returns generally exhibit time dependent and seasonal clustering of volatility. This paper proposes a new class of models featuring periodicity in conditional heteroskedasticity explicitly designed to capture the repetitive seasonal time variation in the second order moments. The structures of this new class of
Periodic ARCH, or P-ARCH, models share many properties with the periodic ARMA processes for the mean. The implicit relation between P-GARCH structures and time-invariant seasonal weak GARCH processes documents how neglected autoregressive conditional heteroskedastic periodicity may give rise to a loss in efficiency. The importance and magnitude of this informational loss are quantified for a variety of loss functions through the use of Monte Carlo simulation methods. An empirical example for the daily bilateral Deutschemark - British Pound spot exchange rate highlights the practical relevance of the new P-GARCH class of models. Extensions to other periodic ARCH structures, including P-IGARCH and P-EGARCH processes along with possible discrete time periodic representations of stochastic volatility models subject to time deformation, are also discussed, along with issues related to multivariate representations and the possibility of common persistence in the seasonal volatility across multiple time series.

Full text available on-line at: