




# Improving the predictability of real economic activity and asset returns with forward variances inferred from option portfolios

Gurdip Bakshi<sup>a 1</sup> , George Panayotov<sup>b 2</sup> , Georgios Skoulakis<sup>c</sup>  

Show more 

 Share  Cite

<https://doi.org/10.1016/j.jfineco.2011.01.002> 

[Get rights and content](#) 

## Abstract

This paper presents an option positioning that allows us to infer forward variances from option portfolios. The forward variances we construct from equity index options help to predict (i) growth in measures of real economic activity, (ii) Treasury bill returns, (iii) stock market returns, and (iv) changes in variance swap rates. Our yardstick for measuring predictive ability is both individual and joint parameter statistical significance within a market, as well as across a set of markets.

## Introduction

Examining the traditional hypotheses about the term structure of default-free interest rates has played a central part in financial economics (Cox, Ingersoll, and Ross, 1981; Fama and Bliss, 1987; and Campbell and Shiller, 1991). Key to these analyses are forward interest rates and bond returns, which are both based on the discount bond price representation  $\mathbb{E}_t^{\mathbb{Q}}\{\exp(-\int_t^{t+\tau} r_u du)\}$ , where  $\tau$  is term to maturity,  $r_u$  is spot interest rate, and  $\mathbb{E}_t^{\mathbb{Q}}\{\cdot\}$  is the time- $t$  conditional expectation under the equivalent martingale measure  $\mathbb{Q}$ . If claims contingent on the exponential of integrated variance, i.e., on  $\exp(-\int_t^{t+\tau} \sigma_u^2 du)$ , where  $\sigma_u^2$  is instantaneous variance of equity index returns, could be valued, then one could exploit the analogy and formulate and empirically investigate a set of hypotheses linked to variance.

In this paper, we contribute by providing a framework for deducing variance-based analogues of forward interest and relating them to variations in economy-wide variables. Specifically, we ask whether forward variances can help forecast real economic activity, Treasury bill and bond returns, stock returns, and movements of asset prices that depend on the integrated variance of equity index returns.

We use the work of Carr and Lee (2008) to synthesize the exponential of integrated variance using a strip of European calls and puts, written on the market index. To study the predictability of asset returns and aggregate real economic activity, we employ S&P 500 index options across four maturities to build time series of prices of exponential claims on integrated variance. These prices are expressed in terms of the prices of investable portfolios of options, and hence, variance is tradable.

Crucial to our investigation are forward variances, extracted from the prices of exponential claims of different maturities. Drawing on the analogy with the term structure of interest rates, the forward variances embody expected variances, inferred from particular index option portfolios. We surmise that forward variances are related to future movements in both the financial and the real sector, as perceived in the equity index option market.<sup>3</sup>

Inference is based on predictive regressions, and the null hypothesis of no predictability is generally rejected, after addressing econometric concerns. Specifically, our conclusions are robust under the Newey and West, 1987, Newey and West, 1994 method with optimal lag selection, the Hodrick (1992) approach for computing standard errors after imposing the null of no predictability, and a parametric bootstrap (i.e., Mark, 1995, Cochrane and Piazzesi, 2005; and Amihud, Hurvich, and Wang, 2009). Our yardstick for measuring predictive ability is both individual and joint statistical significance of the slope coefficients within a market, as well as across a set of markets. A simulation exercise indicates that the Hodrick (1992) test offers the correct size in small samples, under empirically relevant assumptions about the data generating process of the predictors, and even when some predictors are allowed to be nearly integrated.

Summarizing the empirical findings, a high level of front-end forward variance is associated with contracting economic activity, as measured by the growth rate of non-farm payroll, industrial production, and other indicators. Our results suggest that forward variances are useful in predicting Treasury bill returns but fail to predict Treasury bond returns. This is the case regardless of whether the Cochrane and Piazzesi (2005) factor is used as an additional predictor.

Furthermore, some of the forward variances help to predict stock market returns in the presence of traditional predictors. The predictability is statistically significant at horizons up to six months. Finally, we find some statistically significant evidence that forward variances predict log changes in variance swap rates.

Going beyond the single-equation testing framework, we examine a system of predictive regressions, which corroborates joint predictability across markets. Overall, forward variances, extracted from index options, appear to be useful predictors of financial and real economic activity variables.

Our empirical findings should be viewed with some caution. The reason is that the construction of monthly forward variances requires index option data with a dense set of strike prices over multiple maturities, which makes us limit our study to the September 1998 to September 2008 sample period.

The paper proceeds as follows. Section 2 outlines the setup underlying the empirical investigation. Section 3 discusses the construction of forward variances. Section 4 presents evidence on the predictability of real economic activity and asset returns. Section 5 concludes the paper.

## Exponential claims on integrated variance

Here we adopt the modeling setup of Carr and Lee (2008). Let  $S_t$  denote the level of the market index at time  $t$  and assume that  $S_t$  follows a general diffusion process under the equivalent martingale measure.

The instantaneous variance of market index return is given by the adapted process  $\sigma_t^2$ . In the absence of price jumps, the integrated variance of returns over an interval  $[t, t + \tau_n]$  equals the quadratic variation over  $[t, t + \tau_n]$ , i.e.,  $\int_t^{t+\tau_n} \sigma_u^2 du = \langle X \rangle_t^{(n)}$ . In the empirical section, we use a set of ...

## Forward variances from option portfolios

What is special about the investable option portfolios that underlie the exponential claims on integrated variance is that they incorporate a pure volatility risk component and are devoid of the market return risk component. Such a feature makes our empirical analysis distinct from the extant literature on option returns. Furthermore, when variances are tradable, it becomes difficult to defend the use of model-based implied volatilities in empirical work.<sup>5</sup>...

## Improving predictability using forward variances

The purpose of this section is to relate proxies for forward variance, as inferred from the option market, to subsequent returns of financial assets and growth in real economic activity. By investigating these relations, we address the pertinent question whether a set of forward variances have the ability to forecast variables that have received attention in prior research, as in, for example, Fama, 1984, Fama, 1990 and Fama and French, 1989, Fama and French, 1993. More importantly, such an...

## Conclusions

Examining the return variation of stocks and bonds, as well as its relation to economic fundamentals, has shaped much of our knowledge about the determinants of asset return dynamics and the sources of return predictability. The empirical treatments of Fama, 1981, Fama, 1990, Fama and Bliss (1987), Fama and French, 1989, Fama and French, 1993, Campbell and Shiller (1991), Ferson and Harvey (1991), Bekaert and Hodrick (1992), and Cochrane and Piazzesi (2005) are some examples of this strand of...

[Recommended articles](#)

---

## References (87)

Y. Aït-Sahalia *et al.*

### [Out of sample forecasts of quadratic variation](#)

Journal of Econometrics (2008)

D. Backus *et al.*

### [Predictable changes in yields and forward rates](#)

Journal of Financial Economics (2001)

A. Beber *et al.*

## The effect of macroeconomic news on beliefs and preferences: evidence from the options market

Journal of Monetary Economics (2006)

G. Bekaert *et al.*

## On biases in tests of the expectations hypothesis of the term structure of interest rates

Journal of Financial Economics (1997)

J. Campbell

## Why long horizons? A study of power against persistent alternatives

Journal of Empirical Finance (2001)

J. Campbell *et al.*

## Efficient tests of stock return predictability

Journal of Financial Economics (2006)

L. Chen *et al.*

## Do time-varying risk premiums explain labor market performance?

Journal of Financial Economics (2011)

J. Cox *et al.*

## A reexamination of traditional hypotheses about the term structure of interest rates

Journal of Finance (1981)

Q. Dai *et al.*

## Expectation puzzles, time-varying risk premia, and affine models of the term structure

Journal of Financial Economics (2002)

T. Day *et al.*

## The behavior of the volatility implicit in option prices

Journal of Financial Economics (1988)



View more references

---

## Cited by (62)

### Options-based systemic risk, financial distress, and macroeconomic downturns

2023, Journal of Financial Markets

Show abstract

### Market risks that change US-European equity correlations

2023, Journal of International Financial Markets, Institutions and Money

Show abstract

## Bond risk's role in the equity risk-return tradeoff

2022, Journal of Financial Markets

*Citation Excerpt :*

...An attractive feature of our risk-return specifications are their simplicity. Recent studies that document a risk-return relation in the equity market have required more complexity; either using mixed-data-sampling econometrics to estimate risk (Ghysels et al., 2005), a nonlinear specification between equity risk and the equity premium (ACV, 2019), or the term structure of option-derived implied forward variances (Bakshi et al., 2011; Luo and Zhang, 2017). In contrast, we uncover a positive linear VIX risk-return relation (in a partial sense) by simply allowing the role of cross-market T-bond risk to vary with economic conditions in a manner suggested by theory and related evidence...

[Show abstract](#) ✓

## Treasury yield implied volatility and real activity

2021, Journal of Financial Economics

[Show abstract](#) ✓

## The SKEW index: Extracting what has been left

2021, Journal of Financial Stability

[Show abstract](#) ✓

## The cross-section of currency volatility premia

2021, Journal of Financial Economics

[Show abstract](#) ✓



[View all citing articles on Scopus](#) ↗

---

☆ We are grateful for the feedback of David Chapman (the referee) and G. William Schwert (the editor), whose comments have dramatically improved the paper. The authors acknowledge helpful discussions with Vikas Agarwal, Foussemi Chabi-Yo, Peter Carr, Eric Engstrom, Xiaohui Gao, Steve Heston, Nengjiu Ju, Nikunj Kapadia, Dilip Madan, Liuren Wu, Hao Zhou, and Zhongyan Zhu. An earlier version of the paper was presented at Georgetown University, the Chinese University of Hong Kong, and the 2010 European Finance Association Meeting.

1 Tel.: +1 301 405 2261; fax: +1 301 405 0359.

2 Tel.: +1 202 687 8401; fax: +1 202 687 4031.

[View full text](#)

Copyright © 2011 Elsevier B.V. All rights reserved.



