



Explaining asset pricing puzzles associated with the 1987 market crash[☆]

Luca Benzoni^{a,1}, Pierre Collin-Dufresne^{b,d,2}, Robert S. Goldstein^{c,d,*}

^a Federal Reserve Bank of Chicago, 230 S. LaSalle Street, Chicago, IL 60604, United States

^b Columbia Business School, 3022 Broadway, Uris Hall 404, New York, NY 10027, United States

^c Carlson School of Management, University of Minnesota, 321 19th Ave S., Minneapolis, MN 55455, United States

^d NBER, United States

ARTICLE INFO

Article history:

Received 18 October 2007

Received in revised form

26 January 2010

Accepted 12 April 2010

Available online 3 February 2011

JEL classification:

G12

G13

Keywords:

Volatility smile

Volatility smirk

Implied volatility

Option pricing

Portfolio insurance

ABSTRACT

The 1987 market crash was associated with a dramatic and permanent steepening of the implied volatility curve for equity index options, despite minimal changes in aggregate consumption. We explain these events within a general equilibrium framework in which expected endowment growth and economic uncertainty are subject to rare jumps. The arrival of a jump triggers the updating of agents' beliefs about the likelihood of future jumps, which produces a market crash and a permanent shift in option prices. Consumption and dividends remain smooth, and the model is consistent with salient features of individual stock options, equity returns, and interest rates.

© 2011 Elsevier B.V. All rights reserved.

[☆] We thank Raj Aggarwal, Gordon Alexander, George Constantinides, Mariacristina De Nardi, Darrell Duffie, Bernard Dumas, Nicolae Gârleanu, Jun Liu, Massimo Massa, Jun Pan, Monika Piazzesi, Mark Rubinstein, Bill Schwert (the Editor), Costis Skiadas, Tan Wang, Stanley Zin, an anonymous referee, and seminar participants at the March 2006 NBER Asset Pricing Meeting, Chicago, the 2006 Western Finance Association conference, the 2007 Econometric Society conference, the 2008 Chicago/London Conference on Financial Markets, and the Federal Reserve Bank of Chicago for helpful comments and suggestions. Olena Chyruk and Andrea Ajello provided excellent research assistance. All errors remain our sole responsibility. Previous versions of this paper circulated under the title 'Can Standard Preferences Explain the Prices of Out-of-the-Money S&P 500 Put Options?'. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Chicago or the Federal Reserve System.

* Corresponding author at: Carlson School of Management, University of Minnesota, 321 19th Ave S., Minneapolis, MN 55455, United States. Tel.: +1 612 624 8581; fax: +1 612 626 1335.

E-mail addresses: lbzoni@frbchi.org (L. Benzoni),

pc2415@columbia.edu (P. Collin-Dufresne),

goldsl144@umn.edu (R.S. Goldstein).

¹ Tel.: +1 312 322 8499.

² Tel.: +1 212 854 6471.

1. Introduction

The 1987 stock market crash has generated many puzzles for financial economists. In spite of little change in observable macroeconomic fundamentals, market prices fell 20–25% and interest rates dropped about 1–2%. Moreover, the crash triggered a permanent shift in index option prices: Prior to the crash, implied 'volatility smiles' for index options were relatively flat. Since the crash, however, the Black-Scholes formula has been significantly underpricing short-maturity, deep out-of-the-money Standard and Poor's (S&P) 500 put options (Rubinstein, 1994; Bates, 2000). This feature, often referred to as the 'volatility smirk,' is demonstrated in Fig. 1, which shows the spread of both in-the-money (ITM) and out-of-the-money (OTM) implied volatilities relative to at-the-money (ATM) implied volatilities from

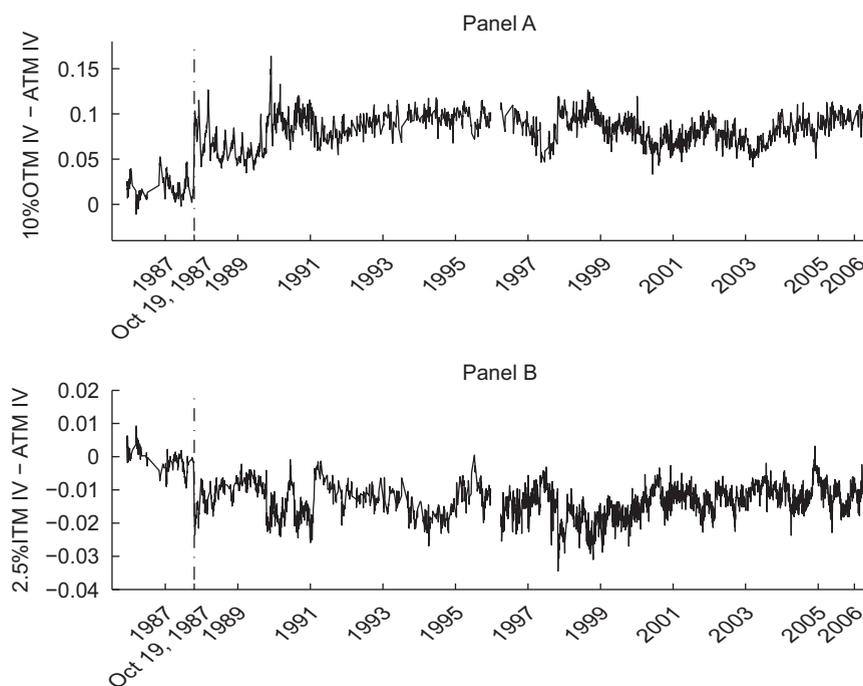


Fig. 1. Pre- and post-crash implied volatility smirk for S&P 500 options with one month to maturity. The plot in Panel A depicts the spread between implied volatilities for S&P 500 options with a strike-to-price ratio $X=K/S - 1 = -10\%$ and at-the-money implied volatilities. The plot in Panel B depicts the spread between implied volatilities for options with a strike-to-price ratio $X=K/S - 1 = 2.5\%$ and at-the-money implied volatilities. Appendix D explains how we constructed the implied volatility series.

1985–2006. This figure clearly shows that the volatility smirk spiked upward immediately after the 1987 stock crash, and that this shift has remained ever since.

Not only is this volatility smirk puzzling in its own right, but it is also difficult to explain relative to the shape of implied volatility functions (IVF) for individual stock options, which are much flatter and more symmetric (see, e.g., Bollen and Whaley, 2004; Bakshi, Kapadia, and Madan, 2003; Dennis and Mayhew, 2002). Indeed, Bollen and Whaley (2004) argue that the difference in the implied volatility functions for options on individual firms and on the S&P 500 index cannot be explained by the differences in their underlying asset return distributions.

In this paper, we attempt to explain these puzzles while simultaneously capturing other salient features of asset prices. In particular, we examine a representative-agent general equilibrium endowment economy that can simultaneously explain:

- The prices of deep OTM put options for both individual stocks and the S&P 500 index.
- Why the slope of the implied volatility curve changed so dramatically after the crash.
- Why the regime shift in the volatility smirk has persisted for more than 20 years.
- How the market can crash with little change in observable macroeconomic variables.

We build on the long-run risk model of Bansal and Yaron (2004, BY), who show that if agents have a preference for

early resolution of uncertainty, e.g., have Kreps and Porteus (1978)/Epstein and Zin (1989), or KPEZ, preferences with elasticity of intertemporal substitution $EIS > 1$, then persistent shocks to the expected growth rate and volatility of aggregate consumption will be associated with large risk premiums in equilibrium. Their model is able to explain a high equity premium, low interest rates, and low interest rate volatility while matching important features of aggregate consumption and dividend time series. We extend their model in two dimensions. First, we add a jump component to the shocks driving the expected consumption growth rate and consumption volatility. These jumps (typically downward for expected growth rates and upward for volatility) are bad news for the agent with KPEZ preferences, who will seek to reduce her position in risky assets. In equilibrium, this reduction in demand leads to asset prices exhibiting a downward jump, even though aggregate consumption and dividends are smooth. That is, in our model, the *level* of consumption and dividends follows a continuous process; it is their expected growth rates and volatilities that jump. Since shocks to expected consumption growth rate and consumption volatility are associated with large risk premiums, jumps in asset prices can be substantial, akin to market ‘crashes.’

Our second contribution relative to BY (2004) is to allow for parameter uncertainty and learning. Specifically, we assume the jump frequency is governed by a hidden two-state continuous Markov chain, which needs to be filtered in equilibrium. This adds another source of risk to the economy, namely the posterior probability of the

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات