The Minneapolis RNPD Initiative: Construction and Monitoring

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Disclaimer

• The views expressed here are my own and not necessarily those of others in the Federal Reserve System.
Summary

• Initiative motivated by the unique features of RNPDs for policymakers

• Construction process uses standard techniques and favors market prices over quotes

• Monitoring focused on standard movements of distributions, tail probabilities, and trading volumes

• We are making RNPD output more widely available to increase its usage by policymakers
Motivations for Initiative

• Lesson from 2007: Essential for policymakers to monitor tail risks

• RNPD output provides a full distribution view of future

• More public visibility of RNPD output = more usage by policymakers
Minneapolis Construction Process

• General approach: Breeden-Litzenberger\(^1\)
  – The risk-neutral probability probability density is the second
derivative of call price as a function of strike price

• Specific approach to estimating the call price
  function: Shimko\(^2\)

\(^1\)Breeden, D. T., and Litzenberger, R. H. (1978), “Prices of state-contingent claims implicit in option

Minneapolis Construction Process

Options on the S&P 500 Index -- 11/15/2012
PricesConverted to BS Volatilities

1. Gather Prices (if possible)
2. Convert to BS Volatilities

Source: FactSet Data Systems
Minneapolis Construction Process

Options on the S&P 500 Index -- 11/15/2012
Clean the Data - Fit Curve - Add "Tails"

3. Remove problematic observations
4. Fit curve to remaining data
5. Attach log-normal tails at deltas of 5 & 95
6. Convert back to prices & differentiate

Source: FactSet Data Systems
Final Result

RISK NEUTRAL PROBABILITY DENSITY FUNCTIONS – S&P 500

Log returns are based on the risk neutral density function of the underlying asset
Derived from options that expire in approximately 6 months

Risk Neutral PDF of the Log Return Distribution

Log(Strike Price / Current Underlying Price)(%)
Minneapolis Construction Process

• We do NOT decompose state prices into probabilities and marginal utilities
  – Policy decisions should be based on the state prices that combine the two
  – See remarks from President Kocherlakota
What We Monitor

• Moments of the Distribution

• Tail Probabilities

• Trading Activity
Moments – Standard Deviation

Sources: FactSet Data Systems
Bloomberg

Gold, Silver, and Oil RNPDs are derived from options on futures. S&P 500 RNPDs are derived from options on the S&P 500 Index. All options have approximately six months to expiration.
Moments – Skew

RNPD Skews - Grains

Source: Bloomberg

Corn, Soybeans, and Wheat RNPDs are derived from options on futures. All options have approximately six months to expiration.
Tail Probabilities

Probability of a Large Change - Yen/Dollar

Yen/Dollar RNPDs are derived from options on Yen/Dollar futures. The options have approximately three months to expiration.

Source: Bloomberg
**Trading Activity**

**S&P 500 Options Volumes - 12m Expiry**

(Sources: FactSet Data Systems)

*S&P 500 RNPDs are derived from options on the S&P 500 Index. The options have approximately twelve months to expiration.*
Enhancing Public Visibility of RNPD Output

• We want to encourage more use of RNPD information by policymakers
  – Policymakers typically use statistical models to formulate probabilistic assessments of the future
  – Our goal is to enhance policymakers’ use of RNPDs
Enhancing Public Visibility of RNPD Output

• To encourage visibility we:
  – Produce RNPD output across many asset types
  – Offer commentary
  – Avoid technical language
  – Developed an interactive website
The FRB Minneapolis Website

http://www.minneapolisfed.org/banking/rnpd/index.cfm
Enhancing Public Visibility of RNPD Output

• Communicating RNPD output has been challenging and is a work-in-progress:

  – The language of RNPDs is inherently technical, posing a barrier to policymakers and advisers

  – Lack of agreement on the benefits of combined probabilities and marginal utilities inherent in RNPD output

  – Work is needed regarding what to monitor and how to respond to changes in output