organization should apply a further capital charge for gamma and vega risk:

i. For gamma risk, the net gammas that are negative for each underlying are multiplied by 0.72 percent (in the case of an individual equity) or 0.32 percent (in the case of an index as the underlying) and by the square of the market value of the underlying;

ii. For volatility risk, a banking organization calculates the capital requirement for vega for each underlying, assuming a proportional shift in volatility of ±25.0 percent; and

iii. The capital requirement is the absolute value of the sum of the individual capital requirements for net negative gammas plus the absolute value of the individual capital requirements for vega risk.

d. For options of foreign exchange and gold positions, the net delta (or delta-based) equivalent of the total book of foreign currency and gold options is incorporated into the measurement of the exposure in a single currency position as set forth in section IV.C. of this appendix E. The gamma and vega risks should be measured as follows:

i. For gamma risk, for each underlying exchange rate, net gammas that are negative are multiplied by 0.32 percent and by the square of the market value of the positions;

ii. For volatility risk, a banking organization calculates the capital requirements for vega for each currency pair and gold assuming a proportional shift in volatility of ± 25.0 percent; and

iii. The capital requirement is the absolute value of the sum of the individual capital requirements for net negative gammas plus the absolute value of the sum of the individual capital requirements for vega risk.

e. For options on commodities, the delta-weighted positions are incorporated in one of the measures described in section IV.D. of this appendix E. In addition, a banking organization must apply a capital requirement for gamma and vega risk:

i. For gamma risk, net gammas that are negative for each underlying are multiplied by 1.125 percent and by the square of the market value of the commodity;

ii. For volatility risk, a banking organization calculates the capital requirements for vega for each commodity assuming a proportional shift in volatility of +/− 25.0 percent; and

iii. The capital requirement is the absolute value of the sum of the individual capital requirements for net negative gammas plus the absolute value of the sum of the individual capital requirements for vega risk.

f. Under certain conditions and to a limited extent, the Federal Reserve may permit banking organizations that are significant traders in options with debt securities or interest rates as the underlying to net positive and negative gammas and vegas across time-bands. Such netting must be based on prudent and conservative assumptions and the banking organization must materially meet the qualitative standards set forth in section III.B. of this appendix E.

g. A banking organization may base the calculation of vega risk on a volatility ladder in which the implied change in volatility varies with the maturity of the option. The assumed proportional shift in volatility must be at least +/- 25.0 percent at the short end of the maturity spectrum. The proportional shift for longer maturities must be at least as stringent instatistical terms as the 25.0 percent shift at the short end.

h. A banking organization should also monitor the risks of rho (the rate of change of the value of the option with respect to the interest rate) and theta (the rate of change of the value of the option with respect to time).

## Attachments to Appendix E

### Attachment I—Sample Calculation of Eligible Tier 1, Tier 2, and Tier 3 Capital for the Risk-Based Capital Ratio Adjusted for Market Risk

a. In each example the weighted-risk assets are $8000 and the market risk-adjusted assets are $625 (capital requirement for market risk = $50, $50 x 12.5 = $625):

**Example 1:** A banking organization has the following qualifying capital: Tier 1 = $600, Tier 2 = $100, Tier 3 = $1000.

(1) The minimum capital requirement for credit risk is $640 ($8000 x 8.0%). This requirement could be satisfied with $540 of Tier 1 capital and $100 of Tier 2 capital.

(2) The remaining capital available for market risk would be: Tier 1 = $60, Tier 2 = 0, and Tier 3 = $1000. The minimum capital requirement for market risk is $50 ($625 x 8.0%). Eligible Tier 3 capital would be limited to $125 ($50 x 2.5).

(3) The Tier 1 capital required to support market risk could be satisfied by allocating $14 ($50 x .285), with eligible Tier 3 capital used for market risk being $36 ($50 − $14).

(4) Total qualifying and eligible capital would be: $540 (Tier 1) + $100 (Tier 2) + $60 (Tier 1, comprising $14 allocated for market risk and $46 unallocated) + $36 (Tier 3) = $736. The banking organization's ratio of qualifying and eligible capital to weighted-risk assets adjusted for market risk would be: $736/$8,625) = 8.5%.

**Example 2:** A banking organization has the following qualifying capital: Tier 1 = $500, Tier 2 = $140, Tier 3 = $600.

(1) The minimum capital requirement for credit risk is $640 ($8000 x 8.0%). This requirement could be satisfied with $500 of Tier 1 capital and $140 of Tier 2 capital.

(2) The remaining capital available for market risk would be: Tier 1 = 0, Tier 2 = $0, and Tier 3 = $600. Eligible Tier 3 capital would be limited to $0 (0 x 2.5). Because there is no Tier 1 capital required to support market risk, no eligible Tier 3 capital may be used for market risk.

(3) Total qualifying and eligible capital would be: $500 (Tier 1) + $140 (Tier 2) = $640. The banking organization's ratio of qualifying and eligible capital to weighted-risk assets adjusted for market risk would be: $640/$8,625) = 7.4%.

b. In both of the examples described in paragraph a. of this attachment the total of Tier 2 and Tier 3 capital for credit and market risk is not greater than 100 percent of Tier 1 capital for credit and market risk and the total of Tier 2 capital for credit risk is not greater than 100 percent of Tier 1 capital for credit risk.

### Attachment II—Sample Calculation of General Market Risk for Debt Instruments Using the Maturity Method

a. A banking organization with the following positions would slot them into a maturity ladder as shown below:

i. Qualifying bond, $13.33mn market value, remaining maturity 8 years, coupon 8%;

ii. Government bond, $75mn market value, remaining maturity 2 months, coupon 7%;

iii. Interest rate swap, $150mn, banking organization receives floating rate interest and pays fixed, next interest reset after 12 months, remaining life of swap is 8 years (assumes the current interest rate is identical to the one the swap is based on); and

iv. Long position in interest rate future, $50mn, delivery date after 6 months, life of underlying government security is 3.5 years (assumes the current interest rate is identical to the one the swap is based on).

| Zone | Time-band and position | Risk wght (%) | Risk-weighted position | Net time-band positions | Net zone positions |
|---|---|---|---|---|---|
| 1 | 10–1 mth | 0.00 | | | |
| | 1–3 mth Long 75 Gov.bond | 0.20 | Long 0.15 | Long 0.15 | Long 1.00 |
| | 3–6 mt Short 50 Future | 0.40 | Short 0.20 | Short 0.20 | |
| | 6–12 mths Long 150 Swap | 0.70 | Long 1.05 | Long 1.05. | |
| 2 | 1–2 yrs | 1.25 | | | |
| | 2–3 yrs | 1.75 | | | |
| | 3–4 yrs Long 50 Future | 2.25 | Long 1.125 | Long 1.125 | Long 1.125 |
| 3 | 4–5 yrs | 2.75 | | | |
| | 5–7 yrs | 3.25 | | | |
| | 7–10 yrs Short 150 Swap Long 13.13 Qual Bond | 3.75 | Short 5.625<br>Long 0.50 | Short 5.125 | Short 5.125 |
| | 10–15 yrs | 4.50 | | | |