

***The New Basel Capital Accord:
The Crucial Importance of a Conceptual Framework***

Theodore M. Barnhill, Ph.D.
The George Washington University

Katherine Gleason
The George Washington University

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ABSTRACT

Bank capital requirements estimated with an integrated market and credit risk simulation are compared to those calculated under the 1988 and proposed New Basel Accords. The Basel Accord is found to require an appropriate amount of capital for higher (lower) risk banks operating in lower (higher) volatility financial environments. However, higher (lower) risk banks operating in higher (lower) volatility environments are significantly undercapitalized (overcapitalized). With correlated interest rate and credit risk, positive (negative) asset/liability maturity gaps increase (decrease) the risk of bank failure. The importance of developing a conceptual framework(s) for integrated risk assessments is demonstrated. As an interim step ad hoc improvements to the Accord are suggested.

1. Introduction

In the authors' view, the most serious limitation of the proposed New Basel Capital Accord is the lack of a conceptual framework(s) for undertaking integrated bank risk assessments. Absent a conceptual framework, each of the three pillars of the New Basel Capital Accord will have significant problems. Pillar 1 (Minimum Capital Requirements) will be based on a set of ad hoc rules that can lead to serious errors in measuring bank risk levels and estimating appropriate capital levels. Pillar 2 (Supervisory Review Process) will lack the capacity to quantify overall bank risk levels and develop effective preemptive measures for managing them. Pillar 3 (Market Discipline) will not identify all crucial data required from banks and other sources for the market to make informed risk assessments.

It is widely believed that economic and financial volatility drives both market and credit risk. This suggests that these two risks vary over time and location (e.g., country or region) and are correlated with one another. In general, risk assessment methodologies seek to assess the maximum potential change in the value of a portfolio with a given probability over a pre-set horizon resulting from changes in market factors, credit risk, and liquidity risk. The current practice is to undertake market and credit risk assessments separately. Combining such separate risk measures into one overall portfolio risk measure is not easily accomplished. The absence of reliable overall portfolio risk measures creates problems for determining capital adequacy requirements, capital-at-risk measures, hedging strategies, etc.

Financial environment simulation modeling combined with portfolio theory offers a very promising integrated risk assessment approach. Earlier work on U.S. bond portfolios (Barnhill and Maxwell, 2001) shows that simulation modeling can essentially match any assumed volatility and correlation structure for important financial environment variables (e.g., interest rates, foreign exchange rates, returns on corporate equities, returns on real estate assets, etc.). They also show that it is possible to produce reasonable credit transition probabilities, bond valuations, and fixed income portfolio risk analyses that integrate market and credit risk.

A similar portfolio simulation methodology applied to South African banks (Barnhill, Papapanagiotou, and Schumacher, 2002), and Japanese banks (Barnhill, Papapanagiotou, and Souto, 2001) shows that bank capital levels appropriate for reducing the risk of failure to a given probability over a given time step are related to: the volatility of the financial environments in which banks operate; the correlations between important financial market variables; the mean returns on important financial market variables (e.g., real estate); the distribution of credit qualities in the bank's loan portfolio; the diversification of the loan portfolio across types of loans (business loans, residential mortgage loans, commercial mortgage loans, etc.); the diversification of the business loan portfolio across sectors of the economy (e.g., agriculture, manufacturing, etc.); the diversification of the mortgage loan portfolio across geographic regions; asset and liability maturity and currency mismatches; and

the amount and diversification of equity and other direct investments across sectors of the economy and regions of the country.

The proposed Basel Capital Accord accounts for some, but not all, of these important factors. For example, the volatility of the relevant financial environments only affects required credit risk capital levels indirectly through its impact on the credit rating of the borrower. This implies that banks operating in more stable financial environments may not have their lower risk levels fully recognized. Furthermore, the correlation between market risk (e.g., interest rates, exchange rates, and equity prices) and credit risk is not accounted for. Capital charges for these two risk factors are not simply additive. This means that if capital charges are set appropriately for credit and market risk separately and then added together, overall bank capital requirements will likely be too high.

This comment compares minimum capital requirements estimated with an integrated market and credit risk simulation to those calculated under the 1988 and proposed New Basel Capital Accords for a set of fifty-four hypothetical banks (see Table 1). The results illustrate the crucial importance of developing conceptual frameworks for undertaking integrated bank risk assessments. Given that agreement on a conceptual framework is not anticipated prior to adoption of the New Accord, some of the above problems are unavoidable. However, too the extent practical, the New Accord should anticipate plausible conceptual frameworks for undertaking integrated bank risk assessments and incorporate their most important insights. We believe that the New Accord should be viewed as an interim improvement over existing rules. A continued active effort on the part of the Basel Committee and others to resolve underlying conceptual and data issues is required. Waiting a number of years before taking the issue up again would seem inappropriate.

The remainder of this paper is organized as follows. First a brief introduction to the conceptual framework of the proposed simulation model is given. Next the portfolio simulation and Basel accords are applied to a set of hypothetical banks to estimate required capital levels under different assumptions about bank credit risk, portfolio concentration, and the volatility of the financial environment in which the bank operates. Comparisons of the two approaches are then undertaken. Finally, recommendations are offered.

2. A Conceptual Framework for Integrated Bank Risk Assessment

2.1. The portfolio simulation approach

Given the correlated nature of credit and market risk (Fridson, Garman, and Wu, 1997), the importance of an integrated risk assessment methodology seems apparent. To address the above risk measurement problem, Barnhill and Maxwell (2000) develop a diffusion-based methodology for assessing the value-at-risk (VaR) of a portfolio of fixed income securities with correlated interest rate, interest rate spread, exchange rate, and credit risk. Barnhill, Papapanagiotou, and Schumacher (2000) extend the model to undertake financial institution asset and liability risk assessments for South African banks. Barnhill, Papapanagiotou, and Souto (2001) apply the model to Japanese banks.

As an overview, both the future financial environment in which the assets will be valued and the credit rating of specific loans are simulated. The financial environment can be represented by any number of correlated random variables. The correlated evolution of the market value of a business firm's equity, its debt ratio, and credit rating are then simulated in the context of the simulated financial environment. For non-recourse real estate loans a similar approach is used where the market value of the real estate property, its loan to value ratio, and credit rating are simulated. The structure of the methodology is to select a time step over which the stochastic variables are allowed to fluctuate in a correlated random process. The firm-specific and property-specific returns (as distinct from economic sector index and real estate index returns) and security specific default recovery rates are assumed to be uncorrelated with each other and the other stochastic variables. For

each simulation run, a new financial environment (correlated interest rate term structures, foreign exchange rate, market equity returns, and regional real estate index returns) as well as firm specific and property specific debt ratios, credit ratings, and default recovery rates are created. This information allows the correlated values of financial assets (including direct equity and real estate investments) to be estimated, and after a large number of simulations, a distribution of portfolio values is generated and analyzed.

2.2 Simulating interest rates

The Hull and White extended Vasicek model (Hull and White; 1990a, 1993, 1994) is used to model stochastic risk-free interest rates. Interest rates are assumed to follow a mean-reversion process with a time dependent reversion level. The simulation model is robust to the use of other interest rate models. The model for r is

$$\Delta r = a \left(\frac{\theta(t)}{a} - r \right) \Delta t + \sigma \Delta z \quad (1)$$

where Δr = the risk-neutral process by which r changes, a = the rate at which r reverts to its long term mean, r = the instantaneous continuously compounded short-term interest rate, $\theta(t)$ = “theta” is an unknown function of time that is chosen so that the model is consistent with the initial term structure and is calculated from the initial term structure, Δt = a small increment to time, σ = “sigma” the instantaneous standard deviation of r , which is assumed to be constant, and Δz = a Wiener process driving term structure movements with Δr being related to Δt by the function $\Delta z = \varepsilon \sqrt{\Delta t}$. The mean reversion and volatility rates can be estimated from a time series of short-term interest rates or implied from cap and floor prices. Credit spreads can either be modeled as correlated log normal variables or as fixed values.

2.3 Simulating asset prices and returns

The model used to simulate the value (S) of the equity and real estate market indices and foreign exchange rate assumes that S follows a geometric Brownian motion where the expected growth rate (m) and volatility (σ) are constant (Hull, 1997, p. 362). The expected growth rate is equal to the expected return on the asset (μ) minus its dividend yield (q). For a discrete time step Δt , it can be shown that

$$S + \Delta S = S \exp \left[\left(m - \frac{\sigma^2}{2} \right) \Delta t + \sigma \varepsilon \sqrt{\Delta t} \right] \quad (2)$$

where ε = a random sample from a standardized normal distribution.

The return on the market index (K_m) is estimated as

$$K_m = ((S + \Delta S)/S) + q \quad (3)$$

The return on equity for individual firms and individual real estate properties is simulated using a one-factor model

$$K_i = R_f + Beta_i (K_m - R_f) + \sigma_i \Delta z \quad (4)$$

where K_i = the return for the asset, R_f = the risk-free interest rate, $Beta_i$ = the systematic risk of asset, K_m = the simulated return on the equity or real estate index from equation 3, σ_i = the asset specific return volatility, and Δz = a Wiener process with Δz being related to Δt by the function $\Delta z = \varepsilon \sqrt{\Delta t}$.

The parameters needed to implement the model are estimated from historical data.

2.4 Simulating an n -variate normal distribution

Many authors have reported positive correlations between default rates and financial environment variables such as interest rates (see Fridson et. al., 1997), and negative correlations with variables such as GNP growth rates. This is consistent with negative correlations between interest rate changes and equity returns.

In the proposed portfolio risk assessment model, the equity indices and foreign exchange rate returns are simulated as stochastic variables correlated with the simulated future risk-free interest rate and interest rate spreads. Hull (1997) describes a procedure (i.e. Cholesky decomposition) for working with an n -variate normal distribution. This procedure requires the specification of correlations between each of the n stochastic variables. Subsequently n independent random samples x are drawn from standardized normal distributions. With this information, the set of correlated random error terms for the n stochastic variables can be calculated. For example, for a bivariate normal distribution,

$$\begin{aligned}\varepsilon_1 &= x_1 \quad (5) \\ \varepsilon_2 &= \rho x_1 + x_2 \sqrt{1 - \rho^2} \quad (6)\end{aligned}$$

where x_1, x_2 = independent random samples from standardized normal distributions, ρ = the correlation between the two stochastic variables, and $\varepsilon_1, \varepsilon_2$ = the required samples from a standardized bivariate normal distribution. It can be shown that the simulated volatilities and correlations for all of the stochastic variables closely match values estimated from historical time series data.

2.5 Mapping debt ratios into credit ratings

The simulated equity and real estate returns are then used to estimate a distribution of possible future equity and real estate market values and debt ratios. The simulated debt ratios are then mapped into credit ratings. This methodology assumes a deterministic relationship between a firm's or property's debt ratio and its credit rating¹. In a contingent claims framework, this is equivalent to assuming a constant volatility for the value of the firm.

After simulating the bond's or loan's future credit rating, its value is calculated using the simulated term structure of interest rates appropriate for that risk class. If the bond or loan is simulated to default, the recovery rate on the bond is simulated as a beta distribution² with a specified mean value and standard deviation.

3. Estimating Bank Capital Requirements

3.1 Application of the simulation model

The fifty-four hypothetical banks analyzed reflect all possible combinations of four factors, including: higher and lower volatility financial environments; 0, +1 and -1 year asset/liability maturity gaps; high, medium, and low loan portfolio credit risk profiles; and high, medium, and low loan portfolio concentrations. Not presented in this comment are capital requirement estimates for banks operating in economies with depressed economic conditions (e.g., negative inflation rates, deflating asset prices, etc.). For more on this scenario, see Barnhill, Papapanagiotou, and Souto (2001).

3.1.1 Financial environment volatility

The higher financial environment volatility case is modeled, in part, on conditions found in South Africa during the stressful 1998-1999 period (see Barnhill, Papapanagiotou, and Schumacher, 2000). In this case, the assumed annualized volatility of returns on sector equity indices is forty-six percent, while the assumed

¹ Blume, Lim, and MacKinlay (1998) suggest that leverage ratios and credit ratings are not constant over time. However, their results are over a longer time frame than simulated in this framework.

² Utilizing a beta distribution allows the recovery rate to fall within a 0-100 percent range, while maintaining the same mean and standard deviation.

volatility of changes in short-term, risk-free interest rates is 4.7 percent. The assumed volatility of returns on individual real estate assets is twenty-five percent.

The lower financial environment volatility case is modeled, in part, on conditions found in the United States during 1998 (see Barnhill and Maxwell, 2000). In this case, the assumed annualized volatility of returns on sector equity indices is twenty-three percent, while the assumed volatility of changes in short-term, risk-free interest rates is 0.74 percent. The assumed volatility of returns on individual real estate assets is fifteen percent.

The correlations among financial environment variables are also important. For the higher (lower) volatility financial environment, the assumed average correlation between interest rate changes and returns on equity indices is -0.538 (-0.3), while between interest rate changes and returns on real estate it is -0.125 (0). The assumed average correlation between the various equity indices is 0.524 (0.4), and between the various real estate indices is 0.305 (0.4). The assumed average correlation between the equity and real estate indices is 0.206 (0).

3.1.2 Market risk

The various asset/liability maturity gaps are the assumed maturity of the banks' interest bearing assets (1 or 2 years) less the maturity of their liabilities (1 or 2 years). Interest rates on the various credit quality loans are adjusted so as to allow banks to earn, on average, a risk premium adequate to cover the default losses on loans.

3.1.3 Credit risk

The various credit risk cases reflect the assumed distribution of business loans by credit rating, and mortgage loans by loan to value ratio, as shown in Tables 2 and 3, respectively. For individual business loans, credit risk is driven by the assumed volatility of the returns on the sector equity indices, and the firm's assumed target debt to value ratio, beta, and firm specific equity return volatility. Table 4 gives the assumed target debt to value ratios for firms with various credit qualities. These values are assumed to be the same for both the higher and lower financial environment volatility cases. Table 5 gives the assumed betas and firm specific equity return risk levels for firms with various credit qualities. These values are based on U.S. data (see Barnhill and Maxwell, 2000) and are assumed to be the same for both the higher and lower financial environment volatility cases.

3.1.4 Portfolio concentration

Bank portfolios are modeled as having approximately two hundred business loans and two hundred mortgage loans (i.e., non-recourse loans secured by real estate). Table 6 gives the number of assumed economic sectors and geographic regions over which these business loans and mortgage loans are assumed to be spread. For example, business and mortgage portfolios with low (high) concentration are assumed to be spread across twenty (1) economic sectors and twenty (1) geographic regions.

3.2 Calculating comparable Basel Accord capital ratios

To compare the portfolio simulation approach to determining bank capital requirements with the Basel Accord approach, capital requirements are estimated for the hypothetical banks based on the 1988 Basel Accord and New Basel Accord standards and compared to the simulated capital required to protect the bank against a 1 percent probability of failure (i.e., negative capital) over a one-year time step as determined using the portfolio simulation approach. As discussed above, these ratios are computed and compared under various assumptions about the volatility of the financial environment in which the bank operates, the credit risk profile and concentration of the bank's loan portfolio, and the maturity gap between the bank's interest-bearing assets and liabilities.

The Basel Accord ratios are computed under the assumptions shown in the Appendix. The first set of assumptions defines the simulated bank's characteristics, and the second set of assumptions defines the different scenarios for the financial environment in which the bank operates. Required capital ratios are computed for all fifty-four banks under both the 1988 and New Accord ratios. Market risk is measured according to the guidelines of the 1996 Market Risk Amendment to the 1988 Accord.

The Basel Accord ratios are adjusted to account for the fact that the Basel Accord and portfolio simulation approaches use a different basis for the measurement of capital required. The portfolio simulation approach measures capital required as a percentage of the market value of total assets, while the Basel Accords measure book value of equity capital required as a percentage of risk-adjusted assets. To provide a common basis for comparison, bank capital requirements are computed based on Basel Accord standards. Then market value-based 1988 Accord and New Accord capital ratios are computed as follows

$$\text{Capital ratio} = 0.08 \times (\text{credit risk-weighted assets} + 12.5 \times \text{market risk}) / (\text{MVTA})^{(7)}$$

where the numerator on the right hand side of the equation is the denominator of the Basel Accord capital ratio multiplied by the 8 percent required ratio, and the denominator is the market value of total assets (MVTA).

4. Analytical Results

The bank capital ratio requirements computed using the portfolio simulation approach, the 1988 Accord standards, and the New Accord Simplified Approach standards are presented in Tables 7-9. Data columns 2 and 3 of Tables 7-9 show that under all scenarios, the market value-adjusted capital ratios as measured using the Basel Accord standards are in the 4-6 percent range.

The portfolio simulation approach uses 10 percent of the market value of total assets as a starting capital ratio and computes the initial capital required to maintain a positive ratio at a ninety-nine percent probability over a 1 year time step. The rows in Tables 7-9 correspond to different scenarios for the volatility of the financial environment, the degree of credit risk in the bank's portfolio, and the degree of concentration in the bank's portfolio. Each table corresponds to a different assumption about the maturity gap between the bank's interest-bearing assets and liabilities. Data columns 1, 2, and 3 of Tables 7-9 show that approximately equal numbers of banks had similar, higher, and lower simulated versus Basel capital requirements.

Banks operating in either a lower volatility financial environment with medium to higher credit and portfolio concentration risk, or in a higher volatility environment with medium to lower credit and portfolio concentration risk, are found to have simulated capital requirements similar to the Basel capital requirements. Banks operating in a lower volatility financial environment with lower credit risk, or medium credit risk and lower portfolio concentration risk, are found to have simulated capital requirements substantially lower than the Basel capital requirements (in some cases, as low as twenty-five percent of the Basel requirements). Similarly, banks operating in a higher volatility financial environment with lower credit risk and lower portfolio concentration are found to have simulated capital requirements lower than the Basel capital requirements.

Banks operating in a higher volatility financial environment with medium to higher credit risk and medium to higher portfolio concentration are found to have simulated capital requirements significantly higher than the Basel capital requirements (in some cases, almost four hundred percent of the Basel requirements). The discrepancy is most pronounced for the +1 maturity gap scenario where the simulated capital requirement for banks operating in a high volatility environment with high credit risk and a highly concentrated portfolio reaches twenty-three percent of total assets. This occurs, in part, because of the negative correlation between

interest rate and credit risk. This very large capital requirement occurs because on those periodic occasions where interest rates spike to very high levels, banks are simultaneously suffering large credit losses and large losses on their asset/liability maturity mismatch.

Overall, the Basel Accord is found to require an appropriate amount of capital for higher risk banks operating in a lower volatility environment, and lower risk banks operating in a higher volatility environment. However, for lower risk banks in a lower volatility financial environment, Basel capital requirements appear to be 3 to 4 times that required to protect against failure at a ninety-nine percent confidence level. Further, for higher risk banks in a higher volatility financial environment, Basel capital requirements appear to be much too low.

5. New Basel Capital Accord Recommendations

It is proposed that the Basel Committee explicitly endorse the need for and adopt rules that encourage the development of improved conceptual frameworks and data bases for undertaking integrated bank portfolio risk assessments which handle correlated market risk, credit risk, and ultimately, operational risk. Additionally, financial reporting requirements should be adopted for banks that provide to the public the basic information needed to estimate overall portfolio risk levels. This would include information on credit quality distributions, sector and region loan concentrations, etc. Furthermore, the Basel Committee should encourage banks, bank regulatory authorities, multi-lateral financial institutions, and others to develop financial databases that will facilitate modeling the global financial environment in which all institutions operate. This database should extend to real estate assets since much lending is secured by mortgages.

5.1 Recommendations on minimum capital requirements

Prior to the development of a conceptual risk analysis framework, the Committee should identify a base level of assumed financial market volatility that underlies the New Basel Capital Accord Minimum Capital Requirements (Pillar 1) and adopt ad hoc adjustments to the proposed capital requirements that increase (decrease) required capital levels for banks operating in more (less) volatile financial environments. Ad hoc adjustments to the proposed capital requirements can be adopted to further increase required capital levels for banks having multiple risk characteristics including high concentrations of high credit risk loans, high concentrations of loans in particular sectors or regions, and high financial market volatilities.

The results of the simulations suggest that required bank capital ratios should be doubled, or even tripled, for banks with medium or high loan portfolio credit risk profiles and concentrations operating in high volatility financial environments. Conversely, when credit risk is low or when both volatility and concentration levels are low, required capital ratios could be adjusted downwards by at least 20 percent.

5.2 Recommendations on supervisory review process

In the authors' view, the supervisory review process (Pillar 2) should be a pro-active one where potential risks are identified and preemptive actions taken before the risks materialize. As can be seen from the above discussion and analysis, we believe that integrated market and credit risk models offer both the opportunity to identify risks and test alternatives for dealing with them. The potential preemptive actions which governments may take revolve around monetary and economic policies which foster stable long-term economic growth. The potential preemptive actions which banks and/or bank regulators may take include changing the lending standards and credit quality of the portfolio, changing the level of direct equity and real estate investment, changing the sector and region concentration levels of the loan portfolio, changing the asset/liability maturity structure and currency structure, and changing capital levels.

5.3 Recommendations on market discipline

Market Discipline (Pillar 3) is generally well conceived and has the potential to be of significant value. However, the proposed data to be provided in the New Basel capital accord is inadequate to undertake integrated bank risk assessments and systemic risk analyses. In Table 10 we identify a set of data which would be adequate to undertake such an analysis along the lines developed by Barnhill, et al (2000, 2001). A split in reporting requirements between banks and other parties (e.g., bank regulatory authorities, multi-lateral financial organizations, data vendors, etc.) is suggested. In general, banks would be responsible for reporting required data on their portfolios, while others would be responsible for the data required to model the financial environment. In cases where all of the data is not available, expert opinions (e.g., central bank officials, commercial bank officials, etc.) may be used. In some cases, it may be necessary to use data from comparable countries.

5.4 Final comment

This research demonstrates the strengths and limitations of the New Basel Accord bank regulatory capital requirements. The simulations show that the New Basel Accord is an improvement over the 1988 Accord in accounting for differences in bank loan portfolio credit quality and concentration and market risk. However, the simulations also show that the New Basel Accord requires too much regulatory capital of safer banks operating in lower volatility economic environments, and requires too little regulatory capital of higher risk banks operating in higher volatility environments. This results in a competitive disadvantage for safer banks and creates an incentive problem requiring greater levels of government intervention during times of financial market instability than would otherwise be required. These problems are more pronounced than is implied by this research, which conservatively estimates real estate asset pricing volatility. Ad hoc improvements in the New Basel Accord, and more importantly, development of conceptual frameworks for integrating market and credit risk assessments are necessary to level the playing field for banks and promote international banking system stability.

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Appendix: Assumptions Underlying Basel Accord Capital Ratio Computations

1. Bank characteristics:

Tier 1 equity is defined as common stock and disclosed reserves, while Tier 2 equity consists entirely of subordinated debt. Credit risk-weighted assets consist of corporate, inter-bank, foreign, and residential mortgage loans. Three credit risk rating scenarios are used for the corporate loans (see Table A.1). Interbank and foreign loans are assumed to be AAA-rated.

The trading book consists of long and short positions in domestic risk-free and foreign loans as well as equity investments. These 3 types of financial instruments are held in the same proportion in the trading book as in the bank as a whole. Domestic risk-free loans are treated as government securities, foreign loans are treated as AAA-rated, and equity investments are treated as diversified.

The market risk of each simulated bank results from interest rate risk and equity risk in the bank's trading book as well as foreign exchange risk associated with the bank's total operations. The \$21,593,486 trading book (representing 3.07 percent of the bank's total assets) consists of a gross long position that is 57.19 percent composed of risk-free domestic loans, 25.94 percent composed of foreign loans, and 16.87 percent composed of equity investments. The trading book is assumed to be funded 84.12 percent by domestic deposits, 6.37 percent by foreign deposits, and 9.52 percent by equity.

Specific interest rate risk premiums are computed based on classifying the gross long and short positions in risk-free domestic assets and liabilities as "government", and by classifying the gross long and short positions in foreign assets and liabilities as "other." The general market risk premium is determined under three different interest rate scenarios. In the 0 maturity gap scenario, all trading book assets and liabilities are assumed to have a 1 year maturity. Under this scenario, the trading book asset and liabilities are all placed within the Zone 1 6-12 month vertical band. Two net positions are computed within this vertical band, one is the difference between the trading book risk-free domestic assets (gross long position) and liabilities (gross short position), and the other is the difference between the trading book foreign assets and liabilities. The vertical disallowance is the smaller of the net domestic and foreign positions. There are no horizontal disallowances under this scenario. Under the +1 year gap interest rate scenario, trading book assets are placed in the Zone 2 1-2 year vertical band, while trading book liabilities and equity are placed in the Zone 1 6-12 month vertical band. Under this scenario, there are both vertical disallowances within each band plus a horizontal disallowance between Zones 1 and 2. Similarly, under the -1 year gap interest rate scenario, trading book assets are placed in the Zone 1 6-12 month vertical band and trading book liabilities are placed within the Zone 2 1-2 year vertical band, and both vertical and horizontal disallowances are determined.

The equity specific and general market risk premiums are calculated as 4 percent and 8 percent, respectively, of the net position in the trading book equity investments over equity funding. Foreign exchange risk results from the bank's \$95,903 long position in gold (representing 0.01 percent of total assets) as well as the bank's net position in one foreign currency (the difference between total foreign assets and liabilities). The maturity method is used to measure general interest rate risk. Foreign exchange risk is defined as the risk due to a full long position in gold as well as the risk due to the net position in one foreign currency-based financial instrument. Commodity and operational risks are assumed to be zero.

2. Financial Environment

Three simple interest rate risk environments are considered. Under the 0 gap scenario, both assets and liabilities have a twelve month maturity. Under the +1 gap, assets have a 2 year maturity and liabilities have a twelve month maturity. Under the -1 gap, assets have a twelve month maturity and liabilities have a 2 year maturity. The assumed economic volatility, meanwhile, does not impact computation of the Basel capital requirements.

Table 1
Summary Results for Fifty-four Simulation Scenarios^a

Zero Maturity Gap (18 scenarios)

Portfolio Concentration/ Financial Market Volatility	Credit Risk Profile		
	Low Credit Risk	Medium Credit Risk	High Credit Risk
Low/Low	4.42% > 0.87%	5.44% > 1.93%	5.94% > 1.95%
Low/High	4.42% > 2.06%	5.44% > 5.34%	5.94% < 7.63%
Medium/Low	4.42% > 1.14%	5.44% > 3.86%	5.94% > 5.50%
Medium/High	4.42% > 3.06%	5.44% < 10.72%	5.94% < 12.32%
High/Low	4.42% > 1.29%	5.44% > 5.29%	5.94% < 7.57%
High/High	4.42% > 4.00%	5.44% < 14.30%	5.94% < 19.08%

Plus One Year Maturity Gap (18 scenarios)

Portfolio Concentration/ Financial Market Volatility	Credit Risk Profile		
	Low Credit Risk	Medium Credit Risk	High Credit Risk
Low/Low	4.44% > 2.05%	5.45% > 2.49%	5.96% > 2.79%
Low/High	4.44% < 11.23%	5.45% < 11.72%	5.96% < 13.22%
Medium/Low	4.44% > 2.31%	5.45% > 5.17%	5.96% < 6.48%
Medium/High	4.44% < 12.59%	5.45% < 13.51%	5.96% < 19.94%
High/Low	4.44% > 2.86%	5.45% < 7.19%	5.96% < 9.37%
High/High	4.44% < 12.85%	5.45% < 19.14%	5.96% < 22.61%

Minus One Year Maturity Gap (18 scenarios)

Portfolio Concentration/ Financial Market Volatility	Credit Risk Profile		
	Low Credit Risk	Medium Credit Risk	High Credit Risk
Low/Low	4.44% > 1.10%	5.46% > 1.44%	5.96% > 1.62
Low/High	4.44% > 2.85%	5.46% > 5.34%	5.96% > 5.03%
Medium/Low	4.44% > 1.21%	5.46% > 3.68%	5.96% > 4.97%
Medium/High	4.44% > 2.66%	5.46% < 10.72%	5.96% < 10.06%
High/Low	4.44% > 1.53%	5.46% > 4.83%	5.96% < 7.08%
High/High	4.44% > 3.25%	5.46% < 11.07%	5.96% < 15.21%

^a The first (second) entry in each row corresponds to the capital ratio required using the New Basel Accord simplified (portfolio theory-based) approach. The symbols < and > indicate New Basel Accord underestimates and overestimates, respectively, of the capital required to maintain solvency at a 99% confidence over a one-year time step.

Table 2
Assumed Distribution of Business Loans by Credit Rating

<u>Credit Rating</u>	AAA	AA	A	BBB	BB	B	CCC	D
Credit Risk Level								
High	0	0	0.1233	0.1233	0.1233	0.39	0.19	0.05
Medium	0	0	0.194	0.194	0.194	0.194	0.194	0.03
Low	0	0	0.33	0.33	0.33	0	0	0.01

Table 3
Assumed Distribution of Mortgage Loans by Loan to Value Ratio

<u>Loan to Value Ratio</u>	0.4	0.5	0.6	0.7	0.8	0.9	1.07	1.2
Credit Risk Level								
High	0	0	0.1233	0.1233	0.1233	0.39	0.19	0.05
Medium	0	0	0.194	0.194	0.194	0.194	0.194	0.03
Low	0	0	0.33	0.33	0.33	0	0	0.01

Table 4
Assumed Target Debt to Value Ratio for Business Loans by Credit Rating

<u>Credit Rating</u>	AAA	AA	A	BBB	BB	B	CCC	D
Target Debt to Value Ratio	0.101	0.1405	0.2355	0.3145	0.432	0.513	0.595	0.95

Table 5
Assumed Betas and Firm Specific Equity Return Risk Level by Credit Rating

<u>Credit Rating</u>	AAA	AA	A	BBB	BB	B	CCC	D
Risk Measure								
Beta	0.670	0.774	0.916	1.0250	1.191	1.311	1.393	n.a.
Std. Deviation	0.317	0.363	0.412	0.507	0.729	0.727	0.954	n.a.

Table 6
Assumed Number of Sectors for Business Loans and Regions for Mortgage Loans

	Number of Sectors	Regions
Portfolio Concentration Level		
High	1	1
Medium	5	1
Low	20	20

Table 7
A Comparison of Capital Ratio Requirements: Zero Maturity Gap

Capital Ratio Required					
Portfolio Theory Based-Approach ^a	1988 Accord ^b	New Basel, Simplified ^b	(%)	(%)	(%)
Financial Market Volatility	Credit Risk Profile	Portfolio Concentration			
High	High	High	19.08	4.15	5.94
		Medium	12.32	4.15	5.94
		Low	7.63	4.15	5.94
Low	High	High	7.57	4.15	5.94
		Medium	5.50	4.15	5.94
		Low	1.95	4.15	5.94
High	Medium High	High	14.30	4.16	5.44
		Medium	10.72	4.16	5.44
		Low	5.34	4.16	5.44
Low	Medium High	High	5.29	4.16	5.44
		Medium	3.86	4.16	5.44
		Low	1.93	4.16	5.44
High	Low	High	4.00	4.16	4.42
		Medium	3.06	4.16	4.42
		Low	2.06	4.16	4.42
Low	Low	High	1.29	4.16	4.42
		Medium	1.14	4.16	4.42
		Low	0.87	4.16	4.42

^a This approach computes the capital ratio required to prevent bank failure with a ninety-nine percent probability over a 1 year time step.

^b This approach computes the capital ratio as 8 percent of the sum of the credit risk-weighted assets plus 12.5 times the calculated market risk. These values are market-adjusted to provide a common base for comparison by dividing the capital ratio by the market value of total assets.

Table 8
A Comparison of Capital Ratio Requirements: Minus One Year Maturity Gap

Capital Ratio Required					
Portfolio Theory Based-Approach ^a	1988 Accord ^b	New Basel, Simplified ^b	(%)	(%)	(%)
Financial Market Volatility	Credit Risk Profile	Portfolio Concentration			
High	High	High	15.21	4.17	5.96
		Medium	10.06	4.17	5.96
		Low	5.03	4.17	5.96
Low	High	High	7.08	4.17	5.96
		Medium	4.97	4.17	5.96
		Low	1.62	4.17	5.96
High	Medium High	High	11.07	4.17	5.46
		Medium	10.72	4.17	5.46
		Low	5.34	4.17	5.46
Low	Medium High	High	4.83	4.17	5.46
		Medium	3.68	4.17	5.46
		Low	1.44	4.17	5.46
High	Low	High	3.25	4.17	4.44
		Medium	2.66	4.17	4.44
		Low	2.85	4.17	4.44
Low	Low	High	1.53	4.17	4.44
		Medium	1.21	4.17	4.44
		Low	1.10	4.17	4.44

^a This approach computes the capital ratio required to prevent bank failure with a ninety-nine percent probability over a 1 year time step.

^b This approach computes the capital ratio as 8 percent of the sum of the credit risk-weighted assets plus 12.5 times the calculated market risk. These values are market-adjusted to provide a common base for comparison by dividing the capital ratio by the market value of total assets.

Table 9
A Comparison of Capital Ratio Requirements: Plus One Year Maturity Gap

Capital Ratio Required					
Portfolio Theory Based-Approach ^a	1988 Accord ^b	New Basel, Simplified ^b	(%)	(%)	(%)
Financial Market Volatility	Credit Risk Profile	Portfolio Concentration			
High	High	High	22.61	4.17	5.96
		Medium	19.94	4.17	5.96
		Low	13.22	4.17	5.96
Low	High	High	9.37	4.17	5.96
		Medium	6.48	4.17	5.96
		Low	2.79	4.17	5.96
High	Medium High	High	19.14	4.17	5.45
		Medium	13.51	4.17	5.45
		Low	11.72	4.17	5.45
Low	Medium High	High	7.19	4.17	5.45
		Medium	5.17	4.17	5.45
		Low	2.49	4.17	5.45
High	Low	High	12.85	4.17	4.44
		Medium	12.59	4.17	4.44
		Low	11.23	4.17	4.44
Low	Low	High	2.86	4.17	4.44
		Medium	2.31	4.17	4.44
		Low	2.05	4.17	4.44

^a This approach computes the capital ratio required to prevent bank failure with a ninety-nine percent probability over a 1 year time step.

^b This approach computes the capital ratio as 8 percent of the sum of the credit risk-weighted assets plus 12.5 times the calculated market risk. These values are market-adjusted to provide a common base for comparison by dividing the capital ratio by the market value of total assets.

Table 10
Data to be Provided by the Following Organizations

Multi-lateral Financial Organizations and Data Vendors
<u>Monthly Time Series Data^a</u>
Foreign exchange rates
Consumer price index
Major commodity prices
Capitalization-weighted overall stock price indices for all equity markets
Short-term, risk-free interest rates
<u>Current Estimates as of the Date the Risk Analysis is Undertaken</u>
Term structure of risk-free interest rates (each currency)
Interest rate option prices (each currency)
Bank Regulatory Officials, Security Market Exchanges, and Data Vendors
<u>Monthly Time Series Data^a</u>
Capitalization-weighted stock price indices for major economic sectors ^b
Return on equity ^c
Real estate price indices (various regions) ^d
Short-term interest rates (or spreads) on various credit quality loans
<u>Current Estimates as of the Date the Risk Analysis is Undertaken</u>
Total asset growth rates and dividend yields for firms operating in various sectors
Mean and standard deviation of recovery rates on defaulted business loans ^e
Mean and standard deviation of recovery rates on defaulted mortgage loans ^f
Dividend yields on corporate bonds (various ratings)
Term structure of risk-free interest rates (each currency)
Loan-to-value ratio for defaulting mortgage loans
Banks
<u>Business Loan and Loan Guarantee Portfolio Information (Each Currency)</u>
Total amount
Credit quality distribution (% each rating)
Sector distribution, or credit quality distribution by sector
Maturity distribution
<u>Mortgage Loan Portfolio Information (Each Currency)</u>
Total amount
Credit quality distribution (% each loan-to-value ratio range)
Regional distribution, or credit quality distribution by region
Maturity distribution
<u>Other Portfolio Asset and Liability Data</u>
Domestic and foreign (each currency) public funding amounts, maturity distributions, and interest rate spreads (relative to benchmark term structures)
Amount of non-interest bearing liabilities, equity, and reserves
Debt capital amounts, maturity distributions, and interest rate spreads
Amount of legal tender, non-interest bearing deposits, gold coins and bullion
Amount, maturity distribution, spreads of foreign and domestic risk-free loans
Equity/real estate investment (each country) amounts and sectors/regions
Time series data on fee and other income, operating expenses, and total assets
Income tax rate

^a Over as many years as possible, including periods of unusual financial stresses and loan defaults.

^b These need to be chosen carefully in each country because returns on these sectors are used to model credit risk for bank business borrowers. If stock index returns are not available, estimates of return on equity in various sectors of the economy may be used.

^c Estimated credit ratings on senior subordinated securities (i.e. AAA,..., default), and debt-to-value ratios (i.e., total liabilities / (total liabilities + market value of equity)) for a large group of companies operating in the various economic sectors of each country. If public credit ratings are not available, private credit ratings on publicly-traded companies may be used. If there are few publicly-traded companies, then bank credit ratings on private companies together with sample balance sheets and income statements may be used.

^d These need to be chosen carefully (e.g. commercial versus residential) because returns on these indices will be used to model the credit risk for bank mortgage borrowers in various regions of each country. If available, use rate of return estimates for a large group of specific real estate assets in the various regions.

^e Reflecting typical loan seniority and security characteristics, and broken down by sectors if available.

^f Broken down by regions if available.

Table A.1
Credit Risk Profiles

<u>Rating Profile</u>							
	AAA to AAA- (%)	AA+ to AA- (%)	A+ to A- (%)	BBB+ to BBB- (%)	BB+ to BB- (%)	B+ to B- (%)	Below B- (%)
Risk							
Low	0	0	33.33	33.33	33.33	0	0
Medium	0	0	19.40	19.40	19.40	19.40	22.40
High	0	0	12.33	12.33	12.33	39.00	24.00