Box 14

DECOMPOSITION OF THE RISKS FACED BY THE BANKING AND THE INSURANCE SECTORS USING A FACTOR MODEL

From a financial stability perspective, it is useful to decompose the risks faced by the financial sector into systematic, sector-specific and idiosyncratic components. The aim of this Box is to apply a latent factor model framework to achieve such a decomposition for both the banking and insurance sectors.

Principal component analysis is a dimension reduction technique that makes it possible to approximate large multivariate datasets with a limited number of factors which account for the largest share of the changes in the original data. The variance of the data can be explained by a model of unobserved factors that are common to all or most of the variables, and an idiosyncratic component which corresponds to variable-specific factors. In this way, each variable can be represented as a linear combination of common factors plus idiosyncratic ones.[1]

A factor model may be used to decompose the variance in equity price returns. The proportion of variance that can be explained by the common factor(s) may be associated with the systematic risk which is common to all equities, e.g. the risk of an unfavourable turn in the business cycle. Idiosyncratic variance is a measure of risks that are specific to individual companies.

Applying factor analysis to equity price returns lacks a strong theoretical background. This is particularly the case when it comes to choosing the number of factors and interpreting the risk premiums that are associated with each factor. For example, from the perspective of factor analysis, the popular capital asset pricing model (CAPM) suggests using just one common factor to represent the market risk premium. Both statistical tests and other more advanced theoretical models typically favour a framework of more than one factor, although in many empirical applications the optimal number of factors and their interpretation has not yet been determined.

An approach that is often adopted to analyse equity returns is to include one common factor and a few local market-specific factors associated with the geographical location of each company in the analysis.[2] However, since most large financial firms operate in a global marketplace, local conditions may not be as important as sector-specific factors.

The factor model can also be adapted to take into account sector-specific risks when equity returns of companies from different sectors are included in the dataset of observed variables.

Let r_{it} be the return of i-th equity, which may be represented in the factor model framework as:

$$r_{it} = \mu_i + \lambda_i C_t + \kappa_{\mathrm{ki}} \mathrm{S}_{\mathrm{kt}} + \Phi_i f_{it}, \quad i = 1,\ldots, n, \ \ k = 1,\ldots, m,$$

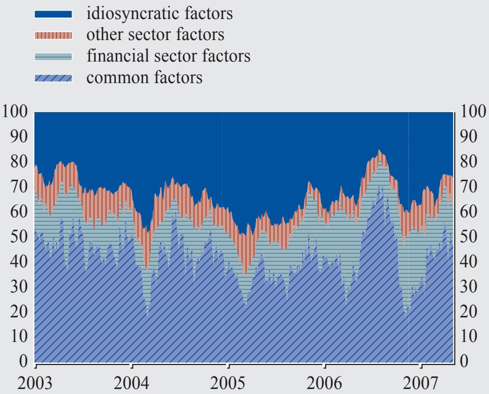
where λ_i is a vector of loadings on the common factor C_t, κ_{ki} is a $n \times m$ matrix of vectors of loadings on the vector of m sectoral factors S_{kt}, each representing risks specific to k-th sector. Finally, Φ_i is a vector of loadings on the vector of n idiosyncratic factors.

To observe changes in systematic, sector-specific and idiosyncratic risk over time, the framework described above was used to calculate loadings for different periods thus allowing changes in the share of variance to be decomposed into particular factors. The exercise was repeated 1,317 times in a moving window frame of 60 trading days from 14 December 2001 to 7 May 2007 for the factor models of equity returns of 50 companies included in the Dow Jones EURO STOXX 50 index. Taking into account the allocation of these companies to

1 Formally, in the factor model framework a vector of observed variables x_i is given by: $x_i = \mu + \Lambda c_i + f_i$, where μ is a constant vector of means, c_i is a vector of independent latent common factors and f_i is a vector of independent latent idiosyncratic factors. Λ is a matrix of coefficients of the k-th factor for the i-th variable. In the factor terminology, this is called the loading matrix.
2 See C. Hawkesby, I. W. Marsh and I. Stevens (2007), "Comovements in the Equity Prices of Large Complex Financial Institutions", *Journal of Financial Stability,* Vol. 2, No 4, 391-411.

Chart B14.1 Contributions of each of the factors to the variance of equity returns of the largest euro area banks

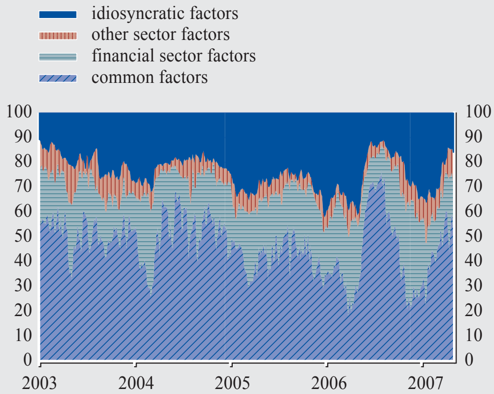
(% of equity variance weighted by the contribution of a company to the Dow Jones EURO STOXX 50 Index, five-day moving average)



Sources: Bloomberg and ECB calculations.

Chart B14.2 Contributions of each of the factors to the variance of equity returns of the largest euro area insurance companies

(% of equity variance weighted by the contribution of a company to the Dow Jones EURO STOXX 50 Index, five-day moving average)



Sources: Bloomberg and ECB calculations.

one of five sectors (banking, insurance, telecommunication, energy and retail), the restrictions on matrix κ were set as well.

The charts present the contribution of particular factors to the variance of equity returns of the 11 largest euro area banks and the seven largest euro area insurance companies. The sectoral factors were grouped into two sets: financial sector factors (the banking and insurance sectors) and other sectors (energy, telecommunication and retail).

The charts provide a picture of the relative importance of different risk factors for the largest euro area banks and insurance companies, as seen by market participants. Systematic risk represents a common factor that can be associated with general macroeconomic and market risk. The share of variance explained by financial sector factors in turn covers financial sector-specific risks, which could be thought of as systemic risk. For banks, this could be linked to risks arising from operations with other financial market participants, such as risks from interbank exposures or exposures to insurance companies, as well as contagion risk. For the insurance sector, financial sector factors cover the risks specific to this sector, e.g. the risk of catastrophic events. The fact that these kinds of risks are specific to insurance companies may explain why financial sector factors explain more of the variance of insurance company stock prices than is the case for banks. With regard to banks, the variance explained by “other sector” factors could be associated with credit risk arising from exposures to the corporate sector that are not covered by the common component (i.e. credit risk that does not result from the business cycle, but from sector-specific risks). The contribution to the variance from the “other sector” for the insurance sector is smaller on average and may be associated with the risk of unexpected claims from sectors where the insurance companies’ clients operate. Finally, the residual variance that cannot be explained by common factors and sectoral factors represents idiosyncratic risk, i.e. the risk that is specific to the operations of each individual bank or insurance company.

The risk factor indicator suggests that the two recent episodes of financial market turbulence in May-June 2006 and February-March 2007 were predominantly driven by common factors, albeit less so in the most recent episode. At the same time, the variance explained by financial sector-specific factors increased beyond the long-term average levels prior to both of these episodes. The financial sector factor among banks was also relatively higher during the more recent market turbulence than during the one in May-June 2006, suggesting that investors' assessment of banking sector-specific risks increased in 2006 and remained above the long-term average in Q1 2007.