Basel II and Market Risk of Selected European Commercial Banks: A VAR Analysis

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Abstract

The Basel Accord on bank capital was amended in 1996 to incorporate market risk. The Basel II accord which will become effective in 2007 envisions the treatment of this risk to remain unchanged. The tremendous growth in product scale and scope offered by European commercial banks has generated an increased exposure to market risk such as interest rate risk, foreign exchange risk, and movements in equities and commodities prices. This paper assesses the exposure of a sample of large European banks adopting quantitative internal models to measure market risk as specified in the Basle Accord to the volatility of their underlying risk drivers. Using a sample of 31 large commercial banks across 8 European countries, we analyze the effectiveness of their risk management policy between 2000 and 2005. The Interest rate, exchange rate and market risk drivers are identified in a three factor Capital Asset Pricing Model. Value-At-Risk analysis (VAR), recommended by the Basel Committee as the main quantitative internal standard measure, is used to evaluate a bank risk ranking within and across countries. Our results can be used to guide policymakers to fine tune prudent bank regulation with respect to the scope of permissible security and derivative activities.

EFM Classification: 520
Key Words: Basel II, Market Risk, European Banks, VAR

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1. Introduction

Over the last decade, global banking has witnessed a dramatic expansion in the array of financial services and products. In particular, the growth of derivative transactions highlights the rapidly changing nature and level of sophistication associated with international banking. This tremendous growth in scale and scope has also generated new risks with global consequences, especially market risk necessitating an assessment of this exposure to the volatility of the underlying risk drivers. International banks are increasingly exposed to market risk defined to include interest rate risk, foreign exchange risk, and movements in equity and commodity prices on and off the balance-sheet. Such developments have prompted the Basel Committee on banking supervision to amend in 1996 the initial accord known as Basel I, which became effective in 1993, to incorporate market risks. The Basel II accord which will become effective in 2007 envisions the treatment of this risk to remain unchanged.

In the wide range of studies on European banking, the focus has been for the most on institutional performance, cost efficiency, or return and profitability. Unlike studies covering the United States (US) banking system,[1] the attention to European bank risk, however, has been significantly less prominent. Within these studies, the analysis of a bank risk using currently practiced risk management techniques as recommended by the Basel Accord such as Value-At-Risk (VAR) is more limited. Hence, the objective of this study is to add to the existing limited literature by identifying the exposure of European commercial banks with respect to individual risk buckets, particularly as their derivative activities are expanding. To that end, we evaluate the

[1] See the prominent studies of Choi and Elyasiani (1997) and Shyu and Reichert (2002) which look at derivative exposure, and the interest and exchange rate risks for US banks.

risk of a bank in each country using a uniform and standard metric VAR specification, recommended in the Basel Accord as the main quantitative internal standard measure for market risk. This evaluation will enable us to develop a risk ranking within and across countries. The analysis will yield three immediate results. The first shows how bank systematic risk varies across countries. The second deals with the way investors within each country assess the risk of each institution and rank various institutions. The third addresses the significance of a bank exposure to the volatility of the equity market, interest rates, and foreign exchange rates. These findings are expected to guide policymakers to fine tune prudent bank regulation with respect to the scope of permissible security and derivative activities and show for various commercial banks the impact of these activities on their capital based on Basel standards.

The rest of the paper is organized as follows. The next section addresses the treatment and measurement of market risk in the Basel Accord. Section 3 reviews related literature on VAR analysis as applied to commercial banks. Section 4 lays down the methodology used and the empirical results obtained. Section 5 concludes with some policy implications.

2. Market Risks in the Basel Accord

In the amendment to the capital accord to incorporate market risks, the Basel committee on banking supervision in a document released in January 1996, develops two broad methodologies for measuring market risk and applying the proper capital charges.[2] The first methodology centers on measuring risk in a standardized manner. The second one uses internal models to measure this risk. Banks can choose which

[2] See the document: "Amendment to the Capital Accord to Incorporate Market Risk, pp. 1-54" published by the Basel Committee on Banking Supervision, 1996.

methodology to use subject to the approval of the concerned national authority. This paper concerns itself with the second methodology and, therefore, will not address the standardized measurement method. The second method will be briefly reviewed. The supervisory authority on the use of internal models to measure market risks will approve these models if several criteria are met. These criteria address the soundness of the bank's risk management system, the skills of the staff in using sophisticated models, the accuracy of the bank's internal models in risk measurement, and the frequency of the stress tests. Bank stress scenarios that should be both of quantitative and qualitative nature include several factors that can cause changes in the value of trading portfolios. In addition to the four mentioned criteria, some qualitative ones discussed in detail in the above mentioned document are also to be met. Similarly, a specification of a set of market risk factors or market prices and rates that influence the value of the bank's trading positions are also an essential part of a bank's internal market risk measurement system. Therefore, guidelines for each market risk element are specified. For interest rates, risk factors correspond to interest rates in each currency in which the bank has interest sensitive positions on and off the balance sheet. For exchange rates, risk factors correspond to each individual foreign currency in which the bank has taken positions. For equity and commodity prices, risk factors address equity and commodity markets in which banks hold positions.

Given all of these criteria and guidelines for market risk factors, banks will have flexibility in devising the nature of their quantitative models. These models could, for example, be based on historical simulations, Monte Carlo simulations, or variance-covariance matrices. However, even though no particular type of model is prescribed,

the Basel Committee provides a detailed use of VAR models in the section on quantitative standards. These VAR models attempt to measure the change in the value of a portfolio due to adverse changes in currency values, interest rates, equity prices and commodity prices. They provide a single figure for the potential portfolio loss over a certain period of time and a level of statistical confidence. Bank regulators determine the amount of capital needed against the risk exposure computed in the VAR analysis based upon a multiple of the VAR's estimate. With the above in mind, the next section presents a review of the literature on some recent banking studies using VAR analysis.

3. Review of Related Literature

In the Finance literature, Value-At-Risk has emerged as an important tool for measuring the risk profile of a bank. It provides a single number to summarize the downside risk in a portfolio of financial assets. VAR estimates the maximum expected loss over a given investment period at a predetermined level of statistical confidence. Its purpose is to quantify the likelihood of experiencing the worst possible loss, or lower-tail outcome, while preserving the bank portfolio's upside potential.

In a recent study, building on the credit-scoring literature, Jacobson and Roszbach (2001) propose a method to calculate portfolio credit risk. Individual default risk estimates are used to compose a VAR measure of credit risk. In general, credit-scoring models suffer from a sample-selection bias. The starting point is therefore to estimate an unbiased scoring model using the bi-variate probit approach. The paper uses a large data set with Swedish consumer credit data that contains extensive financial and personal information on both rejected and approved applicants. The authors study how

marginal changes in a default-risk-based acceptance rule would shift the size of the bank's loan portfolio, its VAR exposure and average credit losses.

Few studies have addressed the handling of capital requirements for credit risk. Sironi and Zazzara (2003) first address the impact of the standardized and Internal Ratings-Based (IRB) foundation approach using general data on Italian bank loan portfolios' default rates. They then simulate the impact of the proposed new rules on the corporate loan portfolios of Italian banks, using the unique data set of mortality rates recently published by the Bank of Italy. Three main conclusions emerge from their analysis: (i) the standardized approach implicitly penalizes Italian banks in their inter-bank funding as their rating is generally below AA/Aa; (ii) The average default rate experienced by Italian banks is higher than the one implied in the benchmark risk weight (BRW) proposed by the Basel Committee for the IRB foundation approach, thereby potentially leading to an increase in the regulatory risk weights; And (iii) the risk-weight is based on an average asset correlation that is significantly higher than the one historically recorded within the Italian banks' corporate borrowers. These findings support the need for a significant revision of the basic inputs and assumptions of the Basel proposals.

Subsequently, an entire literature has been generated that deals with the issue of risk and value. Gonzalez (2004) uses a panel database of 251 banks in 36 countries to analyze the impact of bank regulation on bank charter value and risk-taking. After controlling for deposit insurance and for the quality of a country's contracting environment, the results indicate that regulatory restrictions increase banks' risk-taking incentives by reducing their charter value. Banks in countries with stricter regulation

have a lower charter value, which increases their incentives to follow risky policies. The findings corroborate a negative relation between regulatory restrictions and the stability of a banking system. The authors also find that deposit insurance has a positive influence on bank charter value, mitigating the risk-shifting incentives it creates. This positive influence disappears when they control for the possible endogeneity of deposit insurance.

Moreover, Leippold, et al., (2005) study the asset-pricing implications of VAR regulation in incomplete continuous-time economies with intermediate expenditure, stochastic opportunity set, and heterogeneous attitudes toward risk. Their main findings show that because of an anticipatory effect of VAR constraints on the optimal hedging demand, the partial equilibrium incentives of VAR regulation can lead banks to increase their risk exposure in highly-volatile states. Moreover, the authors show that in general equilibrium, VAR constraints can produce unambiguously lower interest rates and higher equity Sharpe ratios. Finally, they find that the VAR impact on equity volatility and equity expected returns is ambiguous.

Berkowitz and O' Brien (2002) provide descriptive statistics on trading revenues at large commercial banks and on the associated VAR forecasts internally estimated by banks. For a sample of large bank holding companies, the authors evaluate the performance of bank trading risk models by examining the statistical accuracy of the VAR forecasts. The results show that the VAR forecasts for six large commercial banks have exceeded nominal coverage levels for the past two years. While these results imply higher levels of capital coverage for trading risk, the reported VARs are less useful for measuring actual portfolio risk.

Finally, Estrella (2003) presents a dynamic model of optimal bank capital in which the bank optimizes over costs associated with failure, holding capital, and flows of external capital. The solution to the infinite-horizon stochastic optimization problem is related to period-by-period VAR in which the optimal probability of failure is endogenously determined. The model also suggests that over a cycle, VAR is positively correlated with optimal flows of external capital, but negatively correlated with optimal net changes in capital and the optimal level of total capital. Analysis of this pattern suggests that a regulatory minimum requirement based on VAR, if binding, is likely to be pro-cyclical. The model points to several ways of reducing this problem. For example, a VAR-based requirement makes more sense if it is applied to external capital flows than if it is applied to the total level of capital. Finally, the empirical testing based on US commercial bank data since 1984 are generally consistent with the model.

The present paper distinguishes itself from existing literature in three respects. First, it incorporates the important factors of both Basel agreements, in particular those pertaining to the assessment of market risk, using the Capital Asset Pricing Model (CAPM) to quantify, perhaps for the first time, European commercial banks' market risks based on their stock market, interest rate and foreign exchange rate risk exposures. Using VAR analysis, it then, provides a ranking of European banks. Finally, the empirical section of the paper uses a significantly large sample of 8 European countries over a five years period and across 31 banks.

4. Methodology and Empirical Results

In this paper, we calculate VAR by estimating the effect of a shock on the bank's net worth position, which may arise because of a sudden change in interest rates,

foreign exchange rates, or equity returns. This approach is consistent with a slew of recent studies on the practice of VAR in banking (Berkowitz and O'Brien, (2002); and Campbell, Huismand, and Koedijk, (2001)).

The methodology is based on a two-stage approach. The first stage is the estimation phase, where we introduce a three-factor capital asset pricing model of the form:

$$R_{i,t} = \alpha_{i,t} + \beta_{m,t} R_{m,j,t} + \beta_{r,t} R_{r,j,t} + \beta_{x,t} R_{x,j,t} + u_{i,t}, \qquad (1)$$

where j=1,2..8, R_{it} is the return on bank stock i (i=1,2,..31), during time period t (t=1,2,..279); β_{mt}, R_{mjt} is the market beta and the return on the market index in country j at time t; β_{rt}, R_{rjt} is the interest rate beta and the rate of interest in country j at time t; β_{xt}, R_{xjt} is the foreign exchange beta and the return on the foreign exchange rate for country j at time t; and α_{it}, u_{it} is the bank-specific constant and random error term, respectively. The stock price data is employed as a proxy to the capital market risk similar to the approach employed by Chaudhry et al (1999, 2000), Hirtle (1997), and McAnally (1996). The CAPM approach is a useful way to analyze the relationship between bank profitability, market interest rate, and exchange rate risk by estimating individual betas using weekly stock return data.

In the second stage, the individual betas are used to construct a bank VAR defined as:

$$VAR = c\sqrt{(\beta_{m,i}\sigma_{m,j})^2 + (\beta_{r,i}\sigma_{r,j})^2 + (\beta_{x,i}\sigma_{x,j})^2}, \qquad (2)$$

where c reflects a given level of statistical confidence[3], the betas pertain to each individual bank *i*, and $\sigma_{m,j}$, $\sigma_{r,j}$, $\sigma_{x,j}$ represent the standard deviations of the market

[3] Thus, a one-tail 99% confidence level implies that c is 2.326, etc.

index, interest rate and exchange rate in country j. These statistics are calculated from historical weekly data which we obtained from Reuters database and the respective country stock market.

4.1 Data and Sample

The data for this study includes a cross-country time-series of publicly traded commercial banks' stocks in 8 European countries: France, Germany, Italy, The Netherlands, Spain, Switzerland, Belgium, and the United Kingdom (UK). All these countries have stock exchanges with reliable data. For each country, the analysis focuses only on the four largest institutions (in terms of assets) for 3 reasons: (1) large banks are most likely to have substantial international activities and foreign exchange exposure; (2) large banks are more active in derivatives securities; And (3) their stocks are actively traded.

The time period covered is July 2000 to November 2005. The period is sufficiently long to assess the risk factors of a bank, and provide a rich set of observations (279 time series across 8 countries) to produce reliable results. The missing data arising from holidays and special events are assumed to be the average of the recorded previous price and the next price. All of the national indices are based on local currencies. Thus, possible correlations due to a common factor such as common currency appreciation or depreciation are eliminated.

The final list of all the banks we investigate covers 31 banks in 8 European countries and their descriptive statistics are provided in Table 1, where the sample includes on average four banks for most countries. The weekly return on the stock of each bank is calculated as

$$R_t = Log\ P_t - Log\ P_{t-1}\ . \qquad (3)$$

Table I
Descriptive Statistics of Bank Stock Prices

FRANCE	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
BNP PARIBAS	49.86	49.95	68.1	29	6.71	273
SOCIETE GENERALE	68.15	68.2	104.2	41.21	11.57	279
CREDIT AGRICOLE	19.89	20.3	26.9	13.59	2.94	210
UK						
BARCLAYS	506	515	624	338	61.52	279
HSBC	830	837	1,067	608	90.08	275
STANDARD CHARTERED	887	900	1,283	566	146	274
LLOYDS TSB GROUP PLC	541	477	817	311	127	279
GERMANY						
DEUTSCHE	67.73	66.50	100.91	36.80	14.72	279
COMMERZBANK	18.24	16.43	38.75	5.54	7.58	279
AAREAL BANK	21.98	24.10	32.64	9.80	6.16	183
BAYERISCHE HYPO-UND VEREINSBANK AG	23.71	18.72	53.32	5.85	12.83	274
ITALY						
BANCA INTESA	3.29	3.13	5.29	1.47	0.85	279
BANCA POPOLARE ITALIANA	9.16	8.50	13.58	6.06	1.69	279
CAPITALIA SPA	2.99	2.65	5.52	0.79	1.26	279
BANCA POPOLARE DI MILANO	5.24	4.90	8.95	3.20	1.53	279
NETHERLANDS						
FORTIS BANK NEDERLAND	45.45	45.30	52.25	41.1	2.4	203
KAS BANK NV	16.64	16.26	22.1	13.30	1.84	279
SNS BANK NV AMSTERDAM	103	104	114	97	3.14	111
VAN LANSCHOT NV	43.03	40.80	63.9	27.85	6.47	279
SPAIN						
BANCO POPULAR ESPANOL	8.64	8.65	10.65	6.52	0.97	279
BANCO VALENCIA	14.17	11.99	26.25	7.68	5.87	279
BANCO SANTANDER CENTRAL HISPANO	8.97	9.14	12.55	5.1	1.59	275
BANCO ESPANOL DE CREDITO	10.92	11.61	14.43	6.01	2.15	279
SWITZERLAND						
CREDIT SUISSE	50.99	48.45	86.2	21.55	14.98	279
UBS	84.15	83.95	121.7	54.3	12.55	277
BANQUE CANTONALE VAUDOISE	251	197	592	62	156	268
NEUE AARGAUER BANK	548.91	550	735	411	73.37	246
BELGIUM						
BANQUE NATIONALE DE BELGIQUE	2,650	2,798	4,055	1,200	865	271
DEXIA CC	15.26	15.91	19.26	7.75	2.83	279
KBC GROEP	44.78	43.1	73.15	25.26	11.57	277
ECONOM GROUP	5.14	5.31	6.9	2.65	1	279

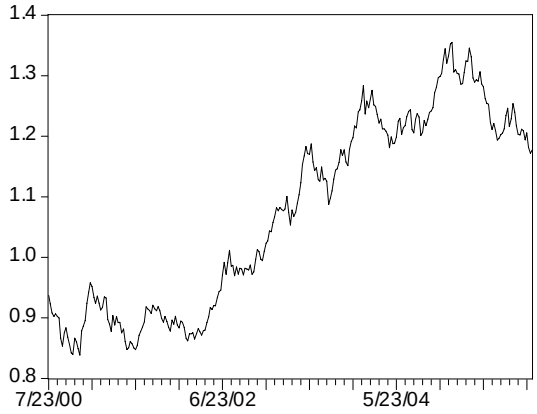
Source: Authors' Estimates.

The return is matched with the country index return, interest and foreign exchange rates. Figure 1 plots the European exchange rates, as well as the LIBOR rate of interest over the 2000-2005 period. After a period of relative stability, the Euro

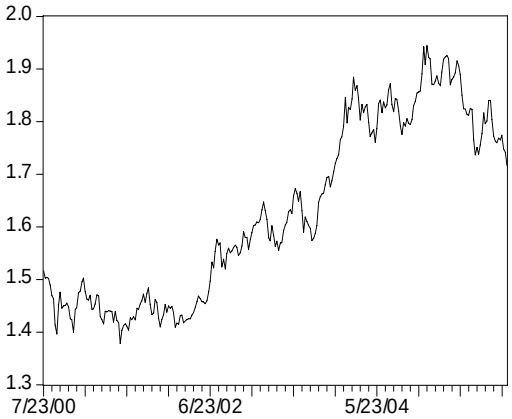
started to appreciate against the US dollar (USD) in early 2000, benefiting those European banks with Euro denominated assets and paid up capital. From USD 0.9/Euro in 2000, the Euro appreciated to about USD 1.3/Euro to revert slightly to the USD1.2/Euro level. With the exception of the UK and Switzerland most countries in our sample have already adopted the Euro since its introduction in 1999. The US dollar British Pound (BP) exchange rate seems to be more volatile over the same period, with a period of steady appreciation in between 2002-2004, and a steady depreciation thereafter, and significant short term volatility.

Figure 1. European Exchange and Interest Rates: 2000-2005

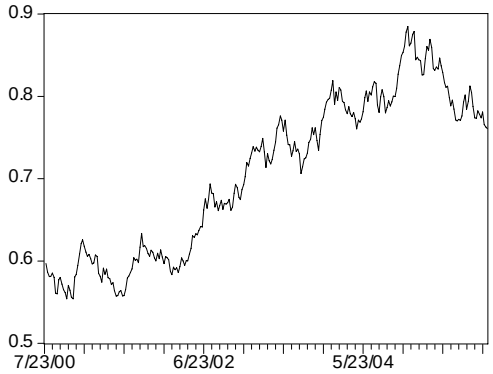
(a) US Dollar/Euro



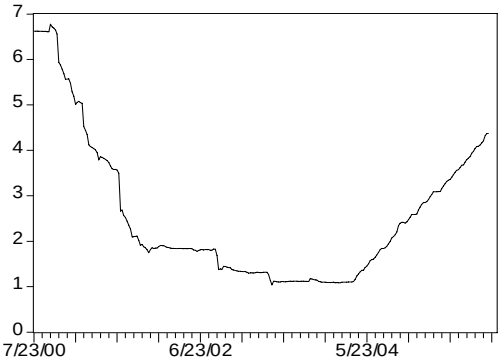
(b) US Dollar/British Pound



(c) US Dollar/Swiss Franc



(d) LIBOR Interest Rate

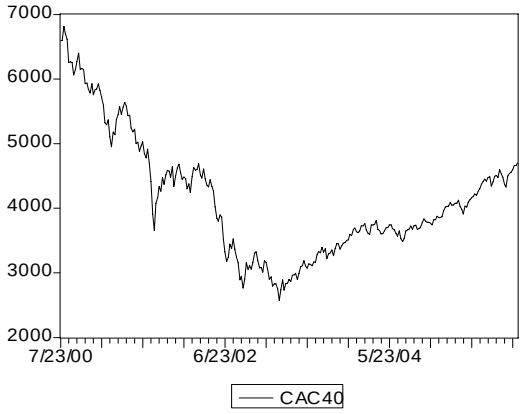


Source: Reuters.

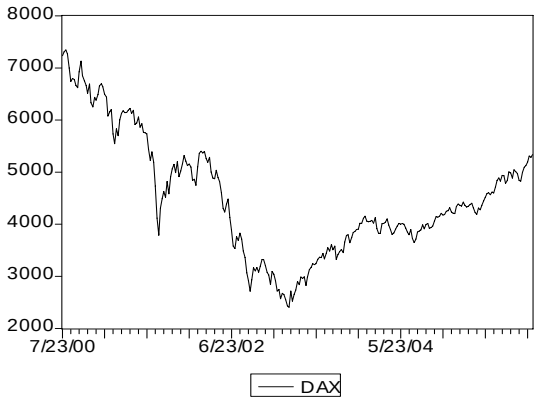
The Swiss Franc (SF) has been on the rise since early 2000, increasing from about USD0.6/SF in early 2000 to about USD0.8/SF in late 2005. The 30 percent appreciation of the SF is having a negative impact on Swiss banks, with USD denominated assets and capital. Similar dynamic volatilities are observed for the LIBOR interest rate, with a steady decline in between 2000-2002 period, and a steady increase since early 2004. These interest rates fluctuations are having a significant impact on banks' balance sheets in general, and their assets and liabilities management policies in particular.

Figure 2. Euro Area Stock Market Indices: 2000-2005

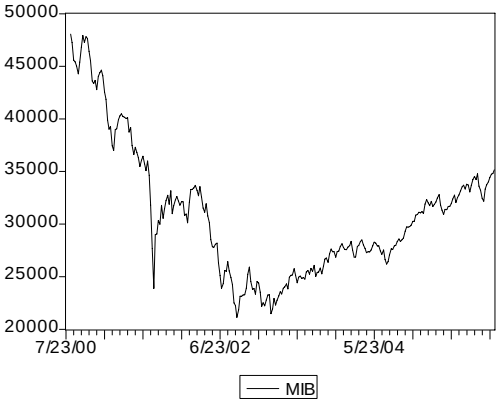
(a) France



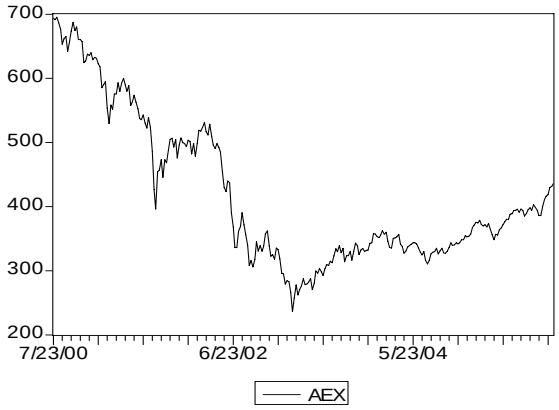
(b) Germany



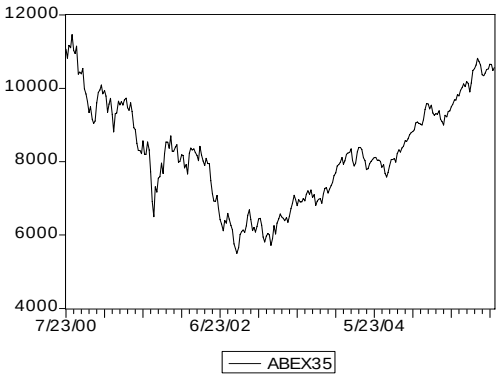
(c) Italy



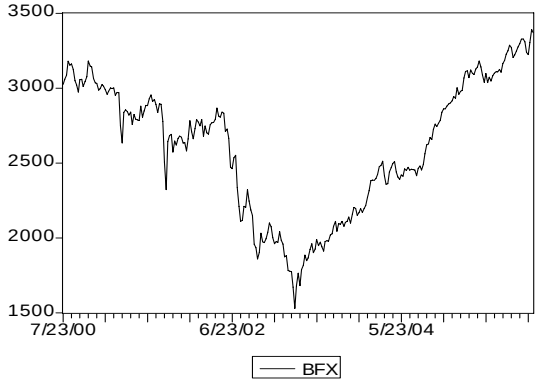
(d) Netherlands



(e) Spain



(f) Belgium

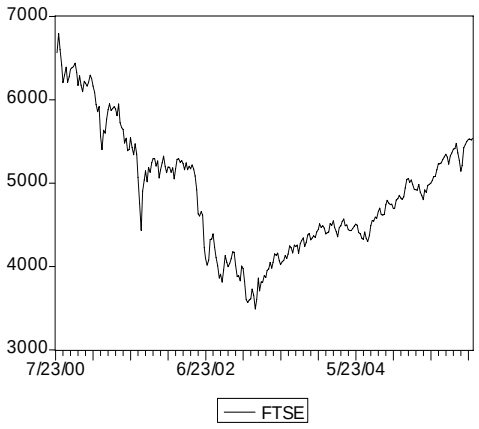


Source: Reuters.

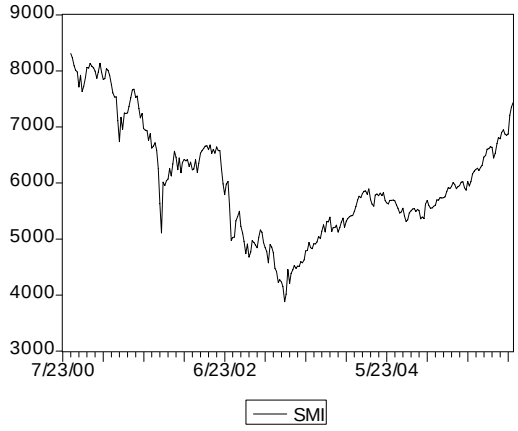
The stock price and market index data is available from the respective country's stock exchange and Reuter's database. We use the following stock market indices: For France: CAC40; UK: FTSE; Germany: DAX; Netherlands: AEX; Spain: ABEX 35; Italy: MIB; Switzerland: SMI; and Belgium: BFX. Figure 2 plots the stock market indices for the Euro Area stock markets. The volatility dynamics of all of these market indices are quite similar. There is an obvious downward trend in between 2000-2002, and a trend reversal thereafter. This is a clear indication of the financial integration of these markets resulting from the introduction of the euro in 1999.

Figure 3. Non-Euro Area Stock Market Indices: 2000-2005

(a) The United Kingdom



(b) Switzerland



Source: Reuters.

Similar volatility dynamics are observed for the remaining non-euro area market indices of the UK and Switzerland (see Figure 3). Although the two countries have not yet joined the Euro area, their stock markets appear to be quite integrated with the remaining European markets. These very similar volatility dynamics will certainly have an impact on our empirical analysis below.

4.2. Empirical Results

In Table 2, we report the estimated betas from the three-factor model in equation (1) above. Each coefficient represents the sensitivity of a bank stock to a change in one individual factor. With the exception of a few institutions, the market betas are generally all positive. In the Netherlands and Spain, Banks have relatively the smallest market betas, whereas banks in the UK, followed by France, have the highest betas on average. As for the remaining countries, Germany's Deutsche Bank, Italy's Capitalia Spa, and Switzerland's UBS have also the highest betas.

The exchange rate betas are generally negative suggesting that banks profits suffer during periods of currency depreciation. This is a theoretically defensible result because a bank's equity is generally paid up in the local currency. Consequently, investors interpret any currency devaluation as a write down in the bank equity. With the exception of Italy and to a lesser extent Belgium, this is true for almost all European countries that have adopted the euro currency since 1999, mainly France, Germany, the Netherlands, and Spain. The exchange rate betas are however mixed for Swiss and UK banks. This may be explained by the higher volatility of both the SF and the BF as opposed to the Euro over the period under consideration, and by the individual bank exposure to exchange rate fluctuations.

The interest rate betas are more mixed. With the exception of the Van Lanschot NV bank, the interest rate betas for all the Netherlands, French, Italian, and Swiss Banks exhibit positive coefficients. By contrast, the UK's Barclays and Lloyds Banks and Spain's Banco Popular Espanol, Banco Valencia, and Banco Santander Central Hispano, as well as Germany's Deutsche and Aareal Banks, have all consistently negative interest rate betas indicating that their stock performance is vulnerable to rising interest rates.

The average interest rate betas for the Spanish (0.02), French (0.04), and Netherlands (0.04), we examined are very close to zero, suggesting that on an aggregate basis these banks are well hedged against interest rate risk. We suspect the Spanish, French, and Netherlands banks to be more sophisticated in their risk management practices and to have well defined guidelines on the use of swaps to mitigate their risk exposures in order to remain within their risk tolerances.

Italian, Belgian, and Swiss banks are next in line with a mean interest rate beta of (0.08) for Italy and Belgium, and (0.09) for Switzerland. Thus, it appears that Swiss Banks are surprisingly the least hedged, significantly benefiting from a rise in interest rates. This can perhaps be explained by the fact that Swiss Banks are known to issue low earning interest on their deposits due to the fact that the bank secrecy law has made those banks' deposits very attractive to a wide range of international investors. Therefore, these banks enjoy a wider opportunity to profit from the spread between the wholesale costs of funds (eg. LIBOR), and the costs of their deposits.

Table 2

Estimation of a Three Factor Capital Asset Pricing Model (CAPM)

$$R_{it} = \alpha_{it} + \beta_{mt}R_{mjt} + \beta_{rt}R_{rjt} + \beta_{xt}R_{xjt} + u_{it}$$

R_{it} = the return on bank stock i during time period t;

β_{mt}, R_{mjt} = the market beta and the return on the market index in country j at time t;

β_{rt}, R_{rjt} = is the interest rate beta and the rate of interest in country j at time t;

β_{xt}, R_{xjt} = is the foreign exchange beta and the return on the foreign exchange rate for country j at time t;

α_{it}, u_{it} = bank-specific constant and random error term, respectively.

Factor Betas by Bank	Market Beta	Exchange Rate Beta	Interest Rate Beta
FRANCE			
BNP PARIBAS	1.2003	-0.0545	0.0496
SOCIETE GENERALE	1.3389	-0.0996	0.0083
CREDIT AGRICOLE	0.6447	-0.3066	0.0697
UK			
BARCLAYS	1.3463	0.1264	-0.0434
HSBC	1.1337	-0.0848	0.0191
STANDARD CHARTERED	1.4199	0.0283	0.0209
LLOYDS TSB GROUP PLC	1.1193	0.0314	-0.0576
GERMANY			
DEUTSCHE	1.1678	-0.0289	-0.0738
COMMERZBANK	0.0339	0.1777	0.1212
AAREAL BANK	0.5804	-0.0022	-0.088
BAYERISCHE HYPO-UND VEREINSBANK AG	0.0937	0.1962	0.0402
ITALY			
BANCA INTESA	1.1829	-0.0718	0.1337
BANCA POPOLARE ITALIANA	0.8228	0.0083	0.0099
CAPITALIA SPA	1.4344	0.0775	0.1638
BANCA POPOLARE DI MILANO	0.8045	0.2371	0.0173
NETHERLANDS			
FORTIS BANK NEDERLAND	0.1228	-0.0101	0.0221
KAS BANK NV	0.284	-0.1872	0.1165
SNS BANK NV AMSTERDAM	-0.06	-0.029	0.0707
VAN LANSCHOT NV	0.4093	0.0423	-0.0189
SPAIN			
BANCO POPULAR ESPANOL	0.4866	-0.0901	-0.0353
BANCO VALENCIA	0.176	0.1043	-0.0427
BANCO SANTANDER CENTRAL HISPANO	1.3867	-0.0111	-0.005
BANCO ESPANOL DE CREDITO	0.1916	0.0326	0.1643
SWITZERLAND			
CREDIT SUISSE	0.0364	0.0226	0.186
UBS	1.1787	0.0223	0.0262
BANQUE CANTONALE VAUDOISE	0.1311	0.2265	0.164
NEUE AARGAUER BANK	-0.0428	-0.0133	0.0044
BELGIUM			
BANQUE NATIONALE DE BELGIQUE	0.128	0.1377	-0.0266
DEXIA CC	1.3678	0.0495	0.0766
KBC GROEP	1.0491	-0.0938	-0.0914
ECONOM GROUP	0.7921	-0.1747	0.3645

Source: Authors' Estimates.

The comparison of betas across countries should be done with great caution to the extent that banking regulations, tax legislations, industry structures, and stock market integration are not uniform for all these countries. For example, Swiss Banks are fully accessible to foreign investors, while UK, French and German Banks have recently introduced significant restrictions on foreign investors. The Spanish, Italian, Belgian, Netherlands and Swiss equity markets are relatively smaller, but well integrated with the remaining European stock markets. The French, German and UK equity markets are not only integrated with the remaining European stock markets but more so with the bigger markets of the Unites States and Japan. All these distinctions have significant consequences on the magnitude of the beta coefficients in each country.

Within each country, the beta coefficients are useful to rank individual banks and better understand their risk drivers. Nevertheless, the sample is diverse and includes countries with significant resemblance in terms of governance, legislation, size, taxation, exchange rate systems, and market structure. The Swiss, German, French and the UK are four such countries. The stock market betas across these four countries exhibit common magnitudes and relations. However, the interest rate betas for the French, and Swiss Banks are clearly positive and opposite in sign to those of Germany and the UK. The result is interesting to note and represents an indication of the duration gap between bank assets and liabilities, and the interest rate exposure of financial institutions in each country. Evidently, the French and Swiss Banks benefit from a rise in LIBOR rates, whereas German and the UK's Banks suffer. Like France, Italy's banks exhibit the same relation with respect to interest rates, and suggest that these institutions are able to pass through the higher cost of funds to their customers and have structured

their balance sheets in such a fashion that their assets re-price faster than their liabilities for a given change in interest rates. In the same vain, but to a lesser extent Netherlands' Banks on average seem to have an asset-liability management (ALM) strategy similar to French, Italian, and Swiss banks. We should note that there is a potential interaction between the interest rate and currency rate betas when for example interest rate swaps are used to hedge cross-currency interest rates risk in situations where a bank has lent money in one currency and funded the loans with deposits denominated in a different currency.

The VAR calculation and corresponding risk ranking for each bank are outlined in Table 3. The VAR is computed from equation (2) above using the historical volatilities for the rate of change in LIBOR, exchange rates, and the stock market. Each VAR represents the fraction of a bank equity at risk in one week with a 99 percent degree of confidence. The Bank equity is assumed to fluctuate with the three individual risk factors given their historical volatilities and the bank betas. The equity at risk is independent of the bank size and is quoted in percent. As such, it is possible to compare it across institutions and countries. The interpretation of bank VARs across countries however is questionable for the same reasons indicated earlier except for countries with similar size, economy, and governance. However, within each country, the VAR results are particularly useful to provide ranking of public banks whose stocks are listed on the country's exchange.

Table 3
Weekly VAR in percent of a Bank Equity at Risk
$VAR = c\,[(\beta_{m,i}\sigma_{m,j})^2 + (\beta_{r,i}\sigma_{r,j})^2 + (\beta_{x,i}\sigma_{x,j})^2]^{1/2}$
For c = 99%

	Bank VAR @ 99% Confidence	Median VAR of Sample Banks by Country	Country Ranking by Lowest VAR
FRANCE			
BNP PARIBAS	0.46%		
SOCIETE GENERALE	0.44%		
CREDIT AGRICOLE	0.65%	0.51%	1
UK			
BARCLAYS	5.21%		
HSBC	2.31%		
STANDARD CHARTERED	0.93%		
LLOYDS TSB GROUP PLC	1.73%	2.5%	6
GERMANY			
DEUTSCHE	1.63%		
COMMERZBANK	1.23%		
AAREAL BANK	0.54%		
BAYERISCHE HYPO-UND VEREINSBANK AG	1.55%	1.2%	2
ITALY			
BANCA INTESA	0.66%		
BANCA POPOLARE ITALIANA	0.31%		
CAPITALIA SPA	0.81%		
BANCA POPOLARE DI MILANO	3.42%	1.3%	3
NETHERLANDS			
FORTIS BANK NEDERLAND	1.30%		
KAS BANK NV	0.98%		
SNS BANK NV AMSTERDAM	2.43%		
VAN LANSCHOT NV	2.65%	1.84%	5
SPAIN			
BANCO POPULAR ESPANOL	4.42%		
BANCO VALENCIA	4.39%		
BANCO SANTANDER CENTRAL HISPANO	3.21%		
BANCO ESPANOL DE CREDITO	3.95%	3.99%	8
SWITZERLAND			
CREDIT SUISSE	3.88%		
UBS	7.69%		
BANQUE CANTONALE VAUDOISE	1.28%		
NEUE AARGAUER BANK	1.06%	3.47%	7
BELGIUM			
BANQUE NATIONALE DE BELGIQUE	1.23%		
DEXIA CC	1.89%		
KBC GROEP	1.65%		
ECONOM GROUP	1.66%	1.6%	4

Source: Authors' Estimates.

In the UK, the risk differences between individual banks are too large to ignore. Standard Chartered Bank is ranked lowest, while Barclays bank is ranked highest. The

main culprit appears to be the foreign exchange beta (0.02 for Standard Chartered versus 0.12 for Barclays). Evidently, Barclays bank was not adequately hedged for the British Pound volatility over the five years period under consideration. The reaction of the stock price reflects the exposure of an individual bank to foreign exchange fluctuations and the extent to which its investors believe in the ability of the bank management to mitigate such risk. It is also possible that the differences may also be partially attributed to differences in liquidity of the bank stock.[4]

Large differences in bank risks within each country are not unique only to the UK. In Italy, Banca Popolare Italiana and Banca Popolare Di Milano also stand out as two banks on the extreme end of the risk spectrum. Banca Popolare Di Milano, one of the largest banks in Italy, is naturally more exposed to the exchange rate risk. Again this risk factor is the primary explanation for their differences in VAR ranking. Other than the exchange rate, the other beta factors for these two banks are not significantly different.

Turning to Switzerland, we find similar traits between UBS (VAR = 7.69%), and Neue Aargauer Bank (VAR = 1.06%), with differences due primarily to exchange rate risk. Perhaps the clearest comparison for Swiss Banks is between the country's two largest banks: Credit Suisse versus UBS. From Table 3, the VAR for UBS is twice the magnitude that of Credit Suisse bank. Commercial banks in other countries, namely France, Germany, the Netherlands, Spain, and Belgium are more homogeneous in risk and hedging policies. Finally, in terms of country ranking based on the lowest VAR score, Table 3 provides evidence pointing to relatively high VARs for Spain, followed

[4] The average traded daily value (traded volume times closing price) for these banks are markedly different on the UK Stock Exchange.

by Switzerland, the UK and the Netherlands. The lowest VARs are observed for France, Germany, Italy and Belgium in that order.

5. Conclusion

This paper has investigated the risk profile of a sample of 31 large commercial banks in eight European countries. All banks represent publicly held financial institutions and their stock trades on the country's organized exchange. The analysis covered 5 years of weekly observations and the results indicated the extent to which market risk, interest and foreign exchanges rates impact profitability across European banks. Using a three-factor multi-index model, we identified the risk drivers for each bank. The sensitivity of each bank to changes in interest rate, exchange rate, and the stock market was captured by factor coefficients. Within each country, the betas were markedly different suggesting non-homogeneous hedging policies across banks. While the sign of the market beta was consistently positive across banks and countries, the interest rate and exchange rate betas were more mixed. The beta coefficients were then combined with the historical volatilities of three risk drivers to generate a modified VAR analysis across banks and countries. The VAR analysis enabled us to rank individual banks and allowed us to identify a wide range in risk exposures in particular in the UK, Italy, and Switzerland. We pointed out that it seems likely that significant differences in bank regulation may explain a number of the country differences. Specifically, our results are expected to guide policymakers to fine tune prudent bank regulation with respect to the scope of permissible security and derivative activities or the acceptance of foreign equity holders. Such tools may enable a bank to mitigate an existing risk to its balance sheet and compete more effectively, but the Central bank as

is the case in Italy and Spain, may be slow in implementing needed banking reform. An enlightened approach to bank regulation should provide banks significant flexibility in risk management, allowing them to exploit the information advantage they have as large diversified financial intermediaries.

Overall, the results also indicate that the current managerial and regulatory interest in VAR modeling is justified because the technique is able to capture important risk differences between banks and countries. The results of this study support the growing body of evidence that, when properly constructed, VAR measures can be an effective tool for commercial bank risk management.

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