

# Capital & Market Risk Insights

Published by the Federal Reserve Bank of Chicago

2003/Number 1

Welcome to the first issue of *Capital and Market Risk Insights* (formerly the Capital Markets Newsletter). Our objective is to provide our readers with informative and practical articles addressing the issues surrounding capital adequacy and market risk. If you have any feedback on articles or suggestions for future topics please contact one of the co-editors, Craig West ([craig.west@chi.frb.org](mailto:craig.west@chi.frb.org) or 312-322-2312) or Matt Foss ([matthew.foss@chi.frb.org](mailto:matthew.foss@chi.frb.org) or 312-322-4780), or the publisher Adrian D'Silva ([adrian.b.dsilva@chi.frb.org](mailto:adrian.b.dsilva@chi.frb.org) or 312-322-5904).

## ON THE RADAR SCREEN

### Perspectives on enterprise risk management

*This interview has been reprinted, with permission, from the RMA Journal.*

Like several of the 12 Reserve Banks of the Federal Reserve System the Chicago Fed has developed what might be considered niches of expertise. The Federal Reserve Bank of Chicago, which is responsible for the Seventh District, has a team focused on the capital implications of enterprise-wide risk management. The Seventh District includes 986 bank holding companies, 192 state member banks, and 18 foreign banking organizations, which range in size from \$5 million to \$275 billion. James W. (Jim) Nelson is SVP of Supervision and Regulation and also serves as a member of the bank's Management Committee and the Federal Reserve System's senior officers' Strategic Planning Steering Committee.

**RMAJ:** *What is the Chicago Fed's definition of enterprise-wide risk management?*

**JWN:** In general, EWRM is the process an organization utilizes to manage its activities across different risk elements, including operational, credit, market,

liquidity, legal, and reputational, as well as across different business units. Accordingly, we focus our EWRM efforts on the institution's overall corporate governance, risk management and internal control processes. While our specific expectations of an institution's EWRM process will be dependent upon the size and complexity of the organization, we expect all institutions to have the ability to identify, measure, monitor and control the risks they incur.

**RMAJ:** *How is the examination process changing?*

**JWN:** Our examination process has been evolving over the past several years to reflect the changes in the banking industry. From a broad perspective, we are increasingly thinking about our supervision process as having two major components. First, to ensure that we have a robust understanding of each institution we assign a central point of contact or CPC for every organization we supervise. This individual is responsible for having a comprehensive understanding of the banking organization's risks and how

*Capital and Market Risk Insights* is published by the Capital and Market Risk Group of the Risk Specialists Division in the Department of Supervision and Regulation. Our purpose is to stimulate discussion on the issues arising from capital adequacy and market risk. *Insights* is meant to be accessible to non technical readers interested in these areas, but still useful to the practitioners who address these issues. For information about *Capital and Market Risk Insights* contact Craig West ([craig.west@chi.frb.org](mailto:craig.west@chi.frb.org) or 312-322-2312) or Matt Foss ([matthew.foss@chi.frb.org](mailto:matthew.foss@chi.frb.org) or 312-322-4780).

The opinions expressed are those of the individual authors and not necessarily those of the federal Reserve Bank of Chicago or the Federal Reserve System.

those risks are managed. This individual is also responsible for the design and execution of a supervisory plan. As an institution grows or becomes more complex, additional people are assigned to form a dedicated team of examiners.

We complement the CPC and/or dedicated team's top down or "vertical perspective" of an institution with a second group of risk specialist that looks not just at one institution but across a number of institutions. From this "horizontal perspective" we are better able to ensure that the CPC's assessment of risk and risk management is appropriate relative to its peers and reflects the information the specialists have on the range of practices for a particular discipline. For example, a CPC may believe that a particular bank's interest rate risk management is strong relative to the bank's other risk management processes. However, when the risk specialist consider the quality of the bank's interest rate risk management vis-à-vis its peer organizations, the risk specialist may identify more significant improvement opportunities. These risk specialists also are utilized by the CPC to contribute to specific aspects of the examination process.

*RMAJ: How does EWRM fit within this supervisory framework?*

Enterprise-wide risk management (EWRM) has both qualitative and quantitative facets. We expect the CPC and/or the dedicated team to be primarily responsible for assessing the qualitative aspects of the institution's EWRM process. Our criteria include whether the organization has active board and senior management oversight, the adequacy of policies, procedures and limits, the appropriateness of risk measurement, monitoring and management information systems and if comprehensive internal controls exist.

One group of the risk specialist division I spoke of earlier is our Capital Group. This group was formed in 1997 to focus on the quantitative aspects of EWRM. This group looks primarily at a banking

organization's internal capital management process. We expect the internal capital management processes to meaningfully tie the identification, monitoring, and evaluation of risk to the determination of the institution's capital. Our overall assessment of an organization's EWRM process will be a combination of both these qualitative and quantitative elements and how well they are integrated.

*RMAJ: What training does the Capital Group have?*

JWN: The people we bring into Capital Group already have some understanding or formal training in these elements. Some are PhDs who have been working in modeling and others have a statistics background. We augment these skills with training sessions, conferences, seminars, on-the-job training, and special studies. Each member of the Group has a specialty and focus.

Other Reserve banks supervising large complex banking organizations have people with this kind of expertise as well, although they don't necessarily call them members of a Capital Group. The Chicago Fed has chosen to invest heavily in its Capital Group because we believe EWRM will become increasingly important. Our payoff has been an increased understanding of what firms are doing and we've brought that increased understanding into our core supervision. Some of the independent research we've undertaken has contributed to the industry's understanding of certain aspects of risk management as well, such as possible misperceptions about "Loss Given Default" (LGD).

*RMAJ: What are your expectations for EWRM at various institutions?*

JWN: We believe both the qualitative and quantitative aspects of an organization's EWRM process should be appropriate for the nature, size and complexity of the organization's activities. I believe that our supervisory expectations of the qualitative aspects of EWRM for different levels of

size and complexity are well established and understood by the banking industry. For example, smaller institutions engaged solely in traditional banking activities and whose senior managers and directors are actively involved in the details of day-to-day operations, relatively basic risk management systems may be adequate. Larger or more complex organizations will require far more elaborate and formal risk management systems.

Given the rapid changes occurring in the quantification of risk, our quantitative expectations continue to evolve as the industry evolves. Clearly, all banking organizations are expected to be in compliance with regulatory capital requirements. In addition, all firms are expected to have a capital planning process that identifies the major risks of the organization, future expectations of the institution's risk profile and the level of capital appropriate for these risks. For banking organizations with more complex risk profiles, we expect the organization to be able to determine the level of capital needed across the market, credit, and operational risk spectra.

*RMAJ: How are firm's adapting to the changes in quantification of risk capital?*

JWN: During the course of our examinations, we review a bank's current practices as well as development plans. For larger organizations we expect the bank's current internal capital management processes to identify and measure all material risks, to relate capital to the level of risk and to state explicitly the organizations capital adequacy goals with respect to risk. We also expect the organization to make steady and meaningful progress towards enhancing the current internal capital management process. Towards this end, we expect larger bank's capital plan to include specific objectives, time frames and accountabilities to implement enhancements.

The quantification of capital for market risk is largely a mature discipline and the majority of banking organization's are

focusing current efforts on credit and operational risk. For credit risk, the focus for several firms has been on their internal loan rating systems. These institutions are working to ensure that the ratings have appropriate granularity to differentiate risk between different counterparties and that the internal systems capture both borrower and facility risk. Other aspects of current efforts are to incorporate the effects of longer tenors, the correlations between different exposures and the impact of industry or geographic concentrations. Estimating capital for operational risk is at an earlier stage of development. Currently capital allocations for operational risk typically utilize some qualitative assessment, such as audit scores and self assessments. Many banks have begun internal operational loss data collection efforts to be utilized for statistical models combining internal and external data.

With all the attention Basel has brought to capital and its allocation, senior management and the boards of directors are now more interested in this topic. Our conversations include communicating the work of the Basel committee to bankers and providing feedback on the banker's concerns to various policy groups. The international regulatory community has been clear that we don't want a gaming situation where banks have one set of standards for regulators and another set for their internal management reporting. At the same time we don't want regulatory expectations to inhibit an evolution or advancement in this discipline. Our encouragement to banks is to take a critical look at their risk management framework in light of the new tools for measurement and to select the appropriate set of tools for their institutions.

*RMAJ: What has the Chicago Fed been observing—good and bad—in its institutions, vis-à-vis EWRM?*

JWN: In a broad context, we're concerned that we're seeing a lot of attention to efficiency ratios. We believe firms must be (and largely are) fairly diligent that as they grow and become more complex, by

continuing to invest in risk measurement and internal controls to manage those risks. That's where the quantification of capital at risk can be very useful. Since each institution has a unique set of factors to manage, the ability to objectively identify risk, measure it, and translate it to capital provides a more objective criteria to support changes in risk management. Specifically, this process can identify where additional investment in internal controls or limitations on concentrations would result in a reduction of capital at risk. The ability to measure the benefit of these investments from a capital perspective is both useful and prudent for an organization. In this manner, we have found that the ability to quantify and allocate capital based on quantitative risk measurement tools contribute to a stronger risk management program.

Furthermore, one aspect of our responsibility is to ensure that firms we supervise are aware of the risks they incur. Institutions won't realize these risks as losses every year, but the risks do exist. The EWRM look is a portfolio view that gives firms the ability to look across their business lines to see risks versus returns and make decisions accordingly. We think this information also provides the Board of Directors with firm-wide perspective they need to be able to determine whether they are comfortable with the institution's risk level.

*RMAJ: What advice would you offer institutions at this juncture?*

JWN: In a nutshell, EWRM is a journey and no bank is at the destination yet. While market forces and industry advances have driven the most advanced banks to initiate EWRM development many years ago, all institutions can benefit from the increased understanding of their risks provided by EWRM. We must all remember, however, that internal capital management processes do not replace the more traditional aspects of risk management—they complement and strengthen them. Banks and their supervisors will

need to continue the dialogue about new and better tools to monitor changes in the risk profile of an institution and the appropriate risk management over those risks. The quantitative models the Federal Reserve Bank of Chicago's Capital Group deals with are an important piece of this process.

*—Beverly J. Foster*

# RECENT DEVELOPMENTS IN AN ELECTRIFYING ENVIRONMENT

## An Analysis of the German Market for Energy Trading

### Introduction

Since the liberalization of the European energy markets, the importance of banks as market participants has been steadily increasing. In Germany, activity in this field has grown since the 1998 Energy Sector Act (Energiewirtschaftsgesetz) and the establishment of the two German power exchanges in Leipzig and Frankfurt in 2000<sup>1</sup>. Furthermore, some trading companies that are now recognized as financial services institutions<sup>2</sup> and are under the control of banking supervision have emerged from within the major electricity supply groups. Because of the role of Enron as one of the (if not the) most important market players within the energy market, energy trading is becoming increasingly a focus of regulatory attention.

With the foundation of German stock exchange trading and the growth in trading volume, commercial banks are taking an increasingly keen interest in this new market. In terms of commercial banks' risk management, there are several areas where energy trading activities differ from classical financial markets. Electricity trading displays stochastic distribution characteristics and volatilities that are not comparable to those of classical financial products. This makes effective risk management more difficult.

The considerations presented below are intended to provide a comparison of various European regional markets (Germany, Scandinavia and United Kingdom) and of various instruments (spot and futures markets) and to examine how positions and products in energy and/or energy derivatives should be dealt with from the point of view of market risk and, ultimately, from a prudential regulatory angle. The analyses are based on freely accessible market data on exchange-traded products only. However, this data represents only a limited section of the total market for energy. OTC (over-the-counter) trading is highly

significant in this context—current estimates suggest that over 95% of trading takes place in the OTC market.

### The market for electricity trading

#### Market breakdown

Since its liberalization in 1998, the German electricity market has experienced a buoyant upswing. The volume of the market in Germany is currently estimated to be around 2,980 TWh. This compares with an annual consumption in Germany on the order of approximately 530 TWh (in 2001)<sup>3</sup>. By far the largest share of the market, at around 95%, is accounted for by unlisted trading, with roughly three-quarters of trading, according to the estimations of market participants, being conducted by brokers.

The table below gives a breakdown of turnover for 2002:

		Share in Total Market	Share in Listed Market
<b>Total Market</b>	<b>2,980 TWh</b>	<b>100%</b>	
of which OTC	2,831 TWh	95%	
of which listed	149 TWh	5%	100%
EEX spot market	32 TWh	1.1%	21.5%
EEX futures market	117 TWh	3.9%	78.5%

A market price of roughly €25.5/MWh (average spot price in 2002) gives a total market volume of approximately €76 billion.

#### Listed products

In the past few years, a large number of stock exchanges have been established as spot and futures markets.<sup>4</sup> Typical market players are the electricity producers, power distributors, energy traders and brokers as well as major customers and end-users.<sup>5</sup> Banks are becoming more and more involved in this market in Germany. The banks initially provided clearing functions and are now increasingly engaged in trading for their own account.

In all cases, the rates of growth are enormous: between 2001 and 2002 the volume

of trading on the EEX increased by around 250%; the increase in the volume of EEX future contracts is even higher (500%).

#### Spot market

When talking about energy spot markets this article refers to what is known as day-ahead block trading, i.e. physical delivery takes place on the next day. Spot trading is generally conducted in baseload and peakload blocks. Baseload refers to the constant delivery of electricity during the period from 0:00 to 24:00 Central European Time of one calendar day into the 220/380 kV level of the supply zone defined by EEX<sup>6</sup>. The "Physical Electricity Index" (Phelix), which is used for analytical purposes below, is an hourly-weighted average price per day. "Peakload" refers the supply of electricity at peak times, although the precise definition varies from one trading centre to another.<sup>7</sup> For

that reason, the levels of the relevant indices are also not directly comparable with each other.

#### Futures trading

At the EEX, participants trade futures on baseload (Phelix Base Index) and peakload (Phelix Peak Index) supply commitments with a supply period of one, three and 12 months.<sup>8</sup> The contracts run for up to three years. The two next-maturing one-month contracts have the highest liquidity. There is only isolated trading in other contracts at present. All contracts are cash settled.

## Assessment of the over-the-counter (OTC) market

As described above, most of traded products and turnover is in unlisted instruments. In the longer established and more highly developed markets, such as in Scandinavia, the share of the OTC market is significantly smaller. It may be assumed that market shares in Germany will shift in favour of stock-exchange trading during the next few years, but that the dominance of the OTC market will be upheld. The exchanges play a crucial role in the establishment of clearing houses, however, which also transact OTC business,<sup>9</sup> thereby significantly reducing the counterparty risks of the trading parties involved.

Besides standardized products, which are likewise OTC-traded, there are many different contracts based on individual hours or hourly blocks. What is striking is that a number of OTC contracts have very long maturities (up to 30 years). In order to take account of macroeconomic factors, there is often an index-linking to variables such as the unemployment rate or even reinforced concrete indices, etc. Linking to partial substitutes, such as aluminum indices, is also quite common.

Recently there has been a large increase in the range of OTC products. A non-exhaustive list would include forwards and timetable deliveries, a detailed form or combination of forward contracts and full deliveries of electricity, which set the volumes of electricity delivered according to need. As a rule, these contracts are delivered physically.

Additionally, there are a number of derivative products, such as swaps, calls or caps and puts or floors based on exchange-traded indices or other instruments. In this connection, weather derivatives are also traded to reduce the risks arising from the weather, as well as environment certificates or green certificates, which provide the possibility of trading, say, contributions to carbon dioxide emissions against energy from regenerative sources,<sup>10</sup> and cross-commodity products.

## Analysis of the market data

### General preliminary remark

A number of different problems arise in obtaining adequate market data for the stock exchanges. It must be noted that the definition of the baseload and peakload indices varies from one exchange to another. Furthermore, there is the problem that, in the case of the baseloads, a quotation is made every Friday for the entire weekend, ie there are de facto prices for Saturday and Sunday which are not attributable to trading activity on those days. For that reason, the prices towards the weekend display specific patterns<sup>11</sup>. Much the same applies to public holidays.

An additional problem consists in the still prevalent illiquidity of stock exchange trading, which is due to the oligopoly of energy suppliers (German utilities RWE and E.on together account for roughly 60% of the production capacity for Germany). On 18 December 2001, for example, the prices in intraday trading soared by around 2,500%. In the view of market players, this was due to the fact that a small number of producers that dominate the market wanted to "test" their influence and market position.<sup>12</sup>

Price-formation models currently used by market participants are usually based on assumed mean-reversion processes for the underlying instrument, i.e. electricity.<sup>13, 14</sup> These models which, when presented in a simplified form, assume that the price fluctuates around a constant mean level and tends to take this price again if there are deviations. The fact that electricity cannot be stored has to be given due consideration in terms of price formation.<sup>15</sup> In practice, the inherent peaks on the electricity markets are included in the prices by way of diffusion processes (eg Poisson processes). In principle, however, the functional dependence of the forward products on spot trading is questionable.

The following study was undertaken, as mentioned above, on the basis of freely accessible data. On grounds of comparability,

baseload products were used to give an account of the spot markets. Peakload products display a higher volatility, but the fundamental results of the analysis are transferable.

The time series for spot markets starts on 2 January 2001. For future markets it begins on 1 March 2001. All series end on 31 December 2002. Around 500 data items per time series are included in the calculations. The weekend data were omitted in all cases, since these are non-stochastic artifacts; no real trading is conducted at weekends or on public holidays (see above).<sup>16</sup>

### Analysis of the spot market data

Fig. 1 shows various international stock exchanges' indexed prices for the baseload indices. It is apparent that these undergo very sharp price fluctuations at irregular intervals. Extreme price fluctuations for individual days can also be observed for US market segments not shown in the chart.<sup>17</sup>

What is particularly striking here is the above-mentioned 18 December 2001 in Germany – a date on which the prices show an extreme spike.

This observation is also shown in Fig. 2 showing the logarithmic returns for the EEX. The market experienced extreme price fluctuations, especially on the aforementioned date of 18 December 2001, which is also obvious in terms of the increase in the relevant measured volatility.<sup>18</sup>

For the purpose of comparability, the average volatility of the daily log returns during the observation period was determined as an initial risk variable using the estimator described above in the various international spot markets (see table below). The respective maximum and minimum are given in the table in order to compare the sharp fluctuations, which are also expressed by this risk variable.

Figure 1:

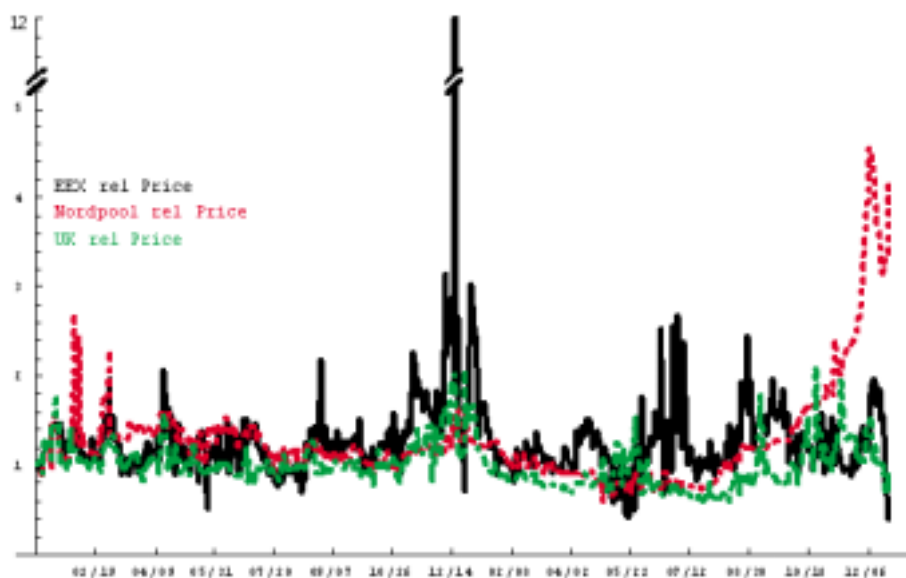


Fig. 1: Indexed price movements of various stock exchange indices in the period from 2001/01/02 to 2002/12/31.

This emphasizes the high volatility in relation to other markets:

Market	Avg. day ahead of baseload daily volatility of the log returns (max/min) <sup>19</sup>
Germany (EEX)	24.6% (46.1%/11.4%)
Nordic	8.5% (26.2%/2.9%)
United Kingdom	12.8% (21.5%/4.5%)

Figure 3 shows the distribution of the one-day log return for each stock exchange centre in a histogram.

The rare and very extreme fluctuations on the flanks of the empirical distribution are highly visible. In comparison with the relevant estimated normal distribution, which is likewise shown for purposes of illustration in the diagrams, the distributions, without exception, have a narrower centre of distribution with a sharp rise and very much stronger flanks (higher leptokurtosis). Hence, in general, the assumption of a normal distribution cannot be upheld.

Figure 2:

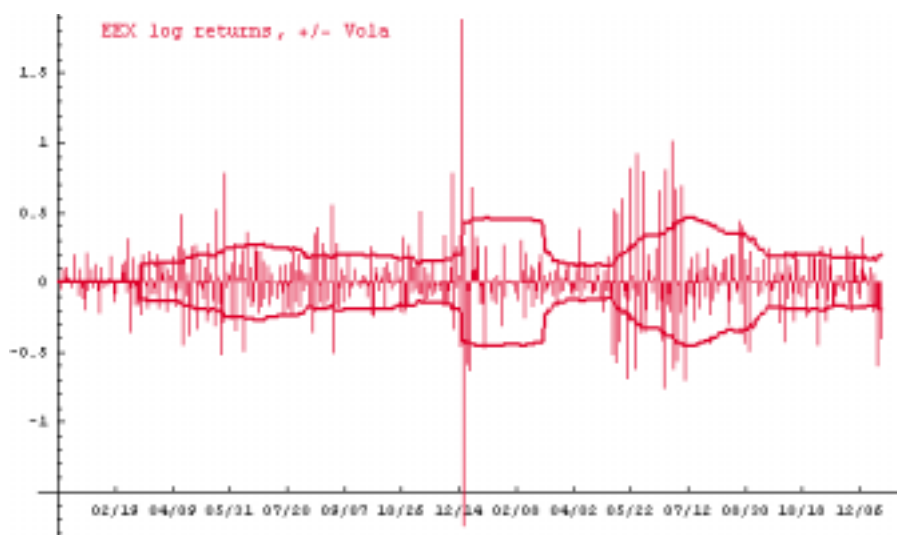


Fig. 2: Log returns of the baseloads for EEX; estimation of volatility in the period from 2001/01/02 to 2002/12/31.

#### Analysis of the forward market

The analysis was based on the time series for the generic one-month future EEX<sup>20</sup> between 1 March 2001 and 31 December 2002. It is worth noting that the underlying of the future is not a one-day-ahead product as in spot trading but a delivery commitment over a period of one month.

The analysis shows that the price movements that can be observed on the spot markets are not – or are, at most, indirectly – transferred to the forward markets (Fig. 4 and 5). This is due to the fact that short-term fluctuations in supply and demand have a direct impact on the spot market, while such day-specific influences are scarcely noticeable on the forward market. In electricity trading, the arbitrage transactions that occur in such cases with other trading instruments are not possible. Owing to its physical properties, electricity is difficult to transport<sup>21</sup>

Figure 3:

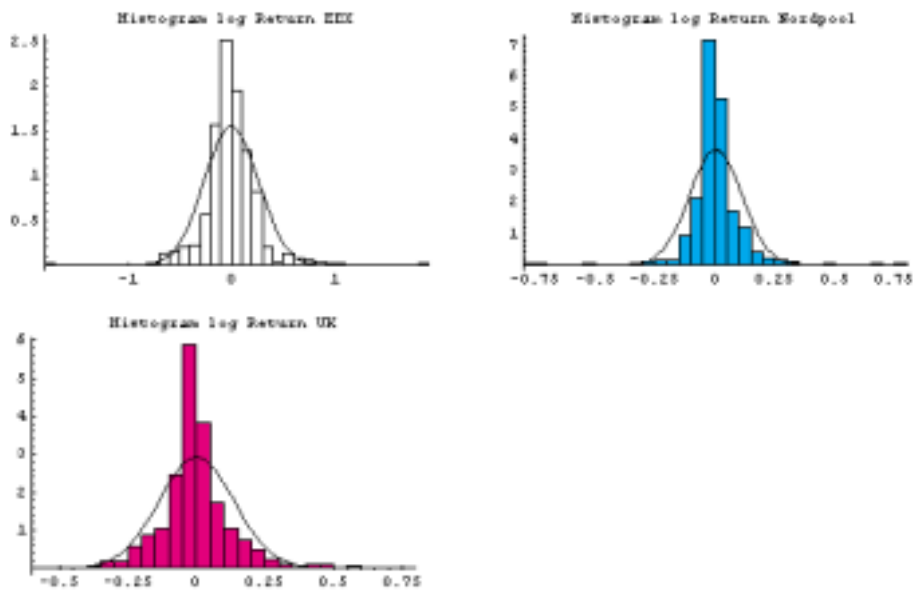


Fig. 3: Histograms of the log returns for all three markets

and cannot be stored. This means that the necessary conditions for “cash and carry” arbitrage are not met.

If the same estimator is assumed as above, significantly lower volatilities are obtained for the forward products. The average daily volatility in the observation period was 2.5%, with a maximum value of 6.3% and a minimum value of 0.9%.

#### Correlations between the analyzed markets

The empirical correlation measured during the observation period makes explicit what is already suggested by the physical properties and the network infrastructure. Since existing capacity limitations mean that the markets, despite liberalization, cannot be directly adjusted to compensate for shortages (ie electricity from the United Kingdom cannot simply be delivered to Germany, for example), the markets are largely uncorrelated.

The empirical correlation matrix of log return is shown below:

	EEX	Nordic	United Kingdom
EEX	100.0%	5.2%	9.2%
Nordic	5.2%	100.0%	6.7%
United Kingdom	9.2%	6.7%	100.0%

#### Conclusion

The past two years have witnessed the emergence of a new market segment in which not only – and primarily – financial services institutions are active but also, to an increasing extent, internationally operating banks are becoming involved. As noted, in many respects the markets for energy trading and energy derivatives do not operate like the classical financial markets. The analysis focused on a description of the markets, the products and the stochastic properties of the analyzed financial instruments. In order to take account of this from a supervisory point of view, it is a great advantage to implement a risk-sensitive procedure for

Figure 4:

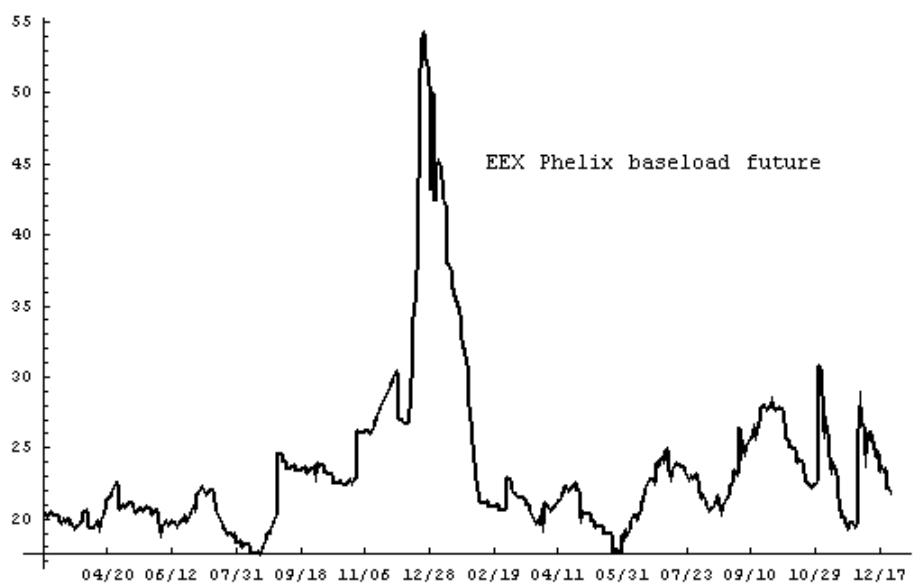


Fig. 4: Time series of the EEX Phelix baseload future contract from 2001/03/01 to 2002/12/31

Figure 5:

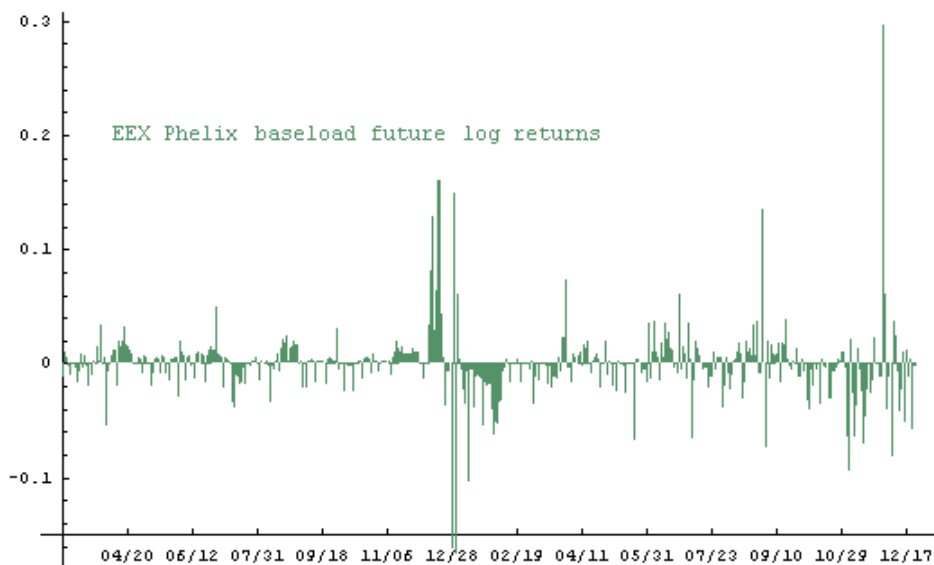


Fig. 5: Time series of the EEX Phelix baseload future log returns from 2001/03/01 to 2002/12/31

Figure 6:

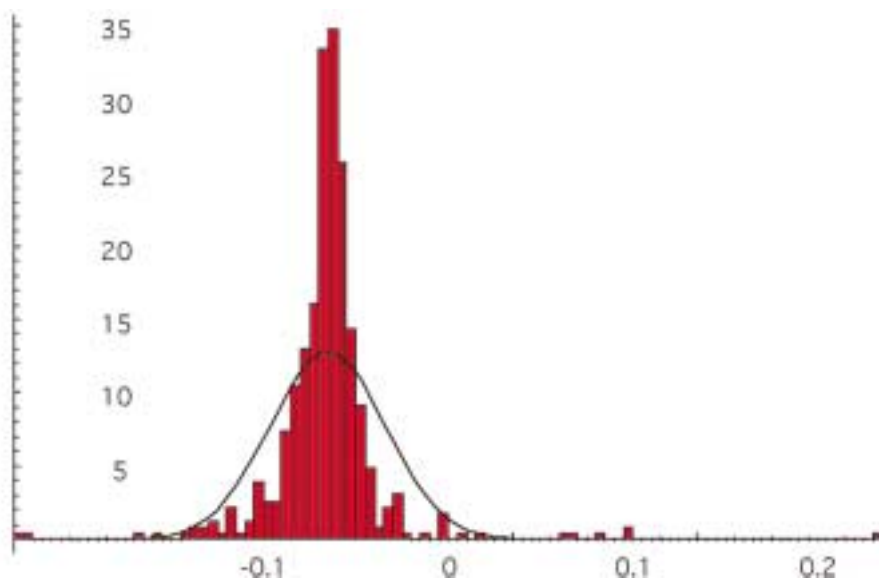


Fig. 6: Histogram of the log returns of the EEX Phelix baseload future.

purposes of calculating the capital adequacy requirements.

The existing prudential regulatory approach in Germany, however, lacks the flexibility to accommodate these particular features. In the next issue of the Capital Markets Newsletter, the authors will present a potential regulatory treatment for energy trading.

–Thomas Morck, Carsten S. Wehn<sup>22</sup>

Footnotes

<sup>1</sup> At the beginning of 2002, the two German exchanges merged to form the European Energy Exchange (EEX) based in Leipzig.

<sup>2</sup> Enterprises that provide financial services to others commercially or on a scale that requires a commercially organized business.

<sup>3</sup> See Marquardt, T.; Eichholz, D.: Ein Vorbild für Deutschland [A model for Germany], in *Marktplatz Energie* (4) 2001, p 16

<sup>4</sup> Examples are EEX (European Energy Exchange) in Germany as well as APX (Amsterdam Power Exchange), OMEL (Spanish Power Exchange), EXAA (Energy Exchange Austria) etc.

<sup>5</sup> On the EEX, there are at present around 120 participants in trading from 12 countries (including eight banks) admitted on the integrated spot and forward market.

<sup>6</sup> In addition it is possible to agree on delivery at a certain hour on the next day.

<sup>7</sup> EEX speaks of the period from 9am to 8pm CET.

<sup>8</sup> In the case of energy futures, there is the special feature of cascading, i.e. a future is replaced by futures of an equivalent value with shorter delivery periods. The quarterly and one-year futures on the EEX cascade on their maturity date into futures of shorter delivery periods. For example, the one-year future is replaced on its maturity date by three monthly futures (January to March) and three quarterly futures (second



to fourth calendar quarter). The quarterly future is replaced on its maturity date by three monthly futures. This special feature of commodity futures is intended to enhance liquidity in the individual contracts.

<sup>9</sup> Besides its activities as a central counterparty for exchange traded spot market and future market transactions, EEX provides a clearing facility for OTC forward contracts. Since January 2003, Clearing Bank Hannover AG – the clearinghouse of the Hannover Commodity Exchange – has also been providing a clearing service for OTC trading. Press release, 2002/12/04: *EEX verzeichnet starke Nachfrage nach OTC-Clearing* [EEX: Strong demand for OTC clearing] / press release, 2002/12/02: *News for the Live start*.

<sup>10</sup> Known as RECS (Renewable Energy Certificate System) contracts.

<sup>11</sup> For the purposes of the analysis below, the spot prices for delivery on a weekend are not taken into consideration.

<sup>12</sup> See Schaubert, D.: *Der liberalisierte Strommarkt hat kurz versagt* [The liberalized electricity market has temporarily failed], in: *Börsenzeitung*, 2002/01/11.

<sup>13</sup> See Philipovic, D.: *Energy Risk, Valuing and Managing Energy Derivatives*, NY, McGraw-Hill, 1998.

<sup>14</sup> See Ditzte, T.; Riebschläger, S.: *Spotpreis-Simulationen auf Basis stochastischer Prozesse* [Simulating spot prices based on stochastic processes], in: *Marktplatz Energie* (5) 2002. The authors simulate a stochastic process with a mean reversion component, a random component, an autoregressive component and a jump component:

$$S_{t+1} = \mu_t + (1 - \alpha) \cdot (S_t - \mu_t) + \sigma_{p,T} \cdot \varepsilon_t + \mu_{st} + J \cdot \varepsilon_{Bt}$$

In addition, they observe that the simulated spot prices have to be adjusted by a “day of the week”-factor.

<sup>15</sup> See Geman, H.; Vasicek, O.: *Plugging into electricity*, RISK (8) 2001. The authors work with diffusion processes and mainly highlight the differences from storable underlyings and the characteristic features of extreme price movements (spikes) in the energy markets.

<sup>16</sup> See also Federico, T.: *Gesichert in die Unsicherheit* [Secured into uncertainty], *Marktplatz Energie* 5-6/2001, p 23 ff. The author describes the effect of “public holiday adjustment”.

<sup>17</sup> See Geman, H.; Vasicek, O.: *Plugging into electricity*, RISK (8) 2001.

<sup>18</sup> As an estimator, the commonly used estimator for the standard deviation was used with the inclusion of a moving window in the order of 50 days:

$$\sqrt{\frac{1}{51} \sum_{i=1}^{50} \left( r_i - \frac{1}{51} \sum_{i=1}^{50} r_i \right)^2}$$

<sup>19</sup> In this analysis, the average volatility of daily log returns is provided. This means that entries in the table are not annualized. To give a comparison: For a stock index like e.g. the German blue chip index DAX 30 the average volatility of the daily log returns in this period is approximately 2.2%.

<sup>20</sup> The greatest information content is generally contained in the next-maturing future. In order to obtain a time series based at each point in time on the future with the greatest information content, the next-maturing futures of each month are linked with each other in the case of the generic so that longer time series are obtained. On the rebasing dates, which equate to contract maturities, this always produces a peak in the time series, which is caused by the change from one contract to the next one and is not due to a market movement. For the purposes of the present study, this effect was therefore filtered out.

<sup>21</sup> It is to be assumed that only transfers up to around 400km (ca. 250 Miles) are still profitable. Greater distances, with

transformation to other voltages, etc entail costs that are too high.

<sup>22</sup> Thomas Morck and Carsten S. Wehn work in the Banking and Financial Supervision Department of the Deutsche Bundesbank and are both involved in the approval of banks’ internal risk management models. Nevertheless, all statements made in the present article represent the authors’ personal opinions and do not necessarily reflect the views of the Deutsche Bundesbank.

E-mail: thomas.morck@bundesbank.de, carsten.wehn@bundesbank.de

## INTERAGENCY ADVISORY ON MORTGAGE BANKING

Record low interest rates have created an unprecedented wave of mortgage refinancing. New technology and streamlined processes have made refinancing easier than ever. When this increase in refinancing is added to the continued rise in first time homebuyers, the output of mortgage product from financial institutions has been at record levels. While mortgage loans exhibit some of the same characteristics as other types of loans (credit worthiness, for example) they also present some different risks. The *Interagency Advisory*<sup>1</sup> focuses on the risks that are specific to mortgage lending: risks associated with valuation and modeling processes, hedging activities, management information systems, and internal audit processes. The guidance highlights regulatory concerns and provides direction to examiners and bankers regarding the supervision of mortgage-banking activities, especially in the valuation and hedging of mortgage-servicing assets (MSAs).

One salient characteristic of mortgage lending is the creation of a separate servicing asset when mortgages are securitized. Mortgage loans made by banks and thrifts are frequently sold in the secondary market to the Federal National Mortgage Association, the Federal Home Loan Mortgage Corporation, the Federal Home Loan Banks, but also to private sector issuers and investors. Institutions that sell mortgages can retain the servicing and under FAS 140, the accounting rule governing such sales, must recognize an asset based on the expected value of the income stream received from servicing activities. MSAs can be complex and volatile assets and their value can be significantly affected by changes in interest rates. MSAs can become impaired (be worth less than their book value) when interest rates fall and borrowers refinance or prepay their mortgage loans. Because current accounting rules require these changes in value to be recognized in earnings<sup>2</sup>, such impairment can lead to earnings volatility and erosion of capital, if the risks have not been properly hedged.

FAS 140 places a number of strictures on the generation of MSAs. Specifically, institutions must:

- Record servicing assets at fair value, either the price paid if purchased, or at an amount based on relative fair values if retained in a sale or securitization;
- Amortize servicing assets in proportion to, and over the period of, estimated net servicing income; and
- Stratify servicing assets based on one or more predominant risk characteristics of the underlying financial assets.

Each of these points embodies concepts that challenge institutions generating MSAs. Fair value is defined in FAS 140 as the amount at which an asset can be bought or sold in a current transaction between willing parties. Actual market prices in active markets provide the best indication of fair value and must be used, if available. Otherwise, the estimate of fair value must be based on the best information available, considering prices for similar assets and the results of appropriate valuation techniques. During the recent refinancing wave, the market for MSAs has become moribund, which means that most institutions have been forced to rely more heavily on their models for valuation.

The bulk of the MSAs are based on mortgages with a contractual life of 30 years. However, it would be inappropriate to amortize MSAs over an equivalent period. The expected life of a mortgage and thus the cash flows it generates is far shorter. The appropriate period is a matter of judgment. This choice has a major impact on the results of value estimations using models.

The concept of strata is key to valuation. The number of strata will affect the degree of impairment, with fewer strata likely to mean less impairment for a given portfolio of mortgages. However, except for its nonspecific guidance

regarding risk characteristics, FAS 140 does not identify the appropriate number of strata, which may range from as few as four to a dozen or more.

The guidance focuses on the expectations the federal banking regulators have regarding those institutions that generate and manage MSAs. The guidance states that “[T]he banking agencies expect institutions involved in mortgage-servicing operations to use market-based assumptions that are reasonable and supportable in estimating the fair value of servicing assets.”

The guidance provides a list of practices that, if encountered by examiners, indicate that closer scrutiny of the institution’s MSA valuation practices is warranted.

Because MSAs have interest rate-related option characteristics that could impact an institution’s earnings and capital strength, institutions engaged in mortgage-banking activities should fully comply with all aspects of their primary federal regulator’s interest rate risk policy. Risk management considerations include the potential exposure of both earnings and capital to possible changes in the value and performance of MSAs. To be consistent with the Interagency Statement on Interest Rate Risk (SR 96-13), an institution’s board of directors must establish limits on investments in mortgage banking assets and evaluate and monitor such investment concentrations (related to both asset and capital levels) on a regular basis.

The guidance identifies the expectations the federal regulators have regarding overall risk management practices as they apply specifically to MSAs in the areas of:

- Valuation and modeling processes
- Mortgage banking hedging activities
- Management information systems
- Internal audit.

The guidance finishes by noting that in our supervision of mortgage-banking operations, the primary objective of the banking agencies is to ensure that institutions implement satisfactory policies, procedures, and controls addressing the risks inherent in such activities. Institutions with significant exposures to MSAs should expect greater scrutiny during examinations. The banking agencies may also require additional capital for institutions that do not follow the sound practices set forth in the advisory.

–Craig West

<sup>1</sup> The guidance has been issued by the Federal Reserve System as SR 03-04.

<sup>2</sup> FAS 140 accounting for MSAs is not symmetric. MSAs are valued at the lower of cost or market (LOCOM). Thus, while declines in value (impairment) will lower earnings, increases in value will not add to earnings unless the MSA is currently valued below book.

## Practices Suggesting the Need for Closer Scrutiny

The use of unsupported prepayment speeds, discount rates, or other assumptions.

Questionable, inappropriate, or unsupported items in the valuation models, such as retention benefits, deferred tax benefits, captive reinsurance premiums, or income from cross-selling activities. The inclusion of these items could result in an overstatement of the value of MSAs and therefore will be deemed an unsafe and unsound practice.

Disregard of comparable market data combined with over-reliance on peer group surveys to support assumptions and the fair value of MSAs.

Frequent changing of assumptions from period to period with no compelling reason for the change, and undocumented policies and procedures relating to the MSA valuation process and oversight of that process.

Inconsistencies in MSA valuation assumptions used in valuation, bidding, pricing, and hedging activities.

Poor segregation of duties from an organizational perspective between the valuation, hedging, and accounting functions.

Failure to properly stratify MSAs for impairment testing purposes. Institutions are expected to identify a sufficient number of risk characteristics to adequately stratify each MSA and provide for a reasonable and valid impairment assessment. Stratification practices that ignore predominant risk characteristics are a supervisory concern.

Inadequate amortization of the remaining cost basis of MSAs, particularly during periods of high prepayments. When valuation models underestimate runoff, the amount and period of estimated net servicing income are overstated.

Continued use of a valuation allowance for the impairment of a stratum of MSAs when repayment of the underlying loans at a rate faster than originally projected indicates the existence of an impairment for which a direct write-down should be recorded.

Failure to assess actual cash flow performance.

Failure to validate or update models for new information. Models should be inventoried and periodically revalidated, including an independent assessment of all key assumptions.

FEDERAL RESERVE BANK  
OF CHICAGO

---

P.O. Box 834  
Chicago, Illinois 60690-0834

**RETURN SERVICE REQUESTED**

*Publisher—Adrian D’Silva*  
(312) 322-5904

*Co-Authors—Matt Foss*  
(312) 322-4780 and  
*Craig West* (312) 322-2312

Capital & Market Risk Insights  
Capital and Market Risk Group  
Federal Reserve Bank of Chicago  
P.O. Box 834  
Chicago, Illinois 60690-0834