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Market Risk Management in Emerging Markets: the Case of Western Balkans*

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Abstract

Risk models that are routinely used in the banking sectors of the developed financial markets might give misleading results when applied to emerging markets. This paper analyzes what are the major sources of these discrepancies, and how the risk measures may be improved. Apart from some technical issues, such as lack of historical data, the principal problem for the conventional approach mainly lies in a serious lack of liquidity. We propose a simple way to improve standard risk assessment techniques to incorporate liquidity risk. The improved measure is based on an adjustment of Value at Risk and outperforms the unadjusted measure for market risk exposures that are typical for Emerging Europe. The second and often neglected issue that we address in this paper is the interaction between market and credit risk in foreign currency loans. We analyze how the likelihood of default of a foreign-currency borrower may substantially increase in case of a significant depreciation of the local currency. Our results indicate that an appropriate risk measure and must integrate both market and credit risk. This has some important implications for the current regulatory framework, especially vis-à-vis the capital requirements imposed by central banks in Emerging Europe.

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Non-technical summary

In this paper we study whether imposing rigid risk modeling standards at headquarters of Western financial institutions identical for all subsidiaries makes sense from the point of view of local subsidiaries in the European emerging markets. Banks in emerging Europe can be roughly divided into two groups: (1) those that have to follow almost the same reporting standards as their mother banks, and (2) those that have full freedom in implementing their own risk models with the main purpose to comply with the local regulations. Both of these approaches may have serious implementation issues. Specifically, banks that try to implement risk models developed for the financial institutions in the Western Europe have problems in transfer of knowledge due to incompetence of local employees. Also, several models easily implementable in developed markets yield misleading results when applied to emerging markets. The most important among them are yield curve models, portfolio optimization models and conditional heteroskedasticity models used for estimation of Value at Risk. Sources of the discrepancies mainly lie in serious liquidity issues, lack of historical data and obsolete and often self-contradictory legal environment in the emerging countries.

Banks that have full freedom in developing their own risk models face a different set of issues, mostly because the lack of human capital prevents them to develop their own models. Also, lack of interest in the academic community and lack of literature that would cover all the legal deviations present in the emerging markets, coupled with the previous point, create an unavoidable obstacle for those trying to manage their risk in a more appropriate way.

Although financial crises have clearly shown that Western investment funds and banks also tend to be vulnerable to liquidity risk, the situation is even more dramatic in the emerging markets. The data from Croatia and (especially) Serbia indicate that demand is scarce even for basic investment categories, such as stocks or government bonds. Also, derivative markets are still very undeveloped in the emerging Europe. This is another contrast with the Western Europe, where banks have substantial exposures to over-the-counter instruments, such as interest rate or currency swaps, forward rate agreements, currency forwards, asset-backed securities, credit default

swaps, etc., although these exposures became significantly reduced after the subprime crisis.

The principal difference between developed and emerging financial systems in Europe is therefore the size of the trading books (on- and off-balance-sheet) relative to the banking books. Small trading books imply that most of the assets are, for all practical purposes, illiquid. Consequently, this has some important effects on the ability of banks to hedge their risk exposures, especially market risks in the banking book. The absence of timely price discovery points to the necessity for adequate methods of pricing and risk modeling. In particular, risk measures such as VaR should be adjusted to account for liquidity risk.

Finally, we analyze how the likelihood of default of a foreign-currency borrower may substantially increase in case of a significant depreciation of the local currency. We present a very simple toy model of the mechanism of transfer of currency into credit risk. Our results indicate that the tradeoff between the exchange rate risk and credit risk is a very important, first order, effect in Western Balkan countries, especially in the largest countries such as Serbia and Croatia. The shear size of the problem requires a coherent response from the regulators and the banking industry. In particular, alternative arrangements need to be considered including hedging of domestic currency loans with exchange rate derivatives, instead of pegging the loan contracts to Euros or Swiss Francs.

1 Introduction

With the globalization of capital markets, emerging market economies have relied more on foreign finance and their economies have become vulnerable to sudden outflows of capital. For example, financial crises related to abrupt exchange rate movements in emerging markets have either been caused or aggravated by excess unhedged foreign currency liabilities of the banking sector in these countries.

In many countries, the growth of the banking sector has been accompanied by a significant increase in foreign capital participation, which can lead to improved risk management practices. Parent banks are also a possible source of direct financial support at times of crisis. However, financial systems of emerging markets often face challenges not typically found in developed economies.

In this paper we study whether imposing rigid risk modeling standards at headquarters of Western financial institutions identical for all subsidiaries makes sense from the point of view of local subsidiaries in the European emerging markets. Banks in emerging Europe can be roughly divided into two groups: (1) those that have to follow almost the same reporting standards as their mother banks, and (2) those that have full freedom in implementing their own risk models with the main purpose to comply with the local regulations. Both of these approaches may have serious implementation issues. Specifically, banks that try to implement risk models developed for the financial institutions in the Western Europe have problems in transfer of knowledge due to incompetence of local employees. Also, several models easily implementable in developed markets yield misleading results when applied to emerging markets. The most important among them are yield curve models, portfolio optimization models and conditional heteroskedasticity models used for estimation of Value at Risk. Sources of the discrepancies mainly lie in serious liquidity issues, lack of historical data and obsolete and often self-contradictory legal environment in the emerging countries.

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The remainder of the paper is structured as follows: Section 2 takes a broad look at current trends in risk management that prevail in developed markets. Section 3 discusses the problems that arise when standard risk modeling framework is applied to European emerging markets. In particular, we focus on the differences between a typical balance sheet structure of financial institutions in the Eurozone and West Balkans (WB). We argue that risk measures such as VaR have to be adjusted to account for other sources of risk that may be less pronounced in the developed markets. Section 4 addresses another the issue of interaction between market and credit risk in foreign currency loans, while Section 5 provides concluding thoughts and some policy implications.

2 Risk modeling standards

The future is uncertain and unpredictable. The risk of an undesirable event is always present: it cannot be avoided in any business, and financial industry is no exception. However, the financial risk that arises from uncertainty can be managed. The ability to identify risk, to measure it, to appreciate its consequences and to take action accordingly is one of the most important issues in modern finance.

The concept of risk management, in a broad sense, can be thought of as a scientific approach to dealing with risk. Although the actual practice of dealing with risks has been present since the very beginning of trade, quantitative risk management in modern corporations is a relatively recent practice – its application started in the 1950s. The first financial theorist who explicitly included risk in his work was Harry Markowitz. His approach, known as Modern Portfolio Theory, was quickly followed by other developments, such as Fischer Black's option pricing theory, Black, Merton and Sholes formula, derivation of the concept of Value at Risk, etc. The concept of

risk management has been changing its definition and interpretations since, according to the ongoing trends and achievements in the finance theory.

The practice of risk management is evolving at a rapid pace, especially with the ongoing implementation of the latest regulatory standards of the Basel Committee on Banking Supervision issued in the revised Capital Accord, known as Basel II. Basel II is primarily designed to set standards for risk management to ensure the adequate capitalization of banks. However, in many ways the regulation of non-bank financial intermediaries, such as pension and mutual funds, insurance companies and securities firms, parallels that of banks. These institutions have to deal effectively with similar sources of financial risks, and therefore methods proposed by Basel II are to a large extent relevant for them as well. But besides the regulatory initiative, an increasing demand for higher standards of risk management and disclosure of risk appears among shareholders and other stakeholders of an institution. Without a doubt, risk consciousness has become a defining characteristic of modern business, especially in financial services industry.

Basel II provides a stimulating framework for institutions to develop their own risk management systems. More precisely, according to Basel II, banks have the option to use their own risk measurement models to determine their capital charge. The rationale for allowing the use of internally developed models is that banks are in a position to produce more accurate measures of their individual risk exposure. This applies to other financial institutions as well: by knowing their own investment policies and their overall portfolio composition, institutions can measure their risk exposure with highest precision.

The Basel Committee on Banking Supervision defines the four main tasks of the risk management process as: identification, assessment (“measuring”), monitoring and control/mitigation of risks. Identification of sources of risk is an essential first step in risk management. Recognizing the risks in a complex environment where modern financial institutions run their businesses is not simple and straightforward, and overlooking or ignoring risks may easily occur. This creates the need for an attentive identification process, i.e. a precise definition and delineation of all sources of risks. After risk factors have been identified, risk exposures can be estimated and the effects

of these exposures can be assessed. Assessment refers to designing a statistical model for quantifying possible gains or losses resulting from movements in risk factors. The risk assessment model has to rely on a coherent set of assumptions. Specification of risk factors may necessitate the use of a significant number of parameters, and has to satisfy all of the qualitative and quantitative standards imposed by regulators. Monitoring refers to the updating and reporting of information obtained in the assessment process. The more frequently the risks are reassessed, the more relevant information can be collected over time. This serves as a basis for forming risk mitigation strategies.

One should not think about risk in defensive terms alone. Mitigation of risk has a goal to achieve the optimal balance between risk and return and involves active selection of the type and level of risk. The ability to make forward-looking choices about risk in relation to reward lies at the heart of the management of all enduringly successful organizations.

Rapid innovations in financial markets and the internationalization of financial flows have significantly changed the face of financial services sector. The growth of financial markets and a greater diversity of financial instruments have provided institutions with a wider access to funds, and, at the same time, created opportunities to design new products and services. By the same token, widening the scope of activities of financial firms has created new sources of risk.

Classification of risks is not unique or completely straightforward. However, the latest categorization adopted by Basel Committee on Banking Supervision classifies major risks into the following three categories:

- Credit risk: the risk of loss following a change in the factors that drive the credit quality of an asset. These include adverse effects arising from credit grade migration including default, and the dynamics of recovery rates.
- Market risk: the risk of losses arising from changes in market risk factors. Market risk can arise from changes in interest rates, foreign exchange rates, or equity and commodity price factors.
- Operational risk: the risk of financial losses resulting from a host of potential

operational breakdowns that we can think of in terms of people risks, process risks, and technology risks (e.g., frauds, inadequate computer systems, a failure in controls, a mistake in operations, a guideline that has been circumvented, or a natural disaster).

- Understanding various types of risks is important because each category demands a different (but related) set of risk management skills. The categories are often used to define and organize the risk management functions and activities within an institution. But, as much as this classification is useful from the organizational perspective, it also brings the danger of missing some elements of risk and creating gaps or overlapping in responsibilities. To avoid this effect, many of the recent initiatives have aimed to break down the rigidity of risk management organization. Risk measurement tools such as Value at Risk and economic capital have been designed to facilitate unification of measurement and management of the various risks – market, credit, and operational.

In many industries, including financial services, a broad tendency toward the integrated system of risk management is labeled as enterprise risk management (ERM). Basically, ERM is an attempt to break through the tendency of firms to ignore the overall picture of risk in its full complexity, with numerous inter-dependencies between various risk types. It is also an attempt to take risk into consideration in business decisions much more explicitly than has been done in the past. ERM represents a convergence of differing measurement tools and aggregation techniques for risks faced by an institution, and the integration of analytics, management and technology.

As a trend, ERM is clearly in tune with a parallel drive toward the unification of risk, capital, and balance sheet management in financial institutions. Over the last years, it has become increasingly difficult to distinguish risk management tools from capital management tools, since risk increasingly drives the allocation of capital in risk-intensive businesses such as banking and insurance. Similarly, the tight connection between capital management and ALM management has arisen in financial institutions' operations, since the risk-reward relationships increasingly drive the structure of the balance sheet.

Proprietary trading has recently become one of the main activities of financial institutions. In an environment with unstable economic performance and volatile asset prices, this activity brings a significant amount of market-related exposures to risk. Therefore, the need has arisen for management systems to control and the capital to absorb those risks. As witnessed with subprime mortgage markets in 2007, if a risk is not properly managed, especially in large internationally operating banks, very significant losses can occur for the institution itself, sometimes even spreading to a broad financial disturbance.

As a specific type of risk, market risk gained a high profile when the Basel Committee on Banking Supervision published "The Supervisory Treatment of Market Risks" in the April of 1993. Although this consultative proposal was heavily criticized and has since been superseded, it was important because it sought, for the first time, to extend the 1988 Capital Accord for credit risk to incorporate market risk. Since then, treatment of market risks has been an inevitable part of any regulation system for financial institutions.

The latest regulatory standards related to market risk are published in the revised Capital Accord, known as Basel II, issued by the Basel Committee on Banking Supervision. According to Basel II, market risk is defined as the risk of losses in on- and off-balance-sheet positions arising from movements in market risk factors. The main sources of market risk are the risks pertaining to interest rate related instruments and equities, foreign exchange risk, and commodities risk. The behavior of these risk factors is not completely predictable, making management of market risk a complex procedure. General tasks of risk management function defined by Basel II – identification, assessment, monitoring and mitigation of risk – are accompanied by backtesting, what-if analysis and stress testing.

According to Basel II, market risk management should be conducted as a regular activity of a financial institution, under the jurisdiction of the risk management unit and independently from the trading sector. In order to efficiently deal with market risk, the unit needs to have access to all of the relevant portfolio information as well

as market data. By knowing the exact structure of the trading portfolio, risk managers may be in a position to value and aggregate positions in various assets in order to identify exposures to all of the relevant market risk factors. The Basel Committee strongly favors the mark-to-market approach for evaluating positions whenever it is applicable, or mark-to-model approach when marking to market is not feasible.

Assessment of market risk includes adoption of statistical models describing the changes in portfolio value by assigning probabilities to possible outcomes. Advanced models based on the Value-at-Risk (VaR) measurement currently represent the "state of the art" in risk management and they are supported by the Basel II standards. VaR is a comprehensive measure of market risk incorporating exposure to individual risk factors as well as portfolio diversification effects.

The choice of a risk measurement model is far from a "one-size-fits-all" procedure. Institutions adopting internal models have to ensure that their models are adequate, having in mind the types of securities they are investing in and markets where their trading activity occurs. Moreover, the validity of a model can be broken due to changes in investment style or market conditions. One of the tasks of the risk management unit is to choose the most appropriate model for a particular institution and to verify the validity of that model on a regular basis. The procedure designed for model validity verification is referred to as backtesting program. Backtesting represents an ex-post comparison of the risk measure generated by the model against actual data. Using the backtesting procedure, the validity of the model can be monitored continuously. In a case of discrepancy of model predictions and observed data, irregularities are noticed timely and further action can be undertaken such as enhancement of the current model or its replacement with a more appropriate one.

Determining an appropriate risk measurement model enables calculating VaR and VaR-based risk measures. However, this is not the end of market risk assessment. Value-at-Risk is designed to quantify potential losses under "normal" market conditions – it can fail to give an accurate measure of risk under extreme situations characterized by large price jumps, rapid increase of volatility and a breakdown in the correlations among the risk factors. Although the probability of the occurrence of such events is small, neglecting them can lead to severe losses. Methodologies

designed to analyze the possible effects of events lying outside normal market conditions are what-if analysis and stress testing. Regulators view these procedures as a necessary complement to the use of VaR models.

Establishing sound and efficient risk measurement system represents a necessary basis to make well-founded investment decisions. The allocation of funds in a portfolio depends primarily on investors' preferences, in a sense of how much risk they are willing to accept and how large a return they require for the given risk. In addition to that, investors require an efficient allocation of funds, meaning either that the risk is minimized for a desired level of expected return or that the expected return is maximized for a given level of risk. The procedure of forming portfolios with such characteristics is known as portfolio optimization. When portfolio contains a large number of assets, portfolio optimization becomes a challenging computational problem whose solution requires use of sophisticated numerical procedures.

The connection between market risk management and the investment process is very tight. The trade-off between risk and return is inherent to the investment process, making an accurate risk measurement a necessary prerequisite for efficient investing. On the other hand, different investment strategies and styles carry different consequences with regard to risk exposure. Risks have to be quantified and monitored, and strategies for risk mitigation have to be applied in order to decrease the likelihood of large losses. Moreover, under Basel II regulations, market risk is subject to capital requirements, so it is in best interest of financial institutions to have true insight and precise measures of their market risk exposure.

Backtesting serves the purpose of obtaining feedback on the quality and precision of the risk measurement system. An institution using the model-based approach must possess regular, sound, documented, and internally tested procedures for backtesting. Such framework serves to banking regulators and risk managers of financial institutions as a decision making tool for the choice of action concerning the acceptance or rejection of a bank's risk model. Back-tests are a critical part of the risk measurement process, as one relies on them to obtain an indication of potential problems with a risk measurement model.

One way to define backtesting is as a statistical testing framework that consists of checking whether actual trading profit and losses (P/L) are in line with VaR forecasts. It is the process of comparing losses predicted by the value-at-risk (VaR) model to those actually experienced over the testing period. This involves systematically comparing the history of VaR forecasts with their associated portfolio returns.

As the use of VaR extends from pure risk measurement to risk control it is essential that the obtained numbers provide accurate information, and that someone in the financial institution is accountable for producing the best possible risk estimates. In order to ensure the accuracy of the estimates and forecasts, risk managers should regularly back-test the risk models being used, and evaluate alternative models if the results are not entirely satisfactory. The institution is then in the position to select the model that performs the best in such tests. These procedures are essential for VaR users and risk managers who need to check that their VaR forecasts are well calibrated.

Backtesting is also central to the ability of regulators to assess internal risk models of banks and adequacy of such models for the determination of capital requirements. The verification of the model's accuracy through frequent backtesting procedure is described in the appropriate Basel Committee document.[1]

The first requirement in backtesting is to obtain suitable data. The main issue is to properly measure all the parameters that are necessary for the successful implementation of the backtesting. The trading outcome or profit/loss (P/L), that can be defined either as the actual (past) profit/loss or hypothetical (forecasted) next day profit/loss, together with the reported daily VaR, are the main inputs used for backtesting purposes. A problem that arises in using P/L data is that they are typically calculated according to standard principles of accounting prudence. This frequently leads to undervaluation of assets. Furthermore, fluctuations in asset values are smoothed over. Thus, for risk measurement purposes it is often more important that P/L data reflect underlying volatility rather than accounting prudence.

[1] "Supervisory framework for the use of backtesting in conjunction with the internal models approach to market risk capital requirements."

P/L data should be cleaned of components that are not directly related to recent or current market conditions. Such components include:

- Hidden P/L from trades carried out at prices different from the mid bid-ask spread
- Fee income
- P/L earned from other forms of risk-taking (e.g. high yields on bonds with high credit risks)
- Unrealized P/L and provisions against future losses.
- Internal funding regime that underlies the institution's trading activity
- Impact of the intra-day trading on both P/L and risk measures

The Amendment to the Capital Accord defines two different types of backtesting:

- Actual backtesting is obtained from actual positions and actual returns. As such, it is influenced not only by changes in prices of instruments and the corresponding gains or losses, but also by changes in portfolio composition over the selected time horizon. For practical purposes such influence may be somewhat reduced by using small time horizons, such as one day.

- Hypothetical backtesting is obtained from actual returns on all securities, measured for consecutive closing daily prices. In other words, the hypothetical P/L data are obtained by revaluing trading positions from one day to the next as if positions remain unchanged. The purpose of using this type of P/L is to eliminate inconsistencies described above.

In combination, these two approaches are likely to provide sound base for understanding the relationship between calculated risk measures and trading outcomes.

Put simply, the backtesting consists of counting the number of times that the (actual or hypothetical) portfolio P/Ls fall outside the VaR estimate. This number is then compared to the number of exceptions implied by the confidence level used.

The backtesting framework consists of counting the number of negative exceptions (losses larger than estimated VaR) for a given period and comparing them to the expected number for the chosen confidence interval. The number of exceptions is reported for each methodology relevant for the calculation of capital charges (see Reporting).

While VaR models have proven themselves to be very useful risk management tools, they are only valid under assumption of usual market behavior. What happens with a portfolio in periods of high market volatility or significant and abrupt price movements? The answer to this question is given by stress testing. Recent financial debacles have highlighted the need for such tests. Stress testing complements the results of VaR analysis and can be defined as procedures that attempt to gauge the vulnerability of portfolio to hypothetical event(s).

Stress tests also explore a range of low-probability events when VaR limits can be dramatically exceeded. Since stress tests typically do not help us assess the likelihood of such adverse events, they are natural complements to probability-based risk measures such as VaR. Therefore, combination of the two approaches gives as a more comprehensive picture of current and future risks facing the institution or its business units.

The standard approach is to provide a comprehensive approach to stress testing procedures which consists of generating plausible scenarios that are relevant to portfolio positions, followed by revaluation of the portfolio under newly imposed stressed market rates and, finally, aggregating results in order to show expected levels of losses or gains for each stress scenario. The key task during the stress testing process is to get an idea of the sensitivities of a portfolio to the underlying risk factors whose hypothetical changes we are considering.

Thee best is to combine best practices with the state-of-the-art modeling in order to estimate changes in portfolio values and VaRs upon various types of stress. Some changes have straightforward effects (e.g. FX position changes are in one-to-one correspondence with the changes in exchange rates). Several other asset types also parallel the changes in the underlying market risk factor. Instruments that have less

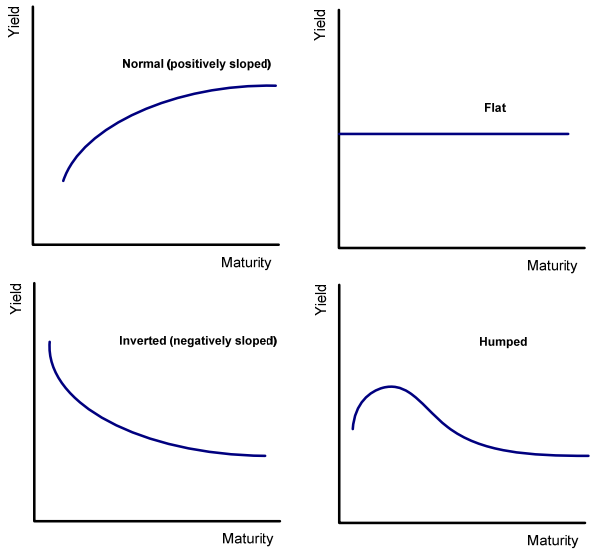
straightforward sensitivities are handled using sophisticated modeling.

What-if analysis practice considers different scenarios or combinations of changes in various risk factors. Once such changes are specified, the calculation engine determines their impact on your current portfolio. Revaluation of the portfolio, based on a specified scenario, is performed using full valuation method. Once the calculation is performed, a comparison is made between the original portfolio value and the new value corresponding to the specified changes in the underlying risk factors. In addition, one can define own scenarios. One should bear in mind, however, that there exists no what-if analysis able to determine the likelihood of different scenarios. You have to use your own judgment when assessing the practical significance and reality of different scenarios. The results of any scenario analyses are highly subjective and depend to a very large extent upon the skill of the analyst.

What-if analysis of a fixed income portfolio is closely related to the notion of interest rate term structure. It helps one to model ad-hoc movements in interest rates term structure in a very flexible way. The complete history of the Treasury zero-coupon yield curves and term structures of other important interest rates, such as Libor and Euribor, is constructed using the available market data. It is advised to continuously monitor the database entries on Treasury securities and constructs the yield curve using the state-of-the-art algorithms. These include the Nelson-Siegel functional, the Svensson's extension and polynomial cubic and quartic splines.

There are four generic shapes of the yield curve that can be usually observed in practice (Figure 1). The most common shape for a yield curve is normal or positively sloped yield curve. A flat yield curve is one in which the yield for all maturities is approximately equal. Downward-sloping yield curve is referred to as an inverted or a negatively sloped yield curve, such that the yield is lower for shorter maturities. Shape of the yield curve has an unpredictable dynamics, that is – evolves over time, which in turn has a direct impact on the fixed income portfolio valuation.

Figure 1. Generic yield curve shapes.



One way to measure the interest rate risk exposure of a fixed income portfolio is to revaluate it whenever the interest rates change. Such analysis usually focuses on the three most relevant types of change: (1) parallel shifts in the level of yield curve, (2) twists in the slope of the yield curve and (3) changes in the curvature of the yield curve. These three factors account for most of the daily variations in the yield curve, and hence are the most relevant ones for assessment of the interest rate risk.

For an illustration, we may want to measure the interest rate exposure on a given date by imposing the following changes in parameters:

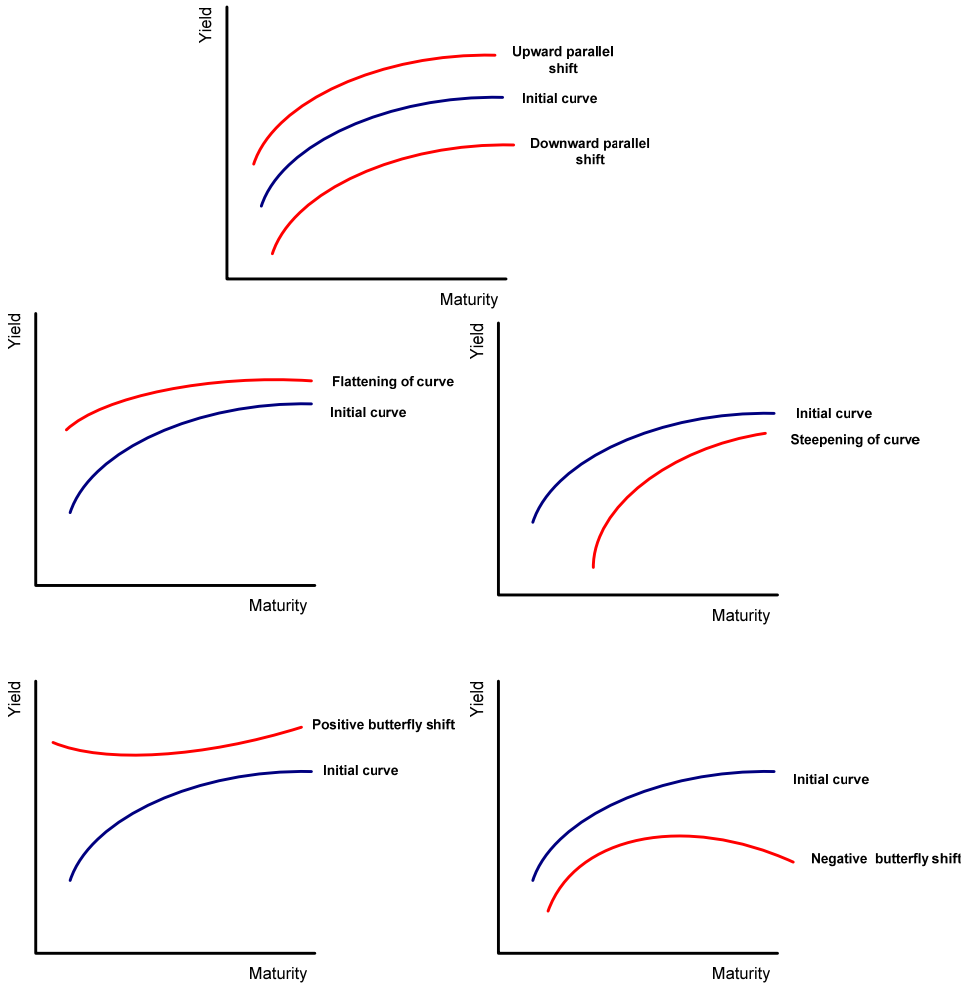
- Parallel yield curve shift + 20 bp
- Twist + 25 bp
- Curvature change – 40 bp

This approach requires revaluation of a fixed income portfolio for a specified interest rate change scenario and is referred to as a full valuation approach. Some of the most common combinations of changes are:

- Parallel shift in the yield curve. This is a shift in which change in the yield for all maturities is the same.
- Nonparallel shift in the yield curve. The yield for different maturities does not change by the same number of basis points. Two common types of nonparallel yield curve shifts are:
    - Twist in the slope of the yield curve refers to a flattening or steepening of the yield curve.
    - Butterfly shifts involve movement of yields at the short maturity and long maturity portions of the yield curve relative to the movement of yields in the medium maturity portion. Such nonparallel shifts in the yield curve that change its primary curvature are called butterfly shifts. If the curvature decreases, this is called a positive butterfly, while if the curvature increases, it is called a negative butterfly.

Figure 2 displays the most common types of changes in the yield curve. Original yield curves are shown in blue, while the ones obtained upon change are shown in red. These typical movements can be obtained by an appropriate combination of changes in shift, twist and curvature parameters. Frequently, one observes a downward shift in the yield curve combined with a steepening of the yield curve. On the other hand, an upward shift in the yield curve is often combined with a flattening of the yield curve. Also there is evidence that positive butterfly shifts tend to be associated with an upward shift in yields, while negative butterfly shifts with a downward shift in yields.

Figure 2. Typical yield curve movements.



3 Risk modeling issues specific to emerging markets

Balance sheets of financial institutions are at the core of the allocation and transmission of risk in any economy. However, financial systems of emerging markets are commonly confronted with challenges not typically found in developed economies. For example, to accommodate loan demand, emerging-market banks typically take foreign credit lines. To attract foreign investors, these banks may offer foreign-currency deposits. They may extend domestic loans in foreign currency to match their foreign-currency liabilities. Sometimes, they may have a large exposure to government paper as a consequence of high public sector deficits. Additionally, supervisory frameworks and practices are often less developed than in advanced economies.

Figures 3–5 illustrate typical differences between aggregate balance sheet structures of financial institutions in the Eurozone on one hand, and Croatia and Serbia on the other. Banking systems of the two emerging economies are evidently based on "traditional" (i.e. credit-deposit) banking, as more than three quarters of total bank assets are held in these two categories. In Serbia, securities comprise merely 1.2% of the assets, while trading in financial derivatives is still negligible. Croatian banks held 8.2% of their assets in securities during 2008, which is relatively close to the level in the Eurozone. However, less than half of these securities were assigned for trade, while the rest were held in the banking books.

Although financial crises have clearly shown that Western investment funds and banks also tend to be vulnerable to liquidity risk, the situation is even more dramatic in the emerging markets. The data from Croatia and (especially) Serbia indicate that demand is scarce even for basic investment categories, such as stocks or government bonds. Also, derivative markets are still very undeveloped in the emerging Europe. This is another contrast with the Western Europe, where banks have substantial exposures to over-the-counter instruments, such as interest rate or currency swaps, forward rate agreements, currency forwards, asset-backed securities, credit default swaps, etc., although these exposures became significantly reduced after the subprime crisis.

Figure 3. The aggregate structure of balance sheets for banks in the Eurozone in 2008. Source: European Central Bank.

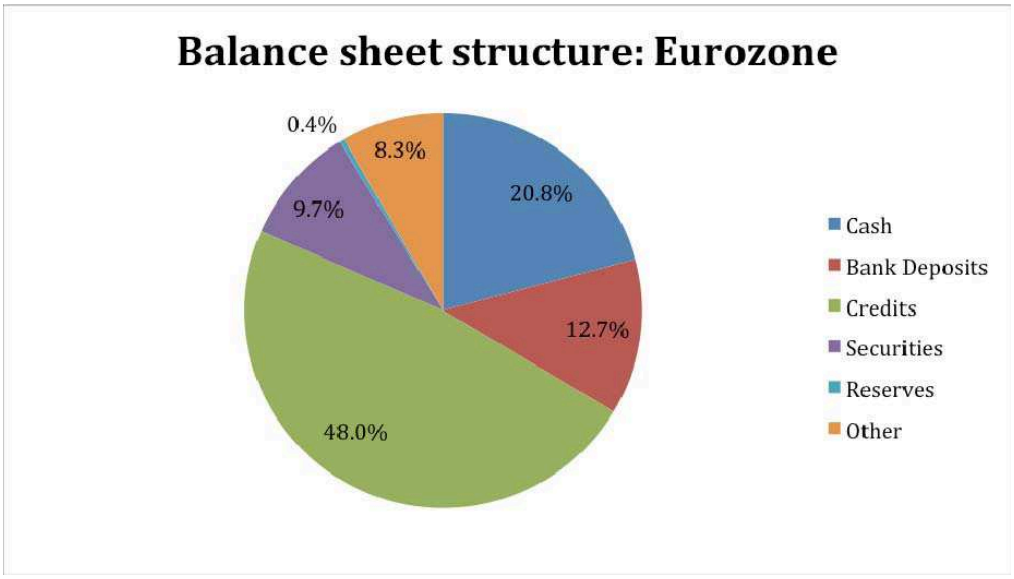


Figure 4. The aggregate structure of balance sheets for banks in Croatia in 2008. Source: National Bank of Croatia.

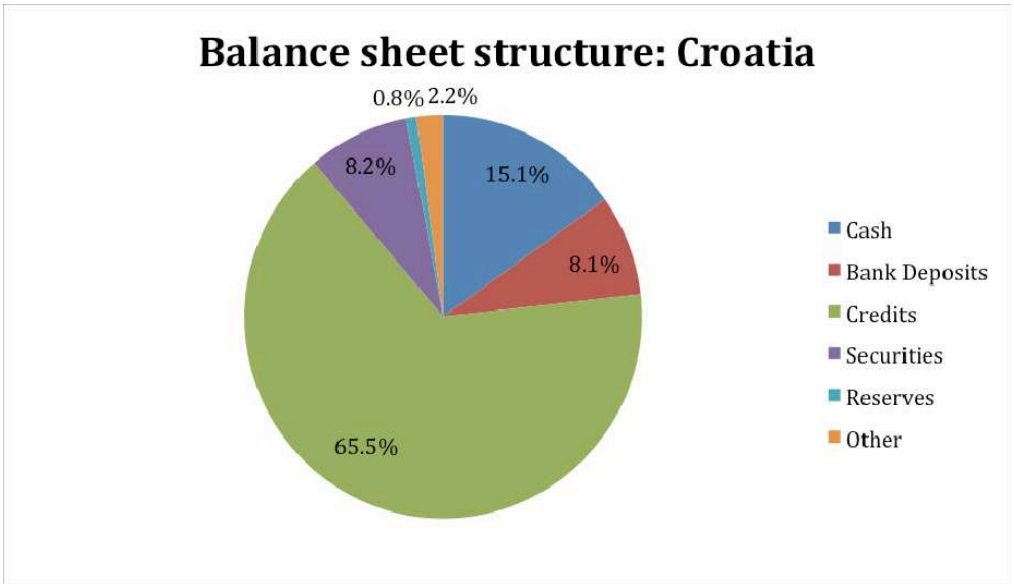
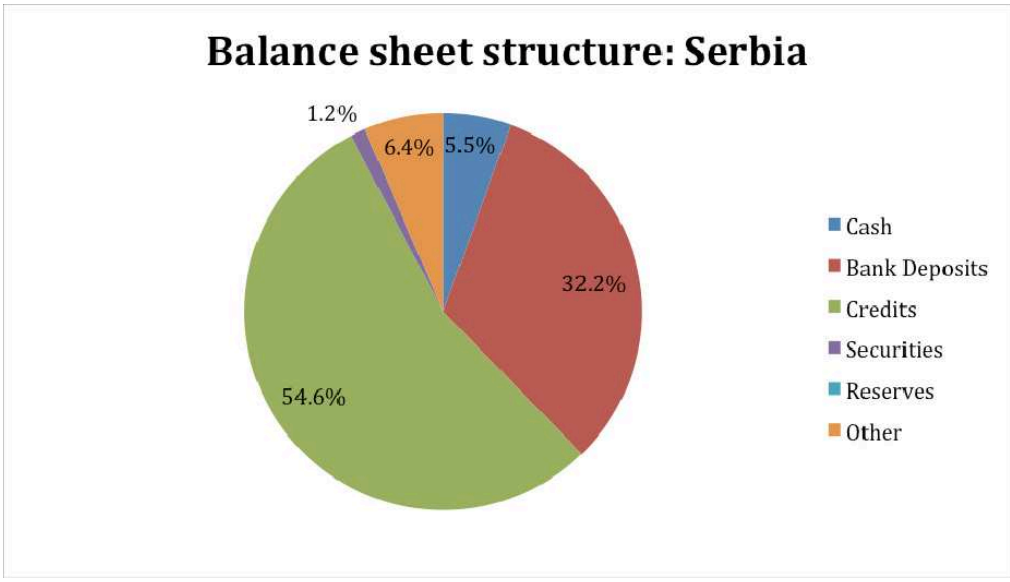


Figure 5. The aggregate structure of balance sheets for banks in Serbia in 2008. Source: National Bank of Serbia.



The principal difference between developed and emerging financial systems in Europe is therefore the size of the trading books (on- and off-balance-sheet) relative to the banking books. Small trading books imply that most of the assets are, for all practical purposes, illiquid. Consequently, this has some important effects on the ability of banks to hedge their risk exposures, especially market risks in the banking book. The absence of timely price discovery points to the necessity for adequate methods of pricing and risk modeling. In particular, risk measures such as VaR should be adjusted to account for liquidity risk.

Standard models for market risk measurement failed to generate adequate market risk estimates that will be holistic in the sense that they incorporate both price and liquidity risk. According to Lawrence and Robinson (1995), the liquidation of a portfolio during a trading day generates an additional liquidity cost. The shorter the time horizon, the more we underestimate liquidity risk. The act to settle a position will have an unfavorable consequence for the investor with respect to the price range. So, on the illiquid markets, a liquidity correction should be a function of trading volume, which is something that standard VaR models do not take into account. Lawrence and Robinson (1995) provide a generic model of VaR by deriving the

optimal execution strategy incorporating the market risk using a mean-standard deviation approach. In the same lines, Häberle and Persson (2000) provide a mathematically simpler model. The authors propose a method based on the notion of orderly liquidation. This method assumes that single investor can liquidate a fraction of the daily trading volume without significant impact on the market price. Le Saout (2002) provides a good overview of liquidity risk models.

Apart from lack of liquidity, emerging market financial systems are also renown by their "dollarization". Today, on average 40 to 45 percent of bank deposits in Emerging Europe, Latin America and the Middle East are denominated in foreign currency (International Monetary Fund, 2004). Patterns of such dollarization are highly uneven: in some countries (e.g., Uruguay, Lebanon, Croatia) foreign-currency deposits greatly exceed domestic currency deposits while in others (e.g., Brazil) their share is zero because banking legislation does not permit the holding of foreign-currency deposits. In the event of devaluation, the liability side of banks' balance sheets would be greatly inflated.

In an effort to balance their local foreign-currency liabilities, emerging-market banks typically increase their foreign-currency lending to residents. Thus, most local foreign-currency deposits are offset by domestic foreign-currency loans, not by assets held abroad (the banking sector's net foreign asset positions are positive, but close to balance). This implies that, in the event of an exchange rate adjustment, banks' balance sheets crucially depend on the performance of their domestic foreign-currency loans and, ultimately, the existence of a viable export sector.

The positive side of dollarization is that it allows the banking system to be the source of large foreign-currency liquidity needs in a crisis. Large positions of liquid foreign-currency assets can increase the resilience of dollarized banking systems both because they may be a source of emergency liquidity, and because these assets typically continue to perform in the event of a domestic shock. Since own foreign exchange resources of commercial banks are often not sufficient, central banks have in many cases acted as a lender of last resort, often with moral hazard implications.

On the other hand, the negative side of dollarization is that the likelihood of default of

a foreign-currency borrower may substantially increase in case of a significant depreciation of the local currency. We discuss this type of risk, which is particularly important for emerging markets, in the following section.

4 Interaction of market and credit risk

In countries of Western Balkans, including the two largest economies in the region, Croatia and Serbia, foreign banks are dominant market players. More specifically, in Serbia more than 75% of the banking assets are in the hands of Austrian, Italian, Greek, French, and Hungarian banks. Qualitatively similar situation is in Croatia and most of other WB countries. Foreign banks entered both Serbia and Croatia after repeated severe banking crises. In Serbia, four major banks were insolvent and the government decided to close them down at the beginning of 2001. Pieces of these four large banks as well as several smaller state-owned banks were subsequently privatized by foreign banks. By 2008, market leaders in terms of capitalization and market share in Serbia were: Banca Intesa, Raiffeisen Bank Austria, and Hypo-Alpe-Adria Bank followed by Komercijalna Banka, the only bank with a majority Serbian capital among the top four. In Croatia, two major banks, Zagrebačka Banka and Privredna Banka Zagreb (PBZ) were sold to Unicredit and Intesa groups, respectively. Together, these two banks currently hold more than 50% of banking assets in Croatia, making them crucially important for the well-being of the Croatian banking sector as well as the overall economy. Similar statement is true for the four largest banks in Serbia.

The privatization of banks by foreign banking groups has had a profound effect on both financial and non-financial sectors in these countries. On the positive side, foreign banks brought fresh cash, abundant loans, a certain degree of sophistication and new banking products as well as, although to a smaller extent, good risk management practices. On the other hand, they gave rise to several important risks.

The most obvious risk is that foreign banks view these markets as small and, therefore, not very significant. In particular, it is not inconceivable that in case of severe adverse market moves the needs for cost cutting necessitate closure of some

foreign-owned banks in one or more of these countries. For the parent companies, that would be a relatively minor strategic decision. For the Croatian or Serbian economies, however, some of these banks are critically important and their closure would severely damage the economy. This gives such banks, especially the largest ones, a significant influence over the local regulators and governments.

In addition, given their dominant market position, foreign banks make decisions that directly impact which industries and which companies will be funded in the WB region. In practice, their focus has been on funding the retail consumption at the expense of production and export industries. In both Croatia and Serbia, banking sector, up until October 2008, has been one of the fastest growing sectors of the economy, and foreign loans one of the key sources of funding. Partially as a result of this, Croatian and Serbian economies are, at present, import-driven trade economies, with relatively little export base and with shrinking industrial base. Both countries have large and widening current account deficits (the coverage of imports with exports is less than 50%), as well as increasingly heavy debt burden.

Another important development related to entrance of foreign banks in the WB markets is that they tend to systematically prefer foreign-currency pegged loans (primarily in Euros in Swiss francs). These loans allowed them to tap into cheaper inter-bank foreign loans and, at least when it came to Euro-pegged loans, transfer the exchange rate risk entirely to borrowers. In Serbia, for example, a typical loan may have had the following characteristics: monthly rates are variable (Euribor plus a spread, say 300 bp), payable in the local currency (Dinars). Each month, the actual payments are determined based on the prevailing dinar-Euro exchange rate. Frequently, there is an additional clause which states that if dinar increases in value with respect to Euro, payments would not be based on the prevailing market exchange rate, but, rather, on the exchange rate at origination. Thus, borrowers get punished when the exchange rate falls and do not get rewarded if the exchange rate goes down.

All of these features are meant to protect banks in case of adverse interest rate and exchange rate move and transfer the market risk entirely to borrowers. In order to understand how prevalent is the use of foreign-denominated loans in the WB region, consider the case of Serbia. According to the National Bank of Serbia, in October

2008 practically all retail loans (retail loans represented at that time roughly 40% of all loans outstanding in Serbia) were pegged to either Euros or Swiss francs. The same was true for around 80% of the commercial loans (commercial loans represented at that time around 60% of all loans outstanding). Note, also, that the growth rates of retail loans have been significantly outpacing the growth rate of commercial loans.

As long as countries, companies and individuals could easily borrow, often to roll over previous loans, this seemed like a win-win situation. Banks were reaping handsome profits and enjoyed very high growth rates that could not be achieved in their home countries. On the other hand, a significant increase in consumer and government spending in WB countries fueled the economies which grew 5% or even 7% annually. However, the onset of the global economic crisis all but arrested the growth of credits in the WB region and elsewhere. As a result, new funds got suddenly scarce and previously taken loans increasingly difficult to repay. Serbia was hit particularly hard since it had virtually no alternative source of foreign income (even monies sent home by Serbs working abroad got significantly reduced since September 2008). As a result, and despite several interventions by the National Bank of Serbia, dinar depreciated from around 75 RSD/EURO in September 2008, to around 95 RSD/EURO in March 2009, i.e. by roughly 27%. Croatian currency at that same period dropped 5% (this was the first significant drop of value of the Croatian currency in several years). The primary difference between the two countries is that Croatia has much higher foreign currency reserves due to, primarily, tourism. Since September of 2008, both countries significantly reduced their hard currency reserves. As a result, further downward presses would likely cause currency meltdown, the prospect rather likely in Serbia and not implausible in Croatia. Given the structure of balance sheets of Serbian and Croatian banks the meltdown may easily lead to the collapse of the banking systems in these countries and, by contagion, seriously undermine banking systems around the region and beyond.

We now turn to discuss a very simple toy model of the mechanism of transfer of currency into credit risk. Ever since the pioneering work of Robert Merton (1974), literally hundreds of papers have been written on issues of credit risk modeling (see Duffie and Singleton, 2003, for a thorough review). There are much less work,

however, on thee interaction of credit and market risk and, in particular, on the interaction of credit and exchange rate risk. One of the first models of credit and market risk interaction is Jarrow and Turnbull (2000). More recently, Alessandri and Drehmann (2007)), among others, focus on the issue of whether separately estimating market and credit risk, which currently is a standard banking practice, under- or over-estimates the total risk.

In order to understand the economics of interaction between currency and credit risk as it applies to the Serbian and other WB markets, we consider the following simple model adapted from Breuer et al. (2007).

Suppose that a typical bank loan is underwritten at time t=0 and that it is issued for an amount of L dinars. Suppose, also, that at time of origination the exchange rate is f(0)=75 dinars per Euro. In order to qualify for the loan, at origination borrower needs to have an income minimum of, say, $A(0) = 1.1L$, i.e. 10% above the loan amount.

Expressed in Euros, the loan amount is equal to $L / f(0)$. The bank borrows the amount of $L / f(0)$ Euros on the inter-bank market (from the parent bank, for example). After one period, at time t=1, which we take to be one year, the loan is due. The bank repays Euros and expects to receive from the borrower the, in dinars, of the amount equivalent to $L(1+r) / f(0)$ Euros (here, s is the spread that earns profits to the bank). The amount that the borrower has to repay, expressed in dinars, would be equal to:

$$B(1) = L(1+r)\frac{f(1)}{f(0)} + Ls\frac{f(1)}{f(0)} = f(1)\left(\frac{L(1+r+s)}{f(0)}\right)$$

Here, f(1) is the exchange rate at time 1. If the interest is fixed, the source of risk in this equation is the exchange rate risk, i.e. the value of f(1).

At time of repayment, the borrower's ability to pay back the loan depends on a host of factors. Breuer et al (2007) model this in a very simple fashion, as:

$$A(1) = A(0)\frac{GDP(1)}{GDP(0)}\varepsilon$$

$$\log(\varepsilon):\ N(-\frac{\sigma^2}{2},\frac{\sigma^2}{2})$$

In this equation, there are two sources of uncertainty, a macroeconomic uncertainty related to the change in the gross domestic product (GDP) and uncorrelated idiosyncratic borrower risk modeled by ε.

Now we are in the position to define the payoff for the bank that helps us understand how currency and credit risks interact:

$$P(1) = \min(A(1), B(1)) - L(1+r)\frac{f(1)}{f(0)}$$

If the borrower's ability to pay, A(1), is greater than the obligation, B(1), bank profit is equal to $P(1) = B(1) - L(1+r)\frac{f(1)}{f(0)} = Ls\frac{f(1)}{f(0)}$. Note that in that case an increase in the exchange rate will actually increase bank profits in the local currency (obviously, expressed in Euros, the profit would not depend on the movement in the exchange rate in that case). On the other hand, if the borrower's ability to pay is less than the borrower's obligations, i.e. $A(1) < B(1)$, the payoff to the bank is given by the expression:

$$P(1) = A(1) - L(1+r)\frac{f(1)}{f(0)} = A(0)\frac{GDP(1)}{GDP(0)}\varepsilon - L(1+r)\frac{f(1)}{f(0)} =$$
$$= L\left(1.1\frac{GDP(1)}{GDP(0)}\varepsilon - (1+r)\frac{f(1)}{f(0)}\right)$$

Let us suppose that the realization of the idiosyncratic risk is equal to its expected value $E(\varepsilon) = 1$ and that no growth is expected in the GDP (this is the current official forecast for the Serbian market). Let us, further, assume that the interest rate (say, the Euribor rate) is r=5%. If the initial exchange rate is 75 dinars per Euro, and the terminal rate is 95 dinars per Euro, realized loss would be 23% of the loan value. If,

what many expect in a bad case scenario, the exchange rate falls to 120 dinars per Euro, the loss would be 58% of the loan value. Of course, in case of serious depreciation of the local currency, it is highly likely that the GDP would actually fall rather than stay constant, i.e. that there would be actually be a recession (Croatia already entered into the recession). Suppose that the GDP decreases by 5%. In that case, the total loss would be 64%. Given the prevalence of foreign-exchange pegged contracts in WB countries, the exchange rate risk may lead to very substantial credit risk that is not sufficiency studied or understood.

In Breuer et al (2007) authors compare regulatory capital based on integrated credit and exchange rate modeling with the sum of the regulatory capital in case when credit and exchange rate risk are handled in separation (the latter is the standard operating procedure in most if not all banks). Using econometric methods of Pesaran et al. (2000) and Pesaran et al. (2006), they find that required regulatory capital for Swiss franc-denominated loans in a stylized Austrian bank may be significantly underestimated if credit and currency risks are handled in separation.

In Serbia and Croatia both banks and regulators treat credit and market risk in separation. While in Serbia the regulator requires higher than customary capital cushion which partially lowers the risk of default, the cushion is determined based on, potentially, seriously underestimated, assessment of risk.

In summary, the tradeoff between the exchange rate risk and credit risk is a very important, first order, effect in WB countries, especially in the largest countries such as Serbia and Croatia. The shear size of the problem requires a coherent response from the regulators and the banking industry. In particular, alternative arrangements need to be considered including hedging of domestic currency loans with exchange rate derivatives (instead of pegging the loan contracts to Euros or Swiss Francs).

5 Conclusion

In this paper we discuss how standard risk management models may be implemented

in the countries of Western Balkans, as well as what are the specific challenges facing risk management professionals of the region. Given these challenges, it is important to ask ourselves the question: are regional regulators, banks and their risk management departments up to the challenge? And, perhaps more importantly, is sufficient attention paid by the regulators as well as market participants to the development of risk management models and skills that address specific WB issues. There is no doubt that by preparing to implement Basel II, Croatian and Serbian regulators are starting to challenge banks to develop serious risk management departments and risk management processes. The response from banks is diverse. Some are making serious efforts to develop a risk management culture and to use risk management for strategic decision-making. Most banks, including some subsidiaries of foreign banks, though, think of risk management as just another regulatory hurdle. In particular, some foreign banks centralize all of their risk management decisions in the headquarters. Subsidiaries are, then, merely asked to report positions that are being fed into the centralized model for further processing in the headquarters. The risk management departments of such banks are, then, devoid of their true meaning and serve a more formal rather than substantive role in the organization. In particular, strategic decisions in subsidiaries are in that case not made based on the careful assessment of risk.

On the one hand, the centralized assessment of risk exposure at the group level is necessary and quite natural. However, not developing risk management skills in subsidiaries and treating them as mere transmitters of data, while ex-ante cost efficient in the short run, may be very costly in the long run. This is so for the following reason: Namely, if subsidiaries do not make allocation decisions based on a keen and systematic measurement and management of risks, there is a very good chance that such subsidiaries will end up in trouble when market conditions turn sour. While the prospect of a failure of a bank in Serbia or Croatia may not look very troubling for shareholders and management in the headquarters, its failure may cause serious reputation damage and, thus, contagion effects across the region. That, in turn, may undermine the solvency of the parent institution. We recommend, therefore, that banks actually take a more challenging but, ultimately, safer approach. They should systematically transfer risk management knowledge to their subsidiaries, encouraging them to develop local risk management modeling and management expertise. Only in

that way will, over time, the proper strategic decisions are made and possible serious disasters averted.

In particular, it is high time to put the issue of currency risk-credit risk transfer at the top of the regulatory and financial institutions' agenda in the WB region. Current practices of risk transfer without clear modeling of the potential impact of such risk transfer should not persist. The regulators need to make financial institutions carefully assess and manage such risks. In part, the use of alternative hedging mechanisms should be considered including the use of foreign exchange derivatives contracts that could be used to hedge foreign exchange risks without pegging loans to hard currencies.

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