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Croatian Banks' Exposure to the Real Estate Risk: A Market Based Approach

Croatian banks' exposure to the real estate risk:

A market based approach

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Abstract
This paper presents a multi-factor model of Croatian banks' stock returns that incorporates market return, interest rate and real estate risk factors. The return-based risk sensitivity is estimated and the recently calculated hedonic real estate price index is being employed. Banks' stock returns are positively related to the general stock market conditions, and negatively related to the real estate market movements. Moreover, banks that have higher share of real estate loans in the retail loans portfolio seem to be more sensitive to the real estate market developments. Bank stock returns seem to be insensitive to movements in interest rates. A dummy variable was introduced for the post-2004 period, indicating decreased sensitivity of the stock returns to the real estate market developments. These findings have different implications for stock market investors, bank managers and the supervisor.

JEL classification: E5, G12, G21, L25
Keywords: Bank stock returns, Risk factors, Real estate risk

1 Introduction

In the recent decade we have been witnessing an accelerated increase in real estate loans in the portfolios of the croatian banks, and the real estate prices amplified as well. However, due to the severe economic crises on the world level, there has been a turnaround in the mentioned processes: some of the banks reported downsizing the annual increase in the real estate loans[2] and the real estate prices have begun to stagnate or even shrink in some areas of the country. Despite the dynamical growth of both real estate loans portfolios and real estate prices, and recent stagnation of real estate market and implied risks, to the best of our knowledge there has not been a research conducted on the exposure of Croatian banks to the real estate risk. Additional motivation is the start of the calculation of the hedonic real estate prices index in Croatia, so that for the first time we can inspect the real estate risk exposure using appropriate proxy which possibly incorporates real estate market fundamentals in a better way then average real estate prices index.

This paper will try to provide answers to the following questions: are banks' returns sensitive to the developments on the real estate market? If so, what is the direction of bank returns' sensitivity to the real estate market movements? Is the possible sensitivity based on the characteristics of the banks? Did the possible sensitivity increase in the recent period?

In answering these questions, the paper builds upon a limited existing literature and employs methodology similar to the one employed by the Allen et al. (1995). We will employ two different approaches to analyse the real estate risk exposure: one is banks' returns based and inspects the exposure via stock exchange data, whereas the other approach relates banks'

[2] Although the 2008 witnessed an increase in the banks' real estate loans to retail customers of 1.156%, this increase is smaller compared to some previous years

real estate exposure to the characteristics of the banks. First one makes use of time series of the banks' returns as observed on the stock exchange market and the second uses data from banks' balance sheets.

Hence, this paper is aimed at bank managers who get insights into shareholders' appraisal of the real estate risk exposure, at stock exchange investors who are interested in drivers of banks' share prices and at national supervisor who can consider the implications of the possible crises on the real estate risk exposure of Croatian banks.

The paper is organized as follows: The next Section provides some stylized facts about the evolution of the categories relevant for this research. Section 3 reviews a selection of the existing literature on banks' return sensitivity. Section 4 introduces the used methodology and Section 5 presents the results. Conclusions are drawn in the Section 6.

2 Stylized facts

Croatia, like many other transition countries[3], witnessed a fast increase in the retail loans in the years of the past decade. Big stake of those loans referred to the real estate loans, which were mostly collateralized with real estate.

**Figure 1: retail and real estate loans (in million HRK) in period 2001-2008**

Source: annual reports of the CNB

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[3] For example Estonia and Latvia encountered increase from around 20% to above 60% of bank credit to the private sector (in percentage of GDP) in 1990 – 2004 period

Some commercial banks report to have over 40% of total retail loans portfolio invested into real estate loans.

Figure 2: Retail real estate loans in the total real estate loans in period 2001-2008

Real Estate Loans in Total Retail Loans
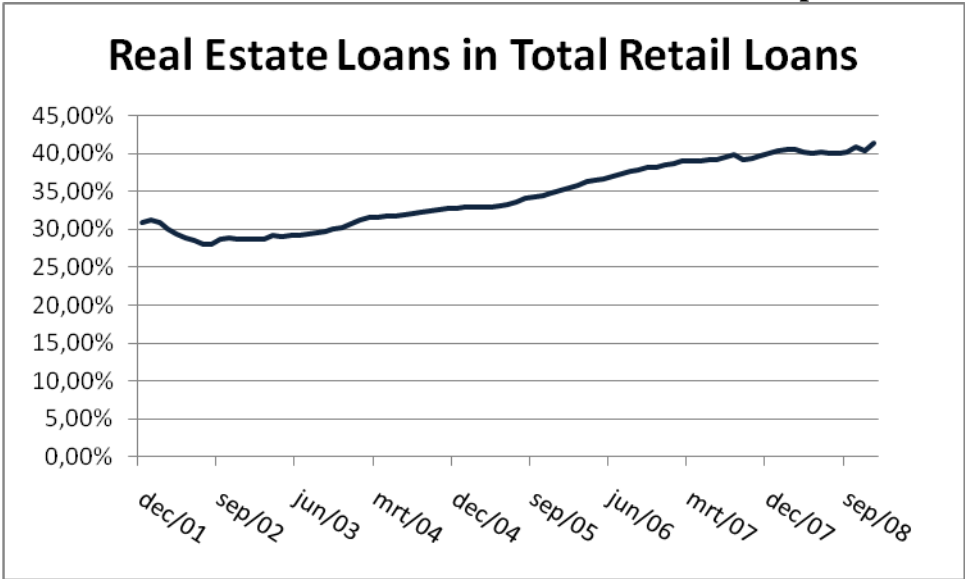
Source: annual reports of the CNB

The commercial banks' investments into real estate in Croatia is regulated with the Decision on limits on credit institutions' holdings in non-financial institutions and holdings of tangible assets (OG 1/2009) which prescribes that a credit institution can invest to 40% of its own funds into tangible assets. The graph below shows that the investments into tangible assets moved within rather narrow margins.
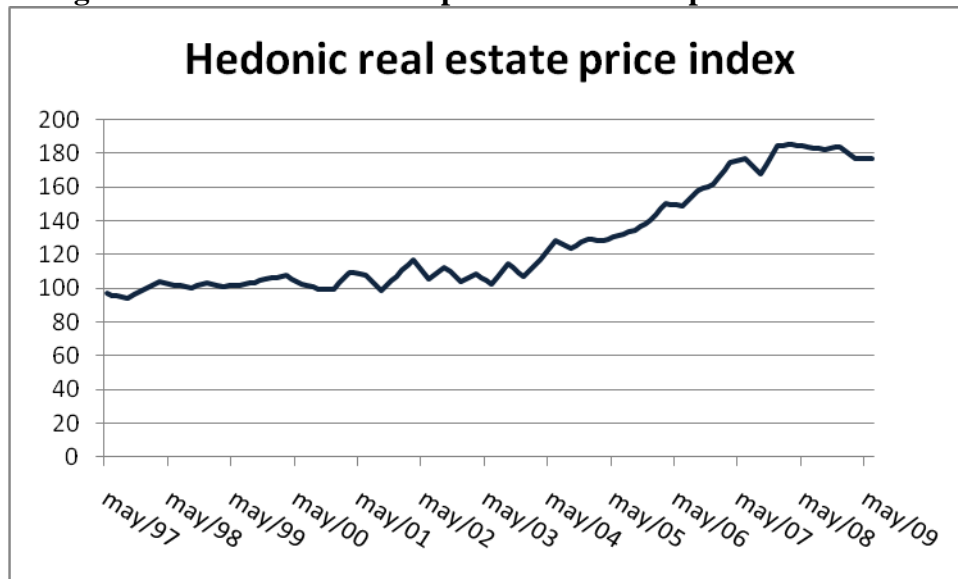
Figure 3: Tangible assets minus depreciation (in million HRK) in period 2000-2008

Investments into Tangible assets
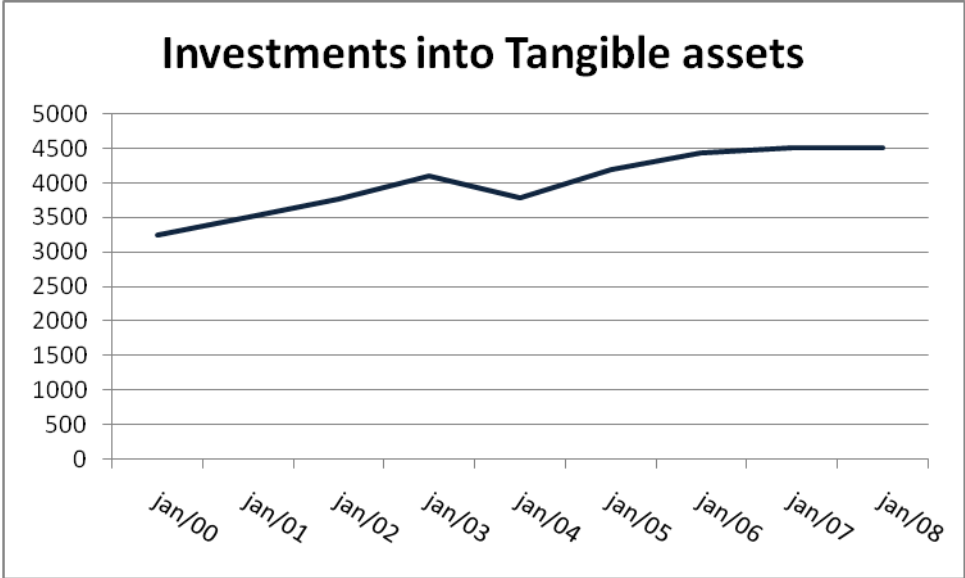
Source: annual reports of the CNB

If we take a closer look at the development of HICN, we observe a break in the 2004, after which the growth of the real estate index casted off.

Figure 4: hedonic real estate price index developments 1997-2009

Source: Croatian National Bank

Not only the real estate market, but the stock market suffered the consequences of the world recession as well. As depicted below, the volatility of returns since the beginning of the crises compared to 2000-2007 period was increased.

Figure 5: Returns on the stock market index CROBEX®
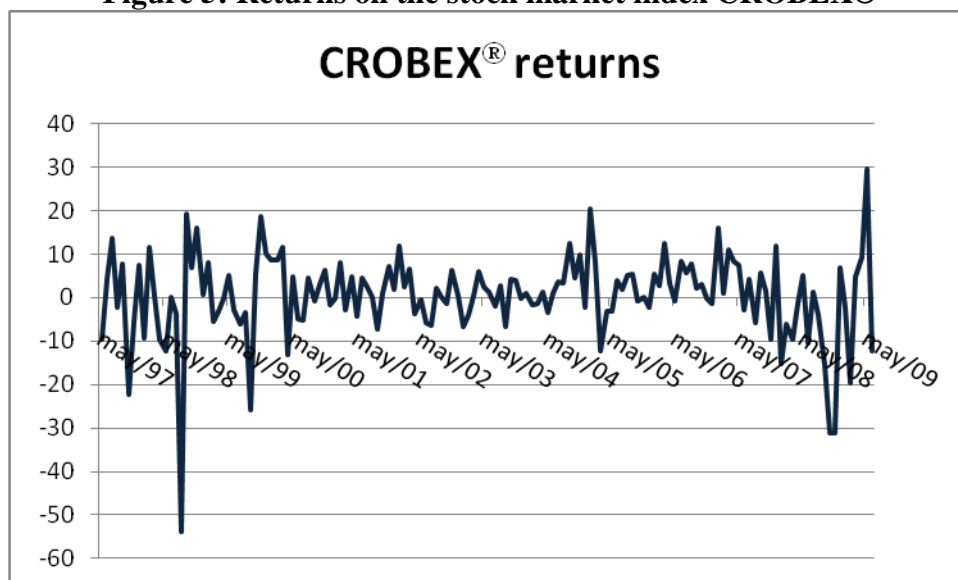
Source: Thomson Datastream and own calculations

Due to the Croatian banks' stake of the retail loan portfolio invested into real estate loans, and their investments into real estate, one would expect the remarkable exposure of Croatian banks to the real estate risk. However, the research hardly tackled this exposure and as the real estate prices kept on rising, it seemed that there were no worries for the risks that the banks were bearing. On the other hand, one should bear in mind that although we

hypothesize the banks' returns sensitivity to the developments on the real estate market, there could only be indirect influence. Namely, both tangible assets and the real estate loans in Croatia are not marked-to-market and as such the balance sheet values do not vary together with the real estate values. We do not presume the sign of the influence of the real estate market movements on the bank returns' exactly because of this indirect influence. As regards to the real estate investments, the effect of the changes in the market values of real estate go beyond the general economic activity because the real estate market and the stock market do not always move in tandem. And as regards to the real estate loans, the real estate risk arises because those loans are mostly collateralized with the real estate. Although the default risk can be a function of the changes in the real estate value, as the real estate value increases the default risk does not necessarily decrease. The market can interpret the rising real estate values as a bubble that will eventually burst and "penalize" the over-exposed banks. If there is a sensitivity of the bank returns' to the real estate market factor, we hypothesize that the sensitivity will be proportional to the degree of the real estate risk exposure. Bigger stake of real estate loans and investments in the total assets could intuitively lead to the higher real estate risk sensitivity. Finally, we will test if the possible sensitivity to the real estate risk increased in the most recent period which is marked by changes in the trend of the HICN and real estate loans developments, possibly due to the overall economic crises.

The crises in Croatia started to show in 2008. Domestic demand started to fall and the growth of the BDP decelerated, so that the annual BDP for 2009 in real terms decreased for 5.8% compared to 2008. Not only the economic activity suffered, but also the trade deficit increased, and Croatia had to increase its foreign debt in 2008 to 88.2% of the BDP. Mentioned developments raised questions about the safety of the banking system and systemic risk, and could have influenced the banks' returns sensitivity.

3 Literature overview

Numerous studies have used the extended version of market model since Stone in 1974 proposed the two-factor bank stock return generating model:

$$R_{jt} = \alpha_j + \beta_{1j}R_{mt} + \beta_{2j}R_{It} + \varepsilon_{jt}$$

where R_{jt} is the bank common stock return, R_{mt} is the market return, and R_{It} is the innovation in the interest rate variable. Coefficients α_j and β_{1j} are the alpha and beta coefficients of the market model, and β_{2j} represents interest rate risk. Hence, parameters are interpreted as bank exposure to risk factors and lot of papers studied the pricing of different risks with varying results. Single and dual-index models can easily be extended for other parameters.

Choi et al. (1992) estimate a multifactor model of bank stock returns that incorporates market return, interest rate and exchange rate risk factors. They find positive relationship between bank and market returns, but negative relation to interest rate changes. The relationship between bank returns and exchange rate changes' influence differs in different subperiods. Baele et al. (1997) used the bank stock return model to decompose total bank risk into components and the study used market based measures of bank risk. Ryan and Worthington (2002) use GARCH-M model when analysing the sensitivity of Australian bank stock returns to market, interest rate and foreign exchange rate risks. They find that bank returns are sensitive to the market returns, that short and medium term interest rates, unlike the long term ones, are important to the bank return generating process, and that the foreign exchange rate risk is not significant determinant of Australian bank stock returns.

Despite the proliferation of studies concerning relations between market, interest rate or other movements and stock returns, there is no vast literature on the exposure to the real estate market. Allen et al (1995) conducted research on the US bank exposure to the real estate market and obtained positive relationships between monthly bank returns and the real estate index, increased sensitivity of bank values to the real estate market and positive relationship between bank-specific sensitivity coefficient and its balance sheet exposure to the real estate. They obtained positive relationship between bank and market returns, but negative relation to the interest rate index.

Although the importance of understanding banks' stock returns background is clear, there have not been enough studies on this matter for the Croatian banking sector. Unfortunately, to the best of our knowledge, nobody has jointly quantified market, interest rate and real estate risk in Croatian banking using return-based time-series techniques.

4 Model

As mentioned, there is a strand of literature using the factor analysis, and comprising several papers which develop this technique for returns' sensitivity purposes. In this paper we employ a model which is similar to the model employed by Allen et al (1995).

We will test Croatian banks' exposure to the real estate risk following two-step methodology. First we will determine the influence of the real estate market developments on the banks' stock returns by estimating the following equation:

$$R_{B,t} = const + \beta_1 R_{M,t} + \beta_2 i_t + \beta_3 RI_t + u_t \tag{1}$$

where $R_{B,t}$ is mean monthly return of the Croatian banks in the sample, $R_{M,t}$ represents the monthly market return, i_t is the interest rate, RI_t represents the real estate index and $\beta_1, \beta_2, \beta_3$ are the coefficients to be estimated, and u_t is the error term.

Thus, the dependent variable is mean monthly return of Croatian banks[4]. The first two independent variables represent stock market return and interest rate, respectively. CROBEX® returns serve as s proxy of stock market return, and we do not use excess bank returns because there is no consensus about the suitable proxy for the risk-free rate in Croatia. For the interest rate we use two proxies: first is the interest rate on kuna placements with foreign currency clause and the second one is the interest rate on 6-month domestic currency Treasury bills issued by the Ministry of Finance of the Republic of Croatia. The results of the equation (1) are reported separately for both types of interest rates.

The first coefficient in equation (1) hence stands for the market risk exposure and the second coefficient reflects the interest rate risk sensitivity. Obviously, both β_1 and β_2 coefficients capture the risk exposure to factors of risk, ignoring the reported risk in the balance sheets. The third independent variable is representing the real estate market developments, and we used the Hedonic Index of Real Estate Prices as a proxy. Since there is a possibility that some of the movements of the real estate values are affecting the banks'

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[4] Following Fama (1965), we assume that stock prices follow a multiplicative random walk :

$P_t = P_{t-1}\{exp[E(R_t)+\varepsilon_t]\}$ $R_{t=}E(R_t)+\varepsilon_t$

Where $E(R_t)$ is the expected return on day t. ε_t is a serially independent random variable. This gives logged daily non-dividend adjusted returns:

$R_t = 100*ln (P_t/P_{t-1})$

stock movements indirectly through the general stock market movements and the interest rates' movements, we will orthogonalize the model in order to get the pure effect of the real estate market movements on the banks' returns. First we will remove the co-linearity between the market and interest rate variables and then regress the real estate variable on the orthogonalized model. This regression's unexplained heterogeneity will represent real estate market developments in the equation (1).

When examining the changes of the sensitivities over time, we will make use of the existing equation in the following way:

$$R_{B,t} = const + \phi_1 R_{M,t} + \phi_2 i_t + \phi_3 RI_t + \phi_4 D_t RI_t + \mu_t \qquad (2)$$

where the equation (1) is augmented by the interaction term, in which D_t equals 1 from the January 2004 forward and zero otherwise. That period was characterized with shift of HICN. Coefficient ϕ_4 will indicate a possible shift in the sensitivity of banks' returns to real estate developments.

Then we will proceed to determining relation between banks' real estate risk exposure and banks' characteristics. Firstly we will apply the equation (1) to the returns of the each bank in the sample and obtained sensitivities to the real estate risk will be used as dependent variable when estimating the following equations per each bank:

$$RIS_j = const + \alpha_1 RIL_j + \alpha_2 RII_j + v_j \qquad (3)$$

$$RIS_j = const + \alpha_1 RIL_j + \mu_j \qquad (4)$$

$$RIS_j = const + \alpha_1 RII_j + e_j \qquad (5)$$

Where RIS_j is the real estate sensitivity of bank j, RII_j and RIL_j denote proxies for the real estate exposure of bank j, and u_j, v_j, μ_j together with the e_j are error terms. The proxies for the real estate exposure are calculated in the following way:

RII = Investment into real estate within tangible assets / Total assets

RIL = Retail real estate loans / Total assets

5 Results

The equations outlined in the previous Section are used on the dataset which is thoroughly described in the Appendix. We use monthly data covering the period from the May 1997 up to the May of 2009 and interpolate with linear interpolation when only quarterly/annual data is obtainable.

When calculating the bank specific sensitivity to the real estate developments and its dependence on the characteristics of that bank, due to the lack of longer time series, we use smaller sample period, adjusted to the bank-specific data length. Calculations are done in E-views and Matlab. The data description and issues can be found in the Appendix.

First we orthogonalize the real estate factor and we calculate the mean monthly return of the banks in the sample. Then we proceed to the computation of the equation (1). Results are displayed in the Table 1.

Table 1: Estimation of the equation (1)
Dependant variable is a mean monthly return of banks in the sample

	Constant	Market coefficient	Interest rate coefficient	Real estate coefficient	R^2
Interest rate on kuna with foreign currency clause					
Coefficient	0,656	0,4624***	-0,03796	-0,0853**	0,2134
Probability	*0,8*	*0,000*	*0,88*	*0,0195*	
Interest rate on T-bills in kuna on 182 days					
Coefficient	0,277	0,4638***	0,003	-0,06*	0,2027
Probability	*0,88*	*0,000*	*0,99*	*0,0584*	

* significant at the 10% level
**significant at the 5% level
***significant at the 1% level
Source: computed by the authors

In Table 1 we regress the mean monthly return of the banks in the sample on the market, interest rate and the real estate coefficient. We observe positive and significant influence of the movements of the market on our variable of interest, so that when the returns on the stock market go up, the returns on the banks' stocks go up as well. This is as expected and it proves that the bank stock returns move in tandem with the general market conditions. There is however no significant influence of the interest rate movements on the bank stock returns, independent of which of the two interest rates we use in the regression. This result implies that the Croatian stock exchange market does not evaluate banks' exposure to the interest rate risk. The model is orthogonalized so that the real estate coefficient represents pure effect of real estate developments on the banks' stock returns and the results show that irrespective of the general market or interest rate movements, the increase of the values on the real estate market has significant negative influence on the banks' stock returns, albeit a minor one. Thus, investors "penalize" the banks in response to the increased real estate values. Next, it would be interesting to examine if real estate market's influence has increased in the recent period, so we proceed to estimating the equation (2). The results can be found in the Table 2.

Table 2: Estimation of the equation (2)

Dependant variable is a mean monthly return of banks in the sample

	Constant	Market coefficient	Interest rate coefficient	Real estate coefficient	D*Real estate coefficient	R^2
Interest rate on kuna with foreign currency clause						
Coefficient	4,49	0,427***	-0,3233	0,055	-0,221**	0,2433
Probability	*0,141*	*0,000*	*0,2604*	*0,4256*	*0,02*	
Interest rate on T-bills in kuna on 182 days						
Coefficient	4,122	0,425***	-0,292	0,084	-0,227**	0,2276
Probability	*0,105*	*0,000*	*0,321*	*0,224*	*0,0215*	

D = 1 from Jan 2004 to May 2009, and zero otherwise
*significant at the 10% level
**significant at the 5% level
***significant at the 1% level
Source: computed by the authors

We interpret these results in the similar manner. Namely, the stock market developments have positive and significant influence on the banks' stock returns. Again, the interest rate developments irrespective of which interest rate we use do not seem to have significant influence on the banks' stock returns. In this Table we observe that the influence of the real estate market appears to be insignificant, but the interaction term with which we capture the shift in the sensitivity to the real estate market is negative and significant. Hence, the sensitivity of banks' stock returns to the changing real estate values was less pronounced in the period after 2004. We will proceed to estimating the equations (3), (4) and (5) in order to examine if the influence that real estate market developments has on the banks' stock returns is related to the banks' exposure to real estate market. In other words: are the stocks of the banks that have more real estate investments and real estate loans more exposed to the real estate market developments, or the sensitivity of bank to the real estate market is not in connection with its real estate exposure. The results can be found in the Table 3.

Table 3: Estimation of the equation (3), (4) and (5)

Dependant variable is Real Estate Coefficient

	Constant	RIL	RII	R^2
Equation 4				
Coefficient	-0,217165***	1,010362***	-0,476097	0,3153
Probability	*0,000*	*0,001*	*0,8082*	
Equation 5				
Coefficient	-0,222545***	1,017862***	-	0,3139
Probability	*0,000*	*0,001*	*-*	
Equation 6				
Coefficient	-0,130079***	-	-1,238132	0,009
Probability	*0,000*	*-*	*0,5917*	

*significant at the 10% level
**significant at the 5% level
***significant at the 1% level
Source: computed by the authors

We find that the banks which have more real estate loans are more sensitive to the movements of the real estate market. On the contrary, the degree to which the banks invest into real estate does not seem to impact the banks' sensitivity to the real estate market developments.

We can now summarize our main findings. Croatian banks' stock returns are positively influenced by the movements of the Croatian stock market and negatively influenced by the movements in the real estate market. There seems to be no relation between interest rate developments and the stock returns, although one would expect that the interest rate changes affect the net worth of the bank. However, if this is not the case, then the validity of the banks' reported interest rate risk exposure, and its influence on the economic capital of the bank is even more important to the supervisor. Although this paper does not intend to explain the reasons behind the observed relations, we can try to offer some intuition behind it. The mentioned negative influence of the increasing real estate values could be due to the possible banks' lower diversification and increasing share of the loan portfolio invested into real estate in times of the growing values on the real estate market, and the market's penalty of such a behaviour. It could as well be the way the markets perceive the fact that banks give out higher loans in the periods of increasing real estate values while pertaining the same loan-to-value ratio. The influence is proportional to the amount of real estate loans that bank has in its portfolio. Hence, the more the bank invests into real estate loans, the more will the real estate market influence her stock exchange performance and this influence will be negative. But we also observe a change in the influence of the real estate market on the stock returns: there is a decrease in the sensitivity to changing real estate values after 2004. This could be attributed to the better hedging of the Croatian banks and more developed risk management techniques. There was possibly a shift in the credit risk management toward more sophisticated determination of the loan-to-value and collateral management, all due to the more wide implementation of the Basel Capital Accord II and sound practices.

Due to the lack of the similar research on the Croatian banks' stock performance we are unable to compare our findings and check the validity of the assumptions, but for the sake of

completeness, we performed different robustness checks and compared our results to the ones described above. As already mentioned, we used two different interest rates but none appears to have significant influence on the Croatian banks' stock returns. We also split the sample, but the results did not change significantly. Because the recent empirical evidence shows that bank returns' risk sensitivity might be time-varying, we have employed the dummy variables in the interaction terms. They should address this problem, although the potential break points could be somewhat arbitrarily assigned. We tried to employ dummies on different dates which are more relevant in development of variables other than hedonic real estate price index, but the results remained the same. Also, the results are not changed by using average real estate price index instead of the hedonic one. When using changes in the interest rates instead of interest rates themselves, the parameter for the interest rate sensitivity remains insignificant. We also tested residuals in order to employ GARCH model which is a more advanced technique for bank stock return, but we did not find any ARCH effects, possibly due to the monthly frequency of data.

6 Conclusion

In this paper we use a factor model to obtain evidence on real estate risk being priced in the Croatian banks' stock values. It gives new and important insights into the relationship between Croatian banks' stock returns, market returns, interest rate movements and real estate developments. This paper extends previous work with the attempt to simultaneously model market, interest rate and real estate risk in the Croatian banking industry.

The results presented in this paper are limited due to the limited dataset and possible uninformative data on returns, since there are some periods for some stocks in which the trade occurred infrequently. This research can serve as a basis for a further investigation of the reasons lying beneath described observations, and it can be potentially improved by employing the GARCH model.

Using the multi-factor least squares regression with Croatian banks' mean monthly returns as a dependent variable, we obtained the parameter estimates which provide an indication of Croatian banks' risk sensitivity. It shows that when the returns on the stock market go up, the returns on the banks' stocks go up as well. There is however no significant influence of the interest rate movements on the bank stock returns, independent of which of the interest rate type we use in the regression. The Croatian stock exchange market seems to not evaluate the banks' exposure to the interest rate risk, and the supervisor has to rely on the banks' reports on the interest rate risk sensitivity. Irrespective of the general market or interest rate movements, the increase of the values on the real estate market have significant negative influence on the banks' stock returns, albeit a minor one. Interaction term, where dummy is set to be 1 in the period from January 2004 onwards, with which we tried to capture the shift in the sensitivity to the real estate market, is negative and significant. We conclude that the sensitivity of banks' stock returns to the changing real estate values was less pronounced in the period after 2004. We confirm that the influence that real estate market developments have on the banks' stock returns is related to the banks' exposure to real estate market. In other words, the stocks of the banks that have more real estate loans are more sensitive to the real estate market developments.

To interpret the results, we can hypothesize that the negative influence of the increasing real estate values could be due to market's penalty of the banks' lower diversification and increasing share of the loan portfolio invested into real estate in times of rapid real estate market values growth. It could also be a reflection of the market perception of the fact that

banks give out higher loans in the periods of increasing real estate values while maintaining the same loan-to-value ratio.

Finding of the decreased sensitivity to the real estate risk of the Croatian banks after 2004 could be due to the possible better risk management techniques and managerial oversight over the real estate loan portfolio, or better hedging.

Appendix

The data for this research was collected from various sources, and includes monthly observations whenever possible. Sample for the calculation of the equations (1) and (2) comprises data from May 1997 to May 2009. The twelve year sample period covers periods with different stock market conditions, different business cycles and regulation. The developments of the hedonic index of real estate prices were kindly provided by the Croatian National Bank out of the database for their internal purposes. The index obtained was on quarterly basis, so the linear interpolation was employed to calculate monthly data. To calculate banks' mean monthly returns, first we used banks' monthly unadjusted prices from the Thomson Datastream. By unadjusted prices we understand the closing prices which have not been historically adjusted for bonus and right issues. Those are actual are so-called "raw" prices. The prices were taken for the banks that together hold over 60% of the total assets of the Croatian banking industry. Mean monthly return was then obtained by averaging calculated monthly returns. To calculate the stock exchange monthly returns, we used the CROBEX$^{®}$ monthly price index from the Datastream. The monthly return was then calculated in a same way as for the banks' stock returns. CROBEX$^{®}$ is the official Zagreb Stock Exchange share index, started to being published in 1997. It includes two banks from our sample and is a vast index for Croatian economy so it is considered appropriate and representative stock market index for this research. Interest rates used in the research are historical rates on kuna placements with foreign currency clause and 6-month Treasury bills in domestic currency issued by the Ministry of Finance of the Republic of Croatia . Linear interpolation was used for the dates on which there were no auctions held in order to get monthly time-series.

Monthly data was used for calculating the individual bank's sensitivity to the real estate developments. However, when regressing the obtained individual bank's sensitivity to the real estate developments on the banks' specific characteristics, we used interpolated monthly data because specific characteristic could have been obtained only on annual basis. They were obtained from the Bankscope when possible, and for some banks the figures from annual financial reports had to be retrieved. For the banks in the sample we tried to obtain data for the years 1997-2009, but for some banks we could not obtain the figures for the most distant years. For some banks the amount of real estate loans was not obtainable for all of the years, so that the percentage of those loans in total retail loans in the years when the figures were disclosed was used to deduct the figures in the years in which they were not disclosed. Since it was not possible to obtain bank-specific data for the whole banking system in Croatia, which consisted of 32 banks in 2009, for all of the years considered, we retrieved the data on real estate exposure for the banks that together hold over 60% of the total assets of the Croatian banking industry. The dataset comprised big banks which individually hold over 20 percent of total banking sector assets as well as the small banks which individually hold less than 1 percent of total banking sector assets. Due to the such range of considered banks, we assumed that within the range of their calculated real estate exposure one could find the whole spectrum of Croatian banks' real estate exposure. Therefore we have simulated random numbers in the range of their minimums and maximums to get additional observations for the remaining banks which hold <40 percent of total banking industry. This way we expanded our dataset to perform the estimations of the relations between banks' sensitivity and banks' real estate exposure.

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