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13 October 2016

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Abstract. In this paper we discuss the implications of the Basel III requirements on the leverage ratio for the banking sector in the Central and Eastern Europe (CEE) and particularly in the Czech Republic. In the empirical study, we applied a data sample of 198 major banks operating in seven countries across the CEE region over the period 2007-2014. The data of the Czech banking sector confirms stronger capital ratios and an overall solid leverage level with only few historical observations being lower than the regulatory guidelines. By analyzing the components of ratios, we conclude that the Czech banks during the last seven years are focusing more on the optimization of risk weighted assets and structuring portfolios with lower risks. We propose an empirical model that allows to test how the leverage ratios and its variables respond to the changes in the cycle. Our analysis across financial institutions in the CEE region shows that the leverage in normal times is strongly related to capital ratio. The statistic evidences on the risk profile and strategy as measured by risk proxy in the model are pointing out on incentives of the banks to manage actively their balance sheet and reduce the riskiness of their portfolios in adverse economic conditions.

Key words: Leverage ratio, capital ratio, Basel III, Czech Republic, CEE

JEL classification: G32, G21

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1   Introduction

It is widely believed that one of the causes of the latest financial crisis was the excessive build-up of the on and off-balance sheet leverage in the banking system. In some cases, the banks accumulated excessive leverage while evidently maintaining strong risk-based capital ratios BCBS (2014a). To address this issue and enhance the banks' resilience to crisis, the Basel Committee in 2010 introduced a minimum leverage ratio as an additional prudential tool to complement minimum capital adequacy requirements. The leverage ratio is defined as a Tier 1 capital divided by on and off-balance sheet exposure. The leverage ratio should be disclosed in the public reports of financial institutions from 1st of January 2015 onwards and fully implemented at the start of 2018 after appropriate review and calibration.

In our paper we discuss the implications of leverage and capital requirements for the banking sector in the CEE and particularly in the Czech Republic. We identify the potential binding constraints from regulatory limits and analyze the interactions among ratios over the country's economic cycle (during the period 2007-2014). The following points are of primary focus of our analysis. On the example of the Czech banks, we evaluate whether the specified regulatory ratios in the Basel III regime (i.e. Tier 1 capital ratio, capital adequacy or leverage ratio) represent a potential binding constraint during the crisis and recovery periods (over the years 2007 to 2014)? What leverage and capital ratios can say about the behavior and strategy of the banks particularly in case of the Czech banking sector? How the leverage ratio and its variables are responding to the business cycles across CEE banking sector and in comparison to the Czech and Slovak banks?

In the debate about financial market regulations and their impact on the economies Musílek (2011), Teplý, Šobotníková and Černohorský (2011) in their works are dealing with the challenges of the Basel III guidelines for the EU and Czech banking sector. The banking regulations and systematic risk in financial market systems are investigated by Klinger and Teplý (2016) with special focus on the capital regulations in studies of Avery and Berger (1991), Gropp and Heider (2009), Estrella, Park and Peristiani (2000). Notably few studies are focusing on the implications caused by interactions among regulatory ratios for example between capital and leverage ratios as risk and non-risk based measures. In the analysis by Adrian and Shin (2008a,b), Kalemli-Ozcan, Sorensen and Yesiltas (2011), Brei and Gambacorta (2014), the cyclical properties of the ratios are tested taking into account structural shifts in banks' behavior during the global financial crisis and its aftermath. They suggest that in normal times the new leverage ratio based on the exposure measure is always more

countercyclical (less procyclical) than the other ratios. In contrast to capital ratios, it is a tighter constraint for banks in economy upturn and a looser constraint in recession. Nuno and Thomas (2013) argue that bank's leverage is endogenously determined by market forces. They found that leverage contributes at least as much as equity to the cyclical movements in total assets and leverage is negatively correlated with equity. Apparently it is positively correlated with assets growth and to a lesser extent with GDP. The impact of capital on bank survival during financial crises and normal times is examined by Berger and Bouwman (2013). Mainly focusing on the economic roles of capital depending on bank size and time period they indicate that the capital helps to enhance the survival probabilities of small banks at all times and for medium/large banks primarily during the banking crises and with limited government support. They note similarly that the off-balance sheet activities of banks are impacting the capital and consequently survivability of banks over the crisis.

The effectiveness of the Basel Accords as a regulatory framework and its implications on the Czech banking sector were investigated by Šútorová and Teplý (2013; 2014) or Teplý and Vejdovec (2012). The related topic of credit risk was modelled theoretically by Janda (2011) and empirically analysed by Janda, Michalikova and Skuhrovec (2013). The possibilities of major improvements over Basel II treatment of indebtedness and credit risk were discussed by (Witzany 2010). In other country specific case study, Kellermann and Schlag (2013) examine the binding constraint factors of ratios on the Swiss banking sector. From their analysis it is evident that the minimum leverage ratio shows a strong tendency to undermine the risk-based requirements. Since at least during the period 2009 to 2011 the minimum leverage ratio requirement became a binding rule for the major Swiss bank UBS. Furthermore, they pointed out that this fact might adversely encourage banks to take greater risks. Cathcart, El-Jahel and Jabbour (2013) investigate the interdependencies and pro-cyclical nature of capital and leverage ratios of the US banking institutions prior to the first 1990-1991 and the second credit crunch of 2007-2009. Their results demonstrate that unlike during the first credit crunch, the leverage ratio during the crisis of 2007-2009 was a binding constraint and generally more to blame for triggering the subprime crisis. Furthermore, they argue that the reversal in correlation patterns between the two ratios was a main reason of the change in binding constraint. The correlation patterns of the ratios are seemingly related to loan growth and GDP market signals.

2   The leverage ratio over the cycle

The Basel III leverage ratio (LR) is defined as the capital measure (the numerator) divided by the exposure measure (the denominator), with this ratio expressed as a percentage

$$LR = \frac{K_t}{Exp_t} \; ,$$
(1)

where K_t - denotes a Tier 1 capital and Exp_t - the exposure measure, at the end of reporting period t

The capital measure represents the numerator of the leverage ratio and is based on the new definition of Tier1 class of capital as set out by Basel Committee (BCBS 2011). Under Basel III, the Tier 1 capital includes: the common equity Tier 1 (CET1) and the additional Tier1. CET1 refers to loss-absorbing equity capital of the highest quality and consists of paid-in capital, disclosed reserves and retained earnings. The exposure represents the denominator of the leverage ratio. The exposure measure in definition of the Basel Committee on Banking Supervision (BSBC 2014a) is the sum of the following exposures: on-balance sheet exposures; derivative exposures; securities financing transaction exposures and off-balance sheet items. During the transition period from January 1, 2013 to January 1, 2017, Basel Committee will test a minimum Tier 1 leverage ratio > 3 %. The disclosure requirements of the ratio and its components at the bank level started on January 1, 2015.

By introducing a leverage ratio the Basel Committee pursued several goals. The minimum leverage provides a simple and transparent accounting measure that serves as a non-risk based „backstop" which ultimately serves to protect against model risk, and the reduction of capital requirements and generally it reinforces risk based requirements (BCBS 2014a). It captures both the on-and off balance sheet exposure which in fact could bear significant risks due to the complex and not fully transparent derivative and guarantees exposures. Finally the primary goal of leverage is to constrain a build-up of excessive leverage in banking system during the times of credit boom and help to soften the deleveraging processes in downturn economy cycle. These cyclical qualities of the leverage and capital ratios have been indicated in several studies. The evidences by Adrian and Shin (2008b), Nuno and Thomas (2013) are based on the empirical analysis of the US financial intermediaries that operate primarily through the highly liquid and dynamic capital markets. They suggest that these financial institutions are adjusting their balance sheets actively in such way that leverage tends to be higher during the economy booms and lower during the slowdown and recession. In normal times however, leverage is less cyclical. The capital ratios reveal opposite counter-cyclical qualities and seem to be more stable and less procyclical in the crisis times Brei and Gambacorta (2014), Kellermann and

Schlag (2013). According to this logic, both leverage and capital measures might represent a binding constraint for the banks in various economy cycles. Depending on which one of the two ratios is the stricter binding constraint, the incentive for the bank strategies might have different approach according to Blundell-Wignall and Atkinson (2010), Cathcart, El-Jahel and Jabbour (2013). All this implies that the management of bank capital and leverage ratios over the course of the business cycle might be as important as the rules-based capital requirements particularly by determining the cyclical impact of capital regulation.

In the Table 1, we summarize the historical evolution and potential regulatory constraints on the capital and leverage ratios for the largest Czech banks over the economic cycles. The period 2007-2009 refers to crisis period and years of 2010-2014 as a recovery and normal times. The following ratios are evaluated: (a) the new Basel III leverage ratio (as Tier 1 / Exposure measure); (b) the accounting leverage ratio (Tier 1/ Total assets); (c) the capital-to-risk-weighted-assets ratio (Tier 1/ Risk-weighted assets); (d) the capital adequacy (Total capital / Risk weighted assets). The first three ratios (a), (b), (c) have different denominators but relate to each other with the same numerator - Tier 1 capital. We have included into our review an accounting leverage (b) which has total assets on balance sheet in denominator instead of exposure. This helps us to separate the impact of off- balance sheet exposures, derivatives and guarantees on the Basel III leverage ratio and additionally to judge the risks stemming from off balance transactions that we are discussing later in the paper. The capital ratio (d) has been added to estimate the development of the banks' capital adequacy over the period. The regulatory guidelines on minimum requirements under the Basel III regime are the following: minimum leverage requirement $\geq 3.0\%$ during the testing period from 1st January 2013 to 1st January 2017 with disclosure requirement starting from 1st January 2015 (BCBS 2014a and BCBS 2011); minimum requirement for Tier 1 capital (incl. Tier 1 additional capital) $\geq 6.0\%$ of Risk Weighted Assets (RWA) with minimum Tier 1 capital ratio in Basel III phase-in arrangements in 2013 $\geq 4.5\%$, in 2014 $\geq 5.5\%$ and starting from 2015 $\geq 6.0\%$; minimum total capital requirement (sum of total Tier 1 and Tier 2 capital) $\geq 8.0\%$ of RWA.

The weighted median of all risk and non-risk based ratios reveal an upward trend during the various economic cycles, newly analyzed by Stadnik and Miecinskiene (2015). Between the crisis period of 2007-09 and recovery years 2010-14, the median of the risk-weighted Tier 1 capital ratio increased from 11.3% to 14.9%, while the leverage ratio in the Basel III regime increased very moderately from 5.6% to 6.8%. The total capital ratio (capital adequacy) increased even at larger extent from 12.3% to 15.8%. The data (in Table 1) show that contrary

to the capital ratios, the leverage of the Czech banks might represent potentially larger constraint in terms of meeting the transitional minimum regulatory limits. We observe that only in 5% of cases from total sample the leverage of few banks has happened to be lower than the regulatory guidelines at some point of time. The mean of the leverage ratio across the sample is around 8.3% that is overall higher than leverage level referred as a minimum requirements $\geq$ 3.0%. Teplý, Šobotníková and Černohorský (2011), Matejašák (2015) similarly noted that Basel III requirements on capital are not presenting a larger constraint because of the historically high capital ratios of the Czech banks.

Tab. 1:   Capital and leverage ratios of the 15 largest banks in the Czech Republic (2007-2014)

Ratios	(a) Leverage (Tier 1 / Exposure)		(b) Leverage (Tier 1 / Total assets)		(c) Tier 1 Capital Ratio (Tier 1 / RWA)		(d) Capital Adequacy (Tier 1+ Tier 2 / RWA)	
	median	<3.0 %	median	<3.0 %	median	<6.0 %	median	<8.0 %
Top 5 largest banks	6.3%		7.0%		12.7%		13.7%	
All banks	8.3%		10.7%		18.6%		19.3%	
As a % from total observations		4.5%		2.7%		0.0%		0.0%
Period 2007-09	5.6%		6.3%		11.3%		12.3%	
Period 2010-14	6.8%		7.6%		14.9%		15.8%	

Source: annual reports and own calculation (**Note:** all ratios are mean weighted by respective denominator i.e. RWA, Exp or TA)

In order to assess the strategies of banking sector towards adjustments in capital and leverage ratios, we take a closer look into interdependencies between the components of the leverage ratio and the Tier 1 capital ratio. Since both of them have the same numerator (Tier 1 Capital), it allows us to relate and analyze changes in their denominators - risk weighted assets versus exposure or total assets Berger and Bouwman (2013), Cathcart, El-Jahel and Jabbour (2013).

We rearrange the relation of Tier 1 capital ratio to leverage ratios (both ratios with exposure based and accounting measure of total assets) as follows:

$$\frac{LR_t}{CR_t} = \frac{\dfrac{K_t}{Exp_t}}{\dfrac{K_t}{RWA_t}} = \frac{RWA_t}{Exp_t}, \tag{2}$$

where K_t - denotes a Tier 1 capital, RWA_t stands for risk-weighted assets and Exp_t - the exposure measure (or total assets on the balance sheet), at the end of reporting period t.

The relationship of risk weighted assets to exposure (or total assets) captures also the riskiness of the business model of the banks. The higher ratio of risk weighted assets to total assets suggests that the portfolio contains more risky assets. For example the sovereign bonds portfolio has usually the lowest risk, depending significantly on the level of interest rates – Stadnik (2014), weight up to 0.0% (in standardized approach of credit risk measurements under the Basel II capital adequacy guidelines), since this asset class is considered to be the safest and on opposite, traded securitization products have the highest up to 1250% risk weight.

In the Figure 2 for example we visualize the historical evolution of risk weights over the period of 2007-2014 of the largest Czech banks. The notable trend is that both risk weights tend to decline steadily during the entire period. Apparently the Czech banks are focusing more on the optimization of risk weighted assets and structuring portfolios with lower risk weights. The minor risk weight increase (for RWA / TA) in the last two years 2013-2014 can be attributable to recent more demanding regulatory requirements on the risk management practices and measurements in the banking sector.

Fig. 1: Historical evolution of risk weights of the 15 main banks in the Czech Republic (2007-2014)
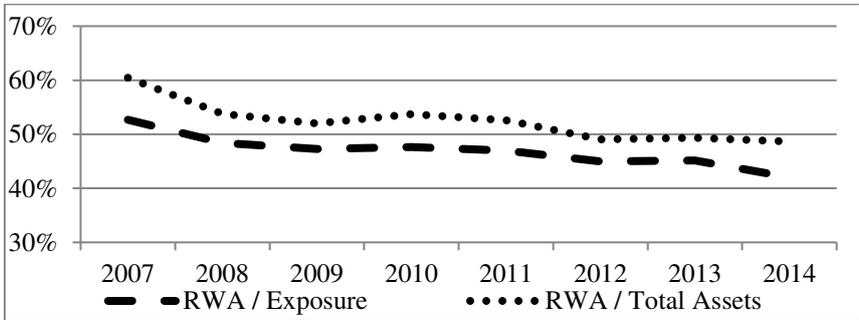
Source: annual reports and own calculation

Other remarkable observation from the Figure 2 is that the off balance sheet exposure, which is mostly stemming from complex derivative transactions and other guarantees has a stable proportion to total assets over the 8 year horizon. This fact suggests that the banks in the sample are not shifting significant risks off balance sheets in times of economic distress. The off balance-sheet items of the Czech banks constitute a relative small fraction to total assets on average (10%). In comparison, the empirical data across the top EU and US banks (over the period of 2000-2009) presented by Kalemli-Ozcan, Sorensen and Yesiltas (2011) shows that the maximum amount of the off-balance sheet items was 65% of assets with a mean of 10%.

3 The data and methodology

The panel data regression model is designed to test how the leverage ratios across CEE countries respond to the cycle and which of the bank specific variables has larger impact on the leverage. The regression model with fixed effect is applied to panel data containing the financial data of 198 financial institutions based in the following countries: Czech Republic, Slovakia, Slovenia, Poland, Hungary, Romania and Croatia. These countries in our view represent a relatively similar set up in the banking sector and showing evidences of business cycle synchronization as noted by Cevik, Dibooglu and Kutan (2016). The financial data is obtained from the database BankScope. Although, the financial data do not fully reveal details about the exposure measure to calculate it precisely according to the Basel III methodology, in our calculation we used the total assets figures as a substitute. The summary of variables for the regression model is provided in the Table 2. The unbalanced data sample is due to the partly missing data for the entire period of last 7 years, mostly for the smallest banks in the dataset.

Tab. 2: Descriptive statistics and definitions for the regression variables

Variable name	Variable description	Obs	Mean	Std. Deviation	Min	Max
LR	Leverage Ratio as Tier 1 over Total Assets	863	0.11	0.10	-0.02	0.98
TA_ln	Total Assets (ln)	863	7.63	1.63	2.37	10.98
Risk	Risk Weighted Assets over Total Assets	863	0.54	0.27	0.00	2.13

CR	Capital Ratio as Tier 1 Capital over Risk Weighted Assets	863	0.15	0.14	-0.16	2.12
GDP	Annual growth rate of GDP	863	0.01	0.03	-0.08	0.11
C_t	Dummy that takes value 1 in the 2007-2009 and 0 elsewhere	863	0.26	0.44	0.00	1.00

Source: BankScope and own calculation

By performing the regression analysis we have to differentiate the cyclical properties of the ratios in normal times and during the crisis. Following the approach by Brei and Gambacorta (2014), we address this issue by introducing the dummy C_t with the regression variables that is allowing for a parameter shift in the estimated response depending on the condition of the economy. The dummy represents the value of 0 in normal times 2010-2014 and 1 in the time of crisis 2007-2009. The dummy C_t aims at capturing not only the effect of the financial crisis but also changes in banks' behavior due to the implementation of new policy of Basel III and the anticipation of more stringent capital requirements in the future. Hence, in our econometric model we apply a two period panel data analysis as follows:

$$LR_{it} = \beta_0 + \delta_o C_t + \beta_1 TA\_ln_{it-1} + \delta_1 C_t TA\_ln_{it-1} + \beta_2 RISK_{it-1} + \delta_2 C_t RISK_{it-1} + \beta_3 CR_{it-1} +$$
$$+\delta_3 C_t CR_{it-1} + \beta_4 GDP_{it} + a_i + \varepsilon_{it} \ , \tag{3}$$

The control variables in the model equation (3) are chosen to explain banks' choice of target leverage ratios and intend to reflect the cyclical qualities, link to targeted capital structure and the risk profile of the banks. The variables are lagged *(t-1)* with one year period to test whether adjusting costs are relevant Ayuso, Perez and Saurina (2004). In particular, *TA$_{t-1}$* equals the amount of the total assets of the banks (note: log of total assets applied to eliminate significant differences in the asset size across countries). The risk profile of institutions is represented by risk proxy $RISK = \frac{RWA_{it-1}}{TA_{it-1}}$ that equals to risk weighted assets divided by total assets. This is also equivalent to an interaction between the capital and leverage ratio, irrespective of Tier 1 capital *K*. The logic behind the risk proxy is explained earlier in the paper in the equation (2). The component will be useful in understanding the relation between leverage and capital ratio over the cycle. The *CR$_t$* denotes a capital ratio and described as Tier 1 capital divided by total risk weighted assets. The statistical evidences between capital ratio and leverage are of interest

for us to understand the patterns of ratios co-movements in various economic conditions. The annual change in GDP_{it} growth reflects the economic cycle of the countries in our model similarly to Jakubik and Fungacova (2013). In addition, there might be the time-invariant fixed effects due to the counties profile Izák (2011), which is captured in a_i and the regular unobserved factor is $\varepsilon_{it.}$

4 Results

The Table 3 shows the results of the estimation of equation (3). The analysis of the components and variables allows us to disentangle leverage ratio movements in reaction to changes in economic conditions. First of all, we tried to assess the interaction of leverage with capital ratio over the cycle. The pattern emerged that the leverage in normal times is strongly related to capital ratio which is particularly true for the Czech and Slovak banks. The capital ratio does not show co-movement with leverage and weak relation during the economy downturn. The statistics evidences of risk taking strategy measured in risk proxy (RWA / TA) are pointing out on incentives of the banks to manage actively their balance sheet and reduce the riskiness of their portfolios (i.e. negative coef. -0.016 and -0.034 in crisis times) which is valid for banking sectors in CEE and Czech and Slovak banks. The reaction of the banks to cycle conditions can be translated into banks' need to reduce the overall riskiness of their portfolios, or to deleverage in reaction to the crisis similarly as mentioned by Blundell-Wignall and Atkinson (2010), Cathcart, El-Jahel and Jabbour (2013). Notably the results do not suggest strong relation between leverage and total assets but fairly point to the counter movement tendencies in normal and crisis times. Over the period of 2007-2014, the leverage ratio reveals a quiet strong relation with GDP annual growth that might be explained by the sample of countries with similar banking sector set up.

Tab. 3: The comparison of regression results for CEE and Czech Republic, Slovakia

Dependent - Leverage Ratio	CEE countries			Czech Republic and Slovakia		
Independent Variables	Coef.	Std. Err.	P values 95%	Coef.	Std. Err.	P values 95%

TA_ln_Normal	-0.011	0.002	0.000	-0.005	0.003	0.086
Risk_Normal	0.072	0.011	0.000	0.317	0.016	0.000
CR_Normal	0.306	0.025	0.000	0.539	0.030	0.000
TA_ln_Crisis	-0.009	0.004	0.014	0.004	0.005	0.520
Risk_Crisis	-0.016	0.023	0.486	-0.034	0.032	0.428
CR_Crisis	0.119	0.038	0.002	0.012	0.039	0.280
GDP	0.539	0.128	0.000	0.224	0.347	0.758
Obs	863			220		
Banks	198			51		
F test	0.0000			0.0000		
R-sq	0.5611			0.8802		

Source: BankScope and STATA calculations

5   Conclusion

In this concluding section we summarize the main results of our analysis of the impact of the leverage Basel III requirements on the banking sector in CEE and particularly of the Czech Republic. In our empirical study, we used a data sample of 198 major banks operating in seven countries of the CEE over the period 2007-2014. The historical data of the Czech banking sector confirm stronger capital ratios and an overall solid leverage level with only 5% of the total historical observations being lower than the regulatory guidelines. By analyzing the components of ratios, we conclude that the Czech banks during the last seven years are focusing more on the optimization of risk weighted assets and structuring portfolios with lower risks.

The panel data regression model is designed to test how the leverage ratios across CEE countries respond to the cycle and which of the bank specific variables has larger impact on the leverage. The results of analysis show that the leverage in normal times is strongly relating and more pro-cyclical to capital ratio that is particularly true for the Czech and Slovak banks. The statistics evidences of risk taking strategy measured in risk proxies are pointing out on incentives of the banks to manage actively their balance sheet and reduce the riskiness of their portfolios in adverse economic conditions. Notably the results show weak relation between leverage and total assets but rather suggest a stronger link to the economic cycle indicator GDP annual growth.

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