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Current Trends and Future Progress in the Banking Risk and Capital Management: Worldwide Experience and Republic of Serbia Case Study

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ABSTRACT
The financial institutions risk and capital management are intensively, constantly developing and transforming. Starting from 80s of the last century, world economy, including banking had significant progress and changing. Aware of this, Basel Committee on Banking Supervision (BCBS), central banks, regulators and business banks were searching for the adequate solutions for the risk and capital management. Regulation related to capital adequacy, measuring, methods and management had one of the central places in the attention of the mentioned institutions. These methods had achieved significant improvement and they are today very comprehensive and sophisticated. However, mentioned institutions were constantly coming to conclusions, that risk and capital management, measuring and methods, should be improved, so that it would be adequate and efficient. The global economic crises had especially important impact on the stated processes. The needs for the new Basel III improvement (in some institutions called Basel IV), were strong. Since Basel III improvement publications and other recommendations for the risk and capital management progress are available, further effects analysis can be conducted. In this paper, comprehensive analysis of the risk and capital management progress is performed. Additionally, recommendations for the improvement of the banking risk and capital management are defined in the paper. For this purpose analysis of the actual risk and capital management and all major factors which are dominantly influencing and shaping worldwide banking risk and capital management is performed. Based on this, special case study for the Republic of Serbia has been conducted with the simulations and stress tests.

Key words: *banking, risk and capital management, capital adequacy*

JEL Classification: G21, G32

INTRODUCTION

Financial institutions capital and risk management progress is intensive. Some of the most important institutions involved in this process are: BCBS, central and business banks, other institutions involved in the financial sector regulation, external agencies responsible for the credit rating assessment, etc. Basel capital standards, i.e. Basel I, II, III and other related regulations were enabling and stimulating banking risk and capital management (BRCM) development in the world.

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It is expected that BRCM development will be implemented primarily through the continuation of the progress, improvement and full implementation of the reformed Basel III standard. Further, full application of International Accounting Standards (IAS) and International Financial Reporting Standards (IFRS), which are specifically related to the risk management segment, such as IFRS 9, will continue to mark the development of risk management in the coming years. The development of BRCM will continue to determine further improvements in banks' recovery and restructuring plans. The adaptation of BRCM, new market conditions and challenges, such as new financial technologies, contemporary digital banking, will continue to play an important role in the coming period. In doing so, some risks take on new forms and characteristics, and some are further enhanced by importance. Banks and other financial market involved parties have significant hopes in the field of artificial intelligence and machine learning, which are expected to have a strong impact on the development of banking, including the development of risk management, in the coming years. The development is conditioned by both macro prudential needs and micro aspects, i.e. the need for banks to improve their current practices and adapt to new market conditions.

In this part of paper the major aims are highlighted. The goals are including analysis of the current key tools for the global BRCM and recommendation definition for the improvement. Special focus in the goals achieving is on the currently actual capital and risk indicators, applied in today's banking: Total Capital Adequacy Ratio (CAR), Tier I ratio, Common Equity Tier 1 (CET1) ratio and other. The research has taken into account other BRCM measures standards (like IFRS 9, etc.). Analysis is taking into consider developed banking sectors / economies experience (like EU and other) and developing economies and smaller banking sectors (for example in countries like the Republic of Serbia and other). The aim is to outline the key elements that should mark BRCM development and then to outline the most important challenges along the way. Additional goal of the paper is to formulate recommendations for the successful implementation of new trends in BRCM. Regarding the research geographical scope it is important to highlight that the paper has worldwide focus and relevant recommendations, but it is more concentrate on the Europe countries and especially on the countries like Republic of Serbia (for which in the paper is conducted few special analysis). Based on the comprehensive analysis of the BRCM (historical, current and future potentials), the research achievements could be valuable for the financial institutions (in Serbia, EU and non-EU countries, etc.) and its BRCM, but also for the other institutions and parties involved in financial development, control, financial stability strengthening and creating conditions for sustainable economic growth.

The key starting hypothesis of the research is the following: using global and domestic experience, published studies, analyzes and databases, it is possible to define perspectives and recommendations for further development of BRCM.

Methodology which is applied in this research is dominantly characterised by the following. Most relevant publicly available historical and contemporary world experience, research results, analysis and databases for the topic of this research will be used. Specifics of the developed banking sectors / economies (especially EU), as well as developing economies and smaller banking sectors (like banking sector of the Republic of Serbia, etc.), will be taken into consider. This should result with adequate overview and analysis of the thesis, as well as conclusions in this research. For this purpose, among others, research includes analysis of the actual BRCM and related regulation, as well as possible future development. Additionally, the goal is to define recommendations for the improvement of the BRCM. For the previously mentioned, especially the following methods will be relevant: descriptive, inductive – deductive, analytical – synthetic and comparative analysis.

Regarding relevant references, research results, analysis which will be taken into consider for this research, among others, following should be highlighted:

- BCBS Capital standards, analysis and recommendations are representing bases for the BRCM development during last decades;

- Central banks and other banking regulatory bodies worldwide analysis and published documents and databases;
- Various published research, working papers and other documents of the experts and institutions are directly or indirectly involved in the banking worldwide.

CURRENT BASEL III RISK AND CAPITAL MANAGEMENT STANDARD

The worldwide economic crisis have strongly influenced on the Basel III measures conducting and its urgent and precise application. One of the new standard goals is to decrease the likelihood of new economic crisis advent and to enable terms for the sustainable economic progress. On the following figure Basel capital framework development is presented. The figure has marked stage of current status of standard application in the EU and Serbia since they are representing major examples for the implementation in this paper.

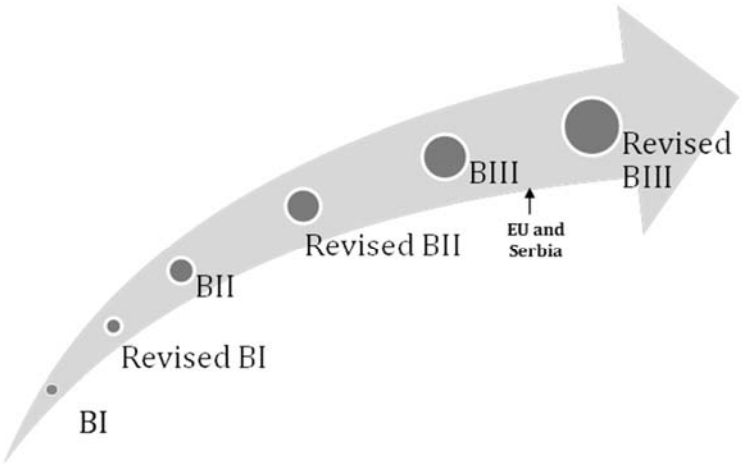

Figure 1. Development of the Basel ("B") risk and capital management framework
Source: Authors

To reach the current capital adequacy basic formula, here is presented formula development which is chronologically stated bellow, from the Basel I to the Basel III.

$$\frac{Regulatory\ Capital}{RWA\ (credit\ risk)} = Capital\ adequacy\ ratio \geq 8\% \quad (1)$$

$$\frac{Regulatory\ Capital}{RWA\ (credit\ and\ market\ risk)} = Capital\ adequacy\ ratio \geq 8\% \quad (2)$$

$$\frac{Regulatory\ Capital}{RWA\ (credit, market\ and\ operational\ risk)} = Capital\ adequacy\ ratio \geq 8\% \quad (3)$$

At the start, BCBS presented revision of the provisions of Basel II in 2009 and 2010. Very soon the provision were called Basel III framework (BCBS, 2011 and 2013, Adrian, 2018). In the meantime, Basel III standards are updated and implementation has started in EU and other countries, including Republic of Serbia. Modifications were very ambitious and challenging for supervisors and commercial banks (Milojević, 2016). One of the important issues was providing

a significant amount of additional capital for a large number of banks. This was one of the reasons why gradual implementation (Table 1) of certain segments of the Basel III framework was defined for the period of 2013 – 2019. In the newest Basel III revision, for some regulatory segments, defined period is: 2022 – 2027, but as of 27 March 2020, BCBS announced prolongation for one year, i.e. 2023-2028 (for more information: BCBS, 2020).

Basel III framework is applied on all continents, similar like the previous international frameworks. Already in 2015, Basel III was applied (or the application is ongoing) in 122 jurisdictions (BCBS, 2015, "Implementation of Basel standards - A report to G20 Leaders on implementation of the Basel III regulatory reforms"). Successful implementation has been countries during last years, so it can be concluded that significant progress has been achieved worldwide (BCBS, 2019, "Seventeenth progress report on adoption of the Basel regulatory framework").

Basel III framework is focused on banking capital strengthening. Particularly the capital quality is important, but Basel III focused also on the risk treatment. With the Basel III implementation, liquidity risk and liquidity management has very increased importance. Like defined in the Basel III implementation plan, in the period 2013 - 2019, regulation for the next segments has gradually become valid: new liquidity ratios, leverage ratio, capital buffer, and higher capital ratios minimum prescribed levels.

Table 1. Initial Basel III framework timetable

	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Leverage Ratio	Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015					Migration to Pillar 1	
CET1 ratio	3.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital conservation buffer				0.625%	1.25%	1.875	2.5%
CET1 plus capital conservation buffer	3.5%	4.0%	4.5%	5.125	5.75%	6.375	7.0%
Phase-in of CET1deductions		20%	40%	60%	80%	100%	100%
Minimum Tier 1 Regulatory Capital	4.5%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
Minimum Total Regulatory Capital	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Minimum Total Regulatory Capital plus conservation buffer	8.0%	8.0%	8.0%	8.625	9.25%	9.875	10.5%
Regulatory capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital	Phased out over 10 year horizon starting from 2013						

Source: Authors, based on data from: BCBS (2011 and 2017)

With the Basel III implementation, Leverage ratio is returned in the capital and risk management as important indicator. During previous century leverage ratio has been used in the financial institutions managing, but few decades ago it was suppressed by the more sophisticated Basel indicators. As part of the Basel III framework, Leverage ratio is a non-risk-based leverage indicator that includes off-balance sheet exposures and serves as a backstop to the risk-based capital requirement. It has an additional role in the protection of the financial system from the extremely high level of leverage.

Treatment of the systemically important financial institutions requires special treatment. Based on this BCBS defines new instructions. Stated institutions must keep additional capital buffers. Namely, during the global financial crisis very high amounts of capital injections were required for the stated institutions (and financial systems) recovery.

The countercyclical and macro prudential measures are representing important contribution of the Basel III to the financial stability strengthening. In this important task, BCBS has cooperation with many other institutions which has role in the financial stability and micro and macro regulation. The capital buffers implementation has central place in the countercyclical and macro prudential measures improvement (Milojević, 2016). With the implementation of these measures, improved BRCM is giving contribution to the financial stability, but also to the optimal balance between of banking and economic growth (Milojević, 2014).

The Liquidity risk has especially important place in the Basel III framework. The two most important liquidity risk Basel III indicators are: Liquidity coverage ratio (LCR) and Net stable funding ratio (NSFR).

The LCR is requesting from financial institutions to keep adequate level of excellent quality liquid assets to stand a one month stressed funding scenario which have prescribed regulators.

$$\frac{High\text{-}quality\ liquid\ assets}{Total\ net\ cash\ outflows\ over\ the\ next\ 30\ \ calendar\ days} \geq 100\% \qquad (4)$$

NSFR is a long term structural indicator defined with the aim to address liquidity mismatches and to cover the entire balance sheet with focus on the stable funding sources.

$$\frac{Available amount\ of\ \ stable\ funding}{Required\ amount\ of\ \ stable\ funding} \rangle 100\% \qquad (5)$$

Stated two liquidity risk ratios are together with internal liquidity adequacy assessment process (ILAAP) bringing new, improved liquidity risk management. However, implementation of the Basel III liquidity risk ratios is demanding, so the BCBS decided that its implementation needs to be phased. Similar opinions can be seen in the various analysis and paper of the researchers and different involved institutions during the implementation preparation. For example, König (2015) was highlighted importance of the carful implementation of the new Basel III liquidity risk management, so that the potential negative effects would not materialize.

In the segment of Pillar 2 requirements, Basel III framework has brought revised risk management and supervision. Some of the improvements are related to the following segments:

- Corporate governance, risk management and stress tests;
- Treatment of the risk generated by the off-balance sheet items and securitisation instruments;
- Concentration risk treatment;
- Guidelines for the financial institutions long term risk and return management;
- Financial instruments valuation and accounting treatment;
- Supervisory colleges and other.

Basel III has also brought more detailed and stricter Pillar 3 requirements, disclosure strengthening and market discipline.

With the stated Basel III framework, significant progress in the BRCM development has been achieved. However, this progress needs to be continued. Related to the BCBS prepared the revision, i.e. finalization of the Basel III framework in 2017.

The start of the new framework, in some worldwide countries is characterized by the following capital adequacy presented in Figure 2.

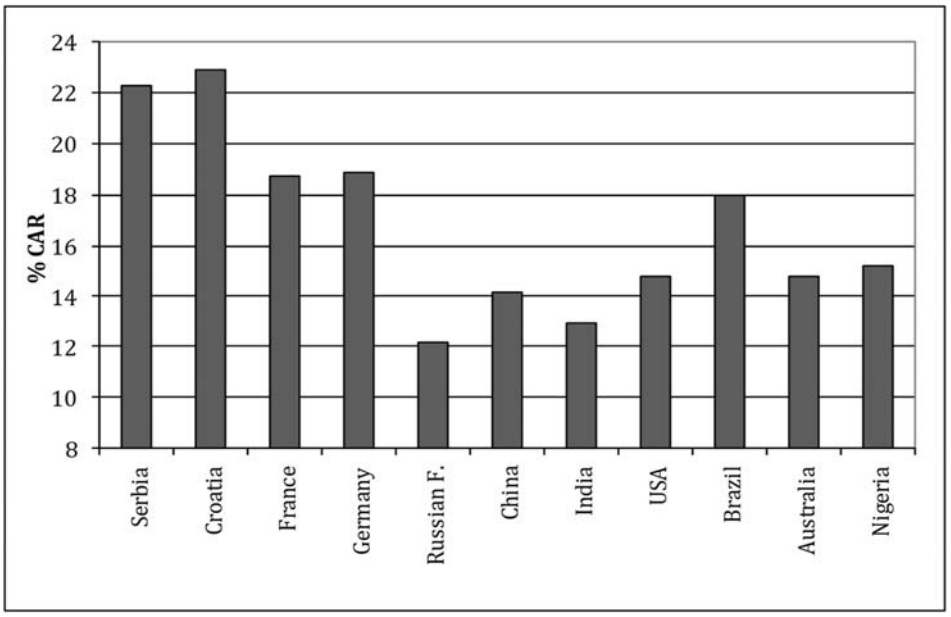

Figure 2. Capital adequacy (Regulatory Capital to Risk-Weighted Assets) of the different countries as of world, as of Q4 2018

Source: Authors, based on: International Monetary Fund (2020) and National bank of Serbia (2019), "Annual Financial Stability Report 2018".

On the previous figure variation of capital adequacy level of the different counties worldwide are presented. The major risk for the capital adequacy in that moment was credit risk, which is traditionally most significant risk worldwide during last decades. As the credit risk worldwide level illustration bellow are presented values of Nonperforming loans - NPL level (one of the major credit risk indicators) of the same countries.

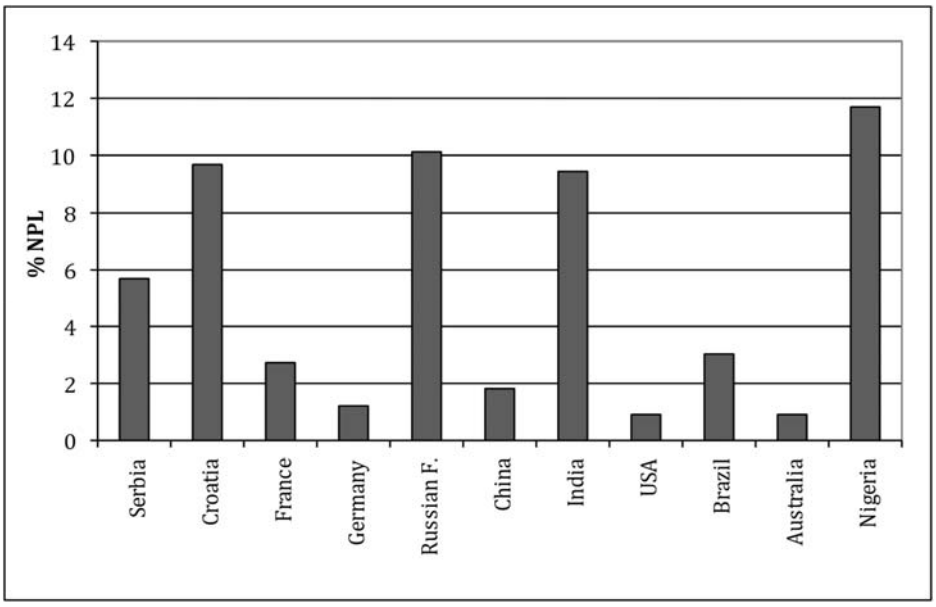

Figure 3. NPL to total gross loans of the different countries as of world, as of Q4 2018

Source: Authors, based on: World Bank (2020) and NBS (2019), "Annual Financial Stability Report 2018".

EXPECTATIONS FOR THE BANKING RISK AND CAPITAL MANAGEMENT DEVELOPMENT IN THE NEXT PERIOD

Basel III reforms from 2017 are representing part of the BRCM development that will be one of crucial elements in the following years. These reforms are in some institutions already called Basel IV standard, but in the current official BCBS document is called revision or Basel III reform (BCBS 2017, "Basel III: Finalising post-crisis reforms"). The reform from 2017 is focused on the risk-weighted assets (RWA) revision. This should restore the RWA calculation credibility and improve the comparability of financial institutions capital adequacy indicators. RWA is a risk measure which defines the minimum regulatory capital level that financial institution needs to keep. This is the reason why importance of RWA is crucial in the modern BRCM.

Basel III reforms should additionally strengthen BRCM framework and eliminate its disclosed weaknesses. For example, huge RWA values variations between financial institutions can not be always connected with the level of risk in the financial institution portfolio and this have negative impact on the capital adequacy ratios (CAR) trustworthiness. This was one of the major reasons for the reforms.

RWA internal models should enable better BRCM in comparison to the standardised approaches. On the other hand, sometimes usage of internal model has unjustified reduced the capital requirement. Additionally, some assets classes are very hard for the trustworthy treatment by the internal models. This is the reasons for the Basel III reforms restrictions (and in some cases removing) of the internal model usage.

Table 2. Timetable for the finalising Basel III framework implementation

2017 standard update	Date of application
Reformed credit RWA standardized approach	1 January 2022
Reformed credit RWA internal ratings-based approach	1 January 2022
Reformed Credit Valuation Adjustment treatment	1 January 2022
Reformed operational risk treatment	1 January 2022
Reformed market risk framework treatment	1 January 2022
Leverage ratio	Reformed exposure definition: 1 January 2018
	Revised exposure definition: 1 January 2022
	G-SIB buffer: 1 January 2022
Output floor	1 January 2022: 50%
	1 January 2023: 55%
	1 January 2024: 60%
	1 January 2025: 65%
	1 January 2026: 70%
	1 January 2027: 72.5% (steady state calibration)

Source: Authors, based on data from: BCBS (2017), "Finalising Basel III - in brief".

It is important to highlight that BCBS has as of 27 March 2020, announced prolongation for one year Basel III finalization deadlines. The prolongation is related to the providing options for financial institutions and regulatory bodies to react to current financial stability priorities related to the coronavirus disease (Covid-19) on the worldwide economy. The initial Basel III finish framework deadline was postponed for one year, i.e. to 1 January 2023. The output floor finalization and provisions regarding transitional cap on the RWA enhancement is also postponed for one year to 1 January 2028. One year postponement is also valid for the reformed market risk standard and Pillar 3 provisions (BCBS, 2020).

The reforms are demanding, so the implementation is phased during 10 year period, which should be finished in 2028, based on the new plan.

The reformed standardised approach for credit RWA should increase the risk sensitivity, but with goal to stay simple approach. It should offer variation of risk weight instead of flat risk weight. This should be especially valid for the residential and commercial real estate. Revised standardised approach should be less dependent on the credit ratings of the external credit rating agencies. With this revision, non-ratings-based approach is precisely defined.

The revised credit RWA internal ratings-based (IRB) framework is not allowing the possibility for advanced IRB (AIRB) usage for the financial institutions and large corporate exposure treatment. IRB approach will not be allowed for the equity exposures treatment. When the bank is using IRB approach it will need to apply the minimum levels for the PD (probability of default) and other relevant parameters.

Revised operational risk framework is focused on simplification. Instead of 4 actual approaches, only one standardised approach will be possible for the application. This approach will have increased risk sensitivity compared with current standardised approach. New standardised approach will include financial institutions history of the losses from the last 10 years.

With the implementation of the RWA changes, improved, more precise capital adequacy calculation should be expected. CET1 ratio will keep its central place in the capital adequacy management. The value of CET1 ratio for the few selected European counties, as of Q2 2019 is presented on the figure 4.

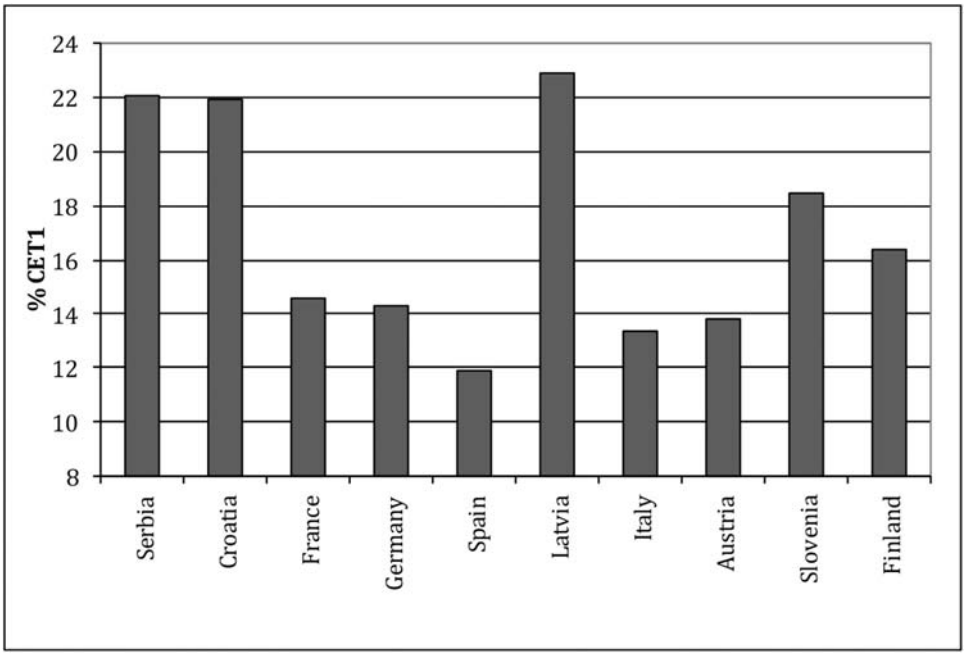

Figure 4. CET1 ratio of the different European countries as of Q2 2019

Source: Authors, based on: European Central Bank (2019), NBS (2019), "Banking Sector in Serbia - Second Quarter Report 2019" and Croatian National Bank (2019).

With the standard revision from 2017, a leverage ratio buffer for global systemically-important banks (G-SIBs) is involved (BCBS, 2017).

Leverage ratio can be simply defined as:

$$Leverage\ ratio = \frac{Capital\ measure}{Exposure\ measure} \tag{6}$$

More detailed Basel III formula for the Leverage ratio is the following:

$$Leverage\ ratio = \frac{Tier\ I\ capital\ (CET\ 1 + additional\ TIER\ 1\ \ instruments)}{On\ and\ off\ \ balance\ sheet\ exposures} \geq 3\% \tag{7}$$

The next section of the Basel III revision is dedicated to the revised output floor, which is limiting the financial institutions capital benefit amount that can be obtained from the use of IRB approach in comparison to the standardised approach usage. When the financial institutions calculate RWA based on IRB approach it cannot be lower than the 72.5% (on the aggregated level) of the RWA computed by the standardised approaches. This means that the limit for the financial institutions benefit from the usage of IRB approach is set to 27.5%.

During 2018 and 2019, BCBS has continued work on the Basel III finalization, like additional revision of the market risk, as well as Pillar 3 disclosure. The start of implementation should be also postponed for one year to start of 2023, based on the BCBS announcement as of 27 March 2020 (BCBS, 2020).

The valuation of financial instruments and the recognition of the credit losses will keep important place in the BRCM development in the next period.

Starting from 2018, IFRS 9 has central place in the stated field. Movement of the impairment, i.e. provisions will be important for the next period (similar like in previous period). This is the reason for the simulation which has been conducted in the next chapter of this paper. The following figure is presenting ratio of bank NPL to total gross loans of the different European countries as of Q2 2019, taking into account that credit risk still has domination in the total risk management and NPL level is one of the major credit risk indicators.

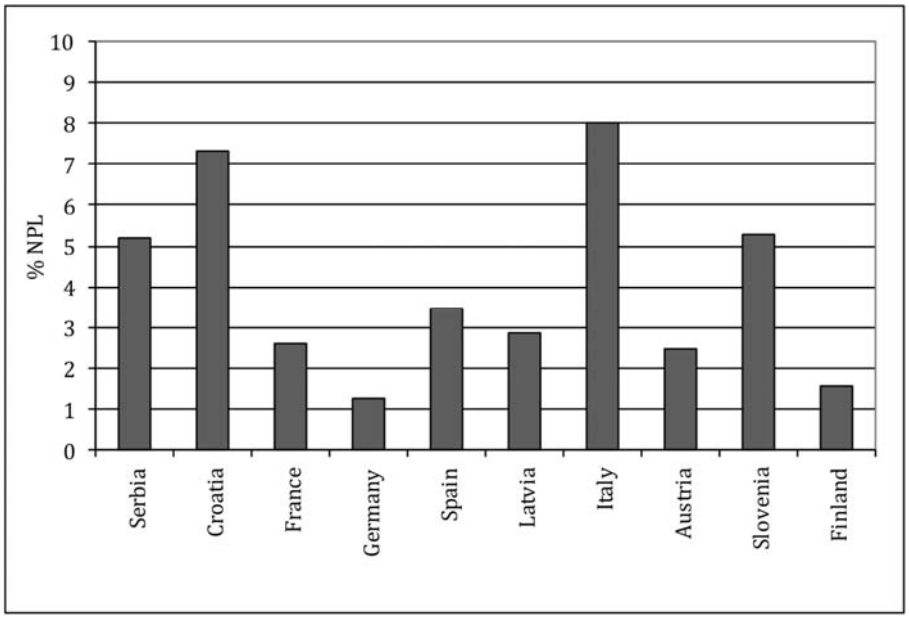

Figure 5. Ratio of bank NPL to total gross loans of the different European countries as of Q2 2019

Source: Authors, based on: European Central Bank (2019), NBS (2019), "Banking Sector in Serbia - Second Quarter Report 2019" and Croatian National Bank (2019).

This segment of the paper is highlighting other important issues which could be important for the future trends in the worldwide BRCM. The adaptation of BRCM on the new market conditions and challenges (Milojević, 2016), economy innovations (Caseiro & Simões 2019, Milojević, 2014), new financial technologies, contemporary digital banking, will continue to be important in the coming period. In doing so, some risks will take on new forms and characteristics, and some are further enhanced by importance. Example for this would be cyber security risk which is related with the new digital trends in the banking and its development. The well known financial risks like credit risk and liquidity risk can get modifications in its effects and management based on the new digital banking trends and combination of old and relatively new risks. Financial institutions are already investing significant amounts in the information security and protection of the cyber risk (Aldasoro, I. et al, 2020). It is expected that this trend would continue during following years.

Banks and other market players have significant hopes in the field of artificial intelligence and machine learning, which are expected to have a strong impact on the development of banking, including the development of risk management, in the coming years. The development is conditioned by both macro prudential needs and micro aspects, i.e. the need for banks to improve their current practices and adapt to new market conditions. Financial institutions had significant investments in the research of artificial intelligence and machine learning application in the banking (Kolanovic & Krishnamachari, 2017, Financial Stability Board, 2017). BRCM was one of the important segments of the stated research. Big hopes are related to the improvement of the BRCM, based on the application of the artificial intelligence, machine learning, deep learning and big data analytics (Leo, M. et al, 2019). Some of the area were the application results of the stated tools can be seen in the last period is the credit risk management, particularly credit scoring (Addo, P.M. et al, 2018), ratings, stress testing and similar. This topic requires that new research will be conducted during next years, with the aim to maximise the positive effects, but also to reduce the potential risks of the non adequate implementations. The careful and adequately prepared further implementation of the artificial intelligence, machine learning, big data analytics and deep learning can have further positive impact, especially on the following BRCM areas: capital adequacy, credit, liquidity, foreign exchange, interest rate and other market risk, operational risk, information security risk and other connected segments.

At the end of this segment it is important to state the impact which COVID-19 virus will have on the worldwide society, economy and inevitably on the financial market and trends in the BRCM. Since the world is still faced with extremely strong challenge of the COVID-19 on all the segments of the world society it is hard to predict what impact it will bring on the BRCM in the future period. The changes in this filed will be conducted. Some risks will have changed or updated treatment. Previously stated can happened to the operational risk, liquidity risk, etc. As of 27 March 2020 BCBS announced prolongation for one year Basel III finalization deadlines (BCBS, 2020). Also, new instructions from the BCBS and other institutions can be expected. However, detailed and compressive analysis (including future perspective, quantitative study, simulations, stress tests, etc.) of this topic can be conducted in some future period, when further COVID-19 impact information and the response of the world society will be available. Methodology and analysis presented in this paper can be basis for the future papers, i.e. BRCM analysis which can include COVID-19, among other elements relevant for the analysis.

SIMULATION OF THE EFFECTS WHICH COULD BE GENERATED BY THE CHANGES IN THE RISK AND CAPITAL MANAGEMENT

BCBS (with the participation of many regulatory bodies and institutions) has conducted several comprehensive Basel III monitoring, analysis and quantitative impact studies. In October 2019, BCBS has published Basel III Monitoring Report. In this report (among others) results of the quantitative study can be seen. It includes expectations of the Basel III revision and

measures which will be introduced during following years, until 2027 (BCBS, 2019), i.e. 2028 after already explained one year prolongation.

The stated BCBS Report is very detailed and useful for the analyses of the future BRCM. Here are highlighted few results which are very relevant for the analysis conducted in this chapter.

Table 3. Transitional, complete phased-in initial and final Basel III accord CET1 ratio of the Group 1 banks in the Basel III Monitoring Report

CET1 ratios	31 December 2018
Transitional initial Basel III CET1 ratio (%)	12.9
Complete phased-in initial Basel III accord CET1 ratio (%)	13.0
Complete phased-in final Basel III accord (2027 / 2028) CET1 ratio (%)	12.2

Source: Authors, based on BCBS (2019 and 2020).

In the stated BCBS Report Group 1 banks are those with Tier 1 capital higher than EUR 3 billion and are worldwide present. All other banks are classified in Group 2 banks. Based on the presented table data, can be concluded that CET1 for Group 1 banks in the complete phased-in final Basel III accord is reduced for 5.4% in comparison to the Transitional opening Basel III CET1 ratio. CET1 for Group 1 banks in the complete phased-in final Basel III standard is reduced for 6.2% in comparison to the complete phased-in opening Basel III CET1 ratio.

Taking into account size (and other characteristics) of the banks from Group 1 and Group 2, for the further simulations with which will be simulated potential impact in the banking sector of the Republic of Serbia, more relevant are results of the Group 2 banks.

Table 4. Transitional, complete phased-in initial and final Basel III accord CET1 ratio of the Group 2 banks in the Basel III Monitoring Report

CET1 ratios	31 December 2018
Transitional initial Basel III CET1 ratio (%)	15.8
Complete phased-in initial Basel III accord CET1 ratio (%)	15.4
Complete phased-in final Basel III accord (2027 / 2028) CET1 ratio (%)	13.0

Source: Authors, based on BCBS (2019 and 2020).

Based on the presented table data, conclusion is that CET1 for Group 2 banks in the complete phased-in final Basel III accord is reduced for 2.8 percentage points (pp) or 17.7% in comparison to the Transitional opening Basel III CET1 ratio. CET1 for Group 2 banks in the complete phased-in final Basel III accord is reduced for 2.4pp or 15.6% in comparison to the complete phased-in opening Basel III CET1 ratio.

Simulation of the effects: Republic of Serbia example

Although banks from Group 2, can be significantly different from banks from the Republic of Serbia, further research will use the Group 2 as a starting point for the following simulation, taking into account that in this moment it is the best possible comprehensive publicly available source for the simulation which will be conducted. If in the next period would happened that similar data which are more appropriate for the Republic of Serbia are available, new simulation can be conducted and probably more precise results can be expected. In the meantime it would be valuable to conduct first analysis with available data, so that the first conclusion could be taken into account.

The starting point for our simulation of the complete phased-in final Basel III standard CET1 ratio of the Republic of Serbia banking sector is the data as of 30 June 2019. CET1 ratio of the Republic of Serbia banking sector, as of 30 June 2019 was 22.07. In the first presented simulation applied on the Serbian banking sector, CET1 ratio has reduction of 15.6% (based on the previously explained Group 2 banks CET1 ratio reduction in the complete phased-in final Basel III in comparison to the complete phased-in opening Basel III CET1 ratio). The result is that the CET1 ratio of the Republic of Serbia banking sector is reduced from 22.07% to 18.63%. This simulated CET1 ratio value is still relatively high and on respectable level (significantly higher than the regulatory minimum).

Table 5. Simulated complete phased-in final Basel III accord CET1 ratio of the Republic of Serbia banking sector

	CET1 ratios
Basel III CET1 ratio (%) as of 30 June 2019	22.07
Simulation 1: complete phased-in final Basel III accord (2027 / 2028) CET1 ratio (%)	18.63
Simulation 2: complete phased-in final Basel III accord (2027 / 2028) CET1 ratio (%)	18.16

Source: Authors, based on BCBS (2019) and NBS (2019), "Banking Sector in Serbia - Second Quarter Report 2019".

Similar conclusion is valid for the Simulation 2 of the complete phased-in final Basel III CET1 ratio of the Republic of Serbia banking sector. In the second simulation applied on the Serbian banking sector, CET1 ratio has reduction of 17.7% (based on the previously explained Group 2 banks CET1 ratio reduction in the complete phased-in final Basel III in comparison to the Transitional initial Basel III CET1 ratio). The result is that the CET1 ratio of the Republic of Serbia banking sector is reduced from 22.07% to 18.16%. Similar like in simulation 1, this simulated CET1 ratio value is still relatively high and respectable level (notably above than the legislation minimum).

Besides previously Basel III finalization simulation, in this research it is conducted additional capital adequacy simulation which is taking into account impairment, i.e. provisions movement. After a long preparation for the implementation, IFRS 9, started to be valid in 2018. Implementation of the IFRS 9 had significant impact on the banking during previous years. Its impact is also strongly present today and it will be during following years.

According to the European Banking Authority (EBA) Report, the IFRS 9 average impairment increase in the EU financial institution (first-time application: year 2018) was: 9% (European Banking Authority, 2018). Stated IFRS 9 impairment movement of the first-time application had following impact on the CET1 ratio in EU: simple average reduction: 51 bps (European Banking Authority, 2018). In the stated research for the relatively smaller banking sectors, like Republic of Serbia Banking sector, most interesting are the results for the smaller banks. In this EBA research, banks with the total financial assets below EUR 100 billion are classified as smaller institutions compared with other banks (European Banking Authority, 2018). IFRS 9 average impairment increase in the EU smaller financial institution was: 7% (European Banking Authority, 2018).

IFRS 9 implementation has strong impact on the worldwide financial institutions parameters, processes, business, including current trends and future progress in the BRCM. Based on this, the research included stress test that is explained in following part of the paper. Movement of the provision is especially important for the capital adequacy. The research included conducted stress test on the Republic of Serbia banking sector capital adequacy data. IFRS 9 impairment movement has shown that the amount of provisions can be volatile and harder to predict and planed in comparison to the old impairment standard (the International Accounting Standard 39 - IAS 39). This is increasing importance of the impairment and credit risk stress tests relevance

for the next years. With this idea, our starting positions for the Republic of Serbia banking sector capital adequacy stress test are the data as of 30 June 2019. The applied data are from the NBS Report: Banking Sector in Serbia - Second Quarter Report 2019 and its Statistical annex. Our stress test included both EBA report provisions increases: 9% (based on whole EBA sample) and 7% (based on EBA smaller financial institutions sample).

Major assumptions of our stress test are presented in this paragraph. Increase in the provisions is directly reducing capital (i.e. CET) in the full amount (by the negative impact on the Profit / Loss). In the same time, full amount of provision increase will reduced Credit RWA. Although the reduction of the CRWA has positive impact on the capital adequacy, the reduction of the capital has much stronger (negative) impact on the capital adequacy.

Major formula for our stress test is following:

$$CommonEquityTier1\,Ratio = \frac{CommonEquityTier1}{RWA} \quad (8)$$

The result of our stress test is in the table. Republic of Serbia Banking sector CET1 ratio is reduced for 0.27 and 0.21pp respectably, but the average CET1 ratio has stayed relatively high and in accordance to regulatory minimum.

Table 6. Basel III accord CET1 ratio of the Republic of Serbia Banking sector – provisions increase stress test results

	CET1 ratios
Basel III CET1 ratio (%) as of 30 June 2019	22.07
Basel III CET1 ratio (%): Stress Test 1: provisions increase 9%	21.80
Basel III CET1 ratio (%): Stress Test 1: provisions increase 7%	21.86

Source: Authors, based on European Banking Authority (2018) and NBS (2019), "Banking Sector in Serbia - Second Quarter Report 2019".

Previously conducted quantitative analyses of this paper (Basel III finalization and impairment stress test) are based on the Serbian banking sector data as of 30 June 2019. It can be concluded that the capital adequacy has stayed on stable and significantly higher value than the regulatory minimum. As the additional support of the previous conclusion, the paper research included conducted additional descriptive statistics analysis of total CAR of the Republic of Serbia banking sector (its average values) for the period 2009 Q1 – 2019 Q2.

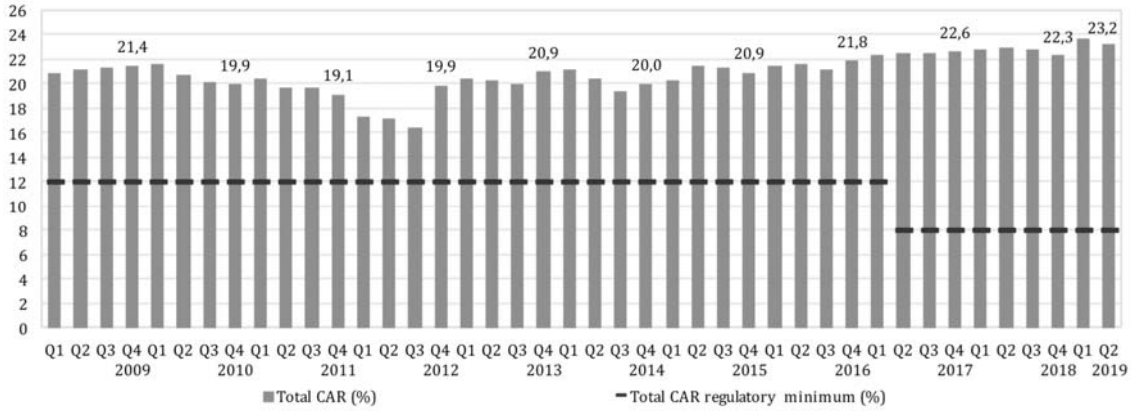

Figure 6. Total CAR of the Republic of Serbia Banking sector during period 2009 - 2019

Source: Authors, based on: NBS (2019), "Annual Financial Stability Report 2018"and NBS (2019), "Banking Sector in Serbia - Second Quarter Report 2019".

In this longer period, the research has included 42 observations and lots of regulatory changes in the capital adequacy calculation in the Serbia (Basel II, Basel III, IFRS 9, etc.). The reason for applying analysis in this case on Total CAR is that this ratio has longest time series, so it enables forming of 42 observations. From the descriptive statistic it can be concluded that during this period total CAR of the Republic of Serbia Banking sector, has stayed relatively stable and significantly higher than the regulatory minimum. The average Total CAR during this period was 20.87%. Regulatory minimum was first 12% and then with Basel III standard aligned to 8%, but Total CAR of the Serbian Banking sector has stayed above the prescribed regulatory minimum even with its minimal value in this period of 16.40%.

Table 7. Descriptive statistics of Total CAR of the Republic of Serbia Banking sector for the period 2009 Q1 – 2019 Q2

Indicators of descriptive statistics	Total CAR
Mean	20.87
Median	21.05
Standard Deviation	1.57
Kurtosis	1.15
Skewness	-0.81
Minimum	16.40
Maximum	23.68
Number of observations	42

Source: Authors, based on: NBS (2019), "Annual Financial Stability Report 2018"and NBS (2019), "Banking Sector in Serbia - Second Quarter Report 2019".

Taking into account previous analysis and results, our recommendations for the successful implementation of new trends in BRCM is related to continuation of careful planning, analysis, stress testing and quantitative impact study of the effects.

CONCLUSIONS

In this paper, worldwide banking risk and capital management progress has been analyzed. The research has been particularly concentrate on Europe and especially on the Serbia. The expectations for the future development of the risk and capital management are presented. The research included analyses of the already implemented Basel III accord, as well as Basel III finalization, which will be implemented during following years. Effects of the IFRS 9, as well as possible future movement of the credit risk impairment were also in the focus of this research. The digital banking, new financial technologies and other new trends in the banking are changing risk and capital management. Banks are increasing usage of the artificial intelligence, machine learning, deep learning and big data analytics in the risk and capital management. The paper highlighted which factors have potential to be crucial for the future risk and capital management. Stated factors are particularly connected with the planned application of the Basel III revision, but also to the new technologies, innovations and new risks.

Well known financial risks are getting new forms, while some new risk segments are getting on the importance. Various simulations and stress tests have been conducted in this research with the main, final focus on the capital adequacy impact. Taking into account European and worldwide experience, the research included special simulations and stress tests on the example of the Republic of Serbia banking sector. The capital adequacy has stayed stable in the research example. The results of the mentioned example, i.e. conducted simulations and stress tests were crucial for the conclusions highlighted in the next paragraph.

The stated results have shown that strong and stable capital adequacy of one banking sector can be very important factor for the planned implementation of the Basel III finalization standard. Additionally, high level of capital adequacy and capital buffers can be very precious in the case of the stress scenarios and various negative impacts that worldwide economy and banking can be faced. Taking into account negative effects of COVID-19, previously stated is even more important for the worldwide economy and banking. Our recommendations for the successful implementation of the new trends in the banking risk and capital management are related to the continuation of comprehensive research, education, investment in resources, state-of-the-art technology and methods, careful planning, analysis, stress testing and quantitative impact study of the effects.

REFERENCES

Addo, P.M., Guegan, D. and Hassani B. 2018. "Credit Risk Analysis Using Machine and Deep Learning Models." *Risks* 6(2): 38.

Adrian, T. 2018. "Risk Management and Regulation." International Monetary Fund, Departmental Paper No. 18/13

Aldasoro, I., Gambacorta, L., Giudici P. and Leach T. 2020, "Operational and cyber risks in the financial sector." BIS Working Papers No 840.

Basel Committee on Banking Supervision. 1988. "International Convergence of Capital Measurement and Capital Standards." https://www.bis.org/publ/bcbs04a.pdf (accessed February 1, 2020).

Basel Committee on Banking Supervision. 2011. "Basel III: A global regulatory framework for more resilient banks and banking systems." https://www.bis.org/publ/bcbs189.pdf (accessed February 1, 2020).

Basel Committee on Banking Supervision. 2013. "Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools." https://www.bis.org/publ/bcbs238.pdf (accessed February 1, 2020).

Basel Committee on Banking Supervision. 2015. "Finalising post-crisis reforms: an update." https://www.bis.org/bcbs/publ/d344.pdf (accessed February 1, 2020).

Basel Committee on Banking Supervision. 2015. "Implementation of Basel standards - A report to G20 Leaders on implementation of the Basel III regulatory reforms." https://www.bis.org/bcbs/publ/d345.pdf (accessed February 8, 2020).

Basel Committee on Banking Supervision. 2017. "Basel III: Finalising post-crisis reforms." https://www.bis.org/bcbs/publ/d345.pdf (accessed February 8, 2020).

Basel Committee on Banking Supervision. 2017. "Finalising Basel III - in brief." https://www.bis.org/bcbs/publ/d424_inbrief.pdf (accessed February 8, 2020).

Basel Committee on Banking Supervision. 2019. "Basel III Monitoring Report." https://www.bis.org/bcbs/publ/d477.pdf (accessed February 8, 2020).

Basel Committee on Banking Supervision. 2019. "Seventeenth progress report on adoption of the Basel regulatory framework." https://www.bis.org/bcbs/publ/d477.pdf (accessed March 7, 2020).

Basel Committee on Banking Supervision. 2020. "Governors and Heads of Supervision announce deferral of Basel III implementation to increase operational capacity of banks and supervisors to respond to Covid-19." https://www.bis.org/press/p200327.htm (accessed April 1, 2020).

Caseiro, C. and Simões, M. 2019, "Business Sector Innovation and Economic Growth: a Comparative Analysis between EU Countries." *Economic Analysis*, 2019, Vol. 52, No. 1: 1-22.

Croatian National Bank. 2019. "Semi-annual Information on the Financial Condition, the Degree of Price Stability Achieved and the Implementation of Monetary Policy in the First Half of 2019." https://www.hnb.hr/documents/20182/2922400/e-polugodisnja-informacija-1polugodiste2019.pdf/eb049c2d-e8ed-5292-08c4-563831548938 (accessed March 7, 2020).

European Banking Authority. 2018. "EBA Report: First Observations on the Impact and Implementation of IFRS 9 by EU Institutions." https://eba.europa.eu/sites/default/documents/files/documents/10180/2087449/bb4d7ed3-58de-4f66-861e-45024201b8e6/Report%20on%20IFRS%209%20impact%20and%20implementation.pdf?retry=1 (accessed March 7, 2020).

European Central Bank. 2019. "Supervisory Banking Statistics, Second quarter 2019." https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.supervisorybankingstatistics_second_quarter_2019_201910~6084c9cbd7.en.pdf?96bbb5f7e0a46afd0974f896fcad43bb (accessed February 29, 2020).

Financial Stability Board. 2017, "Artificial Intelligence and Machine Learning in Financial Services, Market Developments and Financial Stability Implications". http://www.fsb.org/2017/11/artificial-intelligence-and-machine-learning-in-financial-service/ [Accessed 29 May 2020].

International Monetary Fund. 2020. "Financial Soundness Indicators (FSIs)." https://data.imf.org/?sk=51B096FA-2CD2-40C2-8D09-0699CC1764DA&sId=1390030341854 (accessed March 7, 2020, 2020).

Kolanovic, M. and Krishnamachari, R. 2017. "Big Data and AI Strategies: Machine Learning and Alternative Data Approach to Investing." https://faculty.sites.uci.edu/pjorion/files/2018/05/JPM-2017-MachineLearningInvestments.pdf [Accessed 18 October 2020].

König, P. J. 2015. "Liquidity Requirements: A Double-Edged Sword." *International Journal of Central Banking*, Volume 11, Number 4:129-168

Leo, M., Sharma, S. and Maddulety, K. 2019. "Machine Learning in Banking Risk Management: A Literature Review." *Risks* 7(1): 29.

Milojević, N. 2014. "Optimal banking and other financial business for the economic growth of Serbia." *Journal of Central Banking Theory and Practice*, Volume 3, No. 2: 61-83.

Milojević, N. 2016. "Contemporary Challenges in the Banking Risk Management." *Business Economics*, Year X, No. 2, Vol. XIX: 66-85

National bank of Serbia. 2019. "Annual Financial Stability Report 2018." https://www.nbs.rs/internet/english/90/fs.html (accessed February 29, 2020).

National bank of Serbia. 2019. "Banking Sector in Serbia - Second Quarter Report 2019." https://www.nbs.rs/internet/english/55/55_4/index.html (accessed March 7, 2020).

World Bank. 2020. "Bank nonperforming loans to total gross loans." https://data.worldbank.org/indicator/FB.AST.NPER.ZS (accessed March 7, 2020).

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