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COULD BASEL III CAPITAL AND LIQUIDITY REQUIREMENTS AVOID BANK FAILURE?

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ABSTRACT

The aim of this study is to examine the contribution of the Basel III requirements in reducing bank failure risk through three different measures: the new long-term liquidity ratio (Net Stable Funding Ratio: NSFR), the Leverage ratio and the capital Tier One ratio. We use data on U.S. commercial banks during the 2008-2010 subprime crisis period. Our results depend on bank size: small banks are more sensitive to their fundamentals than large banks when it comes to failure risk. For large banks, no more safety is driven from the Leverage ratio or from the NSFR when Tier One ratio is applied. We also find that Leverage ratio considering off-balance sheet can be a complementary constraint for reducing bank regulatory arbitrage.

JEL: G01, G20, G21, G28

KEYWORDS: Financial Crisis, Bank Failure, Liquidity Creation, Basel III, Regulation, NSFR

INTRODUCTION

Basel III emerged in response to the 2007-2008 subprime crisis. To reduce systemic risk, regulators consider both the asset risk through the capital requirements and the transformation risk through two liquidity ratios (one for the short-term, Liquidity Coverage Ratio, LCR, and one for the long-term, Net Stable Funding Ratio, NSFR). Previous literature on failure risk focused either on asset risk or on transformation risk. The first theory considers asset risk as the main cause of bank failure and uses CAMEL (Capital adequacy, Asset quality, Management, Earnings, Liquidity and Sensitivity to market risk) indicators as a tool of analysis (Lanine and Vander Vennet, 2006; Wheelock and Wilson, 2000). The second theory supports the idea that transformation risk can cause financial instability leading to systemic crisis. In fact, there is a mismatch between liquid short-term payable deposits, and illiquid long-term loans (Diamond and Dybvig (1983). Few studies tried to explore simultaneously the role of these two risks in bank failure (Vazquez and Federico, 2012).

Some of empirical studies explored the impact of Basel III requirements but did not consider the off-balance sheet. Our paper will focus on the major pillars of the Basel III requirements (capital and liquidity) being essential to avoid bank failure and financial crises. It will also bring up the idea that size can affect bank sensitivity to these requirements. This paper will be mainly divided in three major parts. Section 1 will be the literature review. Section 2 will focus on data and the methodology applied. In section 3, we will analyze and evaluate applying Basel III requirements. Finally, we will conclude.

LITERATURE REVIEW

Literature identifies bank failure risk through different aspects. First, the asset risk under the « Weak Fundamentals Hypothesis » (Torna, 2010; Lanine and Vander Vennet, 2006; Wheelock and Wilson, 2000; Peek and Rosengreen, 1997) and second, the transformation risk under the « Liquidity Shortage

Hypothesis» (Diamond and Dybvig, 1983; Gorton and Winton, 2014). In the first hypothesis, capital requirement makes bank more resilient to shocks and protects depositors, creditors and investors. It leads banks to set up more strict criteria for their assets selection (Bolt and Tieman, 2004) and for their risk management (Holmstrom and Tirole (1997).Capital reduces debt ratio, lowering bank risk in presence of deposit insurance (Furlong and Keeley, 1989). Berger and Bouwman (2013) support that capital helps small banks to increase their chance of survival during normal times and during banking or market crises. For medium and large banks, capital improves their survival only during banking crises. Earlier, Jensen and Meckling (1976), in their work on the agency relationship, argued that higher capital reduces agency costs between shareholders and borrowers, improving the financial health of the firm. However, some studies criticize capital regulation. Kim and Santomero (1988) argue that capital requirement reduces the expected return and encourages banks to increase their risk leading to bank failure. Barth, Caprio and Levine (2004) did not find a strong relationship between capital regulation and bank stability in presence of other regulation and supervision. Girod and Bruno (2011) found there is an incentive bias to take excessive risk because of higher cost of capital, which is in contradiction with Basle II goal. Under « Liquidity Shortage Hypothesis », banking is based on confidence that can fail in any time leading to bank run. Indeed, banks, even solvent, can become illiquid due to arbitrary changes in the behavior of depositors or to liquidity shocks. Regulation, such as capital requirements, deposit insurance, lender of last resort or funds injection are proposed to cope with this risk (Diamond and Dybvig, 1983; Diamond and Rajan, 2005; Gorton and Winton, 2014). However, liquidity risk has not received as much attention from regulators until the 2008 crisis, even if Cifuentes *et al.* (2005) state that "liquidity buffers may play a role similar to capital buffers. In some circumstances, liquidity requirements may be more effective than capital buffers in forestalling systemic effects".

In the aftermath of this crisis, Basle III, in its original version of 2010, proposed a set of reforms to raise the quality of capital and to establish liquidity coverage. It proposed two complementary standards of liquidity to strengthen bank resiliency: The Liquidity Coverage Ratio (LCR) that concerns the short-term liquidity risk profile through high quality liquid asset and the Net Stable Funding Ratio (NSFR) that reduces long-term funding risk by requiring enough stable funding to finance their activities. Empirical research examining the link between liquidity risk and bank failure focused on both the sources of funding and the asset composition. Bologna (2013) analyzed the role of funding in explaining U.S. bank failure during the recent crisis through deposit structure. He found that riskier deposits such as brokered and large time deposits are positively linked to bank failure. Cole and White (2012) found that loan portfolio composition (personal versus commercial loans) affects US commercial bank failure and plays a key role in failure prediction while capital ratio loses its predictive power over the long-term. Vazquez and Federico (2012) analyzed the role of both capital and NSFR in explaining U.S. and European banks failure before the 2008 crisis. They showed that liquidity and capital have a complementary role in preserving bank soundness. To our knowledge, few empirical studies explored the impact of Basel III requirements on bank failure. Most of studies used the simple short-term liquidity ratios (Wheelock and Wilson, 2000 and Cole and white, 2012), and did not consider off-balance sheet (Vazquez and Federico, 2012 and Fungacova et al., 2013). Most of these studies did not analyze these issues during the crisis period.

DATA AND METHODOLOGY

The dataset comes from the FDIC annual Call Reports. It consists of an original sample of all US commercial banks, during the 2008-2011 period. We exclude from the sample banks that have zero commercial and industrial loans, and those having deposits held in foreign offices. Information about bank failure comes from the FDIC web site. Based on this information, the dataset consist of 13,105 bank-year observations using financial data for the years 2008, 2009 and 2010, i.e. one year before the failure. There are 478 failed banks during the 2008-2012 period.

Explanatory Variables

Our explanatory variables are at first Basle 3 Tier One, Leverage and long-term liquidity ratio -NSFR-. We use also financial variables such as Asset Quality, Management, Earnings and Liquidity and Control variables. Our expectations of these variables contributions are as follows: Tier One ratio (TO) is Basle 3 capital requirement considered as buffer allowing to absorb any losses incurred on banks assets. We expected that Tier One reduce the likelihood of failure. Leverage (LEV) is a non-risk-based leverage ratio as supplementary to Tier One (BCBS, 2013) which helps to limit the procyclicality of regulatory capital. We expect LEV to reduce bank failure risk. Net Stable Funding Ratio (NSFR) is the long-term liquidity ratio required by Basel III. It needs a classification by category and by maturity for each asset class. This information is not available for loans. We propose two measures of NSFR, one by category (NSFRc), used in our baseline models and one by maturity (NSFRm) used for robustness check. We expect banks with higher NSFR to be less likely to fail.

Asset quality (NPL): nonperforming loans ratio is a measure of loan quality. We expect that higher NPL increase bank failure risk.

Management quality (MNG): we consider cost control as an indirect measure of management quality. The more important are these costs, the more banks are likely to fail. The expected relationship is positive.

Earnings (ROA): the return on average assets measures bank profitability, since it considers all revenues and expenses related to banking. We expect that more profitability reduces bank failure risk.

Liquidity (LIQ): is the ability to satisfy the needs of depositors to withdraw their deposits. It is a measure of short-term liquidity. Thus, less liquid banks are more exposed to failure risk.

Size (LNTA): is the natural logarithm of total assets. It reflects the differences between large and small banks for constraints on credit and diversification. According to "too big to fail" statement, we expect that bank size can be a protection against failure risk.

Empirical Model

We use the panel logistic model to predict bank failure. It is a regression model taking in consideration a dichotomist dependent variable, Fail, which takes the value one for failed banks and zero for non-failed banks. It establishes a relationship between the likelihood that the failure event happens or not and a vector of lagged explanatory variables. The probability that a bank fails at a moment is given by the value of the cumulated logistic distribution evaluated for the data and the estimated parameters. The posteriori probability of failure can be derived from the following equation:

$$Fail_{i,t} = log\left(\left[\frac{P_{i,t}}{(1-P_{i,t})}\right]\right) = \beta_0 + \beta_1 X_{1,t-1} + \beta_2 X_{2,t-1} + \cdots + \beta_n X_{n,t-1}$$

And $P_{i,t} = \frac{1}{1+e^{Fail_{i,t}}}$

Where log is the natural logarithm, P_i is the probability that bank i will fail next period, X_j is the *j*th independent variable, and β_j is the coefficient of the j^{th} predictor variable. The coefficients measure the effect on the odds of bank failure of a unit change in the corresponding independent variables. Positive coefficients will increase probability of failure, while negative ones will be associated with a decrease in the probability of failure. To test our hypothesis, we estimate the multivariate panel logit models

described by equations (1) to (7). We introduce separately Tier One (TO), Leverage (LEV), and NSFR, in equations (1) to (3) respectively to study the relevance of each variable. Equation (4) includes Tier One and Leverage. Equation (5) includes Tier One and NSFR and equation (6) include Leverage and NSFR. In equation (7), we try to mimic the requirements of Basel III by introducing in the same model Tier One, Leverage and NSFR.

$$\text{Fail}_{i,t} = \beta_0 + \beta_1 \text{TO}_{i,t-1} + \beta_2 \text{NPL}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 LIQ_{i,t-1} + \beta_5 MNG_{i,t-1} + \beta_6 LNTA_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

$$\text{Fail}_{i,t} = \beta_0 + \beta_1 \text{LEV}_{i,t-1} + \beta_2 \text{NPL}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 LIQ_{i,t-1} + \beta_5 MNG_{i,t-1} + \beta_6 LNTA_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

$$\text{Fail}_{i,t} = \beta_0 + \beta_1 \text{NSFR}_{i,t-1} + \beta_2 \text{NPL}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 LIQ_{i,t-1} + \beta_5 MNG_{i,t-1} + \beta_6 LNTA_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

$$\text{Fail}_{i,t} = \beta_0 + \beta_1 \text{TO}_{i,t-1} + \beta_2 \text{NPL}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 LIQ_{i,t-1} + \beta_5 MNG_{i,t-1} + \beta_6 LNTA_{i,t-1} + \beta_8 \text{LEV}_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

$$\text{Fail}_{i,t} = \beta_0 + \beta_1 \text{TO}_{i,t-1} + \beta_2 \text{NPL}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 LIQ_{i,t-1} + \beta_5 MNG_{i,t-1} + \beta_6 LNTA_{i,t-1} + \beta_8 \text{NSFR}_{i,t-1} + \varepsilon_{i,t} \quad (5)$$

$$\text{Fail}_{i,t} = \beta_0 + \beta_1 \text{LEV}_{i,t-1} + \beta_2 \text{NPL}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 LIQ_{i,t-1} + \beta_5 MNG_{i,t-1} + \beta_6 LNTA_{i,t-1} + \beta_8 \text{NSFR}_{i,t-1} + \varepsilon_{i,t} \quad (6)$$

$$\text{Fail}_{i,t} = \beta_0 + \beta_1 \text{TO}_{i,t-1} + \beta_2 \text{NPL}_{i,t-1} + \beta_3 \text{ROA}_{i,t-1} + \beta_4 LIQ_{i,t-1} + \beta_5 MNG_{i,t-1} + \beta_6 LNTA_{i,t-1} + \beta_8 \text{LEV}_{i,t-1} + \beta_9 \text{NSFR}_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

RESULTS AND DISCUSSIONS

We present the means and standard errors for the subsamples of non-failed and failed banks, for the 2008-2010 period in Table 1. We use the t-test to compare the difference in mean between failed and non-failed banks. Not surprisingly, financial variables are statistically significant at the 1% level and present the expected sign. As expected, failing banks have significantly lower NSFR by category. However, the difference in the means for the NSFR by maturity is significant but does not have the correct sign. The correlation matrix for the independent variables shows no excessive correlation between them, except between Tier One (TO) and Leverage (LEV).

Table 1 : Descriptive Statistics for Non-Failed and Failed Banks During the 2008-2010 Period

Variable	Non-Failed Banks		Failed Banks		Difference	T-Statistic	
	Mean	Std. Dev.	Mean	Std. Dev.			
TO	13.56	6.38	4.47	3.55	9.09	26.84	***
LEV	1.18	1.48	0.54	0.63	0.63	8.11	***
NSFRc	1.03	0.13	0.98	0.11	0.04	6.17	***
NSFRm	1.74	1.88	2.07	1.8	-0.33	-3.24	***
NPL	2.99	.03	11.13	.48	-8.14	-39.47	***
MNG	89.04	42.14	126.62	128.25	-37.58	-15.03	***
ROA	-0.16	1.95	-5.1	3.26	4.93	46.19	***
LIQ	29.28	17.59	23.71	12.53	5.56	5.94	***
LNTA	12.38	1.14	12.6	1.2	-0.21	-3.49	***

Difference in the means of non-failed and failed banks and t-test for significant differences are presented in the two last columns. Data in Millions of US Dollars. Source Federal Deposit Insurance Corporation.

Empirical Results

We present the regression results of the equations (1- 7) in Table 2. Each target variable introduced separately (1-3) presents the expected contribution with significant coefficients at the 1% level. Higher Tier One ratio, Leverage ratio and NSFR by category reduce bank failure risk. This implies that well capitalized banks and those with sound liability structure are more resilient to failure. These results follow our assumptions, Basel III expectations and former and new literature (Bolt and Tieman, 2004; Berger and Bouwman, 2012, Vazquez and Federico, 2012).

NSFR by category loses its significance with Tier One and Leverage ratios (equations 5, 6 and 7) suggesting the two capital ratios are sufficient in explaining banks failure in contrast to the new Basel III long-term liquidity requirements. Surprisingly, Leverage ratio increases significantly bank failure risk, when introduced with Tier One (equations 4 and 7) in opposition to Basel III hypothesis and to our assumptions. Rugemintwari *et al.* (2012) justify the coexistence of the tier one ratio and the simple leverage ratio by their complementarity when banks underestimate their risk, while it would be superfluous in the absence of cheating and essential when cheating is high. Positive correlation between leverage and bank failure in presence of the tier one ratio suggest that banks underestimate their risk by choosing riskier assets and speculative derivatives. This finding may be the result of the composition of the leverage ratio introduced by Basel III that considers the off-balance sheet items (derivatives, CDS and MBS). These products, designed for coverage objectives, can deviate from their original purpose to become speculative products, increasing bank risks. In fact, the respect of a minimum leverage can be an incentive bias to take excessive risk to compensate the increasing cost of capital. Girod and Bruno (2011) found similar results for capital ratio under Basel II.

Table 2: Baseline Panel Logistic Regression Results for the Entire Sample

Variable	Eq1		Eq2		Eq3		Eq4		Eq5		Eq6		Eq7	
TO	-2.26	***					-2.43	***	-2.22	***			-2.46	***
	(0.18)						(0.19)		(0.18)				(0.19)	
LEV			-1.76	***			1.08	***			-1.75	***	1.15	***
			(0.24)				(0.32)				(0.25)		(0.32)	
NSFRc					-2.56	***			-2.04		-0.2		-3.18	
					(0.9)				(2.25)		(0.95)		(2.33)	
NPL	0.05		0.16	***	0.16	***	0.03		0.05		0.16	***	0.04	
	(0.03)		(0.02)		(0.02)		(0.04)		(0.03)		(0.02)		(0.04)	
ROA	-0.47	***	-0.57	***	-0.6	***	-0.47	***	-0.46	***	-0.57	***	-0.48	***
	(0.08)		(0.06)		(0.05)		(0.09)		(0.08)		(0.06)		(0.09)	
LIQ	0.01		-0.03	***	-0.03	***	0.01		0.01		-0.03	***	0.01	
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
MNG	0.01	***	0		0		0.01	***	0.01	***	0		0.01	***
	(0)		(0)		(0)		(0)		(0)		(0)		(0)	
LNTA	0.36		0.06		0.3	***	0.55	**	0.31		0.06		0.5	**
	(0.22)		(0.08)		(0.08)		(0.23)		(0.22)		(0.08)		(0.24)	
CONS	2.46		-5.25	***	-7.19	***	0.38		4.84		-5.06	***	4.11	
	(2.96)		(1.22)		(1.49)		(3.1)		(3.97)		(1.51)		(4.15)	
ll	-638.2		-968.35		-1023.2		-633.31		-637.86		-968.32		-632.33	
aic	1,292.4		1,952.6		2,062.4		1,284.6		1,293.7		1,954.6		1,284.6	
bic	1,352.2		2,012.4		2,122.2		1,351.8		1,360.9		2,021.9		1,359.4	

In all models, the dependent variable equals one for failing banks, and zero otherwise. The three target variables are Tier One (TO), Leverage (LEV) and NSFR by category.t-statistic between parenthesis.,** and *** indicate statistical significance at the 0.1, 0.05 and 0.01 levels, respectively.*

The coefficients associated to earning are negative and significant at 1% level. This result is consistent with previous studies suggesting that failure risk increases for less profitable banks (Arena, 2008; Lanine and Vennet, 2006; Wheelock and Wilson, 2000). More liquid banks and those with high asset quality are less likely to fail when associated with leverage ratio or with NSFR (equations 2, 3 and 6) in line with Cole and White (2012) findings. However, liquidity and asset quality lose their relevance with Tier one

ratio (equations 1, 4, 5 and 7). This result could be justified by the construction of Tier one ratio that considers credit risks, market risks and operational risks. Finally, better management quality reduces bank failure risk. Estimated coefficients for bank size are positive but not statistically significant for all the models.

Robustness Check

To evaluate the importance of alternative criteria for measuring liquidity requirement from Basle 3, we performed an additional estimation to examine the robustness of our results by using an alternative measure of NSFR, i.e. NSFR by maturity (NSFRm). The results in Table 3 show that, surprisingly, NSFRm has a positive and significant impact on bank failure risk. We can explain this result, inconsistent with our assumptions and Basle 3 objectives, by excessive reliance on short-term activity since the denominator of NSFR by maturity, RSF, decreases when the short-term loans are important. Another limit of the NSFRm concerns the problem of accurate credit liquidity evaluation. Long-term credits can be securitized and so become liquid. In absence of precise information about the real credit liquidity, NSFRm is incoherent (Berger and Bouwman, 2009). These results confirm the findings of the baseline model for all the other variables bringing some robustness to our previous results.

Table 3 : Robustness Check by Alternative Measure of Long-Term Liquidity Ratio, (Eq7)

Variable	NSFRc		NSFRm	
TO	-2.46	***	-2.43	***
	(0.19)		(0.2)	
LEV	1.15	***	0.93	***
	(0.32)		(0.34)	
NSFR	-3.18		0.44	***
	(2.33)		(0.14)	
NPL	0.04		0.03	
	(0.04)		(0.04)	
ROA	-0.48	***	-0.45	***
	(0.09)		(0.09)	
LIQ	0.93		1.15	
	(0.73)		(0.99)	
MNG	0.68	***	0.68	***
	(0.25)		(0.24)	
LNTA	0.5	**	0.49	**
	(0.24)		(0.24)	
CONS	4.11		0.36	
	(4.15)		(3.13)	
ll	-632.33		-629.14	
aic	1,284.66		1,278.29	
bic	1,359.41		1,353.03	

In all models, the dependent variable equals one for failing banks, and zero otherwise. The alternative measure of liquidity is NSFR by maturity (NSFRm).t-statistic between parenthesis.,** and *** indicate statistical significance at the 0.1, 0.05 and 0.01 levels, respectively.*

Classification by Size

Size is an important factor in explaining banks failure. The large number of small banks may hide the specificities of medium and large banks. We classify banks by asset size in two groups: small banks with assets less than 1 billion dollars and medium and large banks with assets greater than 1 billion dollars. There are 11 717 small banks and 1 362 medium and large banks. Table 4 presents estimation results by asset size class. For small banks, as expected, the results are similar to the baseline model, in terms of sign and significance. The major result concerns the NSFR that becomes significant at the 10% level reducing banks failure risk as expected by the BCBS. So, small banks, with higher stable funding are less likely to fail. For medium and large banks, only the two capital ratios remain significant. These results show that small banks are more sensitive to their fundamentals (Cole and White, 2012). Bank size variable is significant for medium and large banks, increasing bank failure risk. These banks benefit from

advantage of state support (in the form of implicit insurance). This confirms the "too big to fail" hypothesis that incites large banks to take excessive risks.

Table 4 : Logit Regressions by Sub-Samples of Size Category

Variable	Baseline Model, All Size		Small Banks		Medium and Large Banks	
TO	-2.46	***	-2.03	***	-3.9	***
	(0.19)		(0.19)		(0.77)	
LEV	1.15	***	0.88	***	3.17	**
	(0.32)		(0.29)		(1.52)	
NSFRc	-3.18		-4.21	*	3.67	
	(2.33)		(2.28)		(6.66)	
NPL	0.04		0.04		-0.08	
	(0.04)		(0.03)		(0.13)	
ROA	-0.48	***	-0.41	***	-0.46	
	(0.09)		(0.08)		(0.32)	
LIQ	0.93		0.7		0.1	
	(0.73)		(0.69)		(5.98)	
MNG	0.68	***	0.56	**	0.36	
	(0.25)		(0.23)		(1.99)	
LNTA	0.5	**	0.07		2.37	**
	(0.24)		(0.3)		(1.09)	
CONS	4.11		8.78	*	-19.08	
	(4.15)		(4.74)		(16.97)	
ll	-632.33		-552.38		-75.22	
aic	1,284.66		1,124.7		172.44	
bic	1,359.41		1,198.4		229.72	

*Large banks have assets greater than 3 billion dollars, medium banks have assets between 1 and 3 billion dollars and small banks have assets less than 1 billion dollars. In all models, the dependent variable equals one for failing banks, and zero otherwise. t-statistic between parentheses. *,** and *** indicate statistical significance at the 0.1, 0.05 and 0.01 levels, respectively.*

CONCLUSION

Basel III tried to consider broader aspects of banking activity. Its objective is to increase banks resilience through higher capital requirements (Tier One and Leverage), and to reduce banks fragility by introducing two liquidity ratios, LCR and NSFR. We used a panel logit analysis on dataset drawn from the 2008-2010 subprime crisis period for US commercial banks to explore the contribution of these measures in reducing banks failure risk. We found that in presence of the tier one ratio, leverage increases bank failure risk, suggesting that banks underestimate their risk by choosing riskier assets and speculative derivatives. This result points out the importance of considering and supervising the off-balance sheet activity in applying Basel III requirements. In regards to the NSFR, we surprisingly found out that its efficiency depends on the bank size. Banks of smaller size are more sensitive to their fundamentals and to regulatory requirements. Especially, they are more affected (by risk) when there is a lack of stable funding. Banks of larger size, however, benefiting from the implicit insurance, are not affected by these elements. Our study provides some support to Basel III, suggesting to the regulators: first, to choose the Leverage ratio as a complementary constraint for reducing bank regulatory arbitrage. Second, to continue implementing liquidity ratios that provide more buffers against the failure risk for small banks. Large banks, taking advantage from the "too big to fail" and "too big to discipline", are not affected by liquidity measures. So, regulators should strengthen supervision and transparency requirements for these banks.

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