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Journal of Economic Science Research
http://ojs.bilpublishing.com/index.php/jesr

ARTICLE

Importance of Balance Sheet Composition in Stress Test Estimates

Salvador Climent Serrano[1]* Elisabeth Bustos-Contell[2] Gregorio Labatut-Serer[2]

1. Department of Financial and Actuarial Economics. Faculty of Economics. University of Valencia. Campus Els Tarongers s/n, 46022 Valencia, Spain

2. Department of Accounting, University of Valencia, Av. dels Tarongers s/n, 46022 Valencia, Spain

ARTICLE INFO

Article history:
Received: 12 November 2018
Accepted: 12 December 2018
Published: 28 December 2018

Keywords:
NPLs
Impairment losses
Financial assets
Economic cycle
OLS, EBA

Codes:
JEL G21
G32
G18

ABSTRACT

The stress tests are based on macroeconomic variables for the estimations of the results. However, there are other factors that may influence them. This paper studies the influence of the balance sheet structure in the NPL and the loss caused by the NPL using econometric models. The objective is to research how they affect the aggregates in the balance sheet to the delay in payment and the the provision for impairment, distinguishing these effects according to the economic cycle, so that can be applied to the stress test. The results show that the Balance sheet structure is important in delinquency and losses caused by it, especially in respect of stockholders' funds, ECB resources and the account Non-current assets held for sale. It also highlights the influence of the economic cycle and the different behavior of the NPL and the losses due to default with respect to the same explanatory variables.

1. Introduction

Stress tests provide transparency to the financial market and are an important tool for banking supervision and for inventors[1]. In recent years, there has been a generalized use and disclosure of the stress test. The aim is to provide security to financial markets, a sector that is significantly affected by rumors[2]. According to Quijano[3], stress tests reduce uncertainty among investors by estimating potential losses by credit institutions.

The agreements Basel encourage the stress tests. Since the approval of this framework, stress tests have become a common risk-management tool on the financial sec-

**Corresponding Author:*
Salvador Climent Serrano
Department of Financial and Actuarial Economics. Faculty of Economics. University of Valencia.
Campus Els Tarongers s/n, 46022 *Valencia, Spain*
Email: Salvador.climent@uv.es

 DOI: https://doi.org/ 10.30564/jesr.v1i1.310

tor[4,5,6,7]. The estimation of the equity needs of credit institutions in stress tests is carried out according to different scenarios of macroeconomic variables. However, not only external variables influence the results of credit institutions. The structure of the balance sheet and its management can largely determine these results. This is why in this research the effect of the balance sheet structure on the PD (probability of default) and the LGD (loss given default) is be studied. The objective is to complement and not to substitute the effect of the economic conjuncture on these variables.

The choice of non-performing loans is motivated by the fact that they have become a significant aggregate for credit institutions, mainly for two reasons: i) the consequences of high NPLs can lead to the bankruptcy or intervention of credit institutions, and ii) there are incentives to increase risk and reduce costs, which reduces risk assessment and increases NPLs[4].

The objective of this research is to construct an econometric model for the estimation of the PD and LGD of the loan portfolio to clients of Spanish credit institutions. This model is based on the methodology recommended by the EBA for the 2016 EU-wide stress test. The result will serve to estimate more carefully the PD and LGD of each credit institution to apply in macroeconomic scenarios of stress tests.

2. Material and Methods

The sample was chosen from just one country, Spain, because the peculiarities of what each country does with the data obtained from the credit institutions of one country are not optimal for the rest. Thus the sample consists of 76 Spanish banks (banks, savings banks and credit unions), which represent about 95% of the assets of the Spanish financial system. As for time, it spans the 12-year period from 2004 to 2015.

The approach proposed in the 2016 EU-Wide Stress Test – Methodological Note EBA[8], to estimate the flow of impairments on new defaulted assets at time t+1 is given by:

Gross Imp Flow New (t+1) = Exp (t) x PDpit (t+1) x $LGDpit^{NEW}$ (t+1)

where Exp (t) is the exposure, in our case the loans granted to customers, PDpit (t + 1) are the NPLs caused by the exposure in year t+1, and LGDpitNEW (t+1) are the estimated impairment losses for the year t+1.

The dependent variables in our models are the probability of default (PD) and the loss given default (LGD).

The explanatory variables chosen are those that influence the NPLs of the portfolio of loans to customers within the balance sheet, being:

ECB Resources. Financing by the Bank of Spain or the ECB. When a credit institution has a liquidity deficit, it is forced to request resources from central banks. This indicates a sign of weakness, so it will be expected that the higher this variable, the greater the PD and the LGD. The variable is the financing by the central banks divided by the assets.

Leverage. The ratio of deposits to credits is another of the fundamental variables. In this case the sign is not predetermined, since it is depend on the management of each entity in the assumption of risks. The ratio is calculated as loans to customers divided by customer deposits.

Solvency. The most solvent credit institutions should have better risk management, thus lower PD and lower LGD. The ratio is calculated as stockholders' funds divided by assets.

Non-current assets held for sale. In this account, the assets that come from the execution of guarantees (collateral) of non-performing loans are recorded. It is expected that the greater the volume this account has, the greater the PD and LGD.

In addition to the effect of the balance sheet variables, the influence of the economic cycle also is studied, that is to say, whether these effects are equal in intensity in periods of economic growth compared to times of recession. This can be done because the sample includes a period of economic growth in Spanish credit institutions from 2004 to 2009, and a recession period that in Spain, unlike in the rest of the industrialized countries, began in 2010.

3. Theory

Figure 1 shows the evolution of the two dependent variables during the study period. A total of 6 econometric models are estimated, three for the PD, one covering the whole period of the sample (2004 – 2015), another for the growth period (2004 – 2009), and the third the recession period (2010 – 2015) and a further three models of the same form for the LGD. The models are estimated with OLS unbalanced panel data, since not all entities cover the 12 periods.

The Levin, Lin & Chu test[9] to detect seasonality indicates that there is no seasonality in the explanatory variables. However, the dependent variables PD and LGD are co-integrated of order 1 C(1), so in the two models these variables are included with a delay of one year, making the models dynamic. Furthermore, in 2012[10], new financial regulations were implemented in Spain that greatly affected the impairment losses. To take account of this circumstance, a dummy variable is included in the LGD models that takes value 1 in 2012 and 0 for all other periods.

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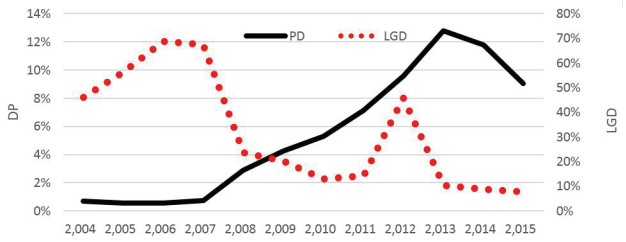

Figure 1. Evolution of the dependent variables

Therefore, the models are the following:

Models 1a, b and 1c

$$PD_{it}=\beta_1+\beta_2\ ECB\ Resources_{it}+\beta_3\ Leverage_{it}+\beta_4\ Solvency_{it}+\beta_5\ Non\text{-}current\ assets\ held\ for\ sale_{it}+\beta_6\ 2012_{it}+\beta_7\ PD_{i,(t-1)}+\varepsilon_{it} \quad \text{Models 1}$$

Models 2a, 2b and 2c

$$LGD_{it}=\beta_1+\beta_2\ ECB\ Resources_{it}+\beta_3\ Leverage_{it}+\beta_4\ Solvency_{it}+\beta_5\ Non\text{-}current\ assets\ held\ for\ sale_{it}+\beta_6\ 2012_{it}+\beta_7\ LGD_{i,(t-1)}+\varepsilon_{it} \quad \text{Models 2}$$

The Durbin-Watson statistic indicates that there are no correlation problems in the residuals. For heteroscedasticity models, they were estimated using the robust method of White and cross-section weights.

4. Results

The results of the econometric models are shown in Table 2. The models obtain quite a high adjusted R-squared value, so one can say that a good prediction from them is expected.

4.1 Models 1a, 1b and 1c for the PDs

The increase in ECB Resources increases the PD. The impact of this increase is greater in stages of growth than in periods of recession. Regarding the leverage variable, of the three models, this variable is statistically significant only in model 1b, the result being that the higher the leverage, the lower the PD. The higher the solvency, the lower the PD. This impact is greater in times of recession than in times of growth. The increase in the Non-current assets held for sale account results in an increase in the PD. This increase is greater in periods of recession than in periods of growth. Finally, there is a strong inertia of the dependent variable. This inertia is greater when the economy is growing compared to when it is in recession.

4.2 Models 2a, 2b and 2c for the LGD

The behavior in the variables ECB Resources, solvency, Non-current assets held for sales and the inertia of the dependent variable is similar to that of the PD model, except that the coefficients are always smaller in the LGD model. Thus the impact of the balance sheet structure is lower in LGD than in PD. Regarding the leverage, it is statistically significant in models 2a and 2c. In both cases the increase in leverage decreases the LGD.

5. Conclusion

The following results can be highlighted: The coefficients of the models in growth periods are different from those of recession periods. Therefore, the impact of the same variables on the balance sheets is different in the PD and LGD, depending on the business cycle. The explanatory variables have a different influence on the PD compared to the LGD. However, this circumstance should not occur. The increase in central bank financing means an increase in the PD and LGD. The leverage does not increase the PD or LGD as might have been expected; on the contrary they decrease slightly. The higher the stockholders' funds of the credit institutions are, the smaller are its PD and LGD. The increase in allotments, that is to say, that the credit institution retains the guarantee of the credit for non-payment, translates into increases in the PD and LGD. The impact of the change in regulations on the LGD had a large influence on the accounts of credit institutions.

6. Discussion and Future Research

There is a smoothing of LGD with respect to the PD. The coefficients of the two dependent variables should be similar, however, they are higher in the PD compared to the LGD. This means that the credit institutions reflect the PD that does not later transform into LGD. This circumstance should be studied in depth in future investigations. The increase in ECB Resources is a sign of weakness and leads

Table 1. Descriptive statistics

	PD	LGD	ECB Resources	Leverage	Solvency	Non-current assets held for sale
Mean	0.044	0.010	0.035	1.116	0.062	0.007
Median	0.025	0.005	0.013	1.044	0.059	0.001
Maximum	0.373	0.192	0.349	2.977	0.167	0.240
Minimum	0.001	-0.004	0.000	0.575	-0.059	0.000
Std. Dev.	0.053	0.019	0.051	0.310	0.025	0.015
Observations	531	531	531	531	531	531

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Table 2. Econometric models

	Model 1a. PD	Model 1b. PD	Model 1c. PD	Model 2a. LGD	Model 2b. LGD	Model 2c. LGD
Sample	2004-2015	2004-2009	2010-2015	2004-2015	2004-2009	2010-2015
c	0.013***	0.010***	0.040***	0.011***	0.002**	0.023***
	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.004)
ECB Resources	0.099***	0.146***	0.046***	0.042***	0.032***	0.014
	(0.017)	(0.021)	(0.020)	(0.007)	(0.002)	(0.018)
Leverage	-0.001	-0.003*	-0.000	-0.003***	-0.000	-0.007**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.000)	(0.003)
Solvency	-0.089***	-0.081***	-0.304***	-0.076***	-0.007	-0.193***
	(0.024)	(0.022)	(0.034)	(0.013)	(0.008)	(0.041)
Non-current assets held for sale	0.563***	0.314***	0.415***	0.167***	0.095***	0.168***
	(0.080)	(0.113)	0.064	(0.026)	(0.024)	(0.024)
Dummy 2012				0.027***		0.029***
				(0.003)		(0.003)
DP(-1) LGD(-1)	0.842***	1.104***	0.759***	0.164***	0.744***	0.123***
	(0.029)	(0.043)	(0.036)	(0.035)	(0.059)	(0.042)
Adjusted R-squared	0.878	0.814	0.931	0.649	0.566	0.738
Durbin-Watson stat	1.531	1.718	1.539	1.722	1.940	2.126
F-statistic	655.78	291.91	403.22	141.00	78.00	71.126

Significance levels *,**,*** at the 1%, 5% and 10% respectively. Robust standard errors between parentheses.

to an increase in the PD and LGD. The impacts of the explanatory variables are different in periods of growth compared to recessionary periods. Therefore, the impact of the economic cycle, in this regard, must be taken into account in the methodology of stress tests. The change in regulations in 2012 caused 3% of the total lending investment to become losses in the year 2012, only due to the regulation change. This seriously aggravated the Spanish financial crisis.

Acknowledgement: The authors wishes to thank the support of the Chair of International Finance-Banco Santander.

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