The balance sheet accounts on the stress tests

Abstract

This paper studies the influence of the balance sheet structure in the PD (probability of default) and LGD (loss given default) using econometric models. The aim is to study how they affect the aggregates in the balance sheet to the PD and the LGD, distinguishing these effects according to the economic cycle, so that can be applied to the stress test. The results indicate that the balance structure is important in PD and LGD, 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 PD and LGD with respect to the same explanatory variables

Keywords

NPLs, Impairment losses on financial assets, economic cycle, OLS, EBA

1. - Introduction

Stress tests provide transparency to the financial market and are an important tool for banking supervision (Sahin & de Haan, 2016). 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. (Climent, 2016). According to Quijano (2014), stress tests reduce uncertainty among investors by estimating potential losses by credit institutions.

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. It can best be understood with an example:

when the human population is threatened by an epidemic (stressed scenario) the entire population will be affected; however, the consequences for the weaker people will be very different than for the healthy and robust people. 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) will 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 (Wang & Huang, 2007).

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 will be 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, (2016) 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 LGDpit^{NEW} (t+1) are the estimated impairment losses for the year t + 1.

The dependent variables in our models will be 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 will be 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 will 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 will also be 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 will be 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.

Figure 1. Evolution of the dependent variables
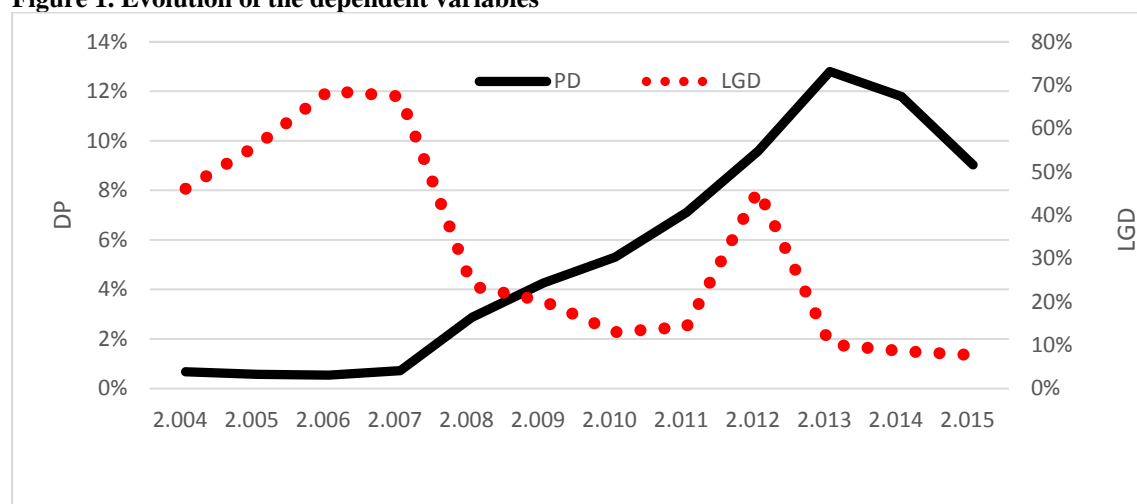
Prepared by author.

The Levin, Lin & Chu test to detect seasonality indicates that there is no seasonality in the explanatory variables. However, the dependent variables PD and LGD are cointegrated of order 1 C(1), so in the two models these variables will be included with a delay of one year, making the models dynamic. Furthermore, in 2012, 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.

Therefore, the models will be the following:

Models 1, 2 and 3

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

Models 4, 5 and 6

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

Descriptive statistics are shown in Table 1

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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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.

Models 1, 2 and 3 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 2, 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.

Table 2. - Econometric models

	Model 1. PD	Model 2. PD	Model 3. PD	Model 4. LGD	Model 5. LGD	Model 6. 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

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Models 4, 5 and 6 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 4 and 6. 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 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.

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