THE IMPACT OF PROBABILITY OF DEFAULT AND SOVEREIGN RISK ON ECONOMIC GROWTH VARIANCE

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Abstract

The banking crises create the need to capture, in the most refined form possible, the vulnerabilities of the banking system. Early warning indicators help in capturing signals that predict, in a timely manner, the likelihood of a banking crisis. In addition, the sovereign risk, captured by CDS 5Y, proved to have a major impact on the probability of default, which negatively influenced economic growth. The results were captured using a Vector Autoregression Model on a sample of EU member states.

Keywords: *gross domestic product, impulse response function, probability of default, sovereign risk, VAR model, variance decomposition*

JEL classification: *A10, D81*

1. Introduction

The global financial crisis has generated significant debates about the broadband connection between sovereign risk and banking instability. Banks play a key role in the economy. They mobilize economies, provide liquidity to other institutions, finance projects and are an essential component of the monetary policy transmission mechanism (Peek, 2014)[2]. The relationship with sovereign risk is strengthened by a complex set of more or less important links for other sectors of the economy. Therefore, banks and government

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[2] Peek, J., Rosengren, E. (1997). The International Transmission of Financial Shocks: The Case of Japan. American Economic Review 87 (4), pp.: 495–505

administration are directly linked through the exposures of sovereign bonds in the balance sheet. The banking sector provides loans to households and corporations, and thus financial instability and banking crises can have a major impact on real economic activity, with negative effects on fiscal policy (Kroszner, 2007).[3]

Establishing the theoretical framework on the most important channels of interaction (direct and indirect) between the sovereign risk premium, the probability of banking instability and economic dynamics involves capturing the consistent size of government portfolios in bank balance sheets, public administration, with a fundamental role of financier of last resort of bank resolution funds, as well as the spread of effects among the population and non-financial companies.

The reciprocal connection between those who save and those who want to invest involves an exchange of flows, on the one hand from the population, through the provision of savings and labor, and on the other hand, from enterprises, through the creation of profit and payment of salaries. Economic dynamics are also influenced by the interaction with the government. It makes transfers to households, respectively subsidies to companies and collects taxes and fees.

In order to ensure a financial balance, public expenditure should be limited to the collected budget revenue. Otherwise, the state is forced to go into debt. Borrowing can be done from several sources, the bank being one of the basic pillars. Excessive takeover of government bonds by the bank can generate systemic vulnerabilities, creating a strong connection between it and the health of public finances. The increase of the yields of government securities generates the decrease of their value and, implicitly, the reduction of the bank solvency. In this way, a negative relationship is established between government bond yields and banking performance. Given that the main purpose of a bank is to maximize profit, the optimal configuration of asset portfolios involves the allocation of banking resources according to the expected net income in relation to the various institutional sectors, mainly non-financial companies, population and public administration.

[3] Kroszner, R., Laeven, L., Klingebiel, D. (2007). Banking Crises, Financial Dependence, and Growth. Journal of Financial Economics 84 (1), pp.: 187–228

Starting from the hypothesis that a credit institution will record a profit, mainly from granting loans to the private environment, the financial accelerator can appear, amid a pro-cyclical mix of economic policies. The overheating of the economy generates higher temporary incomes, respectively rapidly increasing salaries for employees and the increase of shareholders' wealth, simultaneously with the appreciation of the assets value. Under these conditions, the demand for loans increases, and banks could increase credit lending, fueling, in turn, the excess demand in the economy, as lending standards relax significantly. However, when the economic cycle reaches the contraction period, the quality of bank portfolios deteriorates, affecting bank solvency, and the situation of public finances deteriorates rapidly.

Under these conditions, the supply of financing for the private sector from banking resources can be severely compressed, especially against the background of the increasing need to finance the additional deficits registered by the public budget. At the same time, financing costs are increasing, putting additional pressure on the financial situation of companies and the population, which would accentuate the demand deficit in the economy. Thus, the increased amplitude of the lending cycle is accompanied by an increased volatility of the economic cycle.

Deterioration of micro and macrostability can increase the country's risk. Country risk can be quantified using market information provided by the world's largest rating agencies, as well as the sovereign risk premium, as well as internal assessments. The CDS (credit default risk) rating is a direct measure of the sovereign risk premium, represented by the cost of insurance against the risk of default and includes both the probability of default and the recovery rate[4].

The current context of the economy reveals a slowdown in global economic activity. Low interest rates have supported, on the one hand, short-term economic growth, but, on the other hand, have encouraged some investors to take more risks. In developed economies, companies borrow more and are less able to repay loans, with debt at risk amounting to $ 19 trillion (about 40% of the total), according to the latest Financial Stability Report

[4] Moinescu, B. Codirlașu, A. (2009) Strategii și instrumente de administrare a riscurilor bancare, Publishing house: ASE, Bucharest

(October, 2019), provided by the International Monetary Fund[5]. Financial firms, such as insurance companies and pension funds, invest in riskier, less liquid assets. In emerging and border markets, external debt increased to 160% of exports.

The article continues with the literature, followed by the description of the methodology used and the results obtained. The paper ends by presenting the conclusions and future research directions.

2. Literature review

Regarding the connection challenges between sovereign risk and banking instability, the literature indicates a number of possible answers, especially in the area of prudential regulations. They aim to adequately reflect sovereign risk in terms of banking rules, either by reviewing the risk weights associated with exposures to general government or by broadening the scope of high exposure limitation requirements.

Policymakers anticipate the need to reduce the link between sovereign risk and banking instability, taking into account the interaction between these channels simultaneously. Fulfilling the functions of a single channel can have unfavorable consequences on the other two. Therefore, the systemic nature between sovereign risk and the banking sector imposes the need to weaken this connection, but without being completely interrupted. Policies should take this constraint into account.

Moreover, macro-prudential authorities recommend banks to be less exposed to sovereign risk. Thus, limiting government securities holdings should improve their financial health and market efficiency, while constraining the minimization of pro-cyclical effects. Given that sovereign bonds are an integral and indispensable part of the financial system, macro-prudential authorities seek to calibrate their benefits and costs, by size, in order to strengthen market discipline.

Strengthening bank balance sheets and governance can play an important role in reducing the significance of the connection between sovereign risk and banking stability, but without severing the link permanently. Strong fiscal buffers and proper public debt management can support debt sustainability and reduce the sovereign risk associated with

[5] Global Financial Stability Report: Lower for Longer (october 2019), International Monetary Fund

banking instability. On the other hand, larger capital buffers as well as a prudential regulatory framework contribute to the health of the banking sector, diminishing sovereign risk-induced banking risk. Also, limiting public guarantees can reduce excessive risk-taking (ex-ante), as well as the direct tax cost of bank resolution (ex-post). However, the consequences of these steps could lead to a possible banking crisis and, implicitly, to the increase of indirect fiscal and economic costs.

Moreover, the connection between sovereign risk and banking instability may also have an international dimension. Its decline means that banks are fully diversified between countries, but bank exposures can change significantly during a crisis. In times of crisis, the cyclical effects of the connection between sovereign risk and banking instability may converge. Thus, a crisis coming from the banking system (sovereign) weakens the sovereign (banking system), worsening, in turn, the banking crisis (sovereign) (Farhi, 2014)[6]. In other words, the sovereign-bank link acts as a multiplier and, at the same time, a financial accelerator for the vulnerabilities of these sectors.

As a solution to diminishing interconnection, macro-prudential authorities are considering a regulatory framework, which includes, in addition to crisis management policies, decisions on exposures to sovereign bonds. The reforms aim to increase banks' absorption capacity by increasing capital, liquidity and leverage requirements. A stronger prudential framework captures measures against systemic risk. In order to minimize the need for taxpayer financing, in the event of a crisis, reforms must contain initiatives to improve the resolution frameworks for systemic banks. The Basel Committee on Banking Supervision (2017)[7] has revised the regulations on the treatment of sovereign exposures, but no consensus has yet been reached on limits.

3. Methodology and empirical results

The macroeconomic model aims to bring a number of innovations and changes to existing crises. Quantifying the effects of financial and fiscal-budgetary shocks on financial developments provides a detailed overview of economic growth modeling, validated by experts in financial stability.

[6] Farhi, E., Tirole J. (2014). Deadly Embrace: Sovereign and Financial Balance Sheets Doom Loops (working paper), Harvard University

[7] Basel Committee on Banking Supervision (2017). The Regulatory Treatment of Sovereign Exposures. Discussion Paper, Bank for International Settlements (BIS)

Thus, the interaction with the probability of a banking crisis and the sovereign risk premium is captured with the help of autoregressive vectors, rendering the reaction of the dependent variable to an unexpected shock at the level of explanatory variables. From a technical point of view, the identification of crises on the basis of quantitative approaches can also be substantiated by means of a financial stress index, recommended by national and European authorities. This approach ensures a more precise definition of the crisis period and allows, adjusting and separating the crisis period and the post-crisis period, facilitating the estimation and calibration of models.

External and internal imbalances can affect the accuracy of the data set. This information is fundamental in selecting the relevant set of events for the models calibration or estimation, designed to study issues specific to banking crises. Thus, based on the translational movements of the CDS quotation curve, along with other specific determinants, the economic growth variance is highlighted, by capturing the impact of the evolution of the banking crisis probability and, respectively, of the sovereign risk premium.

To analyze the random shocks effects on system variables, we used a Vector Autoregression Model (VAR). The other regressors of the equation represent the explained and expected variable dynamic evolution of the variable, modeled according to the other variables in the system, as well as its past values. For each equation in the system, the ordinary least squares method is used to estimate the coefficients. In order to capture the banking crisis probability and the sovereign risk impact on economic growth variance, the decomposition of the variation will be used. It indicate the relative importance of external shocks in explaining the dependent variable dynamics. Moreover, the impulse-response function will capture the reaction of the dependent variable to an unexpected shock at the level of explanatory variables. Thus, the reaction of each variable to a one-unit shock will be tested at the standard errors of the other two variables in the system. With the help of causality tests we will follow the establishment of the directions of these relations, the econometric causality designating the capacity of a variable to predict and, implicitly, to cause another variable.

In order to establish the optimal number of lags for the model, we used the following informational criteria: LR: sequential modified LR statistical test (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn

information criterion. In this regard, we identified 2 as the optimal number of lags, according to the table below.

Table 1. Optimal number of lags

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	107.659	NA	8.13E-07	-5.508371	-5.379087	-5.462373
1	141.9378	61.341	2.16E-07	-6.838833	-6.321701	-6.654842
2	169.4927	44.95798	8.20E-08	-7.815407	-6.910425*	-7.493421
3	181.4757	17.65916*	7.19E-08	-7.972407	-6.679575	-7.512427*
4	192.2416	14.16565	6.88E-08	-8.065348	-6.384668	-7.467375
5	202.8893	12.32895	6.84E-08	-8.152071	-6.083541	-7.416104
6	214.7186	11.82922	6.70E-08	-8.300977	-5.844598	-7.427016
7	227.6448	10.88526	6.63e-08*	-8.507621*	-5.663393	-7.495667

* indicates lag order selected by the criterion

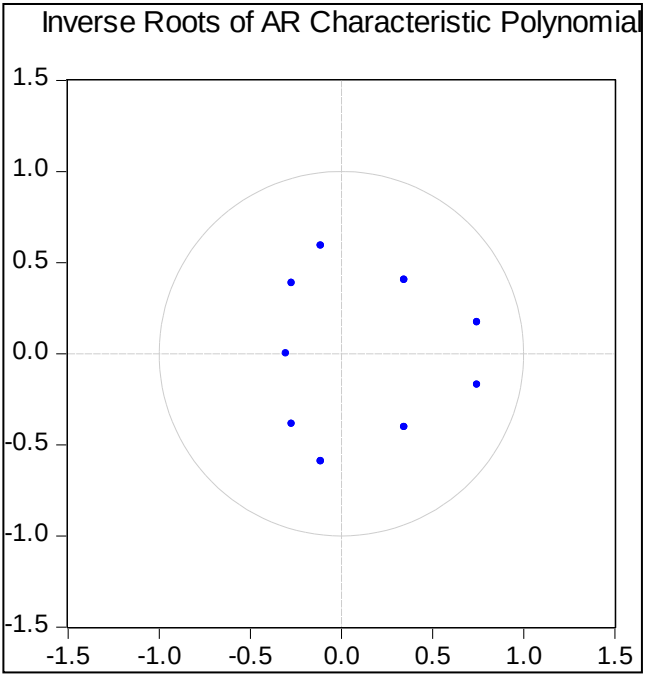
LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion
Source: own estimates, using EViews

The roots of the polynomial proved to be subunitary, which is why we can substantiate our decisions based on autoregressive model estimation:

Figure 1. The roots of the characteristic polynomial



Source: own estimates, using EViews

After estimating the model, we obtained the following results:

Table 2. Estimates of the autoregressive model

	PD	CDS_5Y	GDP
PD(-1)	**0.719696**	2.094973	0.009281
	-0.16176	-1.61023	-0.03793
	[4.44927]	[1.30104]	[0.24469]
PD(-2)	-0.202371	-0.940156	0.045192
	-0.19967	-1.98768	-0.04682

	[-1.01352]	[-0.47299]	[0.96524]
PD(-3)	0.187565	-1.686025	-0.017437
	-0.15412	-1.53422	-0.03614
	[1.21700]	[-1.09894]	[-0.48250]
CDS_5Y(-1)	**0.055519**	0.111811	**-0.01483**
	-0.01363	-0.13571	**-0.0032**
	[4.07232]	[0.82387]	**[-4.63923]**
CDS_5Y(-2)	-0.012022	-0.072088	7.22E-05
	-0.01605	-0.15973	-0.00376
	[-0.74924]	[-0.45131]	[0.01919]
CDS_5Y(-3)	-0.007642	0.031157	-0.001751
	-0.01534	-0.15273	-0.0036
	[-0.49813]	[0.20400]	[-0.48680]
GDP(-1)	-0.665803	9.271164	**0.282845**
	-0.66782	-6.64795	**-0.15659**
	[-0.99698]	[1.39459]	**[1.80625]**
GDP(-2)	-0.464261	5.155557	0.111742
	-0.7065	-7.03297	-0.16566
	[-0.65713]	[0.73306]	[0.67452]
GDP(-3)	-0.004604	-6.041972	0.180197
	-0.52938	-5.26984	-0.12413
	[-0.00870]	[-1.14652]	[1.45167]
C	**0.069656**	0.432442	0.006031

	-0.03598	-0.3582	-0.00844
	[1.93581]	[1.20727]	[0.71476]
R-squared	0.689451	0.107009	0.413528
Adj. R-squared	0.638634	-0.039116	0.31756
Sum sq. resids	1.188827	117.8078	0.065364
S.E. equation	0.147021	1.463544	0.034474
F-statistic	13.56732	0.732311	4.30902
Log likelihood	37.81515	-111.5577	132.0896
Akaike AIC	-0.855851	3.740236	-3.756604
Schwarz SC	-0.52133	4.074758	-3.422083
Mean dependent	0.260011	0.387214	0.018853
S.D. dependent	0.244571	1.435733	0.041731
Determinant resid covariance (dof adj.)		3.85E-05	
Determinant resid covariance		2.33E-05	
Log likelihood		69.98289	
Akaike information criterion		-1.230243	
Schwarz criterion		-0.226679	

Source: own estimates, using EViews

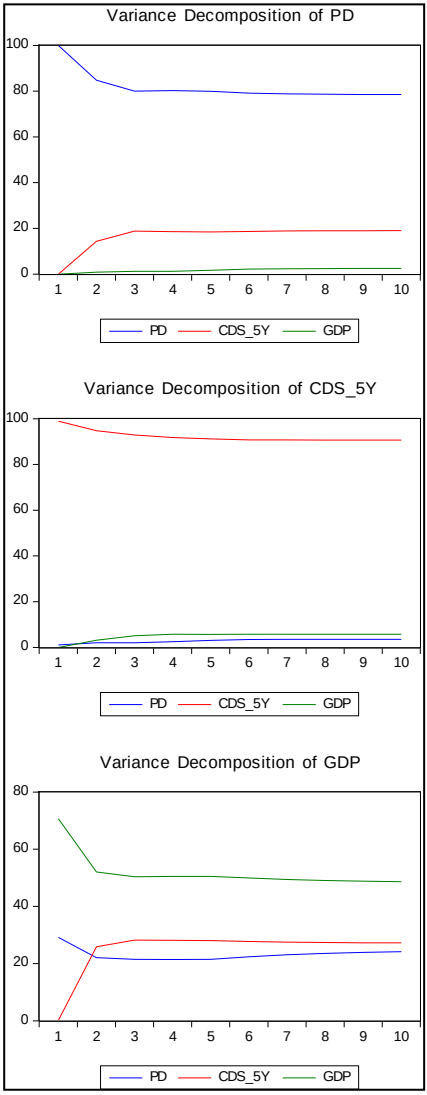
In order to obtain robust results, we eliminated the indicators whose standard error is very high, or whose t-statistical value does not fall within the confidence interval. After regression processing, the following equation is obtained:

$$GDP = 0.282845*GDP(-1) - 0.01483*CDS\_5Y(-1)$$

The past values of economic growth have a positive effect on the present values, there being inertia in its evolution. This fact is explained by the fact that the effects of the welfare of the economy spread, at least, from one year to another, the period in which the economic growth effects are captured by the impact of the decrease of the sovereign risk premium cost.

Next, we used the variation to indicate the relative importance of external shocks in explaining the dependent variable evolution.

Figure 2



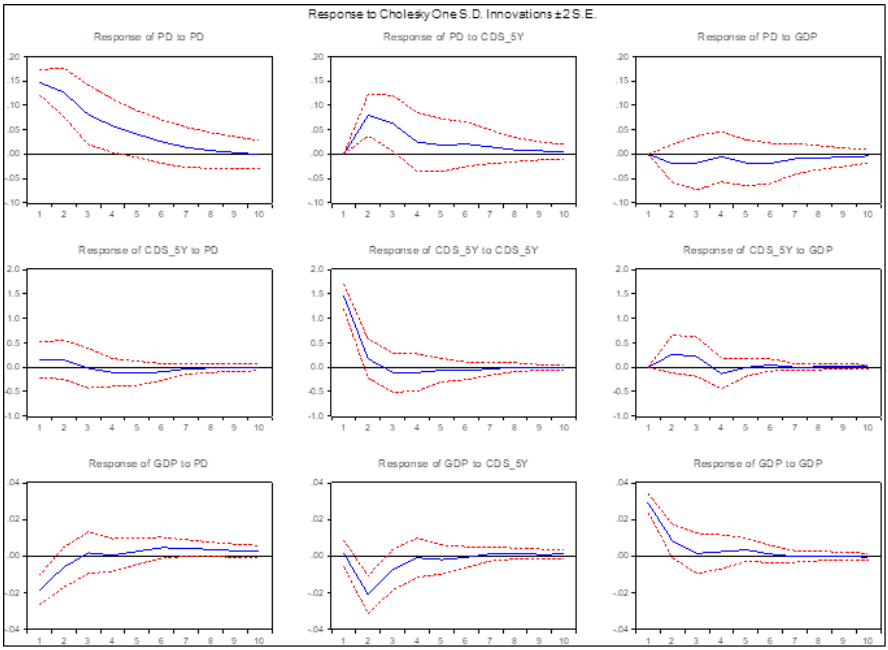
Source: own estimates, using EViews

We tested the effect of shocks on variables by decomposing the GDP variance. The results indicate the very large share of their own changes in the GDP variation. It is also explained in a proportion of about 50% of its own variation (after 1-2 years). The probability of banking crises (PD) and the risk premium (CDS 5Y) have an approximately equal weight in explaining the GDP dynamics. After about 1-2 years, PD causes about 20% of GDP change, while CDS 5Y has an impact of about 25% of the indicator change.

Also, with the help of causality tests we aimed to establish the directions of these relationships, econometric causality designating the ability of one variable to predict (and implicitly cause) another variable.

The impulse-response function follows the reaction of the dependent variable to an unexpected shock at the level of the explanatory variables. The reaction of each indicator to a one-unit shock is tested at the standard errors of the variables included in the system.

Figure 3



Source: own estimates, using EViews

The results suggest that the most significant reaction is observed on the variable PD, CDS 5Y, respectively GDP, in case of applying a shock on itself, but the effect is mainly visible in the first 1-2 years.

It is also observed that GDP cannot cause considerable variations on CDS 5Y in case of a shock. Therefore, in the situation where extraordinary values are registered for economic growth, the risk premium would not suffer significant fluctuations. But, in the opposite direction, the economic growth would be affected, in the sense of the decrease, after approximately 2 years, from the application of the shock. Therefore, the most pronounced influence on the GDP variable is presented by CDS 5Y, the negative impact reaching -0.3.

Also, the GDP variation proves to be sensitive, in the sense of decrease, in case a shock appears on the PD variable, a fact proven in the economic reality. Thus, the probability of banking crises determines a change in the opposite direction of economic growth. Moreover, the phenomenon of "bank run" may occur, resulting in a massive withdrawal of capital, following the rumors on the market. PD is in turn influenced by CDS 5Y. Thus, the increase of the risk premium impresses an increase effect on the probability of occurrence of the banking crisis, statistically significant, after about 1 year, reaching a peak after 2 years. After this maximum, the effect of the shock on PD begins to dilute, and after 7-8 periods it becomes asymptotic to 0.

Consequently, the estimated results aim to highlight the impact of the dynamic of a banking crisis likelihood and sovereign risk premium on the economic growth variance.

4. Conclusions and future research directions

The interaction among economic growth, sovereign risk and the banking crisis likelihood completes the analytical framework for the macroprudential assessment of EU member states.

The early warning indicators, proposed by the European Commission, proved to be significant in this model as well, in order to issue PD signals. CDS 5Y modeling provided an overview of the macroeconomic picture, with an impact on economic growth.

The results of this model capture the GDP dynamic in interaction with PD (approximately 20%) and CDS 5Y (approximately 25%), emphasizing, first of all, its own interest in applying a shock on each variable. It is observed that the evolution of GDP is strongly affected, in a negative sense, if CDS 5Y

would register an increasing trend, costs that are reflected, especially, in fiscal-budgetary vulnerabilities.

Also, the vulnerabilities in the banking sector, by registering a positive slope of PD, is found in an evolution, in the opposite direction, of economic growth, a visible effect with a lag of 3 years, after which it dilutes, becoming asymptotic to 0, after the first 9-10 periods.

As future study directions, research can be extended to the microeconomic level. By developing an analytical framework for the sovereign risk spread at credit institutions level, the banking portfolio and the CDS 5Y influence are taken into account.

5. References

- Basel Committee on Banking Supervision (2017). The Regulatory Treatment of Sovereign Exposures. Discussion Paper, Bank for International Settlements (BIS)
- European Systemic Risk Board (ESRB) report on the regulatory treatment of sovereign exposures, March 2015
- Farhi, E., Tirole J. (2014). Deadly Embrace: Sovereign and Financial Balance Sheets Doom Loops (working paper), Harvard University
- Global Financial Stability Report: Lower for Longer (october 2019), International Monetary Fund
- Kroszner, R., Laeven, L., Klingebiel, D. (2007). Banking Crises, Financial Dependence, and Growth. Journal of Financial Economics 84 (1), pp.: 187–228
- Lang, Jan Hannes; Peltonen, Tuomas A.; Sarlin, Peter (2018) - "A framework for early-warning modeling with an application to banks", Working Paper Series, No 2182, October 2018
- Lo Duca, Marco et all (2017) - "A new database for financial crises in European countries. ECB/ESRB EU crises database", Occasional Paper Series, No. 194, July 2017
- Moinescu, B. Codirlasu, A. (2009) Strategii şi instrumente de administrare a riscurilor bancare, Publishing house: ASE, Bucharest
- Peek, J., Rosengren, E. (1997). The International Transmission of Financial Shocks: The Case of Japan. American Economic Review 87 (4), pp.: 495–505

- Vulnerabilities in a Maturing Credit Cycle, Global Financial Stability Report (apr 2019), International Monetary Fund