Modelling the volume of corporate loans

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The aim of this article is to propose several possible forecasting approaches for the development of the volume of bank loans to corporates and to discuss their suitability for macro stress testing purposes. Proposed model specifications are based on the error correction framework with main macroeconomic data as explanatory variables. Our results show that a possible structural break on the lending market after the outbreak of the financial crises cannot be rejected. Results also show that corporates with the largest volume of loans have a significant impact on the development of the volume of bank loans and are difficult to predict. We propose some possibilities how to deal with this group of clients. Then, we make a comparison of forecasting properties of proposed specifications. Ultimately we select the most suitable approach for stress testing purposes.

MOTIVATION

Given the traditional business model of Slovak banks, lending is the most important activity of the Slovak banking sector and the interest income is the main source of profit for banks. Loans to corporates account for a significant part of total loans granted by domestic banks. Therefore, an estimation of a forecasting model linking the development of the total volume of corporate loans to main macroeconomic variables is essential, since the dynamic balance sheet assumption is adopted in the macro stress testing framework of the Slovak banking sector. The volume of bank loans to corporates is then used for calculation of both, credit losses stemming from the corporate portfolio and the interest income from the portfolio of corporate loans. The changes of the volume of loans are also reflected in the changes of the risk weighted assets.

There are several issues and limitations which stem from either some structural changes or specific characteristics of Slovak lending market when it comes to estimation. First limitation is the data availability, given the restructuralisation of the banking sector in the early 2000's connected with the massive balance sheets clean-up. Some structural changes could have occurred after the outbreak of the financial crisis in the sense of the relationship between GDP and the volume of corporate loans. While up to 2009/2010 the movements of GDP were more or less followed by the dynamics of banks loans, after 2010 this relationship does not seem to hold further. These changes can be attributed to both, demand and supply side of the lending market. The size of the lending market also plays an important role. Slovak corporate lending market is quite small with limited number of clients, especially large ones. However, these large clients, despite their small number, are affecting the overall volume of corporate loans to a large extent while their behavior is difficult to estimate.

Currently used models have some forecasting limitations, thus the aim of this article is to discuss possible approaches for forecasting the development of the overall volume of bank loans to corporates.

METHODOLOGY AND ESTIMATION RESULTS

For the estimation of corporate loans, we used quarterly data from the credit register from the last quarter of 2003 until the last quarter of 2014. As the main goal is to estimate corporate loans for stress testing purposes, we used in all cases the natural logarithm of the seasonally adjusted nominal volume of corporate loans. As explanatory variables, we included into the regressions macro variables that based on the economic theory can help explaining the development of corporate loans and that are available also for the purposes of stress testing. The list of macro variables used includes the GDP of Slovakia and the euro area, the HICP inflation in Slovakia, the 3-month EURIBOR interest rate, the average interest rate on corporate loans granted by domestic banks and the spread between the yield on Slovak and German 10-year government bonds. Due to the fact that all variables can be treated as non-stationary variables integrated of order 1 and in case of all relevant combinations the hypothesis of cointegration between the variables cannot be rejected, we used the error-correction framework that is relatively common also in the literature[2].

As mentioned above, there are several caveats when estimating the volume of corporate loans due to the fact that, especially in case of large corporates, the market in Slovakia is relatively small and the volumes can be influenced by the decision of a few larger players. Furthermore, a structural brake in the behavior of corporates could have occurred after 2009 in the form of a switch from domestic loans to other sources (like foreign loans, funding on the capital markets directly or indirectly through mother companies, etc.), as mentioned also in the Analysis of the Slovak financial sector for the year 2010 or in the November 2012 Financial Stability Report.

3 *The estimation of the cointegrating vector is presented in the table, which means that if an explanatory variable enters the vector with a negative coefficient, the increase of this variable yields in the increase of the volume of corporate loans.*

4 *Based on the LR test, the coefficient for the inflation in case of the full period is significantly different from 0.*

The first question we address is therefore if such a change in the development of corporate loans, or a possible switch in the behavior of corporates, can be identified. For this purpose, first of all, we estimated an error-correction model including the total volume of corporate loans granted by domestic banks using the full period available and also using a shortened period until end-2010, it means without the period when the possible switch in the behavior could have occurred. Estimation details are presented in Table 1.

When estimating the error-correction model on the full period available, best estimates were achieved using the domestic GDP, 3M EURIBOR and the domestic HICP inflation (column "Full period"). In line with the expectations, an increase in domestic GDP and a decrease in interest rates yield in an increase of the volume of corporate loans[3]. On the other hand, the coefficient for the GDP can be assessed as relatively large in absolute terms. The inflation enters the cointegrating vector with a positive coefficient, which means that the model expects an increase of the volume of corporate loans in case of a decreasing inflation. While this is in contradiction with the economic theory, it is hard to decide whether this relationship can be interpreted as causality or more as a correlation. Our interpretation is that the sign of the coefficient is affected by the period used for the estimation,

when the positive development of corporate loans until 2009 took place in an environment of positive economic development and decreasing inflation. The adjustment coefficient is slightly more than 30%, which means that in case there is a deviation of the volume of corporate loans from their long-term equilibrium level relative to the explanatory variables, approximately one-third of this deviation is corrected within one quarter.

The specification that gives the best estimates using the shortened period (column "Short period") is slightly different from the one described above. While the inflation does not enter the specification in this case[4], the coefficient for the GDP is more plausible as its value is much lower and the speed of adjustment is higher (nearly 40%). Based on the different specification, the significantly different coefficient for the GDP and the different adjustment coefficient the hypothesis of the switch after 2010 cannot be rejected. This outcome is further supported by the last estimation (column "Full period 2"), where the specification estimated using the shortened period was estimated using the full period. In this case, none of the estimated coefficients is plausible and is significantly different from the coefficients estimated using the shortened period.

As the hypothesis of a change in the development of the volume of corporate loans granted by domestic banks cannot be rejected based on a relatively simple methodology described above, the next question is whether this change, or the possible switch, is present also in the development of the overall financial liabilities of corporates (it means not just domestic loans, but including other sources of funds like loans from non-resident banks or funding on capital markets). To address this question, an error-correction model was estimated again, including in this case the overall volume of financial liabilities of the corporate sector and using the full and the shortened period. Estimation details are presented in Table 2.

There are several differences when comparing the estimation of the volume of domestic loans and the volume of total financial liabilities. Opposite to domestic loans, the development of total financial liabilities can be captured with the same specification relatively well using both the full and the shortened period. While the inflation does not enter the specifications in case of total liabilities, the spread on 10-year government bond yields proved to be a significant explanatory variable using both periods. The coefficient for the GDP has the expected sign, its value is plausible using both periods and there are not so significant differences between these two estimation results. An interesting difference is that the interest rate enters the cointegrating vector with negative sign using both the full and the shortened period. Our interpretation of this result is that a negative impact of the increasing interest rates on the volume of loans is captured by the spread on government bonds and the interbank interest rate is in this case more an approximation of the economic cycle – the central bank increases its key rate in the period of economic expansion associated with

Table 1 Estimation of the volume of corporate loans granted by domestic banks

Cointegrating equation	Full period	Short period	Full period 2
Domestic loans, total	1.000	1.000	1.000
GDP, domestic	-2.857	-1.723	-13.076
EURIBOR 3M	0.025	0.014	-3.797
HICP	0.034		
Adjustment coefficient	-0.302	-0.396	-0.001
aR²	68%	70%	56%
No. of lags	1	2	2

Source: NBS.

Table 2 Estimation of the total volume of financial liabilities of corporates

Cointegrating equation	Full period	Short period
Financial liabilities, total	1.000	1.000
GDP, domestic	-1.377	-1.029
EURIBOR 3M	-0.021	-0.051
Spread, 10Y	0.050	0.475
Adjustment coefficient	-0.329	-0.126
aR²	57%	54%
No. of lags	2	2

Source: NBS.

increasing inflation and increasing volume of loans, while this monetary contraction is reflected almost immediately in the increasing interbank rates.

To sum up, while there are differences in the estimation results for the total volume of financial liabilities using the full and the shortened period, mainly in case of the coefficient for the GDP and the adjustment coefficient, these differences are much lower than in case of the domestic loans. Furthermore, the development of liabilities can be captured relatively well using the same specification for both periods. It means that while the hypothesis of the changing development, or the switch in the behavior of corporates, cannot be rejected in neither cases, its presence is much more significant in case of the volume of domestic loans.

Due to the fact that medium and small enterprises are much more constrained in terms of financing than large corporates – their possible source of external financing is almost exclusively loans from domestic banks – it is expectable that the change in the development of domestic loans relative to macroeconomic fundamentals can be mainly attributed to large corporates. As in the credit register there is no information about the size of corporates, we approximated this categorization by the size of loans – we divided domestic loans into small (with the volume of loans up to €250 thousand), medium (between €250 thousand and €1 mil.) and large (above €1 mil.). While the total volume of large loans has the highest share in the overall volume of domestic loans (more than 70 %), the category of small and medium sized loans is more homogenous with a significantly higher number of loans. Again, the error-correction model for the respective categories was estimated using the full and the shortened period. Estimation details are presented in Table 3.

Estimation results confirmed to a large extent our expectations. In case of small and medium sized loans there are just small differences in the estimation results between the full and the shortened period. The coefficient for the GDP is plausible in all

cases as is around 1 in absolute terms. The speed of adjustment is around 23% in case of small and 32% in case of medium sized loans. In case of small loans the largest difference is that when the error-correction model is estimated using the full period the spread on 10-year government bond yields can be used as a significant explanatory variable. Our interpretation is that this variable in this case captures the increased credit risk due to the overall macroeconomic uncertainty that became significant after the outburst of the financial crisis. This uncertainty is present when using the full period but missing when focusing just on the shortened period. In case of medium sized loans the inflation can be used as an explanatory variable when estimating the regression using the full period. Again, it is a question whether this relationship can be interpreted as a correlation or causality.[5] The largest differences are in case of large loans. Similarly to the estimation of the overall volume of domestic loans, the coefficient for the GDP is relatively large using the full period – more than 3 in absolute terms. This coefficient is significantly lower and more plausible using the shortened period, while the goodness of fit (measured by adjusted R^2) also improves and the speed of adjustment is significantly larger.

As the change in the development of corporate loans relative to macroeconomic fundamentals can be detected mainly in case of large loans, there are several possibilities how to estimate the development of corporate loans for stress testing purposes. The first is to use a shorter time period for the estimation of large loans that doesn't include years 2004-06, when the volume of corporate loans increased significantly due to the small base as a result of the restructuralization of the banking sector and the clean-up of the banks' balance sheet at the early 2000's.

Estimation results (presented in Table 4) confirmed the feasibility of such an approach. An interesting outcome is that when using the shortened period from the last quarter of 2007, it is the GDP of the whole euro area that can be used as

5 Both in case of small and medium sized loans, LR tests confirmed that the coefficient for the spread and the inflation, respectively, is significantly different from zero.

Table 3 Estimation of the volume of corporate loans granted by domestic banks, by loan size

Cointegrating equation	Small		Medium		Large	
	Full period	Short period	Full period	Short period	Full period	Short period
Domestic loans, total	1.000	1.000	1.000	1.000	1.000	1.000
GDP, domestic	-0.943	-0.988	-1.348	-1.169	-3.390	-1.255
Interest rates on corporate loans	-0.023	-0.038			0.016	-0.033
Spread, 10Y	0.028		0.010	0.040		
HICP			0.009		0.035	-0.025
EURIBOR 3M			-0.074	-0.064		
Adjustment coefficient	-0.241	-0.231	-0.315	-0.339	-0.416	-0.939
aR^2	90%	90%	91%	87%	71%	84%
No. of lags	2	2	2	2	2	2

Source: NBS.

an explanatory variable instead of the domestic GDP. The rationale behind this result can be the fact that as Slovakia as an export oriented small open economy is reliant on the overall macroeconomic development, the development of corporate loans, mainly the larger ones, is influenced indirectly by the macroeconomic situation in the euro area. This is just amplified by the fact that the main export partner for Slovakia is Germany. Beside the GDP of the euro area, the interest rates on corporate loans and the spread on 10-year government bond turned out to be significant explanatory variables.

By comparing the absolute value of the coefficient for the GDP of all above mentioned estimation results it is clearly visible that large loans or large corporates have a significant impact on the development of the corporate loan portfolio. This is confirmed by higher absolute value of the coefficient for the GDP in case of the estimation of large loans (Table 3) and of the total volume of loans (Table 1). The question then arises whether a significantly higher volatility of the

sample where large loans are included can be attributed to the whole category of large loans or some adjustment can be made in terms of exclusion of the biggest players from the sample. Using credit register data we were able to follow this approach by identifying corporate clients that have been significant outliers in terms of aggregate volume of loans per company. Therefore this approach is applicable only to loans granted by domestic banks. We excluded from the total volume of domestic loans every corporation whose total volume of domestic loans exceeded €400 mil. at least in one observation[6]. While only 6 firms were excluded, they accounted for slightly more than 10 % of total domestic loans on average. Again, similar to the above described case presented in Table 4, an error-correction model was estimated for the adjusted volume of domestic loans using the full and shortened period (from the last quarter of 2007 until the last quarter of 2014). Table 5 presents estimation results and its comparison with estimation results using the full – not adjusted – sample.

Based on estimation results there are clear signs of the improvement using the adjusted sample. While the sign of the coefficient for the GDP remains negative, it is more plausible in terms of absolute value. On the other hand, the difference is that the development of the interbank rates has opposite effect on the volume of domestic loans and also the spread of government bonds can be used as a significant explanatory variable[7]. Our interpretation is again that the interbank interest rate can rather describe the economic cycle and a negative impact of the raising interest rate can be captured by the spread of government bonds. Using the shortened period we ended up with model specification similar to the estimation of large loans presented in Table 4. Main difference between these two estimations is that while in case of the adjusted sample, the domestic GDP and EURIBOR 3M are used instead of the GDP of the euro area and the interest rates on corporate loans. But in terms of signs of coefficients and its absolute values these two model specification behave quite similarly. The speed of adjustment using the adjusted sample is slightly higher than 6% in case of the full period and around 17% in case of the shortened period. The appropriateness of this adjustment is also visible from the goodness of fit measured by adjusted R^2 as it's higher than 80 % in both cases.

As the main motivation is to discuss possible approaches for forecasting the development of the total volume of domestic loans, the last part of this article is focusing on the comparison of the forecasting ability of selected model specifications. For this purpose we've selected four model specifications: the regression including the adjusted volume of domestic loans using both the full and shortened period entitled hereafter as "total domestic loans adjusted – full period" and "total domestic loans adjusted – shortened period", respectively. In these cases we use a simple assumption that the total volume of loans granted to compa-

Table 4 Estimation of the volume of large loans

Cointegrating equation	Full period	Short period
Domestic loans, total	1.000	1.000
GDP, domestic	-3.390	
GDP, euro area		-0.603
Interest rates on corporate loans	0.016	-0.084
HICP	0.035	
Spread, 10Y		0.011
Adjustment coefficient	-0.416	-0.190
aR2	71%	77%
No. of lags	2	1

Source: NBS.

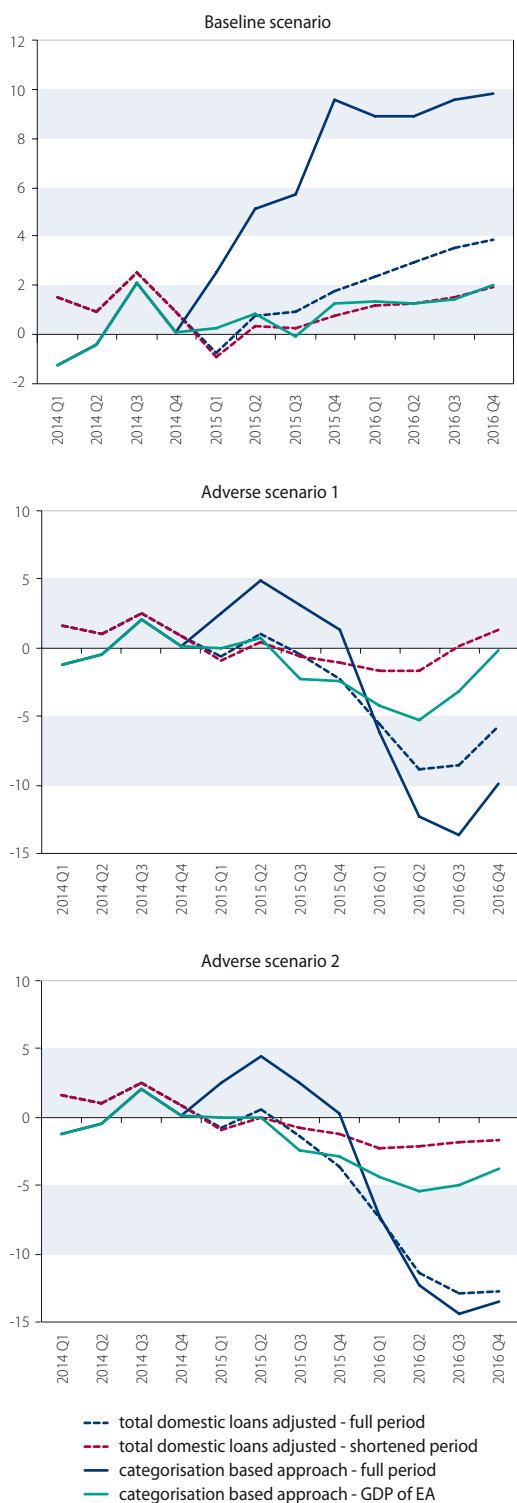**Table 5 Estimation of the volume of total loans granted by domestic banks**

Cointegrating equation	Full period		Short period
	Full sample	Adjusted sample	Adjusted sample
Domestic loans, total	1.000	1.000	1.000
GDP, domestic	-2.857	-1.741	-0.651
EURIBOR 3M	0.025	-0.107	-0.080
Spread, 10Y		0.067	0.007
HICP	0.034		
Adjustment coefficient	-0.302	-0.064	-0.157
aR2	68%	82%	81%
No. of lags	1	2	2

Source: NBS.

nies excluded will remain constant over the forecasting period. Further, the regression including the aggregate volume of domestic loans using the full period presented in Table 3 is selected, entitled hereafter as "categorisation based approach – full period". The last regression selected is the one including the aggregate volume of domestic loans

and the GDP of the euro area as an explanatory variable presented in Table 4 and entitled as "categorisation based approach – GDP of EA". For stress testing purposes three different scenarios are used; the baseline scenario and two adverse scenarios[8]. The development of the total volume of domestic loans is forecasted over a two year horizon from the first quarter of 2015 to the last quarter of 2016. Chart 1 shows a comparison of the annual dynamics of the total volume of domestic loans for all selected specifications and for all scenarios used.

The categorisation based approach using the full period is not suitable for its rapid increase in case of the baseline scenario as well as for its severe decline in both adverse scenarios. This behaviour can be attributed to the very high sensitivity to movements of the GDP in case of large loans. Estimated development of the adjusted volume of domestic loans using shortened period and the categorisation based approach using the GDP of the euro area have also some disadvantages. They give reasonable predictions under the baseline scenario but in case of adverse scenarios they forecast only a mild shock to the volume of domestic loans. The specification using the adjusted volume of domestic loans using the full period shows plausible forecasting properties for stress testing purposes as it predicts a quite reasonable increase of the loan volume in the baseline scenario and a sufficient decline of the total volume of loans under severe conditions. Ultimately, this specification was chosen for stress testing purposes.

Chart 1 Development of total volume of domestic loans by different specifications and scenarios[9]

Source: NBS.

CONCLUSIONS

In this article, we discussed possible approaches for construction of the forecasting model for the development of the total volume of loans to corporates. We addressed several modeling issues stemming either from structural changes or market specificities. Based on estimation results, the presence of the structural break in the behavior of domestic banking loans in 2009/2010 cannot be rejected. This result is less obvious in case of the total financial liabilities, which can be attributed to the fact that some portion of financing activity was switched to abroad after the outbreak of the financial crisis. Estimation results also confirmed our expectations that the change in the development of domestic loans relative to macroeconomic fundamentals can be mainly attributed to large corporates. This problem was addressed by shortening of the time horizon and by using the GDP of the euro area instead of the domestic GDP as an explanatory variable. Another option is to exclude the largest market players from the estimated sample. From the perspective of stress testing the forecasting properties of respective specifications are particularly important. From this point of view, the estimation of the adjusted volume of domestic bank loans to corporates using the full period was selected, owing to its reasonable prediction under the baseline scenario and the ability to reflect a sufficient shock under adverse scenarios.

8 A detailed description of scenarios used in the stress testing framework is available in the Analysis of the Slovak financial sector for year 2014.
9 Different paths of the volume of domestic bank loans in 2014 are a result of the fact that two different samples were used – the full sample and the adjusted one.