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Abstract

This note looks at the role of country factors in the 2018 EBA stress test. This is a European exercise but its severity varies between jurisdictions. We show that two thirds of the cross-country variation in the key variables of the adverse scenario are explained by country factors. This suggests that - although the severity of the headline stress scenario varies across countries - the overarching approach to the calibration of the stress is consistent across countries. Moreover, we show that the adjustments made to the original calibration increase the extent to which the shocks map to these country factors.

1 Introduction

This note looks at the role of country factors in the 2018 EBA stress test. The exercise is intended to probe bank specific resilience to macro-financial shocks; these shocks vary at the country level, based on the contagion channels of a hypothetical crisis (the narrative of the adverse scenario). We study the relation between the severity of the shocks and the country factors which have a role in the narrative. We find that two thirds of the variation in the shocks is explained by variables capturing the key channels at play in the crisis.

Moreover, we investigate whether the judgment-based adjustments made to the original calibration, which was obtained from a statistical method, imply a departure from the crisis narrative. Our results show that these adjustments increase the extent to which the shocks map to the narrative, supporting the view that the changes were made to account for country-specific considerations which are implicit in the narrative but not captured fully in the statistical-based calibration method.¹

Finally, we briefly study how the shocks correlate with the impact on aggregate capital in national banking systems.

The rest of the note is organised as follows. In section 2, we describe the scenario and its calibration. In section 3 we present the empirical analysis on the adverse scenario. In section 4 we investigate the role of adjustments. In section 5 we look at stress test results. Section 6 concludes.

¹ This does not apply to the GDP add-ons, introduced to ensure that all countries have negative growth: these were not intended to reflect imbalances in faster growing countries.

2 The scenario

The scenario embodies the four main risks which the ESRB General Board identified as the most material threats to financial stability in the EU. These risks are:

1. Abrupt and sizeable repricing of risk premia in global financial markets – triggered e.g. by a policy expectation shock – leading to a tightening of financial conditions;
2. Adverse feedback loop between weak bank profitability and low nominal growth, amid structural challenges in the EU banking sector;
3. Public and private debt sustainability concerns amid a potential repricing of risk premia and increased political fragmentation;
4. Liquidity risks in the non-bank financial sector with potential spillovers to the broader financial system.

The narrative then goes as follows. There is an initial shock, exogenously created in advanced economies outside the EU. This causes a repricing of risk premia in global financial markets, including the EU financial system, and a negative confidence shock. Aggregate demand is negatively affected; the long term interest rate shock is larger for countries with higher public debt sustainability risks.

The fall in global demand translates into a recession in the EU; further pressure on internal demand follows, generating an adverse loop between bank profitability and low nominal growth, especially in countries with structural challenges in their banking sectors. More specifically, the economic slowdown and the rise in corporate yields negatively affect investment, increasing unemployment. The downward pressure on aggregate demand affects real estate markets, especially in countries where prices are above fundamental values. The increase in unemployment and long term interest rates, and the strain in real estate market negatively affect households' creditworthiness and their ability to service their mortgages. This triggers a feedback loop between bank profitability and low growth, especially in countries structurally exposed to the most affected sectors.

The recession is amplified by two factors: indebtedness in both public and private sectors; and liquidity risks in the non-bank financial sector. Debt sustainability concerns triggered by the recession put further upward pressure on government bond yields; in turn, credit conditions for the private sector tighten. A sell-off of assets by liquidity-constrained non-bank financial institutions trigger additional declines in asset prices; this amplifies fragility in the banking sector and deteriorates household repayment capacity, reinforcing the negative loop between growth and bank profitability.

Calibration

In this section, we summarise the calibration of the key shocks in the scenario: long term interest rates, residential property prices and real GDP growth. These variables are key summary statistics of the overall severity of the stress scenario.

In addition, we present the country factors used in subsequent analysis. Variable selection was done as follows. A set of variables was collected which represent the underlying vulnerabilities that the narrative of the stress scenario is intended to explore. Variables with no explanatory power and no impact on other variables' coefficients were removed. The selection was based on two estimated equations: the first with the final shocks as dependent variable, the second with the shocks before add-ons as dependent variable. The set of selected variables did not change across the two equations.

We first reproduce the passages of the narrative which motivate the selected variables; then, we indicate the expected sign of the relationships.

“Sovereign credit spreads in the European Union would widen, especially in countries where there are higher market concerns on debt sustainability. Overall, long-term interest rates in the European Union would be higher by 83 basis points in 2018, 85 basis points in 2019 and 80 basis points in 2020.”²

We expect long-term interest rate shocks to be higher in countries that could be most exposed if there were to be a re-emergence of concerns over public debt sustainability. These are likely to be countries with higher public debt-to-GDP ratio and countries with external imbalances. We measure these concepts with the ratio of public debt-to-GDP, the ratio of net international investment position to GDP, and a dummy variable for countries affected by the Euro debt crisis.

“The global shocks are also assumed to negatively affect confidence in all EU countries, resulting in country-specific reductions in private consumption and investment which take into account recent economic performance of each country. The significant decline of domestic demand, together with increased risk premia, would trigger domestic vulnerabilities in the residential and commercial real estate sectors which would result in a major slowdown in property market activity, both in the residential and commercial property segments. Residential property prices would fall by 27.7% below the baseline level by 2020 and the cumulative fall in residential property prices over the scenario horizon is about 19% at the EU aggregate level.”³

We expect residential property price shocks to be more severe in countries with more pronounced vulnerabilities in real estate markets in terms of price dynamics, and banks' exposure to the sector. To capture these factors, we use the following metrics: an index of residential property prices; a measure of residential property prices expressed in percentage point deviation from the fundamental value estimated by the ECB;⁴ and the share of bank loans to domestic households for house purchase in total credit to the private sector.

“The size of the shocks to the macroeconomic parameters varies across countries for a number of reasons. Countries with greater trade openness tend to experience larger shocks, all else being equal. Countries characterised by high vulnerabilities in real estate markets and particularly high levels of overvaluation in their residential property markets experience larger shocks. This is especially true of countries which are also more vulnerable to shocks in housing markets. In addition, countries where public debt sustainability concerns are greater would experience larger shocks to sovereign yields.”⁵

The path of real GDP summarises in one metric the impact through the different channels. We expect larger shocks for countries with more open economies; faster recent economic performance; overheated real estate markets; higher public debt; and lower per-capita income (as a general measure of economic development). We measure these concepts by the ratio of imports plus exports over GDP; the 2016-2017 cumulative growth of real GDP; the residential real estate measure estimated by the ECB; the ratio of public debt to GDP; and the log of GDP per-capita in PPP terms.

² ESRB (2018) “Adverse macro-financial scenario for the 2018 EU-wide banking sector stress test”, pp. 5

³ ESRB (2018) “Adverse macro-financial scenario for the 2018 EU-wide banking sector stress test”, pp. 6

⁴ Estimates of the over/undervaluation of residential property prices are an average of four different valuation methods: price-to-rent ratio, price-to-income ratio and two model-based methods (for details, see Box 3 in Financial Stability Review, ECB, June 2011 and/or Box 3 in Financial Stability Review, ECB, November 2015).

⁵ ESRB (2018) “Adverse macro-financial scenario for the 2018 EU-wide banking sector stress test”, pp. 7

3 Empirical analysis

Tables A1, A2 and A3 in the Appendix report the paths of real GDP growth, residential real estate prices, and long term rates, respectively. The paths are presented both for the baseline scenario, where no crisis takes place, and the adverse scenario, for the years 2018, 2019 and 2020. We compare the severity of the scenario based on two measures, reported in the last columns of tables A1, A2 and A3: the difference from the starting value in 2017, which we refer to as adverse growth or adverse rate; and the level deviation from the baseline path in 2020, which we refer to as shock.

The scatter plot in Figure 1 shows GDP growth and residential property price (RPP) overvaluation.⁶ The chart demonstrates that vulnerability in the real estate sector has an important role in calibration: 44% of the variance of GDP growth is explained by RPP overvaluation (the R-squared of the fitting line). Countries where the price is inflated above fundamentals have a more severe GDP path.

Figure 1 also demonstrates that the scenario for Sweden, while severe, is not an outlier. The distance between GDP growth and the linear approximation is not disproportionately larger than other countries, for instance Portugal. The severity of the scenario in Sweden largely reflects real estate vulnerability in this country.

In the remainder of this section, we present linear regression results.

3.1 Long-term interest rate

Table 1 presents estimates of a set of equations relating the long-term interest rate in the adverse scenario with measures of vulnerability in the public and external sectors, and a dummy for the countries most affected by recent crises. In columns 1 to 4, the dependent variable is the shock to the long-term interest rate, measured in deviation from the baseline in the year 2020. In columns 5 to 8, the dependent variable is the overall long-term interest rate in the adverse scenario in 2020.

On average, as reported in column 1, the long term interest rate shock is 66 basis points for non-crisis countries and 106 basis points for Euro debt crisis countries. The differentiation between crisis and non-crisis countries explains 62% of the variation in the shocks (the R-squared). Looking at the unconditional relation with the ratio of public debt to GDP in column 2, 10 percentage point higher public debt is associated with 4 basis point larger shock, on average. The public debt ratio explains 56% of the variation in the shocks. Finally, in column 3, countries with 10 percentage points of GDP more negative net international investment position (NIIP) have on average 1 basis point larger shock.

From the estimates in column 4, the average interest rate shock for a non-crisis country with a negligible public debt ratio is approximately 54 basis points. A non-crisis country with public debt 100% of GDP has a shock of 76 basis points. For a crisis country with the same relative level of public debt, the shock is 107 basis points.

The R-squared demonstrates that overall, these variables explain 71% of the variation in the shocks (column 4), and 34% of the variation in the adverse rate (column 8). This difference is not surprising since the crisis narrative determines the shocks, not the adverse path. The baseline interest rate may depend on the same variables as the shock, to the extent that the vulnerabilities captured in

⁶ Estimates of the over/undervaluation of residential property prices in selected EU countries are based on four different valuation methods: price-to-rent ratio, price-to-income ratio and two model-based methods (for details, see Box 3 in Financial Stability Review, ECB, June 2011 and/or Box 3 in Financial Stability Review, ECB, November 2015).

the repricing of risk premia are also priced, at a discount, in normal times. For instance, a country with high public debt may have a higher baseline interest rate as well as a more severe shock. The estimates in columns 5 to 8 confirm that these vulnerabilities are priced also in the baseline scenario (the coefficients are larger), although other factors play a more important role in the baseline (the R-squared is lower).

3.2 Residential property prices

In Table 2, column 1 reports results on price-related vulnerability. The estimates suggest that 10 percentage point larger overvaluation is associated with 5 percentage point more severe shock to RPP. As shown in the scatter plot in Section 3, this alone explains 44% of the variation in the shocks. In addition, 10 percentage point faster growth of RPP in 2016 is associated with 11.7 percentage point more adverse shock to RPP in 2020. This means that the shock includes a reversal of prices which is orthogonal to their overvaluation. This is consistent with what has occurred in recent real estate-related crises, where prices have fallen below fundamental values (see for example Kennedy, O'Brien and Woods, 2016). The estimates in column 1 suggest that if RPP grew 10% in 2016 and overvaluation is 10%, on average residential property prices in the adverse scenario are 40% lower than the baseline in 2020.⁷ The two variables help explain 58% of the variation in the RPP shocks.

From the estimates in column 2, a 10 percentage point higher share of household loans for house purchase is associated with a more adverse shock by 4 percentage points. Column 3 shows that overall, these three variables help explain 59% of the variation in the shocks.

Columns 4 to 6 demonstrate that the path of RPP in the adverse scenario is largely driven by the extent of overvaluation of these prices. The variation in the data which these variables are able to explain is lower; that is, the sources of vulnerability to shocks are less important drivers of real estate prices in good times.

3.3 Real GDP growth

Table 3 reports the results of regressions where the dependent variable is the real GDP growth shock (columns 1 to 5) or the adverse path (columns 6 to 10). Consistent with the narrative, more open economies are faced with more severe shocks (column 1). However, the result does not hold when controlling for the other variables.

In the broadest specification in column 5, 1 percentage point faster growth in the two years prior to the stress event is associated with 57 basis point more severe shock. RPP prices overvalued by 10% are associated with 1.1 percentage point lower growth. Public indebtedness is not significant; the positive coefficient in column 4 is due to the poor growth performance of indebted countries: when controlling for past growth, it becomes insignificant. The coefficient on the log of GDP per-capita in column 5 suggests that a country with 10% higher income per-capita has 45 basis point milder shock.⁸ Overall, 63% of the variation in GDP growth shocks is explained by these country factors.

RPP overvaluation also matters for cumulative GDP growth. In column 10, more open countries have faster overall growth in the adverse scenario, due to faster baseline growth. Past growth and the size of the economy do not matter for overall GDP growth.

⁷ For comparison, average RPP shock in the EU is 27.7% (see Table A2 in the appendix).

⁸ While economic development is not mentioned in the narrative, it is reasonable to assume that more developed countries would be more resilient to external shocks due to stronger institutions and more developed financial markets.

4 The impact of judgment-based adjustments

The narrative provided a rationale for the size of the shocks. Their calibration was obtained by a statistical model, based on the historical distribution of the variables in each economy; a number of judgment-based adjustments were implemented in the form of add-ons to the original calibration. In this section, we investigate whether these adjustments change the results in the previous section.

Table 4 reproduces the results in Table 2 comparing them with estimates of the same equation where the add-ons have been removed. The results are qualitatively similar, but the variables only explain 37% of the variation without the add-ons, compared to 59% with the add-ons. Therefore, the adjustments have made the calibration closer to the narrative.

The RPP Index is not related to the shocks without the add-ons. The adjustments ensure that countries where property prices have grown faster are faced with more severe shocks regardless of the estimated overvaluation. This is positive for two reasons. First, given the uncertainty around the estimated RPP overvaluation, having the growth rate in the model ensures that shocks are more closely related to developments in the real estate sector. Second, it allows for the fact that even fundamental price increases can reverse during a crisis.

Table 5 reports results for a similar exercise done for real GDP growth. Without the adjustments, the key variables from the narrative explain only 26% of the variation in the shocks, compared to 63% in the final calibration. The difference is less pronounced for the cumulative path than for the shocks, since the adjustments were designed to correct the shocks, not the paths, for anomalies. This is also true for RPP in Table 4.

A notable difference in the GDP shock regressions is that the statistical significance of the *Past growth* coefficient is lower without the add-ons. In additional analysis not shown, we ascertained that the estimated coefficient in the scenario with add-ons results from reductions in shocks granted to countries where recent policies reduce vulnerability; and these countries happen to have low recent growth.

5 Impact on capital ratios

The analysis so far suggests that the severity of the stress across countries reflects country-specific vulnerabilities, within an overall consistent approach to calibration across countries. We now briefly show the impact of the adverse scenario on aggregate capital ratios, focusing on EU countries. Consistent with the summary result provided by the EBA, the impact is measured as the difference between the initial aggregate CET1 ratio and the fully loaded CET1 ratio in the adverse scenario.⁹

Excluding Sweden, we find quite a strong correlation between GDP growth and the aggregate impact in Figure 2. Countries with larger declines in GDP suffer larger losses in their banking systems; almost a third of the variation in capital reductions can be explained by GDP growth.

Sweden is an outlier in this relation: its real estate market is very stretched, which results in a very large decline in RPP and GDP in the scenario, compared to other countries. At the same time, Sweden's restrictive prudential policies may limit the impact of shocks on its banks.

⁹ Fully loaded means that the capital ratio is calculated based on the full implementation of the Capital Requirements Regulation, the Capital requirements Directive, and IFRS9, rather than the requirements imposed during the transitional period. Initial capital ratios are restated in accordance with IFRS9, because IFRS9 enters into force in 2018 while the balance sheet on which the initial capital ratio is calculated is from 2017, thus based on the old accounting system.

6 Conclusion

This analysis demonstrates that the macroeconomic shocks in the EBA stress test exercise are proportionate to the risks assumed to materialise in the narrative. We show that the key sources of vulnerability to the hypothetical crisis explain two thirds of the variation in the shocks.¹⁰ This vulnerability is then reflected in losses for the banking systems.

The analysis of shocks before and after the judgment-based adjustments has demonstrated that these add-ons have improved the ability of the calibration to represent the narrative. However, the analysis has also shown that a substantial amount of adjustments have been made. While some room for expert judgement is warranted, there is a trade-off between accuracy and accountability.

Finally, we have shown that with a simple regression model, one can extract the important factors in the narrative and verify if these are reflected in the calibration. Stress test designers may use this method to cross-check their calibration exercise and ensure that each source of vulnerability in the narrative is given appropriate weight.

References

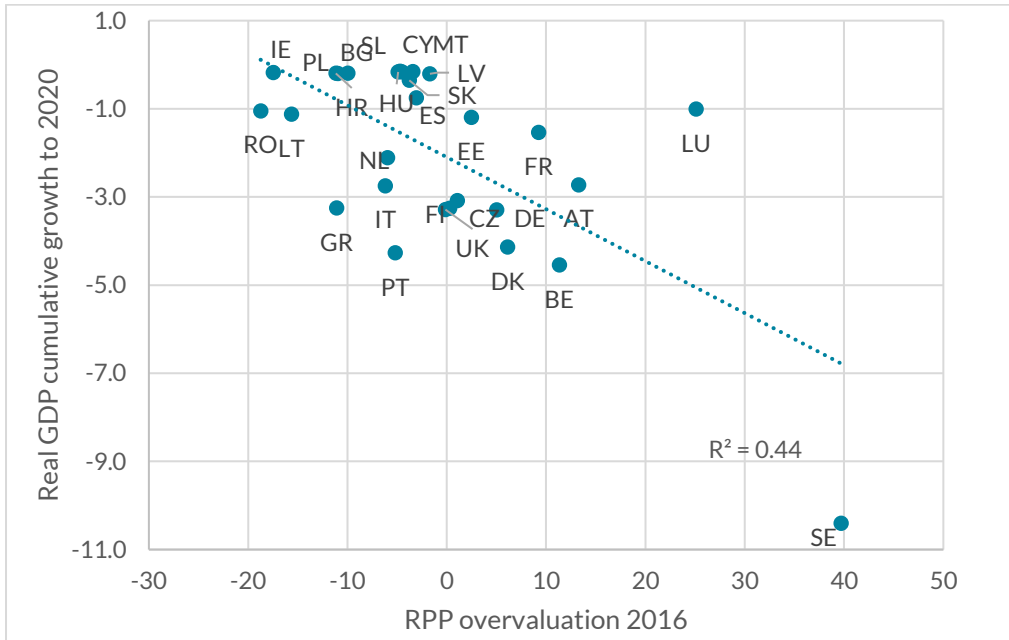
Haselmann, Rainer and Mark Wahrenburg (2018) "How demanding and consistent is the 2018 stress test design in comparison to previous exercises?", In-depth analysis requested by the European Parliament's Committee on Economic and Monetary Affairs and undertaken by the Economic Governance Support Unit;

Kennedy, Gerard, Eoin O'Brien and Maria Woods (2016) "Assessing the sustainability of Irish residential property prices: 1980Q1-2016Q2", Economic Letter Series, Central Bank of Ireland.

¹⁰ On average across the three shocks considered.

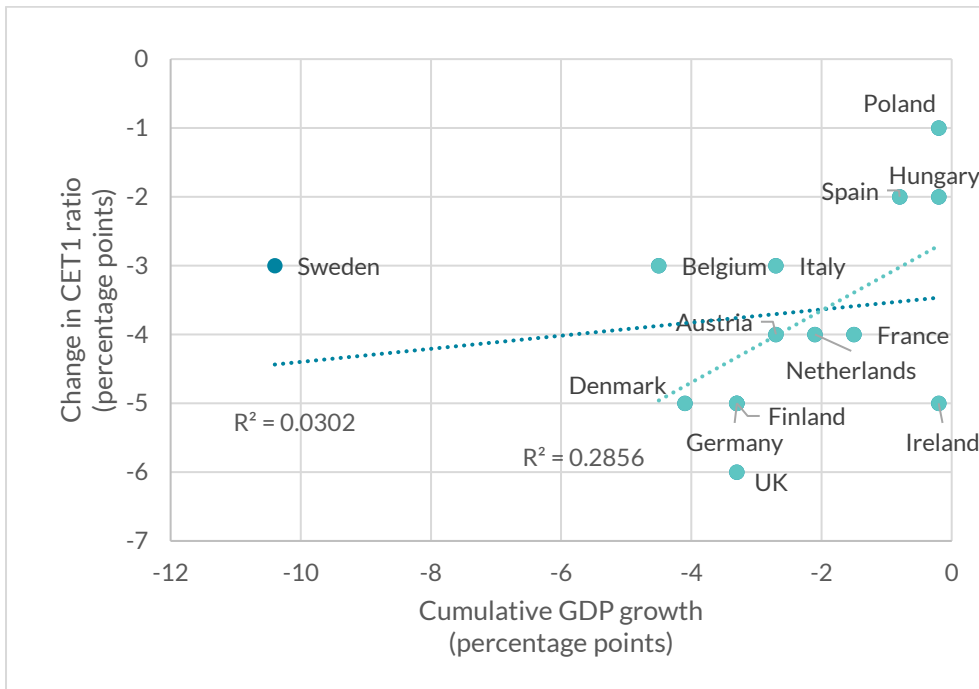
Tables and Figures

Figure 1 GDP growth in the adverse scenario and RPP overvaluation



Note: The horizontal axis measures residential property price overvaluation, estimated by the ECB and expressed in percentage point deviation from the estimated fundamental value (SDW: Average valuation measures for all types of property, poor and good conditions). The vertical axis measures GDP cumulative growth 2018-2020.

Figure 2 Aggregate impact on CET1 ratio and GDP growth in the adverse scenario



Note: The horizontal axis measures 2018-2020 cumulative real GDP growth in the adverse scenario. The vertical axis measures the difference between the initial CET1 ratio, restated to account for IFRS 9 implementation, and the fully loaded common equity tier 1 (CET1) capital ratio in 2020 in the adverse scenario. The blue line is an ordinary least squares line fitting all points in the scatter; the orange line is analogous but excluding Sweden.

Table 1 Long-term interest rate in the final scenario

	Deviation from baseline in 2020				Interest rate in 2020			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Crisis	40.2*** (6.3)			31.2*** (9.9)	131.6* (65)			-80.3 (102)
Public debt ratio		0.4*** (0.08)		0.2** (0.09)		1.7** (0.7)		1.5 (1)
NIIP ratio			-0.1** (0.06)	0.05 (0.05)			-1.2*** (0.4)	-1.2** (0.5)
Constant	66.3*** (3)	42.9*** (6.3)	70.9*** (4.4)	53.6*** (6.3)	274.5*** (30.6)	180.7*** (59.8)	265.5*** (28)	171.1** (64.8)
Observations	27	27	27	27	27	27	27	27
R-squared	0.62	0.56	0.16	0.71	0.14	0.17	0.27	0.34

Note: Dependent variable is the long-term interest rate in the adverse scenario: basis point deviation from the assumed baseline for 2020 (Columns 1 to 4) and the overall rate in 2020 (columns 5 to 9). *Crisis* is a dummy equal to one for Cyprus, Ireland, Greece, Italy, Portugal and Spain. *PD ratio* is public debt in percent of GDP at the end of 2016. *NIIP ratio* is the net international investment position in percent of GDP at the end of 2016. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: ECB.

Table 2 Residential Property Prices in the final scenario

	Deviation from baseline in 2020			Adverse growth to 2020		
	(1)	(2)	(3)	(4)	(5)	(6)
RPP overval	-0.49*** (0.11)		-0.46*** (0.12)	-0.66*** (0.15)		-0.56*** (0.15)
RPP index	-1.17*** (0.40)		-1.14*** (0.41)	0.11 (0.56)		0.18 (0.53)
HH loans share		-0.39* (0.20)	-0.14 (0.15)		-0.65*** (0.23)	-0.41* (0.20)
Constant	92.71** (42.36)	-15.12* (7.67)	95.09** (42.59)	-30.72 (58.98)	4.55 (8.56)	-23.69 (55.61)
Observations	28	28	28	28	28	28
R-squared	0.58	0.12	0.59	0.43	0.24	0.51

Note: Dependent variable in columns 1 to 3 is the residential property price percentage point deviation from the baseline assumed in the final adverse scenario for the year 2020. Dependent variable in columns 4 to 6 is the cumulative growth of residential property prices up to 2020 in the final adverse scenario. *RPP overval* is a measure of residential property prices in 2016, expressed in percentage point deviation from the fundamental value estimated by the ECB (SDW “Average valuation measures for all types of property, poor and good conditions”). *RPP* is an index of residential property prices with base year 2015. *HH Loans share* is the share of monetary financial institutions loans to domestic households for house purchase in total credit to the private sector. Latest available data are used: *RPP Overval* and *RPP Index* are at 2016; and *HH Loans share* is the average share in 2017. All variables in percentage points. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: ECB and Eurostat.

Table 3 Real GDP growth in the final scenario

	Deviation from baseline in 2020					Adverse growth to 2020				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Openness	-0.01** (0.00)				-0.01 (0.00)	0.01* (0.01)				0.02*** (0.01)
Past growth		-0.46*** (0.13)			-0.57*** (0.17)		0.39** (0.16)			-0.07 (0.18)
RPP			-0.21* (0.10)		-0.07 (0.09)			0.05 (0.10)		-0.06 (0.09)
RPP overval			-0.04 (0.03)		-0.11*** (0.03)			-0.12*** (0.03)		-0.12*** (0.03)
PD ratio				0.02** (0.01)	-0.01 (0.01)				-0.01 (0.01)	-0.01 (0.01)
Log GDP PC				-0.01 (2.29)	4.54* (2.39)				-4.58* (2.66)	-2.59 (2.53)
Constant	-8.29*** (0.69)	-6.98*** (0.86)	11.94 (10.83)	-11.21 (10.55)	-18.36 (14.66)	-3.23*** (0.82)	-4.33*** (1.05)	-7.75 (10.26)	19.56 (12.24)	15.05 (15.51)
Observations	28	28	28	28	28	28	28	28	28	28
R-squared	0.18	0.32	0.22	0.18	0.63	0.10	0.18	0.45	0.12	0.67

Note: Dependent variable in columns 1 to 5 is the real GDP growth percentage point deviation from the baseline rate assumed in the final adverse scenario for the year 2020. Dependent variable in columns 6 to 10 is the cumulative real GDP growth rate up to 2020 in the final adverse scenario. *Openness* is the sum of exports and imports in percent of GDP. *Growth* is the 2016-2017 cumulative growth of real GDP (2010 prices). *RPP* is an index of residential property prices with base year 2015; this is taken as at 2016, therefore it reflects 2016 growth in RPP. *RPP overval* is a measure of residential property price overvaluation estimated by the ECB and expressed in percentage point deviation from the fundamental value (Average valuation measures for all types of property, poor and good conditions). *PD ratio* is public debt in percent of GDP at the end of 2016. *Log GDP PC* is the base-10 log of GDP per-capita in PPP terms in 2016 (current international USD). All variables except log GDP per-capita are in percentage points. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Source: ECB and Eurostat.

Table 4 Residential Property Prices with and without judgment-based adjustments

	Deviation from baseline in 2020		Adverse growth in 2020	
	(1)	(2)	(3)	(4)
RPP overval	-0.46*** (0.12)	-0.39** (0.15)	-0.56*** (0.15)	-0.49** (0.20)
RPP	-1.14*** (0.41)	-0.78 (0.52)	0.18 (0.53)	0.86 (0.71)
HH loan share	-0.14 (0.15)	-0.16 (0.20)	-0.41* (0.20)	-0.50* (0.27)
Constant	95.09** (42.59)	66.21 (54.97)	-23.69 (55.61)	-82.24 (74.21)
Observations	28	28	28	28
R-squared	0.59	0.37	0.51	0.36

Note: Dependent variable in the first two columns is residential property price in percentage point deviation from the baseline assumed in the adverse scenario for the year 2020. Dependent variable in the last two columns is the cumulative growth of residential property prices up to 2020 in the adverse scenario. In column 2 and 4, the main judgment-based adjustments have been removed. *RPP overval* is a measure of residential property prices in 2016, expressed in percentage point deviation from the fundamental value estimated by the ECB (SDW “Average valuation measures for all types of property, poor and good conditions”). *HH Loans share* is the share of monetary financial institutions loans to domestic households for house purchase in total credit to the private sector, in 2017. All variables in percentage points. Latest data available at the time of calibration are used. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: ECB.

Table 5 Real GDP growth with and without judgment-based adjustments

	Deviation from baseline in 2020		Adverse growth to 2020	
	Final scenario	No add-ons	Final scenario	No add-ons
Openness	-0.01 (0.00)	0.01 (0.01)	0.02*** (0.01)	0.03*** (0.01)
Past growth	-0.57*** (0.17)	-0.48* (0.26)	-0.07 (0.18)	0.04 (0.29)
RPP	-0.07 (0.09)	-0.10 (0.14)	-0.06 (0.09)	-0.09 (0.16)
RPP overval	-0.11*** (0.03)	-0.10** (0.05)	-0.12*** (0.03)	-0.11** (0.05)
PD ratio	-0.01 (0.01)	-0.02 (0.02)	-0.01 (0.01)	-0.01 (0.02)
Log GDP PC	4.54* (2.39)	2.28 (3.69)	-2.59 (2.53)	-5.21 (4.19)
Constant	-18.36 (14.66)	-5.83 (22.61)	15.05 (15.51)	29.24 (25.71)
Observations	28	28	28	28
R-squared	0.63	0.26	0.67	0.60

Note: Dependent variable in the first two columns is real GDP growth in percentage point deviation from the baseline rate assumed in the adverse scenario for the year 2020. Dependent variable in the last two columns is the cumulative real GDP growth rate up to 2020. In column 2 and 4, the main judgment-based adjustments have been removed. *Openness* is the sum of exports and imports in percent of GDP. *Past growth* is the 2016-2017 cumulative growth of real GDP (2010 prices). *RPP* is an index of residential property prices with base year 2015; this is taken as at 2016, therefore it reflects 2016 growth in RPP. *RPP overval* is a measure of residential property price overvaluation estimated by the ECB and expressed in percentage point deviation from the fundamental value (Average valuation measures for all types of property, poor and good conditions). *PD ratio* is public debt in percent of GDP at the end of 2016. *Log GDP* is the base-10 log of real GDP (2010 prices). All variables in percentage points. Latest data available at the time of calibration are used. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: ECB and Eurostat.

Appendix

Table A1 The real GDP growth paths in the 2018 EBA stress test scenarios

	Baseline growth (%)			Growth rate deviations (percentage points)			Adverse growth (%)			Adverse cumulative growth (%)	Level deviation 2020 (%)
	2018	2019	2020	2018	2019	2020	2018	2019	2020		
Belgium	1.7	1.6	1.4	-3.2	-4.4	-1.6	-1.5	-2.8	-0.2	-4.5	-8.8
Bulgaria	3.6	3.6	3.8	-6.2	-4.4	-0.5	-2.7	-0.8	3.3	-0.2	-10.4
Czech Republic	3.4	3.1	3.1	-4.7	-6.2	-1.8	-1.2	-3.1	1.3	-3.1	-11.9
Denmark	1.8	1.7	1.7	-4.0	-4.9	-0.4	-2.2	-3.2	1.3	-4.1	-9.0
Germany	2.5	1.7	1.5	-4.4	-4.5	-0.2	-1.9	-2.8	1.4	-3.3	-8.6
Estonia	4.2	3.1	2.7	-4.7	-4.1	-2.4	-0.5	-1.0	0.3	-1.2	-10.4
Ireland	4.3	4.0	3.4	-4.7	-5.0	-2.2	-0.4	-1.0	1.3	-0.2	-11.0
Greece	2.4	2.5	2.4	-3.7	-4.6	-2.2	-1.3	-2.1	0.2	-3.3	-10.0
Spain	2.4	2.1	2.1	-2.7	-3.6	-1.0	-0.3	-1.5	1.1	-0.8	-7.0
France	1.7	1.8	1.6	-1.8	-3.2	-1.7	0.0	-1.4	-0.1	-1.5	-6.4
Croatia	3.1	3.0	3.0	-5.0	-4.2	-0.1	-1.9	-1.1	2.9	-0.2	-8.8
Italy	1.4	1.3	1.3	-2.0	-2.8	-1.9	-0.6	-1.5	-0.6	-2.7	-6.5
Cyprus	3.4	3.2	3.1	-3.1	-4.0	-2.8	0.3	-0.8	0.3	-0.2	-9.3
Latvia	4.1	3.2	3.0	-4.3	-4.3	-1.9	-0.2	-1.1	1.1	-0.2	-9.8
Lithuania	2.8	2.7	2.5	-4.3	-4.8	0.0	-1.5	-2.1	2.5	-1.1	-8.7
Luxembourg	3.7	3.6	3.5	-6.4	-5.2	-0.2	-2.7	-1.6	3.3	-1.0	-11.0
Hungary	3.7	3.2	3.2	-3.7	-5.3	-1.3	0.0	-2.1	1.9	-0.2	-9.7
Malta	5.6	4.5	4.0	-6.5	-6.7	-0.9	-0.9	-2.2	3.0	-0.2	-12.9
Netherlands	3.1	2.3	1.9	-3.2	-4.5	-1.7	-0.1	-2.2	0.2	-2.1	-8.9
Austria	2.8	1.9	1.6	-3.9	-4.4	-0.7	-1.2	-2.5	0.9	-2.7	-8.6
Poland	3.6	3.2	3.0	-2.5	-4.5	-3.0	1.1	-1.3	0.0	-0.2	-9.4
Portugal	2.3	1.9	1.7	-3.4	-4.9	-1.9	-1.1	-3.0	-0.2	-4.3	-9.7
Romania	4.4	3.4	2.7	-4.7	-5.0	-1.9	-0.3	-1.6	0.8	-1.0	-10.7
Slovenia	4.2	3.6	3.4	-4.9	-5.3	-1.2	-0.7	-1.7	2.2	-0.2	-10.5
Slovakia	4.3	4.7	3.8	-4.8	-6.2	-2.1	-0.5	-1.5	1.7	-0.4	-12.1
Finland	2.6	1.5	1.4	-3.4	-4.1	-1.3	-0.8	-2.6	0.1	-3.3	-8.4
Sweden	2.7	2.0	1.7	-5.8	-8.0	-3.3	-3.1	-6.0	-1.7	-10.4	-15.9
United Kingdom	1.6	1.7	1.7	-4.5	-3.9	0.1	-2.8	-2.2	1.8	-3.3	-8.0
Euro area	2.3	1.9	1.7	-3.1	-3.9	-1.2	-0.9	-2.0	0.5	-2.4	-7.8
European Union	2.2	1.9	1.8	-3.5	-4.1	-1.1	-1.2	-2.2	0.7	-2.7	-8.3
Norway	2.3	2.2	1.9	-3.4	-3.2	-1.1	-1.1	-1.0	0.8	-1.4	-7.4
United States	2.3	1.9	1.8	-2.7	-2.5	1.3	-0.3	-0.6	3.1	2.2	-3.8
Japan	0.7	0.8	0.2	-1.8	-1.2	0.3	-1.1	-0.4	0.5	-1.0	-2.6
Canada	2.1	1.7	1.7	-1.8	-2.1	0.9	0.3	-0.5	2.6	2.4	-3.0
Switzerland	1.3	1.6	1.7	-1.5	-1.3	0.2	-0.1	0.3	1.9	2.1	-2.5
Australia & New Zealand	2.9	2.9	2.8	-1.4	-1.4	-0.7	1.6	1.5	2.1	5.2	-3.4
Turkey	3.5	3.5	3.5	-4.3	-1.6	0.0	-0.8	1.9	3.5	4.6	-5.6
Russia	1.6	1.5	1.5	-3.5	-1.9	0.6	-1.9	-0.4	2.1	-0.2	-4.7
Emerging Asia	6.5	6.5	6.5	-3.3	-1.6	0.3	3.1	4.8	6.8	15.5	-4.3
China	6.5	6.3	6.2	-2.8	-1.6	0.4	3.7	4.7	6.6	15.7	-3.8
India	7.4	7.8	7.9	-3.8	-2.1	-0.1	3.6	5.7	7.8	18.0	-5.6
Latin America	1.9	2.4	2.6	-3.0	-1.6	1.2	-1.1	0.8	3.8	3.5	-3.4
Brazil	1.5	2.0	2.0	-3.3	-1.6	1.5	-1.8	0.4	3.5	2.0	-3.4
Mexico	1.9	2.3	2.7	-2.6	-2.0	1.2	-0.8	0.4	3.9	3.5	-3.3
Chile	2.5	2.7	2.9	-3.0	-1.5	0.9	-0.5	1.3	3.8	4.6	-3.5
Rest of the World	3.5	3.4	3.5	-3.2	-1.9	0.1	0.2	1.5	3.6	5.4	-4.8

Source: Adverse macro-financial scenario for the 2018 EU-wide banking sector stress test.

Table A2 The residential real estate prices paths in the 2018 EBA stress test scenarios

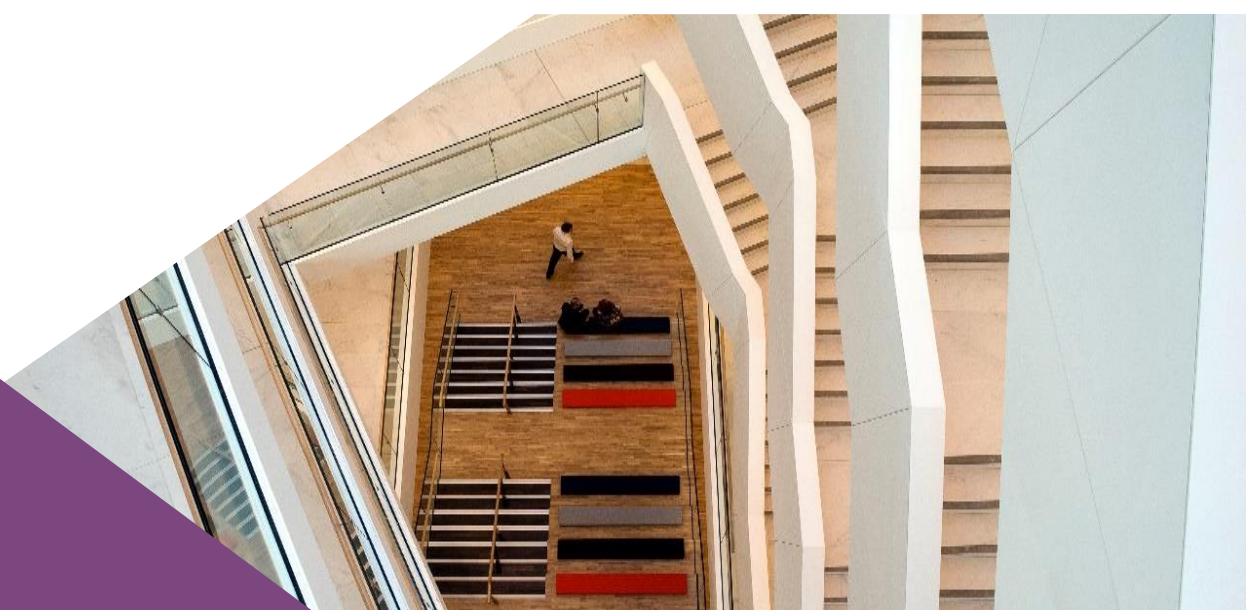
	Baseline growth (%)			Growth rate deviations (percentage points)			Adverse growth (%)			Adverse cumulative growth (%)	Level deviation 2020 (%)
	2018	2019	2020	2018	2019	2020	2018	2019	2020		
Belgium	2.2	1.9	1.6	-17.0	-16.1	-4.3	-14.8	-14.2	-2.7	-28.9	-32.8
Bulgaria	8.4	10.2	10.8	-12.2	-12.4	-4.9	-3.8	-2.2	5.8	-0.5	-24.8
Czech Republic	11.1	8.7	8.7	-15.9	-14.4	-3.9	-4.7	-5.7	4.7	-5.9	-28.3
Denmark	2.9	2.8	2.4	-12.6	-19.3	-7.1	-9.8	-16.4	-4.7	-28.1	-33.6
Germany	4.8	4.0	3.8	-13.6	-13.5	-3.6	-8.8	-9.5	0.2	-17.3	-26.9
Estonia	7.6	5.5	5.8	-27.1	-25.4	-9.0	-19.5	-19.8	-3.3	-37.6	-48.0
Ireland	7.1	5.4	4.9	-8.4	-7.9	-6.3	-1.3	-2.4	-1.4	-5.1	-19.8
Greece	-0.5	0.5	1.0	-6.8	-7.2	-4.6	-7.3	-6.7	-3.6	-16.6	-17.4
Spain	5.2	4.9	4.7	-4.6	-13.2	-11.8	0.6	-8.3	-7.2	-14.3	-25.8
France	3.7	3.5	3.8	-15.3	-12.9	0.0	-11.6	-9.4	3.8	-16.9	-25.4
Croatia	3.1	1.3	1.6	-5.9	-8.2	-4.4	-2.8	-6.9	-2.8	-12.1	-17.2
Italy	1.5	2.2	2.6	-8.9	-7.1	-2.7	-7.3	-4.9	-0.1	-12.0	-17.3
Cyprus	3.0	3.5	3.5	-9.7	-8.4	-2.3	-6.7	-4.9	1.2	-10.2	-18.6
Latvia	5.9	6.2	3.0	-27.3	-24.9	-2.8	-21.4	-18.8	0.2	-36.0	-44.7
Lithuania	4.2	4.7	4.7	-19.2	-17.9	-9.7	-15.0	-13.2	-5.0	-29.9	-38.6
Luxembourg	6.3	6.4	6.1	-25.0	-23.0	-2.6	-18.7	-16.6	3.6	-29.8	-41.5
Hungary	12.6	12.6	12.6	-16.9	-18.0	-2.6	-4.3	-5.4	10.0	-0.4	-30.3
Malta	5.0	4.1	3.2	-15.1	-21.0	-16.4	-10.0	-16.9	-13.2	-35.2	-42.5
Netherlands	7.1	5.2	3.9	-9.8	-11.7	-7.7	-2.7	-6.4	-3.8	-12.5	-25.2
Austria	3.3	3.2	3.3	-22.4	-21.2	-2.8	-19.1	-18.1	0.5	-33.3	-39.4
Poland	6.5	2.2	1.0	-5.6	-6.1	-5.9	0.9	-4.0	-4.9	-7.9	-16.2
Portugal	4.4	3.8	3.8	-8.6	-9.9	-5.2	-4.2	-6.2	-1.4	-11.3	-21.2
Romania	7.4	5.9	5.9	-12.4	-9.8	-5.2	-5.1	-3.9	0.7	-8.2	-23.7
Slovenia	6.3	5.8	5.5	-13.2	-13.1	-3.1	-6.9	-7.4	2.5	-11.6	-25.5
Slovakia	3.8	3.6	3.2	-11.9	-11.3	-1.8	-8.1	-7.7	1.4	-14.0	-22.5
Finland	2.2	1.9	2.1	-11.6	-12.5	-4.0	-9.4	-10.6	-1.9	-20.5	-25.2
Sweden	6.3	4.8	4.2	-33.7	-32.8	-7.3	-27.4	-28.0	-3.1	-49.4	-56.4
United Kingdom	2.7	3.1	3.2	-18.5	-17.4	-5.2	-15.9	-14.3	-2.0	-29.3	-35.3
Euro area	4.0	3.6	3.6	-12.2	-12.2	-4.1	-8.2	-8.6	-0.5	-16.5	-25.2
European Union	4.1	3.7	3.6	-13.8	-13.5	-4.4	-9.6	-9.8	-0.8	-19.1	-27.7
Norway	-1.6	2.9	4.2	-29.5	-17.5	0.0	-31.1	-14.6	4.2	-38.7	-41.9
United States	5.4	5.4	5.4	-20.5	-15.3	0.0	-15.0	-9.9	5.4	-19.2	-31.1
Switzerland	1.1	1.1	1.1	-18.7	-13.9	0.0	-17.6	-12.8	1.1	-27.4	-29.7
Turkey	13.0	13.0	13.0	-14.5	-9.8	0.0	-1.5	3.1	13.0	14.8	-20.4
Russia	-0.9	-0.9	-0.9	-15.9	-11.2	0.0	-16.8	-12.1	-0.9	-27.5	-25.5
China	1.7	1.7	1.7	-16.3	-11.6	0.0	-14.6	-9.9	1.7	-21.8	-25.6
Brazil	0.9	0.9	0.9	-16.5	-11.8	0.0	-15.7	-10.9	0.9	-24.2	-26.2
Mexico	6.2	6.2	6.2	-14.8	-10.2	0.0	-8.6	-4.1	6.2	-6.9	-22.2
Chile	6.1	6.1	6.1	-17.4	-12.6	0.0	-11.3	-6.5	6.1	-12.1	-26.3

Source: Adverse macro-financial scenario for the 2018 EU-wide banking sector stress test.

Table A3 The long term interest rate paths in the 2018 EBA stress test scenarios

	Starting point rates (%)	Baseline rates (%)			Deviation from the baseline (basis points)			Adverse rates (%)		
	2017	2018	2019	2020	2018	2019	2020	2018	2019	2020
Belgium	0.7	0.8	1.0	1.3	73	74	70	1.5	1.8	2.0
Bulgaria	1.8	1.8	1.9	2.1	58	60	56	2.3	2.5	2.7
Czech Republic	1.0	1.3	1.7	2.2	67	68	64	2.0	2.4	2.8
Denmark	0.6	0.6	0.9	1.2	53	55	52	1.2	1.4	1.7
Germany	0.4	0.5	0.7	0.9	62	64	60	1.1	1.4	1.5
Estonia					0	0	0	0.0	0.0	0.0
Ireland	0.8	1.0	1.3	1.5	82	84	79	1.8	2.1	2.3
Greece	6.1	5.5	5.7	6.0	131	133	126	6.8	7.1	7.2
Spain	1.6	1.7	2.1	2.4	115	118	111	2.9	3.3	3.5
France	0.8	0.7	1.0	1.3	76	78	73	1.5	1.8	2.0
Croatia	2.8	2.7	2.9	3.2	58	60	56	3.3	3.5	3.8
Italy	2.1	2.1	2.5	2.8	121	124	117	3.3	3.7	4.0
Cyprus	1.9	1.2	1.4	1.6	77	79	74	2.0	2.2	2.3
Latvia	0.8	0.8	1.1	1.3	59	60	56	1.4	1.7	1.9
Lithuania	0.8	1.2	1.8	2.3	78	80	75	1.9	2.6	3.1
Luxembourg	0.6	0.7	0.9	1.1	84	86	81	1.5	1.8	1.9
Hungary	3.1	3.8	4.1	4.4	62	64	61	4.4	4.8	5.0
Malta	1.4	1.5	1.7	1.9	63	64	60	2.1	2.3	2.6
Netherlands	0.5	0.6	0.9	1.1	65	66	63	1.3	1.5	1.7
Austria	0.6	0.7	0.9	1.1	79	81	76	1.5	1.7	1.9
Poland	3.4	4.0	3.7	3.9	76	78	74	4.8	4.5	4.6
Portugal	3.2	2.3	2.8	3.2	137	140	132	3.7	4.2	4.5
Romania	3.9	4.4	5.1	6.1	57	58	55	5.0	5.7	6.7
Slovenia	1.0	1.0	1.3	1.6	64	65	62	1.6	2.0	2.2
Slovakia	1.0	0.9	1.2	1.4	77	79	74	1.7	2.0	2.2
Finland	0.5	0.6	0.9	1.1	74	76	72	1.4	1.6	1.8
Sweden	0.6	1.1	1.7	2.2	71	73	69	1.8	2.4	2.9
United Kingdom	1.2	1.4	1.6	1.8	87	89	84	2.3	2.5	2.6
Euro area	1.1	1.1	1.4	1.6	84	86	81	1.9	2.2	2.5
European Union	1.2	1.3	1.6	1.8	83	85	80	2.1	2.4	2.6
Norway	1.6	1.6	1.6	1.9	62	81	77	2.2	2.4	2.7
United States	2.3	2.8	3.3	3.4	235	145	30	5.1	4.7	3.7
Switzerland	-0.1	-0.1	0.0	0.2	29	18	4	0.2	0.2	0.2
Turkey	11.0	9.7	9.2	8.4	76	47	10	10.5	9.7	8.5
Russia	7.9	4.5	4.5	4.5	45	28	6	4.9	4.7	4.5
China	4.2	6.5	5.0	5.0	6	4	1	6.6	5.1	5.0
Brazil	10.3	10.4	11.0	11.3	42	26	5	10.8	11.2	11.4
Mexico	7.1	7.2	7.3	7.3	62	38	8	7.8	7.6	7.3
Chile	4.2	4.6	4.9	4.9	18	11	2	4.7	5.1	5.0

Source: Adverse macro-financial scenario for the 2018 EU-wide banking sector stress test.



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