



EUROPEAN CENTRAL BANK

EUROSYSTEM

23 July 2010

EU STRESS-TEST EXERCISE

TECHNICAL NOTE ON THE MACROECONOMIC SCENARIOS AND REFERENCE RISK PARAMETERS

INTRODUCTION

This note presents the main technical features of the stress test exercise that has been conducted by the CEBS and national supervisory authorities, in cooperation with the ECB. ECB staff provided the macroeconomic scenarios (benchmark and adverse) and the corresponding key micro parameters (probabilities of default (PDs), loss given default (LGDs), and haircuts for holdings of government bonds in the trading book). The changes in these parameters under the adverse scenario represent a substantial stress for the European banks.

The “benchmark” scenario is on average not very far from currently available forecasts, while the “adverse” one, taking stock of prevailing tail risks – especially related to the sovereign debt situation – is in turn substantially below these forecasts.

In addition, the severity of the stress arises from the combination of the increase in the haircuts and especially from the increase in the PDs and LGDs under the adverse scenario. The reference haircuts were computed from changes in the prices of 5-year sovereign bonds. The impact of the increase in the haircuts on government debt in the trading book is mitigated by the fact that banks’ holdings of government securities are primarily in the banking book, and the average maturity of these securities is only around 5 years. On the other hand, the increase in PDs and LGDs affects all portfolios in the banking book and is substantial. For instance, comparing the end-2009 values with those under the adverse scenario in 2011, PDs of corporate assets double or triple in some countries, while for the euro area they increase by over 61%, on average.

I. THE MACROECONOMIC SCENARIOS

For the purpose of conducting the stress-test exercise, two macroeconomic scenarios, covering the period 2010-11, were developed: a “benchmark” scenario (see Table 1), and an “adverse” scenario (see Table 2), taking stock of prevailing tail risks, especially related to the sovereign debt situation. The adverse scenario GDP, cumulated over 2010-11, is close to three percentage points lower than the benchmark one for the European Union (EU) and for the euro area as a whole.

The benchmark scenario is mainly based on European Commission (EC) forecast numbers that were available when work on the CEBS exercise began in March 2010, i.e., the Autumn 2009 European Economic Forecast (November 2009) and the EC Interim Forecast (February 2010). This was complemented with more up-to-date information on country forecasts in cases of significant changes. Assumptions for market interest rates as well as for exchange rates were set in line with the methods employed by the EC to construct their forecast.

In this scenario, the slow recovery initiated in 2010 is expected to gain further momentum, with e.g. GDP growth for the euro area reaching 1.5% in 2011 after 0.7% in 2010 – largely in response to the ongoing world trade pick-up. At the same time, unemployment remains high – even increasing in a number of countries, owing to the lagged effects of the past activity slowdown. Consumer price inflation is assumed to be contained and stable overall, as the upswing occurs in economies where the degree of slack is substantial. There are however a number of countries where inflation declines or increases significantly – reflecting their cyclical positions or fiscal policy measures.

The scenario involves somewhat more contained dynamics in 2010, while by contrast it appears generally on the upside for 2011. On balance over the two years, differences with currently available forecasts are limited.

The adverse scenario¹ has two main features, a global confidence shock, that affects demand worldwide, and an EU-specific shock to the yield-curve, originating from a postulated aggravation of the sovereign debt crisis. The latter impact is differentiated across countries, taking into account their respective situation.

The global confidence shock occurs in a context of downgraded employment and profit expectations worldwide. It affects both private investment and consumption, through a lasting downward shock to these variables, cumulating overall to some 2 percentage points of GDP points over the horizon, concentrated over the second half of 2010 and the first quarter of 2011. The EU is directly affected by this confidence shock and by the effect on exports of the implied lower world demand.

In addition, related to prevailing sovereign debt risks, a common upward shift in the yield curve was applied for each country in the EU (reaching 125 basis points for the three-month rates and 75 basis points for the 10-year rates at end-2011), supplemented with country-specific upward shocks to long-term government bond yields (overall amounting to 70 basis points at end-2011 for the euro area). The rise in short-term rates reflects an assumption of tensions in the interbank market – as was seen during earlier financial turmoil episodes. The country-specific bond yield shock in turn accounts for differentiated fiscal situations and related market perceptions.

Accordingly, the distribution of the country-specific upward shock to long-term interest rates across countries reflects two elements. First, a widening of spreads in line with market developments since the beginning of May 2010. Second, an additional widening of spreads reflecting an average additional increase of 30 basis points. Its impact on each country's long-term bond yields was determined in proportion to the volatility of 10-year sovereign bond spreads that was observed between December 2009 and June 2010. Taken together, the country-specific shock implies an additional average increase of 70 basis points (see Table 3). To underline the importance of the combined shocks affecting interest rates, it is worthwhile to mention that, for example, they result in 2011 in 10-year government bond yields of 4.7% for Germany and 14.7% for Greece (see Table 7).

The macroeconomic effects of these assumptions were calibrated using econometric models, also taking into account trade spillovers across EU countries. GDP growth is particularly affected in the adverse scenario, and is lower than in the benchmark scenario for all countries, on average by about one percentage point in 2010 and by close to two percentage points in 2011. The unemployment rate is higher, especially in 2011 (e.g. by 0.6 percentage point in the euro area), while inflation is significantly lower in 2011 (e.g. by 0.4 percentage point for the euro area). The adverse scenario generally appears to be substantially below available forecasts and projections, thereby corresponding to the materialisation of downside risks to economic growth prospects.

¹ In all tables in this note, the adverse scenario includes the sovereign risk.

Table I Macroeconomic scenarios – benchmark scenarios

2010 - Benchmark	GDP at constant prices	Unemployment	Short-term interest rates	Long-term interest rates	Nominal USD exchange rate	CPI
Austria	1.1	6.0	1.2	4.0	0.7	1.3
Belgium	0.6	9.9	1.2	4.0	0.7	1.3
Cyprus	0.1	6.6	1.2	4.7	0.7	3.1
Finland	0.9	10.2	1.2	3.5	0.7	1.6
France	1.2	10.2	1.2	3.8	0.7	1.2
Germany	1.2	9.2	1.2	3.5	0.7	0.7
Greece	-4.1	11.7	1.2	6.8	0.7	1.4
Ireland	-1.4	14.0	1.2	5.1	0.7	-0.6
Italy	0.7	8.7	1.2	4.4	0.7	1.7
Luxembourg	1.1	7.3	1.2	3.8	0.7	1.8
Malta	0.7	7.4	1.2	4.5	0.7	2.0
Netherlands	0.9	5.4	1.2	3.8	0.7	0.8
Portugal	0.5	11.1	1.2	4.7	0.7	1.3
Slovakia	1.9	12.8	1.2	4.1	0.7	1.9
Slovenia	1.3	8.3	1.2	3.9	0.7	1.7
Spain	-0.6	20.0	1.2	4.4	0.7	1.1
Euro area	0.7	10.7	1.2	3.5	0.7	1.1
Bulgaria	0.4	8.8		6.9	1.4	2.4
Czech R.	1.4	8.1		4.7	18.7	1.4
Denmark	1.5	5.8	2.1	3.8	5.0	1.5
Estonia	1.0	16.0		12.1	11.5	1.3
Hungary	0.9	11.8		8.4	196.5	4.9
Latvia	-3.3	20.4		12.7	0.5	-3.4
Lithuania	0.5	17.1		12.1	2.5	0.4
Poland	2.9	10.4	4.8	6.3	2.9	1.6
Romania	-0.7	8.1		9.4	3.0	4.3
Sweden	1.4	10.2	1.4	3.6	7.0	1.7
UK	0.6	8.7	1.5	4.3	0.6	2.4
Rest of the EU	1.0	9.2				2.3
2011 - Benchmark	GDP at constant prices	Unemployment	Short-term interest rates	Long-term interest rates	Nominal USD exchange rate	CPI
Austria	1.5	5.7	2.1	4.3	0.7	1.6
Belgium	1.5	10.3	2.1	4.4	0.7	1.5
Cyprus	1.3	6.7	2.1	5.1	0.7	2.5
Finland	1.6	9.9	2.1	3.9	0.7	1.5
France	1.5	10.0	2.1	4.1	0.7	1.4
Germany	1.7	9.3	2.1	3.8	0.7	1.0
Greece	-2.6	14.1	2.1	7.1	0.7	2.1
Ireland	2.6	13.2	2.1	5.4	0.7	1.0
Italy	1.4	8.7	2.1	4.7	0.7	2.0
Luxembourg	1.8	7.7	2.1	4.2	0.7	1.7
Malta	1.6	7.3	2.1	4.9	0.7	2.2
Netherlands	1.6	6.0	2.1	4.1	0.7	1.2
Portugal	0.2	11.9	2.1	5.1	0.7	1.4
Slovakia	2.6	12.6	2.1	4.6	0.7	2.5
Slovenia	2.0	8.5	2.1	4.4	0.7	2.0
Spain	1.0	20.5	2.1	4.7	0.7	2.0
Euro area	1.5	10.9	2.1	3.8	0.7	1.5
Bulgaria	4.0	8.0		6.9	1.5	2.5
Czech R.	1.8	8.5		4.4	18.8	1.8
Denmark	1.8	5.6	2.9	4.1	5.0	1.8
Estonia	4.0	14.5		12.1	11.6	1.1
Hungary	3.2	11.9		6.2	197.2	3.0
Latvia	3.9	18.2		12.7	0.5	0.2
Lithuania	3.1	15.9		12.1	2.6	1.7
Poland	2.4	11.5	5.7	6.3	2.9	1.7
Romania	3.6	8.8		9.4	3.1	2.4
Sweden	2.1	10.1	2.8	3.9	7.0	1.7
UK	1.9	8.0	3.0	4.7	0.6	1.6
Rest of the EU	2.2	8.9				1.7

Source: ECB calculations.

Note: GDP at constant prices (annual percent change (y-o-y)), Unemployment (as % of the labour force at year-end), Short-term interest rate (Short term interest rates (3M) at year-end - Euribor or Libor depending on the country), Long term interest rates (Long term interest rates (10Y) at year-end - Treasuries), Nominal USD exchange rate (Level of nominal USD exchange rate to the respective currency at year-end), CPI (% change from previous year (y-o-y)).

Table 2 Macroeconomic scenarios – adverse scenario, including sovereign risk

2010 - Adverse	GDP at constant prices	Unemployment	Short-term interest rates	Long-term interest rates	Nominal USD exchange rate	CPI
Austria	-0.1	6.1	2.1	4.5	0.7	1.5
Belgium	-0.3	9.9	2.1	4.8	0.7	1.2
Cyprus	-0.7	6.7	2.1	5.4	0.7	3.1
Finland	-0.1	10.4	2.1	4.0	0.7	1.3
France	0.7	10.2	2.1	4.3	0.7	1.2
Germany	0.2	9.2	2.1	4.0	0.7	0.7
Greece	-4.6	11.8	2.1	11.8	0.7	1.4
Ireland	-2.1	14.1	2.1	6.7	0.7	-0.6
Italy	-0.3	8.8	2.1	5.4	0.7	1.7
Luxembourg	-0.1	7.3	2.1	4.6	0.7	1.8
Malta	-0.8	7.6	2.1	5.1	0.7	1.8
Netherlands	0.0	5.5	2.1	4.3	0.7	0.8
Portugal	-0.3	11.3	2.1	7.0	0.7	1.3
Slovakia	0.8	12.9	2.1	4.5	0.7	1.8
Slovenia	0.7	8.5	2.1	4.4	0.7	1.8
Spain	-1.4	20.3	2.1	5.8	0.7	1.0
Euro area	-0.2	10.8	2.1	4.4	0.7	1.1
Bulgaria	-0.7	9.2		8.0	1.4	2.0
Czech R.	0.9	8.6		5.8	18.7	0.9
Denmark	0.8	6.0	3.0	4.4	5.0	1.2
Estonia	-0.1	16.4		13.2	11.5	0.9
Hungary	-0.2	12.6		9.5	196.5	4.8
Latvia	-4.2	20.7		13.8	0.5	-3.9
Lithuania	-0.9	17.6		13.2	2.5	-0.2
Poland	2.1	10.7	5.7	7.4	2.9	2.5
Romania	-1.8	8.5		10.5	3.0	3.9
Sweden	0.9	10.2	2.4	4.3	7.0	1.3
UK	-0.2	9.1	2.4	5.0	0.6	2.4
Rest of the EU	0.2	9.6				2.3
2011 - Adverse	GDP at constant prices	Unemployment	Short-term interest rates	Long-term interest rates	Nominal USD exchange rate	CPI
Austria	-1.2	6.1	3.3	5.3	0.7	1.0
Belgium	-0.6	11.1	3.3	5.6	0.7	0.6
Cyprus	-0.1	7.3	3.3	6.3	0.7	2.1
Finland	-0.6	11.4	3.3	4.9	0.7	0.1
France	-0.1	10.5	3.3	5.1	0.7	1.0
Germany	-0.6	9.7	3.3	4.7	0.7	0.6
Greece	-4.3	14.8	3.3	14.7	0.7	2.1
Ireland	1.0	13.7	3.3	7.8	0.7	0.7
Italy	-0.3	9.3	3.3	6.3	0.7	1.7
Luxembourg	-0.8	7.7	3.3	5.5	0.7	1.4
Malta	-1.2	8.2	3.3	6.0	0.7	1.6
Netherlands	-1.0	7.0	3.3	5.1	0.7	1.0
Portugal	-2.3	12.8	3.3	8.5	0.7	0.9
Slovakia	-0.6	13.2	3.3	5.4	0.7	1.4
Slovenia	0.6	9.1	3.3	5.3	0.7	1.9
Spain	-1.2	21.6	3.3	6.8	0.7	1.2
Euro area	-0.6	11.5	3.3	5.3	0.7	1.1
Bulgaria	2.8	8.4		8.0	1.5	0.5
Czech R.	0.6	9.6		5.8	18.8	0.9
Denmark	0.2	6.3	4.1	5.1	5.0	1.2
Estonia	3.0	14.8		13.2	11.6	-1.0
Hungary	1.6	13.2		9.5	197.2	2.5
Latvia	2.5	18.8		13.8	0.5	-3.6
Lithuania	2.4	16.3		13.2	2.6	-2.3
Poland	0.5	12.2	7.0	7.6	2.9	2.3
Romania	2.1	9.2		10.5	3.1	1.2
Sweden	0.9	10.3	4.1	4.9	7.0	1.2
UK	0.1	8.8	4.2	5.7	0.6	0.6
Rest of the EU	0.5	9.6				0.9

Source: ECB calculations.

Note: GDP at constant prices (annual percent change (y-o-y)), Unemployment (as % of the labour force at year-end), Short-term interest rate (Short term interest rates (3M) at year-end - Euribor or Libor depending on the country), Long term interest rates (Long term interest rates (10Y) at year-end - Treasuries), Nominal USD exchange rate (Level of nominal USD exchange rate to the respective currency at year-end), CPI (% change from previous year (y-o-y)).

Table 3 Contribution of the sovereign risk shock to the five-year bond yields in the euro area under the adverse scenario

Country	Five-year yields		Common upward shift of the yield curves	Country-specific sovereign risk shock
	Benchmark 2011	Adverse 2011		
Austria	3.03	4.04	75	25
Belgium	3.23	4.47	75	49
Cyprus	4.07	5.29	75	47
Finland	3.16	4.16	75	25
France	2.94	3.92	75	24
Germany	2.74	3.49	75	0
Greece	6.28	13.87	75	685
Ireland	3.28	5.62	75	158
Italy	3.19	4.80	75	86
Luxembourg	3.23	4.53	75	55
Malta	4.01	5.07	75	31
The Netherlands	2.87	3.82	75	20
Portugal	3.96	7.40	75	268
Slovakia	3.55	4.41	75	10
Spain	3.61	5.78	75	142
Slovenia	3.84	4.80	75	21
Euro area average	3.15	4.60	75	70

Source: ECB calculations.

Note: Contributions are expressed in basis points. Due to insufficient data on bond yields of Cyprus, Luxembourg, Malta, Slovakia and Slovenia, a uniform additional widening of 30 basis points was imposed for these five countries.

2. PROBABILITIES OF DEFAULT AND LOSS GIVEN DEFAULT

Estimates of probabilities of default (PD)² and loss given default (LGD)³ parameters were computed at the country level for five main portfolios (financial institutions, sovereign, corporate, consumer credit and retail real estate). For all countries in the exercise, these parameters were computed for both the benchmark and adverse scenarios for 2010 to 2011.⁴

To calculate the PDs and LGDs conditional on the different scenarios, sector-specific regression models⁵ were used to link PDs and LGDs with macroeconomic variables. These models provide estimates of sector-specific elasticities of PDs and LGDs with respect to changes in macroeconomic variables – conditional on shocks to the system. In the models, three propagation channels for the shocks were identified: the demand channel; the supply channel and the long-term borrowing costs channel. To obtain

² The PD describes the likelihood that a loan will not be repaid and that it will fall into default. To calculate the PD for each loan category the credit history of the counterparty as well as the nature of the investment is taken into account. All PD figures in the EU-wide stress test are constructed for non-defaulted exposures.

³ The LGD is the amount of funds that is lost by a bank or other financial institution when a borrower defaults on a loan.

⁴ In particular, PDs and LGDs increase as a result of the sovereign shock included in the adverse scenario, with the only exception of the sovereign portfolio in the banking book, for consistency with the assumption of no government default.

⁵ The regression models take account of dynamic interaction between the variables that drive PDs and LGDs. The variables considered in the models were GDP, unemployment, long-term interest rates and sectoral PD and LGD covering the period from 1991 until end-2009.

country-specific PD and LGD parameters for 2010 and 2011 under the benchmark scenario, these elasticities were multiplied by the projected changes in macroeconomic variables for each country using the PD and LGD levels that were observed at end-2009 as a starting point. Similarly, to obtain PDs and LGDs under the adverse scenario in 2010 and 2011, the differences between the macroeconomic variables in the benchmark and adverse scenarios for each year were multiplied with the elasticities implied by the sector-specific regression models. For the purposes of using these parameters for stress-testing the balance sheets of individual financial institutions, national supervisory authorities were encouraged to use as a starting point their own PD and LGD levels for 2009 and to apply the changes of these parameters in 2010 and 2011 with respect to their values in the benchmark scenario in the respective year according to the outcomes of the ECB models. For some of the largest banks for which a full bottom-up exercise was conducted, together with supervisory authorities, supervisors could decide to allow these banks to feed the common macroeconomic scenarios into the banks' own internal models for the computation of PDs and LGDs.

Regarding the data entered into the ECB models for PDs and LGDs, country-level financial sector PDs were approximated using the Moody's EDFs (expected default frequency) extracted from the Moody's KMV database.⁶ Sovereign PDs were derived from CDS spreads. Retail real estate PDs, consumer credit PDs and corporate sector PDs were obtained from the ECB Monetary and Financial Institutions (MFI) database on write-offs, while LGDs were extracted from Moody's LossCalc database assuming a constant PD over time.⁷

To illustrate the severity of the adverse scenario, Chart 1 plots the ranges of changes across all countries in the PDs between the adverse scenario and the end-2009 values over 2010 and 2011, for the four private-sector portfolios sectors considered in the credit risk part of the exercise, and Table 4 shows the corresponding figures for 2011. Chart 2 shows the results of the same exercise as Chart 1, now for the LGD parameters. As seen in both charts, the PDs and LGDs increase substantially across sectors and countries under the adverse scenario compared to end-2009 in both 2010 and 2011. In this regard, it is important to note that the stresses on long-term interest rates that result from the sovereign shock feed through to higher PD and LGD levels.

3. SOVEREIGN BOND HAIRCUTS

The increase in bond yields affects the valuation of holdings of government debt in the banks' trading books,⁸ and in the exercise its impact is not offset by changes in the valuation of derivative positions (credit derivatives, interest rate swaps, etc.) that are used to hedge the sovereign bond exposures.

⁶ For details see "www.moodyskmv.com".

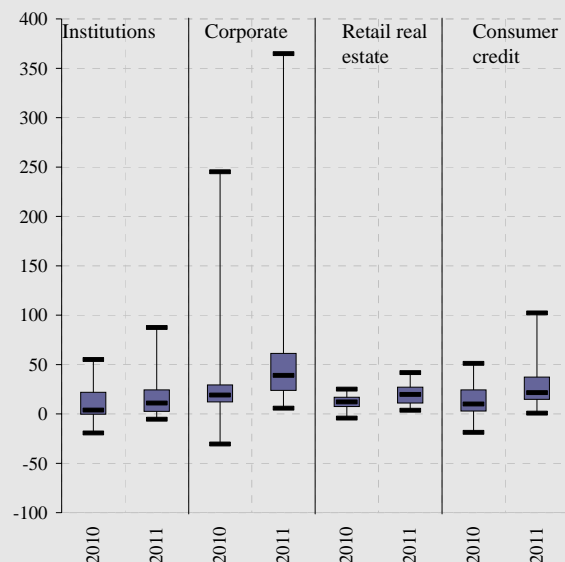
⁷ PD and LGD levels for 2009 were calibrated on the basis of results from data collections from national authorities, various surveys conducted by the CEBS and the ECB, and market information.

⁸ Since no sovereign defaults are considered in the exercise, there is no impact on holdings of sovereign bonds which are held to maturity in the banking book.

For the purposes of estimating valuation haircuts, it was agreed among participating supervisors that a five-year maturity was representative of the approximate duration of sovereign bond holdings held by banks in the EU. Hence, the haircuts for sovereign bonds are computed in two steps, first by estimating

Chart 1 Changes in PDs across sectors - dispersions across countries under the adverse scenario compared to 2009

(%, maximum, minimum, interquartile range, median)

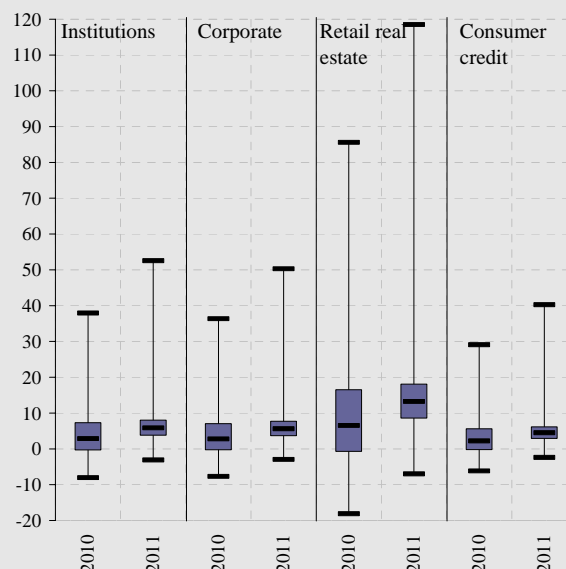


Source: ECB calculations.

Note: Box-Whisker plots show the interquartile range of the distribution within the blue box, which includes the median denoted by the black bar. The upper and lower black bars at the extremes illustrate the maximum and the minimum of the distribution.

Chart 2 Changes in LGDs across sectors - dispersions across countries under the adverse scenario compared to 2009

(%, maximum, minimum, interquartile range, median)



Source: ECB calculations.

Note: Box-Whisker plots show the interquartile range of the distribution within the blue box, which includes the median denoted by the black bar. The upper and lower black bars at the extremes illustrate the maximum and the minimum of the distribution.

Table 4 Changes in PDs in 2011 across sectors under the adverse scenario, compared to 2009

(%)

	Institutions	Corporate	Retail real estate	Consumer credit
Austria	10.8	47.4	21.9	24.9
Belgium	68.6	112.4	32.0	55.4
Cyprus	14.8	69.4	14.5	34.8
Finland	10.8	46.8	29.2	18.4
France	11.3	31.4	13.0	21.4
Germany	22.6	57.5	36.2	32.1
Greece	45.0	364.8	26.5	74.2
Ireland	-0.5	21.7	3.6	4.9
Italy	10.0	41.6	11.2	21.4
Luxembourg	11.0	71.6	21.8	34.6
Malta	11.9	54.9	18.5	36.0
Netherlands	66.1	88.5	39.0	46.9
Portugal	31.0	147.0	30.3	102.3
Slovenia	0.7	23.9	24.9	4.2
Slovakia	-1.8	7.7	8.0	0.8
Spain	29.4	113.1	17.1	56.3
Euro area	8.5	61.3	20.8	25.8
Bulgaria	14.3	12.9	8.5	15.2
Czech Republic	87.4	61.2	41.6	66.7
Denmark	1.9	26.7	5.6	14.7
Estonia	-5.4	5.8	4.5	8.6
Hungary	36.2	35.3	21.5	40.8
Latvia	-1.0	13.1	9.7	15.9
Lithuania	9.5	6.9	12.6	10.8
Poland	58.9	56.0	39.7	62.3
Romania	16.9	19.8	14.9	23.4
Sweden	2.6	32.4	14.5	12.3
UK	0.9	22.6	6.2	13.9
Rest of the EU	1.6	25.0	5.5	13.7

Source: ECB calculations.

five-year bond yields, consistent with the assumptions for ten-year yields and then, in a second step, translating these five-year yields into their corresponding sovereign bond prices.

A. TRANSFORMATION OF TEN-YEAR YIELDS TO FIVE-YEAR YIELDS

The transformation uses the ten-year yields prevailing in the benchmark and adverse scenarios together with the five-year yields that were assumed to prevail in the market at the end of 2009. The changes in five-year bond yields from 2009 to 2010 and to 2011 were set equal to the changes (in basis points) in the ten-year yields. This method was applied for all countries, apart from Germany, which acts as the reference sovereign issuer with the lowest yield in the euro area.⁹ The exceptions are the euro area countries where the bond markets are not liquid or where this method would lead to a significant compression of sovereign bond yield spreads vis-à-vis German bonds. For those countries (Cyprus, Malta, Slovakia, and Slovenia) it was assumed that the sovereign bond yield spreads over the German yields would remain constant in the benchmark scenario.

In the adverse scenario, the five-year yields are constructed from the values in the benchmark scenario using the same procedure as followed for the ten-year yields, taking into account both the yield curve flattening and the sovereign risk components. Again Germany, being the reference issuer, is assumed to be unaffected by the elevated sovereign risk.

B. HAIRCUTS ON SOVEREIGN DEBT

The haircuts were computed from changes in the prices of five-year sovereign bonds under both scenarios. The parameters that are essential for the pricing of sovereign bonds (coupons, coupon frequencies, coupon and maturity dates) were collected from Bloomberg. In order to eliminate potential distortions which may arise when the bonds that are currently the most actively traded have been issued with very high or very low coupons,¹⁰ all bonds for which market quotes were available on Bloomberg for each country that had a remaining maturity of 4.5 to 6.5 years were priced and the weighted average change in their prices was used to construct the haircut. The weights in the average are based on the outstanding amount of the bonds.

In the pricing of sovereign bonds the discounted cash-flow method was used, in which the yields to maturity under the relevant scenario are used to construct the discount factors. This method takes into account the actual maturity dates, coupon dates and coupon frequencies for the individual bonds.

The haircuts are applied to the market value of bonds at the end of 2009, separately for each year. Therefore, a bond which was worth 100 at the end of 2009 and which has a haircut of 4% in 2010 and 6% in 2011 should be valued at 96 at the end of 2010 and at 94 at the end of 2011. The haircuts used in the

⁹ For the computation of haircuts, the country-specific sovereign risk takes Germany as the reference, so that the German yields and haircuts under the adverse scenario are not affected by the elevated sovereign risk (see Table 3).

¹⁰ For example, a bond used in the exercise may have an original maturity of 30 years (i.e. issued in 1985) and a remaining maturity of 5 years. The coupons on such a bond can be out of line with the prevailing yields, thereby distorting the comparisons between the sensitivities of bond prices to changes in the yields.

exercise (Table 5) are the future values of the outstanding sovereign bonds. The exercise is supposed to provide the values of the bonds to be booked in the end-2010 and end-2011 accounts. This implies that a 5-year bond, representative of the average maturity of this portfolio by banks, has a duration of only 3 years at the end of 2011, when accounts are closed.

Table 5 Five-year bonds yields and haircuts used in the exercise

Country	Bond yields					Haircuts			
	end-2009	Benchmark		Adverse		Benchmark		Adverse	
		2010	2011	2010	2011	2010	2011	2010	2011
Austria	2.69	2.72	3.03	3.29	4.04	1.0%	2.8%	3.1%	5.6%
Belgium	2.79	2.92	3.23	3.66	4.47	1.4%	3.1%	4.3%	6.9%
Cyprus	3.75	3.58	4.07	4.30	5.29	0.3%	3.2%	3.0%	6.7%
Finland	2.62	2.35	3.16	2.91	4.16	0.0%	3.3%	1.9%	6.1%
France	2.48	2.63	2.94	3.18	3.92	1.5%	3.0%	3.7%	6.0%
Germany	2.42	2.25	2.74	2.81	3.49	0.1%	2.5%	2.3%	4.7%
Greece	4.96	5.97	6.28	11.03	13.87	3.9%	4.3%	20.1%	23.1%
Ireland	2.91	2.97	3.28	4.50	5.62	1.6%	4.2%	8.6%	12.8%
Italy	2.80	2.89	3.19	3.90	4.80	1.2%	2.9%	4.9%	7.4%
Luxembourg	2.79	2.92	3.23	3.72	4.53	1.4%	3.1%	4.3%	6.9%
Malta	3.69	3.52	4.01	4.13	5.07	0.7%	3.6%	2.9%	6.4%
The Netherlands	2.46	2.57	2.87	3.08	3.82	1.1%	2.5%	3.0%	5.2%
Portugal	3.08	3.53	3.96	5.83	7.40	2.3%	3.7%	11.1%	14.1%
Slovakia	3.24	3.07	3.55	3.46	4.41	0.1%	2.4%	1.6%	5.0%
Spain	2.96	3.31	3.61	4.74	5.78	1.3%	4.1%	6.7%	12.0%
Slovenia	3.52	3.35	3.84	3.84	4.80	0.0%	1.1%	1.4%	4.2%
Czech Republic	3.29	3.19	2.87	4.35	4.22	0.0%	2.7%	4.6%	11.4%
Denmark	2.80	2.63	3.12	3.63	4.29	0.0%	1.4%	2.1%	5.2%
Poland	5.96	6.56	6.78	7.72	8.13	2.6%	6.1%	6.4%	12.3%
Sweden	2.41	2.64	2.92	3.32	3.97	1.3%	2.3%	5.0%	6.7%
United Kingdom	2.81	3.67	4.02	4.34	5.07	5.0%	6.9%	7.7%	10.2%
Other non-euro area EU countries						1.3%	4.4%	5.5%	11.8%
EU average						1.3%	3.3%	5.2%	8.5%

Source: ECB calculations.

Note: As discussed in the note, future value haircuts, relative to the market value of the bonds on 31 December 2009, are used in the exercise and are listed in this table.

The haircuts can be decomposed to reflect the three main contributing factors: the overall rise in long-term interest rates foreseen in the benchmark macroeconomic scenario, the common upward shift of the yield curves, and the country-specific sovereign risk shock (Table 6). The decomposition illustrates that for some non-euro area countries, the higher haircuts are driven primarily by the expected increase in long-term interest rates, with the impact of the sovereign risk shock playing a lesser role.

For the purposes of illustration and comparison with the haircuts on five-year bonds, the same calculations were carried out for ten-year bonds (Table 7). The yields used to calculate the haircuts on ten-year bonds are the yields provided as part of the macroeconomic scenario that, where appropriate, include a sovereign risk component. The haircuts on the ten-year bonds are generally higher than the corresponding haircuts on the five-year bonds due to the higher duration. Taking Austria as an example, the haircut on the five-year bonds under the adverse scenario is 5.6%. The corresponding haircut on ten-year bonds is 9.5%. For Greece, the respective figures are 23.1% and 42.2%.

Table 6 Decomposition of the five-year adverse scenario haircuts

Country	Benchmark macroeconomic scenario	Common upward shift of the yield curves	Country-specific sovereign risk shock
Austria	2.8%	2.1%	0.7%
Belgium	3.1%	2.3%	1.5%
Cyprus	3.2%	2.2%	1.4%
Finland	3.3%	2.1%	0.7%
France	3.0%	2.4%	0.7%
Germany	2.5%	2.2%	0.0%
Greece	4.3%	2.1%	16.8%
Ireland	4.2%	2.9%	5.8%
Italy	2.9%	2.1%	2.4%
Luxembourg	3.1%	2.3%	1.5%
Malta	3.6%	2.0%	0.8%
The Netherlands	2.5%	2.1%	0.5%
Portugal	3.7%	2.4%	7.9%
Slovakia	2.4%	2.2%	0.3%
Spain	4.1%	2.4%	5.5%
Slovenia	1.1%	2.4%	0.7%
Czech Republic	2.7%	2.5%	6.2%
Denmark	1.4%	2.4%	1.4%
Poland	6.1%	2.6%	3.5%
Sweden	2.3%	3.0%	1.4%
United Kingdom	6.9%	2.4%	0.9%
Other non-euro area EU countries	4.4%	2.6%	4.8%

Source: ECB calculations.

Note: the decomposition illustrates the impact of the three factors that influence the haircuts on the sovereign bonds under the adverse scenario in 2011. These factors are: the macroeconomic outlook in the benchmark scenario, the upward shift of the bond yields by 75 basis points that is common to all countries, and the country-specific sovereign risk shock (see Section 1 for further details). The rows sum to the total 2011 haircut for each country's bonds under the adverse scenario.

Table 7 An Example: Yields and future value haircuts on ten-year bonds

Country	end-2009	Bond yields				Haircuts			
		Benchmark		Adverse		Benchmark		Adverse	
		2010	2011	2010	2011	2010	2011	2010	2011
Austria	3.94	3.97	4.28	4.54	5.29	0.3%	2.6%	4.7%	9.5%
Belgium	3.91	4.05	4.36	4.79	5.59	1.1%	3.2%	6.7%	11.5%
Cyprus	4.60	4.66	5.08	5.37	6.30	2.6%	5.2%	7.5%	12.4%
Finland	3.73	3.46	3.88	4.02	4.89	0.0%	0.6%	1.9%	7.2%
France	3.65	3.81	4.11	4.35	5.09	1.2%	3.7%	5.4%	10.4%
Germany	3.27	3.50	3.80	3.97	4.72	1.6%	3.5%	5.2%	9.4%
Greece	5.77	6.79	7.09	11.84	14.69	7.1%	8.8%	33.3%	42.2%
Ireland	5.06	5.12	5.43	6.65	7.76	0.5%	2.7%	11.0%	16.6%
Italy	4.29	4.37	4.68	5.39	6.29	0.4%	2.3%	7.7%	12.3%
Luxembourg	3.91	3.80	4.23	4.60	5.53	0.0%	1.4%	4.9%	9.7%
Malta	4.54	4.49	4.92	5.10	5.98	0.2%	3.8%	4.5%	10.3%
The Netherlands	3.71	3.81	4.12	4.32	5.07	0.9%	3.0%	4.6%	9.0%
Portugal	4.20	4.66	5.08	6.96	8.52	3.7%	6.5%	19.4%	26.6%
Slovakia	4.72	4.14	4.57	4.54	5.42	0.0%	0.0%	0.0%	3.9%
Spain	4.03	4.38	4.68	5.81	6.85	4.6%	8.3%	14.6%	21.7%
Slovenia	4.37	3.93	4.36	4.42	5.32	0.0%	0.0%	0.4%	5.8%
Czech Republic	4.80	4.70	4.39	5.84	5.84	0.0%	0.0%	7.4%	12.2%
Denmark	3.62	3.77	4.05	4.45	5.10	1.5%	3.7%	6.3%	10.2%
Poland	6.22	6.82	7.05	7.42	7.65	3.9%	4.7%	7.8%	13.1%
Sweden	3.35	3.58	3.85	4.25	4.90	3.0%	6.0%	8.2%	13.2%
United Kingdom	3.45	4.32	4.66	4.99	5.71	7.3%	9.9%	11.9%	16.2%
Other non-euro area EU countries						1.9%	2.4%	7.6%	12.6%
EU average						1.9%	3.8%	8.3%	13.5%

Source: ECB calculations.

Note: these haircuts were not used in the stress test exercise and are presented only for the sake of comparison.