EFFECTS OF SCENARIOS PROPOSED BY EBA STRESS TESTS ON TRADED BANK STOCKS

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Abstract

In this study we'll investigate the relationship between some of the variables that define the economic scenarios for the stress tests by the EBA in 2011 and 2014 and the stock price of banks across all Europe. We'll investigate correlations and propose several factor models to perform time series' descriptive analysis. This way we'll try to draw conclusion applicable to stress tests and scenario building. Last, we'll use the estimated models to predict stock price evolution under the adverse scenarios and compare the results with the conclusions of the stress tests.

Contents

1. Introduction.

In the summer of 2007 it started the last global crisis we have known. Though it began in the USA as a financial crisis regarding some of the most important banks, the systemic effects rapidly extended to the rest of the banks, to Europe and in general to the whole first world. The financial crisis became an economic crisis when the effects reached the real economy (GDP dropped, unemployment grew) and in the case of some countries even a crisis on the sovereign debt rose. The impact was and still is very important.

Since these effects can reach the whole economy, there is a growing public and scientific interest in all matters related to the financial sector. This isn't new; regulations specific to the financial sector and banking existed since a long time ago, and have been revisited and extended as new crisis happened. As example, the creation of the BIS, elaboration of Basel I and Basel II or the adoption of these measures as law by the Europe Union. This specific crisis is no exception and brought us more advances in the area as the creation of the EBA (European Banking Authority), the ESRB (European Systemic Risk Board) and a new Basel regulatory framework (Basel III).

One of the actions that the EBA performed was the elaboration of stress tests regarding the solvency of the banks across Europe on 2011, the year of its creation, and then on 2014. Stress testing is also a methodology that has been used for long time. Consists on estimating what would be the effects over a certain matter or variable under a hypothetic scenario that is extreme but possible and adverse to the issue at hand.

These tests are usually performed privately, so the company itself selects the variables included in the scenario, the level of stress or adversity of these variables and the procedure to estimate what are the effects of the scenario. Those tests are useful for the company itself, since it gives insight on the situation of the company and its weakness. It's also useful for stakeholders for the same reasons, it gives information to the public.

So, the reasons to perform a stress test for all Europe and by the EBA is exactly that: public information. Since the start of the financial crisis the uncertainty on the real situation, accounts and risks of the banks grew constantly with each negative result and each institution that seemed healthy but received injections of capital. The EBA, as an independent institution could provide a reliable source of information; using the same framework but with individual results for the stressed scenarios for all European countries provides a comparison basis between countries; and with a large sample of banks that comprises most of the volume of the financial sector in Europe the amount of information released should improve the transparency of the sector and reduce uncertainty.

Both stress test performed by the EBA are centered on the solvency of the different institutions, measured by the CET1 (Common Equity Tier 1) ratio. This ratio is calculated as the sum of the most liquid assets in possession of the entity against its risk weighted assets; it's a measure of leverage and financial strength. Based on the scenarios proposed on the test the EBA estimates what will be the remaining CET1 ratio at the horizon of the scenario and extracts conclusions about which banks are still solvent after the impacts of the scenario and which are at risk.

The variables that characterize the macroeconomic and financial scenarios for both tests were similar but not the same. On the 2011's scenario the sovereign crisis worsens, yields and uncertainty increase while labor markets deteriorate; stock prices and house prices fall; caused by sovereign crisis, short-term interbank rates increase; an exogenous shock affects consumption and investment even more; for the rest of the world, USD

depreciates and worldwide demand suffers a negative shock; last, all these effects generate higher unemployment, decreases on the real GDP and lower inflation.

For the test performed in 2014 the basis are similar and adds effects on corporate bonds, Euro Swaps and depreciation of currencies for some countries outside of the Eurozone; all of them affecting real GDP, unemployment, inflation and this time the effects differentiate between residential property prices and commercial property prices.

Several studies show interest in the practices of stress testing from different points of view. For example, Petr Jacubík and Gregory D. Sutton make a theoretical approach to stress testing and scenarios. They introduce several sources of risk, including self-reinforcing feedback loops, and how to introduce them in the tests. They conclude that starting points for stress tests should be multi-variable macroeconomic shocks that are severe yet plausible and that stress testing could improve financial stability. Another study, Sorge, M. (2004), takes a more technical approach and discusses the different methodologies used for stress testing and concludes that, though there's been an improvement based in quantitative techniques, several areas are still lacking an acceptable response.

In this study we'll center our attention on the stress tests performed by the EBA, specifically in the variables chosen for the macroeconomic shocks for the adverse scenarios. We'll use them to analyze a different issue: We'll investigate which are the effects of these variables on the stock price of the banks. This would allow us to see if the scenario has any effect at all on stock prices, which variables are more important and which seem irrelevant and the nature of the effect caused.

The variable of study is different from the tests themselves since we measure stock prices instead of solvency. This issue could make the conclusions drawn for this study inapplicable to stress testing if stock prices and solvency are mostly independent. However, there are several reasons to think the results would be applicable.

First, solvency is a measure of the risk of the entity and we assume the agents in the economy use the information they are given to take decisions. If the macroeconomic conditions worsen the solvency of entities, agents will discount now the future risks they are assuming and the stock prices should decrease. With high ratios of solvency small changes might not affect stock prices, but lack of solvency should affect prices. Risk is not the only element in stock prices, though, and we should take this into account while reaching conclusions.

Second, movements of stock prices are caused by the agents in the market and we're assuming they are rational. Stress test are made to release information to the agents in the economy. Those groups of agents are not exactly the same but in any case they should follow the same rationality. If the scenarios are built under assumptions opposed to the rationality of the markets, they won't be believable for the agents and the purpose of the tests will fail.

On the issue of the effect of macroeconomic variables on stock prices there's also several studies. For example Babayami et al. (2008) investigates the FDI (Foreign Direct Investment), external debt and money supply. Moss, J. and Moss, G. (2010) use several interest rates, US dollar index, price of gold, VIX volatility and other factors. Other studies focus in just one variable and issues about the functional form of its effect on stock markets, like Díaz, A., and Jareño, F. (2009) with unexpected inflation rates or Gonzalo, J. and Taamouti, A. with expected unemployment. We'll use similar techniques, but with more of an overview on the numerous variables and more focus on the stock prices and scenarios.

In summary, we'll use the results to analyze the convenience and relevance of the scenarios and try to extract practical applications that could improve the implementation of stress tests for the banking sector.

This work is structured as follows. In part 2 we introduce the tests and models used. On part 3 we'll comment which variables from the scenarios we used, bank stock prices and the nature of the data. Part 4 consist on a short descriptive analysis of stock prices and scenario variables, independently. On part 5 and 6 we'll comment the results of the analysis and provide the final conclusions.

2. Concepts and methodology

This section will introduce the framework of models, relevant concepts and tests used further in this work.

2.1. Unit roots, stationarity and fractional integration.

For the models we propose we are assuming that if the model is right, parameters are correctly estimated and are significant it proves some kind of stable relationship between explicative variables and the dependent variable. However, for non-stationary time series this relation could be spurious, meaning there is no real dependence between them.

In reality, this could mean several things: that the relationship is purely spurious and disappears after transforming the variable, that it's not spurious or that the relation takes the form of a long-term equilibrium between variables' levels (co-integration). These ideas were introduced in the works of Engle (1981) (1983) and Engle and Granger (1987).

Time series are non-stationary if they follow a process with a deterministic time trend (exact function of time) or if the stochastic process that they follow has one or more unit roots in its characteristic equation: Integrated of order X time series "I(X)".

To know the level of integration of our time series we'll use the following tests:

Augmented Dickey-Fuller test. For this test we estimate the model:

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{i=1}^{I} \beta_i \Delta Y_{t-i} + u_t$$

Where:
ΔY: First difference of the variable.
α: An unrestricted constant.
βt: Represents a linear deterministic time trend.
u: Random innovation term.
I: Number of lags

We test for H0: $\delta = 0$, meaning the time series has a unit root and thus is non-stationary. The results of the test depend on the number of lags, which are used to make the residuals autocorrelation approach zero since residuals with autocorrelation cause bias and inconsistency in the model

Kwiatkowski–Phillips–Schmidt–Shin (KPSS test) is a stationarity test that can be performed together with the Augmented Dickey-Fuller to check the potency of the unit root test. We estimate this model:

$$Y_t = \beta t + (r_t + \alpha) + e_t \quad ; \quad r_t = r_{t-1} + u_t$$

Where:
βt: Represents a linear deterministic time trend.
r: Represents a random walk with initial value α
u: iid (independent identically distributed) random variable with variance σ^2

We test H0: $\sigma^2 = 0$ meaning the time series is trend-stationary. If we make $\beta = 0$ we could check for level-stationary. This test is against H1: The time series has a unit root.

Since both ADF and KPSS can be done with or without a time trend we can also use them to check for deterministic trends.

Geweke-Porter-Hudak (GPH) test for fractional integration. We could describe a time series having a unit root (integrated of order 1) with the following expression, assuming it follows a simple AR(1) process:

$$(1 - L)Y_t = u_t \quad ; \quad \textit{Where L is the lag operator.}$$

We can also describe a more general expression of long-memory time series with:

$$B(L)(1 - L)^d Y_t = C(L)u_t$$

With:
B(L) and C(L) polynomials of the lag operator.
d as the fractional integration parameter

We'll obtain the first, specific case with: B(L) = C(L) = d = 1. We are interested in estimating parameter *d*. Geweke-Porter-Hudak propose estimating the following model:

$$\ln\left(I(w_j)\right) = \varphi_0 - \varphi_1 \ln(4\sin^2(\frac{w_j}{2})) + e_t$$

Where:
I(w): *Periodogram at harmonic frequency* $w_j = 2\pi j/T$.
e: *Random error term.*
$j = 1,2 \ldots n.$
$n = T^{\mu}$ *Number of low-frequency ordinates used in the regression.*
φ_1*:* *Estimation of d.*

We'll perform two t-Student type tests: H0: d = 0 and H0': d = 1. Each represent the time series being stationary or having a unit root.

2.2. Multicollinearity.

Multicollinearity refers to a phenomenon where several variables are correlated in a way that any of them can be expressed as a lineal combination of the other variables and thus contains the same information.

In practice, we'll find variables that are almost a linear combination of the others. Though not as troublesome, near multicollinearity in our models will cause unstable coefficients with high standard deviation and thus low potency for tests involving those coefficients. This happens because as we add collinear variables, the new information added is centered only on observations where the value differs from the collinear pattern.

Since coefficients are unstable, they easily change signs depending on the sample. This interferes in the process of choosing the correct factors and determining the precise effect. However, it doesn't affect the predictive value of a model.

We'll test for multicollinearity using the Variance Inflation Factor (VIF):

$$VIF_j = \frac{1}{1 - R_j^2}$$

R_j^2: $\textit{The } R^2 \textit{ of the following regressions}$: $X_{jt} = \sum_{i \neq j}^{J} \beta_i X_{it} + u_t$

X: *Explanatory variables.*
$j = 1,2,\ldots J$: *Number of explanatory variables.*

The VIF takes a value of 1 when the R_j^2 is 0 and tends to +inf as R_j^2 approaches 1 (perfect multicollinearity). We use the following empirical rule: we consider multicollinearity problems arise with values above 10. Note that as we increase the number of lags, the VIF increases as a rule. This is not a characteristic of our sample, it's a mathematical result: Since VIF is directly proportional to the R^2 of a regression with all of the other variables, each variable we add increases VIF.

2.3. Linear correlation coefficient.

As the starting point of this work we'll use the linear correlation coefficient, which measures the relationship between two variables in a linear form.

$$\rho_{xy} = \frac{E\left[(X-\mu_x)(Y-\mu_y)\right]}{\sigma_x \sigma_y}$$

This is a measure of association, not causality or effect. It accounts for, not only the effects of X over Y or vice-versa, but also for the effects of all the other variables that affect both of them. Also note that 0 correlation does not mean independence.

2.4. Multivariate models.

Some of our macroeconomic variables are expected to be correlated and thus it could prove interesting to contrast the results with a multivariate model that measures the direct effects of several variables on another one. The influx of third variables is still possible, but only variables not included in the model.

Model #1: Variables in first differences without lags.

It can be summed in the following expression:

$$Y_t = \alpha + \sum_{k=1}^{K} \beta_k X_{tk} + u_t$$

Where:

Y:	*Dependent variable*
X:	*Independent variables*
k = 1, 2, 3… K:	*Number of independent variables*
t = 1, 2, 3… T:	*Time periods.*
u:	*Random innovation term.*

For this model we are assuming β is the same for every period of time, the relationship between Y and any given X is linear. Also, the index t is the same for all variables so X affects Y on the same moment of time (we introduced no lags so far).

Since the time series we are using are non-stationary and we want to find a possible dependence between them we should use a stationary transformation of variables. If both dependent and independent variables are I(1), this model ignores the possibility that they are cointegrated since it doesn't add an error correction term.

Model #2: Variables in first differences with lags and sequential variable omission.

For the next model we'll stop assuming X affects Y only for the same period since it's possible that information about certain variables won't be released or won't be credible until time passed. We'll add some complexity to the model adding lags of the independent variables. We won't add lags of the independent variable and the number of lags will be the same for all variables:

$$Y_t = \alpha + \sum_{i=0}^{I} \beta_{i1} X_{1_{t-i}} + \sum_{i=0}^{I} \beta_{i2} X_{2_{t-i}} + \cdots + \sum_{i=0}^{I} \beta_{iK} X_{K_{t-i}} \; u_t$$

Where:

Y:	*Dependent variable.*
X:	*Independent variables.*
K:	*Number of independent variables.*
I = 0, 1, 2… I:	*Lags of the independent variables.*
t = 1, 2, 3… T:	*Time periods.*
u:	*Random innovation term.*

After estimating the model, we'll start with a process that omits one variable at a time, starting with the highest p-value for individual significance test, and estimates the model again until all variables are significant at a 90% confidence interval. We do this because, as we discussed earlier, collinearity for explicative variables grows quickly as we increase the number of lags.

Also, we won't select a fixed number for "I" and use it for all the estimations. We'll use a range of values of I. Specifically 0, 1, 2 and 3 which represent up to a whole year for the explanatory variables to take effect. This way we'll end up with four different models for each bank. Note that the model estimated with 0 lags will be different from the one we discussed in the previous section since this has omitted variables.

Once again we are assuming that a stable long-term relationship does not exist between the levels of variables and thus we didn't add an error correction term.

Model #3: VECM.

For the last model we'll add the possible long-term relationship we ignored on the two previous models. If said relationship exist and the levels of the variables follow a common trend, when one of the variables deviates from the trend, those variables will return to that trend. Thus, the first differences would tend to be positive when the level of the variable is below the trend and to be negative when the level of the variable is above.

We could add this effect finding co-integration vectors that represent the common trends the variables follow. It allows us to determine the magnitude in which any of those variables is above or below the long term equilibrium on each period. These ideas also appear on the work of Engle and Granger (1987).

A simple method to find co-integration vectors is using Engle-Granger test. Since in our case the co-integration vectors would involve several (more than two) variables, procedures like Engle-Granger shouldn't be used because, when it gives results, it provides a single co-integration vector. If several of them exist, which can only be if there are more than two variables, Engle-Granger gives a linear combination of the real co-integration vectors.

We introduce now the VECM (vector error correction term) model and Johansen tests. A VECM takes after the following formula:

$$\Delta X_t = \mu_t + \Pi X_{t-1} + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \cdots + u_t$$

Where:

ΔX: A kx1 vector of variables in differences.

μ_t: A kx1 vector of constants.

ΠX: A kx1 vector of the error correction terms for the t-1 period.

Γ_i: Matrix of size kxk that contain in (n,m) the effect of the i-th lag of the m-th variable over the n-th variable.

u: A vector of random effects.

Johansen tests. Johansen co-integration tests estimate the model above and check the range of Π matrix.
Trace test. H0: Range(Π) ≤ m against H1: Range(Π) > m.
Eigenvalue test. H0: Range(Π) = m against H1: Range(Π) = m + 1

If:

- Range(Π) = 0. There are no co-integration vectors. None of the variables included are co-integrated with any other in any combination possible.
- 0<Range(Π)<k. There are range(Π) number of co-integration vector linearly independent.
- Range(Π)=k. X is I(0) so there is no need for an error correction term and neither to transform the variables to differences.

The results of this tests can differ drastically depending on the number of lags chosen for the VECM model, which of the two Johansen's test to use and the confidence interval for the tests. A common approach could be using the number of lags that the Akaike information criterion deems best and the trace test at a 95% confidence. For this work we'll avoid using a common rule for our estimation and check the different possibilities case by case.

2.5. Measures of predictive capacity of a model.

Since we'll want to use the estimated models to predict the prices under the adverse scenarios we want to know how accurate these predictions are. Measures of predictive power of a model like R^2, likelihood or selection criterions (Akaike, Schwartz, Hannan-Quinn) account for the adjustment to sample and don't represent how capable is a model to predict results out of that sample. To see the predictive power we have to see the adjustment to data out of the sample. We'll estimate models without using some of the data, use them to predict the results for the data we didn't use and compare using:

$$\text{Root mean square deviation (RMSD)} = \sqrt{\frac{\sum(\widehat{y_t} - y_t)^2}{n}}.$$

$$\text{Theil-U (U1)} = \frac{\sqrt{\frac{\sum(\widehat{y_t}-y_t)^2}{n}}}{\sqrt{\frac{\sum y_t^2}{n}}}$$

With

$\hat{y}$: Estimated value
y: Out-of-sample real value
n: Number of out-of-sample periods predicted.

RMSD is measured as the standard deviation of the prediction error, it's unbounded and higher means worse predictions.

U takes values from 0 to +inf. Values lower than 1 show improvement over a no-change forecast (in our case, forecasting the average for returns and forecasting the previous value for prices). Values over 1 can also be interpreted as the predictions being worse than just guessing.

2.6. Simulation of prices with models in returns.

The models we'll use further in this work will use logarithmic returns as dependent variable. Thus, we can obtain a prediction of returns using the expected return under a certain scenario, according to these models, and also add a prediction interval that accounts for the error of the model.

We are interested in results for stock prices at the end of each scenario, to compare between banks and with the results of the stress tests regarding the ratio of common equity tier 1 under baseline and adverse scenarios. However, the expected stock price is not obtained using the price on the previous period and the expected return obtained in the model:

Since: $r_{t+1} = lnP_{t+1} - lnP_t$

$$E(P_{t+1}) = P_t\, E(\exp(r_{t+1})) \neq P_t \exp\big(E(r_{t+1})\big)$$

With
P: Stock prices
r: Logarithmic returns.

So, to obtain expected prices and confidence interval for price predictions we'll need to know the expression of the moment generating function of the returns and the percentiles. We'll also need to take into account that the returns accumulate for several periods.

To avoid these complications we can simulate a high number of groups of returns, one for each period, obtain the paths that the price followed for each of the simulations using: $P_t = P_t \exp r_{t+1}$ and calculate the average or the percentiles of the paths.

Since the residuals of the models won't follow a common standard distribution, for the simulation part of this work we'll use mixture distributions to capture the asymmetry and excess of kurtosis of the residuals left by the models. Since there will be a large number of residuals with different characteristics but all of them follow a Gaussian-like distribution, we chose a mixture of two Normal distributions to model the residuals.

A mixture of Normal distributions is characterized by the following parameters:

π: Mixture probability. Indicates the chance to choose one of the two distributions to generate the random number. 1-π is the probability to choose the other one.

N(μ1,σ1) and N(μ2,σ2): Normal distributions. The different values of μ, σ, α and s generate the asymmetry and excess of kurtosis.

The ordinary (non-centered) moments of this mixture are the linear combination, using the mixture probability, of the ordinary moments of both Normal distributions. We'll use that property to estimate the parameters of the mixture using GMM (Generalized method of moments) minimizing a non-compensating sum of the differences between the real parameters (μ,σ^2,τ,κ) and the estimated ones:

Mean: $\mu^* = M_1$
Variance: $\sigma^{2*} = M_2 - M_1^2$
Asymmetry: $\tau^* = \sigma^{-3}(M3 - 3M_1M_2 + 2M_1^3)$
Kurtosis: $\kappa^* = \sigma^{-4}(M_4 - 4M_1M_3 + 6M_1^2M_2 - 3M_1^4)$

With:

$$M_1 = \pi\mu_1 + (1-\pi)\mu_2$$
$$M_2 = \pi(\sigma_1^2 + \mu_1^2) + (1-\pi)(\sigma_1^2 + \mu_2^2)$$
$$M_3 = \pi(3\mu_1\sigma_1^2 + \mu_1^3) + (1-\pi)(3\mu_2\sigma_2^2 + \mu_2^3)$$
$$M_4 = \pi(3\sigma_1^4 + 6\mu_1^2\sigma_1^2 + \mu_1^4) + (1-\pi)(3\sigma_2^4 + 6\mu_2^2\sigma_2^2 + \mu_2^4)$$

3. Data

For this work we will be using time series of several bank's stock prices for some of the EU countries. We'll also use several of the variables that characterize the macroeconomic scenarios of the EBA. The frequency for the variables will be quarterly because that's the lowest frequency among all the variables used. The time range of data used will be in general from 2000Q1 to 2014Q4, since data for CPPI in the Eurozone starts in 2000Q1.

Stock prices, UR, HICP, STIR, LTIR and EX are obtained as monthly time series and transformed to quarterly by taking the average of 3 months. GDP and RPPI are obtained directly as quarterly data.

Stock prices.

Even though we are using stress testing as a reason for making this study, we cannot forget that it uses accounting information where we use stock prices. Meaning most of the banks tested would be left out.

For example, the long list of "Landesbanks" in Germany or the "Cajas de Ahorros" and "Montes de Piedad" in Spain won't have continuously exchanged stocks that we could use. We should add to this list all cooperative banks, other banks owned by governments or by other banks and in general banks with stocks but not traded.

For holdings and filial companies it's been a case per case choice. The financial services performed by some automobile companies (Renault, Peugeot-Citroën, Volkswagen) were left out because it's a small part of their business and the rest is unrelated to finances. On the other hand, banks with just an insurance branch were kept.

Also, the restructuring process in the financial sector since the crisis in 2007 is also a hindrance to this study: Acquisitions, fusions and new banks create short or broken data. For example Bankia in Spain, Raiffeisen Bank International in Austria or the KBC group in Belgium.

On the other hand we won't limit ourselves to the ones chosen for the stress tests by the authorities, at least for the descriptive part of this work. This study will be centered on 52 banks around 15 European countries

Scenario variables.

As explanatory variables we will use the following data, most of them different for each country.

- **Real GDP (GDP).** We'll use a chained volume time series that reflects the real grown in GDP and does not account for the different level of prices through time. Data will be adjusted by stationality and also by working days (except for Ireland, where data will be adjusted only by stationality). Data for these series is quarterly and different for each country.

- **Unemployment rate (UR),** obtained as monthly data using the following formula:

$$\text{UR} = \frac{U}{U+E} * 100$$

Where:

  - *U (Unemployed): Persons of 15-74 years of age who were not employed during the reference week, had actively sought work during the past four weeks and were ready to begin working immediately or within two weeks*
  - *E (Employed): all persons who worked at least one hour for pay or profit during the reference week or were temporarily absent from such work.*

- **Price index (HICP):** We'll use the Harmonized Index of Consumer Prices, which is an indicator of the changes over time of the prices of goods and services acquired by households. It's obtained with the same approach and definitions for all the countries.

- **Residential Property Price Indicator (RPPI)**: Is an index akin to HICP. It captures price changes of both new and used residential properties and includes the prices of soil. This magnitude is relevant to the banking sector involved in real state loans and related financial instruments.

- **Commercial Property Pricing Index (CPPI):** In the same fashion, we'll use this index to capture the prices of the non-residential properties. In this case the index is experimental and obtained as an average of 19 countries of Euro Area. We'll also use this index as a proxy for the countries outside the Eurozone except for the United Kingdom since we have data for its CPPI.

- **Short term interest rate (STIR):** Measured, as is common, using the 3-month yield on money markets. The money market serves as a measure of the cost of interbank lending and borrowing. Using 3 months is merely a convention. For the Eurozone we'll use 3-months Euribor yield and 3-months Libor yield for the rest.

- **Long term interest rate (LTIR):** We will use the different 10 year sovereign bonds' yields. The sovereign 10 year bond is commonly used as an approximation to riskless interest rate, though for some countries it's considered more like a measure of country risk premium.

- **Exchange rates (EX):** We'll use the BIS effective exchange rate. Measured as geometrically weighted averages of bilateral exchange rates. A growth in the index indicates appreciation of the currency.

Simulation scenarios.

For the last part of this work we'll use the adverse scenarios proposed by the EBA on the stress tests of 2011 and 2014. For the one in 2011 it consists in an unfavorable scenario for the global economy during 2011 and 2012. The one in 2014 extends the scenario to three years and comprises 2014 to 2016.

These scenarios are detailed by year and by country for the principal variables: GDP, UR, HICP, RPPI, CPPI and LTIR. While other numerous variables are less detailed and are mostly used as causes for the changes in the principal ones. These other variables include exchange rates, interbank rates, Euro swaps, domestic consume, investment…

Since our models use quarterly lags some assumptions were used to transform the scenarios:

- For GDP, HICP, RPPI, CPPI (2014). Scenarios are measured in average growth rates in whole years. We'll assume the changes were continuous and equal during the year, thus following a linear interpolation.
- For UR and LTIR (2014). Scenarios are measured in average percentages, the same way the variables are in our models. We could make infinite scenarios if the only condition is the average value of the 4 periods of the year. We'll use the average value as the level of the variable at the end of the year and not the average. Changes are continuous and equal during the year, thus following a linear interpolation. This will make the scenario slightly less extreme.
- For STIR and LTIR (2011), both tests present a single change in the first moments of the scenario, with no further changes during the next years. We'll assume this change is done in the first quarter of the year.
- For exchange rates, the 2011 scenario just assumes a depreciation of the Dollar in the first period. The 2014 scenario gives more attention to exchange rates and for the adverse scenario provides a depreciation of the currency in some non-Euro areas: Hungary, Poland, Czech Republic, Croatia and Romania. For the Eurozone the scenario centers on Euro Swap Rates. Rates depend on sovereign yields and expected exchange rates, but the changes in Euro Swap Rates are assumed to be caused by sovereign yields and not by exchanges rates in the scenario. Thus there will be no appreciation/depreciation for most currencies in our 2014 scenario.
- There's no scenario for CPPI in the 2011 stress test, so we won't use that variable when simulation that scenario.

4. Data analysis.

Stock prices.

Using graphic representations we can see that stock prices follow intensely similar behaviors over time for banks not only in the same country but also across all Europe. The similitudes, however, seem stronger for banks in the same country. This happens not only for series in levels but also for series in differences. This is a general pattern, however, since some of the banks show particular behaviors.

By periods we can the crisis episodes of 2008-2009 for all of the banks across Europe, independent from the country of origin: A period of two extreme negative returns followed by two extreme positive results and then falling again into the negatives.

For the rest of the time series, it depends on the country in question and the period. For example in France or the UK the returns of the banks are different for all periods and show the most differences for banks in the same country during the crisis. On the other hand, all the banks in Greece present almost the same behavior since 2004. As for the rest of countries, they are more similar during the crisis and differences arise for periods far before or after the crisis.

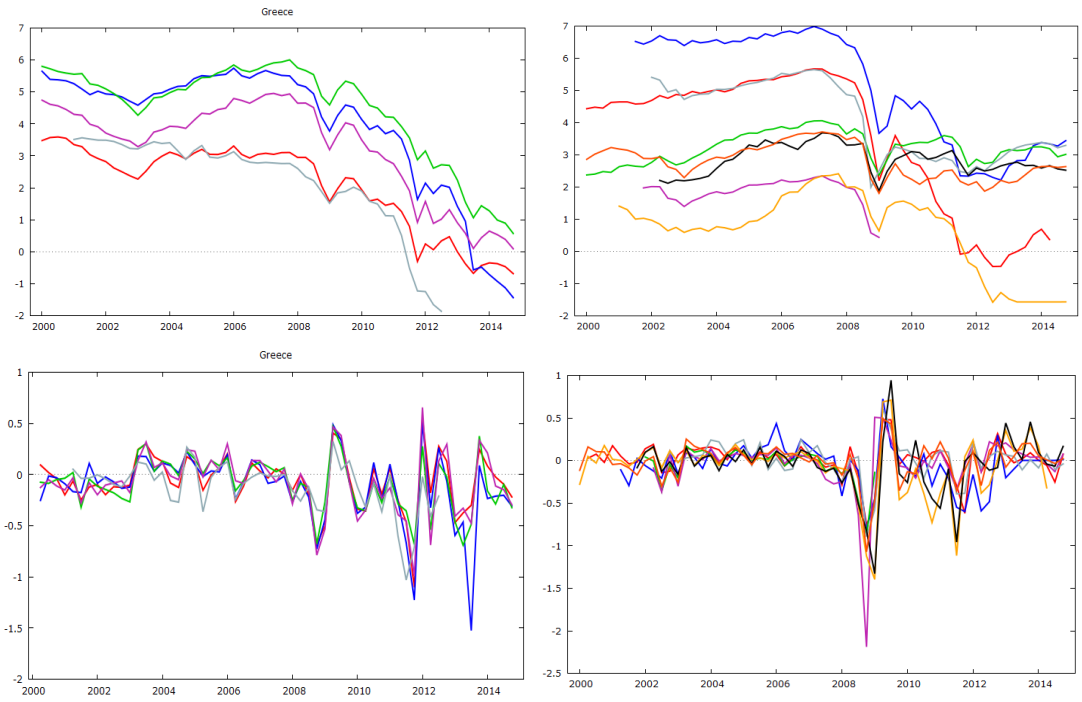

Figure 1: Greece on the left (from Appendix B) and some banks from Austria, Belgium, Cyprus, Hungary, Ireland and the Netherlands on the right. Up in prices, down in returns.

To provide a quantitative proof of this, on the first page of Appendix D we show the correlation matrix for stock returns using the whole sample. The results confirm the visual examination: Very high correlations in the same country and slightly lower for cross-country bank returns. The maximum value is 0’921 and the average 0’519. Leaving cross-country correlations out the average increases to 0’705.

Stock prices show trends and the fact that for some periods stock prices take values way higher/lower than other periods the issue of stationarity arises. We also see on the graphs that series in returns don't show trends. The only hint of a trend is comparing periods of 2003-2007 and 2008-2011, where returns are mostly positive and negative, respectively. This could also represent a change in averages or different values of asymmetry. Usual assumption is that stock prices are I(1) variables and their first differences or returns are I(0) and graphs show that.

For formal analysis on the matter on the first page of Appendix D we provide a table with the results of several tests and our conclusion. In general we reject that variables in levels are stationary and don't reject the unit root hypothesis; the opposite happens for variables in returns and we conclude those series are I(1). However, this does not happen for all of them.

Looking at ADF and KSPP results for prices in 12 out of 52 case both hypothesis can't be rejected. The same happens for 14 series in returns. We can't conclude that a time series is stationary and at the same time has a unit root; so we conclude that the ADF test, for those series, has low potency. In no case we conclude that the series is stationary in levels or has a unit root in differences.

Accepting that some of the time series have a unit root, when they don't, would have three implications for our study. First we'll wrongly assume the results of the OLS model in levels could be caused by spurious correlations. Second, a model in returns shouldn't be necessary since we wouldn't need to differentiate the time series. And, lastly, there can't be co-integration between I(1) and I(0) variables.

We conclude, from visual and formal analysis that our series are I(1).

However, we should mention the special case of some series in Greece and Italy: ADF tests don't reject unit root unless we add a linear time trend. This would mean the returns of these stock prices are a function of time and stationary only around a time trend. On Figure 2 below we show a graphic proof of this phenomenon for the four cases in Greece.

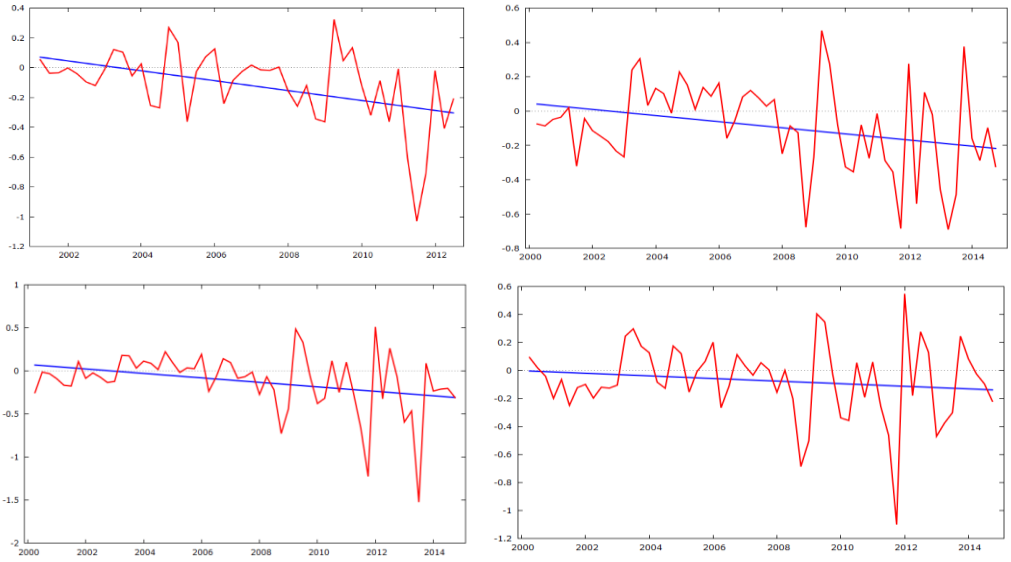

Figure 2: Fitted and observed returns from an OLS regression over a time trend. Agricultural Bank of Greece (up-left), Alphabank (up-right), Eurobank Ergasias (down-left) and National Bank of Greece (down-right).

Except for the Agricultural Bank of Greece, the time trend is significant and the R^2 shows values between 0.08 (NBG) and 0.2 (Alphabank). This would mean that returns for those banks decrease over time and are basically condemned to bankrupt in the long time. An alternative explanation, which we will follow, is that this trend is similar to the evolution of the economy in the last part of the sample, and the prices for other countries don't show these patterns because their economy didn't follow the same trend. Thus, we decided not to add a time trend in the models for these banks since the scenario factors should be able to represent it.

Lastly, about the frequency distribution of variables, on Appendix K we show standard deviation, skewness and kurtosis of the returns and also a test for normality. For the majority of them, the hypothesis of normality is rejected. Seeing the stats of most of them, the reason is clear: positive and high excess of kurtosis and negative asymmetries for most of them.

Scenario variables.

For scenario variable we're also interested in their order of integration. We already concluded that stock prices for our work are I(1) time series. Prices could show spurious correlations with other non-stationary variables, and co-integration vectors can be found only between variables that are not stationary. On the first part of Appendix B we show a summarized result of the tests performed on the explanatory variables for each country.

Results show that applying the same criteria used for prices and returns, almost all the variables aren't stationary in levels. We also get a few cases where ADF gives the opposite conclusion than KPSS. On the other hand, results for series in first differences show mostly conflicting results and the cases where we can conclude I(1) series are few. We also find series where we conclude the first differences have a unit root and for second differences they are stationary, meaning the series is I(2). We find them mostly among GDP, HICP and RPPI.

Time series that really have two unit roots are scarce sometimes is the result of the test chosen. On works like Carrera, Féliz, and Panigo (2003) a high number of tests are performed for macroeconomic series. They conclude that most variables are I(1) under most test, while only monetary aggregates and prices index seem I(2) for most tests.

For the apparently I(2) and unclear cases we also used GPH test to have a third criteria. Based on this tests, though most of them are long memory processes, only a few of them are really I(1) in differences and I(2) in levels, mostly on Spain and Greece.

Another issue we face with these series is that, since all of them will be used as explanatory variables, we'll want each of them having distinct information that the rest don't provide. Judging by what the variables is measuring, some of these variables could give the same information on a given time:

GDP and UR are measuring, respectively, output and input. Of course, the economy of a country is much more complex than that, but with the same conditions of investment and technology level they might end up measuring the same.

HICP, CPPI and RPPI are index of prices. And residential and commercial property are part of the goods in the HICP. If the prices of all goods in the economy grow at the same speed, one of these variables doesn't add new information.

We formally investigate this issue calculating VIF for macroeconomic variables, grouped by country, and linear correlations for GDP-UR and for the triad of price index. Results are shown also on Appendix B.

Since variables in levels aren't stationary VIF shows extremely high levels for them. Variables in first differences on the other hand don't show any value above 5 and don0t present any collinearity problem. However, as we start adding increasing number of lags, collinearity appears and grows, not only in intensity but also in number of macroeconomic series affected. For 3 lags some of them approach and surpass a tolerable limit for VIF and the number of variables that surpass this limit would increase as we add more lags. This is the effect of the correlation between variables but also of the long memory of the series.

As for correlations, GDP and UR are correlated negatively for all countries and RPPI and CPPI between them except for Austria, Greece and Hungary. HICP and RPPI are have low positive correlations with the exception of Spain, Greece, Ireland and Portugal; while HICP and CPPI have only strong correlations for Belgium, Germany, Ireland and Portugal.

5. Results

5.1. Linear correlation coefficients.

We'll start with a simple parametric approach to measure the grade of association between stock prices and each of the macroeconomic variables. Linear correlation is a measure of adjustment, not sensibility: we can know the strength and sign of the relationship but we can't measure the effects of changes in one variable over the other, and they can't be aggregated to predict the effect of a whole scenario for all of the variables. Also, this isn't a measure direct dependence. We saw that correlations between the macroeconomic variables are strong in some cases. If two of the variables are correlated between them and to the stocks, the coefficient will measure a conjoint effect.

Since prices aren't stationary we'll use stock returns and macroeconomic variables in first differences for the rest of this work, but the reasoning is the same that for prices: with positive correlation, when the variable increases, returns are higher and thus stock price grows.

On the following pages we'll show the results for correlations and related analysis in different tables. Also on Appendix C we show correlations with GDP, UR and price index lagged one period. We do this because there isn't a trade market with daily values for these variables, and the information could take more time to reach the markets.

GDP

Correlations with GDP are systematically positive. This follows both economic theory and the basis of the adverse scenario. However, the adjustment changes drastically between banks: Values range between 0.05 for Group Crédit Agicole (France) and 0.7 for Dexia NV (Belgium). Several of them fall in values close to zero that we consider to be insignificant and thus not linearly dependent. Apart from these extreme cases most are in the 0'25-0'5 range.

The distribution of the values seems homogenous between countries except for Greece where most of them are higher than the average while in Spain they are mostly below, but the difference is barely relevant.

As for countries outside the Eurozone their correlations are above average in most cases, but the difference is also very small. Since the countries in the Eurozone are more integrated than the rest, it could make banks in those countries to be less dependent on their own economies and more to the general status of the economy in Europe. The evidence is thin in this aspect.

Grouping the banks by the relative focus of their business, the average correlations are also the same.

In this case there is very little to say, GDP seems to be an important variable for all countries, areas and types of bank; and the stress test already took that into account since is the variable with most detailed information in both scenarios.

UR

Correlations with UR are hardly consistent for all the sample: almost always negative, but with as much cases of insignificant correlation as significant ones.

Greece, Ireland and Spain are the countries where not only all banks are systematically negative correlated but also the values are the highest of all the sample, these countries are also the ones with more unemployment (in general and after the crisis) of all our sample and were strongly affected by the crisis.

On the other side we have Denmark, Germany (except Hypo Real Estate), France, Portugal, Sweden and the UK (except Lloyds) all with low correlations. With exception of Portugal, all of them are countries with healthier economies than the rest and low values of unemployment even during the crisis. This could mean that their countries and the banks could overcome the effects of high unemployment. This also happens with correlations with the lagged UR but in that case, for countries with low unemployment, correlation is not insignificant but positive. In any case, the dichotomy maintains.

Last, we also find some cases with significant positive correlation: Fortis (Belgium) and IKB Deutsche Industrielbank (Germany); this goes against economic theory and common sense, also against the composition for the adverse scenarios. These three cases don't present strong similitudes that could explain this behavior: Dexia is more diversified, IKB is more related to medium sized enterprises and GCA to agriculture.

One possibility is that unemployment in these countries reached levels that generate problems for the economy only on a few occasions, if at all and changes on unemployment while it's low don't matter, for example, because the defaults in loans don't increase. According to this theory, it would be important if the adverse scenario reaches this threshold.

We tested this possibility dividing the sample for Belgium, Germany, Denmark, France and Sweden according to two thresholds for UR (in levels) by using two methods: choosing a reasonable value from visual examination of the UR time series; and the optimal threshold for a regime change estimation. Results. However, don't point to this theory except for Germany. There might be no threshold, we couldn't find it or it was never reached in the data.

Another explanation could be the one presented in works like Boyd, Hu and Jagannathan (2005) or Bestelmeyer and Hess (2010), where they conclude that the effects of unemployment depend on the economic cycle. The explanation they give are based not on the effects of unemployment, but on the intrinsic information given about the future movements of interest rates, cash flows growths, risk premium and monetary policy. Contrary to common sense, the net effect of bad news about unemployment could increase stock prices on adverse economic cycles.

Gonzalo and Taamouti, on the other hand use quantile regression analysis over the expected unemployment. The effects of higher unemployment are positive for quantiles between 0'3 and 0'85 and negative for the rest.

In any case, either of the theories point that the effects on stock prices of the values of unemployment in the adverse scenarios won't necessary be negative and in a recessive cycle the effects could indeed be positive.

Country	Institution	ΔlnGDP	ΔUR	ΔlnHICP	ΔlnRPPI	ΔlnCPPI	ΔSTIR	ΔLTIR	ΔlnEX
Austria	Erste Group Bank	0.31	-0.09	0.2	-0.04	0.07	0.25	0.19	0.16
Belgium	Fortis	0.46	0.17	0.01	0.05	0.06	-0.04	0.14	0.21
	Dexia NV	0.7	0.09	0.18	0.47	0.47	0.31	0.36	0.24
Cyprus	Bank of Cyprus Public Company Ltd	0.19	-0.23	0.02	0.32	0.18	0.27	-0.25	0.16
Germany	Aareal Bank AG	0.26	-0.08	0.09	-0.21	0.03	0.09	0.54	-0.07
	Commerzbank AG	0.46	-0.08	0.14	-0.22	0.21	0.33	0.51	-0.03
	Deutsche Bank AG	0.33	0	0.19	-0.29	0.03	0.15	0.51	0.06
	Hypo Real Estate Holding AG	0.23	-0.35	0.41	0.15	0.32	0.4	0.38	-0.39
	IKB Deutsche Industrielbank AG	0.27	0.19	-0.08	-0.04	0.14	0.17	0.27	0.14
	Wüstenrot & Würtembergische AG	0.17	-0.15	-0.04	-0.16	-0.05	-0.02	0.28	0.05
Denmark	Danske Bank	0.33	-0.17	-0.09	0.5	0.23	0.34	0.23	0.00
	Jyske Bank	0.45	-0.13	0.08	0.62	0.17	0.31	0.42	0.15
	Sydbank	0.26	-0.01	0.1	0.57	0.07	0.27	0.33	0.17
Spain	BBVA	0.19	-0.37	0	0.04	-0.02	0.08	-0.27	-0.06
	Banco Popular Español	0.41	-0.47	-0.04	0.38	0.21	0.17	-0.19	0.04
	Banco Santander	0.23	-0.37	0.04	0.23	0.03	0.12	-0.18	-0.09
	Banco Sabadell	0.21	-0.3	-0.1	0.17	0.07	0.24	-0.16	0.06
	Bankinter	0.15	-0.29	-0.17	0.07	-0.16	-0.07	-0.28	0.01
France	BNP Paribas	0.31	-0.08	0.08	0.16	0.04	0.24	0.28	0.00
	Groupe Crédit Agricole	0.05	0.1	-0.31	0.12	0.05	-0.11	0	0.25
	Natixis	0.47	-0.13	0.05	0.26	0.14	0.15	0.18	0.14
	Société Générale	0.42	-0.12	0.02	0.23	0.12	0.27	0.29	0.10
Greece	Alpha Bank	0.43	-0.3	-0.06	0.15	0.11	0.14	-0.09	0.06
	Eurobank Eregasias	0.38	-0.27	0.08	0.3	0.12	0.02	0	0.05
	National Bank of Greece	0.4	-0.33	0	0.29	0.15	0.08	-0.06	0.07
	Piraeus Bank	0.45	-0.37	-0.04	0.2	0.12	0.14	-0.15	0.11
	Agricultural Bank of Greece SA	0.51	-0.54	0	0.48	-0.01	0	-0.35	0.18
Hungary	OTP Bank Ltd	0.33	0.01	0.35	0.18	0.07	0.29	-0.58	0.07
Ireland	Allied Irish Banks plc	0.18	-0.48	0.21	0.38	0.21	0.23	-0.35	0.16
	The Governor and Company of the Bank of Ireland	0.07	-0.45	0.16	0.36	0.11	0.36	-0.32	0.08
Italy	Banca Carige SPA - CdR di Genova e Imperia	0.1	-0.35	-0.02	0.37	0.06	-0.06	0.2	0.36
	Banca Monte dei Paschi di Siena SpA	0.39	-0.37	-0.1	0.19	0.25	0.24	-0.19	0.01
	Banca Piccolo Credito Valtellinese	0.17	-0.34	-0.18	0.14	0.04	-0.06	-0.31	0.16
	Banca Popolare Dell'Emilia Romagna	0.27	-0.27	0.01	0.17	0.06	0.12	-0.21	0.17
	Banca Popolare Di Milano - SCRL	0.22	-0.11	-0.2	0.08	0.08	0.15	-0.32	0.07
	Banco Popolare - Società Cooperativa	0.38	-0.13	-0.06	0.08	0.15	0.4	-0.21	0.01
	Credito Emiliano SpA	0.43	-0.22	-0.01	0	0.07	0.25	-0.19	-0.03
	Intesa Sanpaolo SpA	0.36	-0.1	-0.04	0	0.14	0.33	-0.12	-0.02
	Mediobanca - Banca di Credito Finanziario SpA	0.29	-0.24	-0.05	-0.01	0.09	0.18	-0.25	0.05
	Unicredit SpA	0.49	-0.3	0.05	0.07	0.13	0.29	-0.12	0.10
Netherlands	ING Bank NV	0.28	-0.03	0	0.05	0.19	0.32	0.33	0.08
Portugal	Banco BPI	0.17	0	-0.16	-0.17	-0.03	0.05	-0.43	0.21
	Banco Comercial Português	0.38	-0.1	-0.06	-0.05	0.11	0.14	-0.27	0.13
	Espirito Santo Financial Group SA	0.23	-0.09	-0.16	-0.04	0.08	0.23	-0.19	0.26
Sweden	Nordea Bank AB	0.39	-0.03	0	0.43	0.10	0.38	0.44	0.00
	Swedbank AB	0.48	-0.15	0.01	0.37	0.13	0.41	0.39	-0.05
	Svenska Handelsbanken AB	0.34	-0.06	0.04	0.37	0.07	0.22	0.35	-0.18
United Kingdom	Barclays plc	0.22	-0.06	0.05	0.14	0.00	0.05	0.15	0.46
	HSBC Holdings plc	0.1	0.02	0.03	-0.04	0.01	-0.05	-0.01	0.25
	Lloyds Banking Group plc	0.47	-0.49	0.08	0.3	0.27	0.41	0.29	0.51
	Royal Bank of Scotland Group plc	0.44	-0.21	0.04	0.24	0.25	0.11	0.1	0.53
	Standard Chartered	0.21	0	0	0.05	0.04	-0.15	-0.03	0.14

Table 1: Linear correlations between banks returns and each of the macroeconomic variables.

	ΔlnGDP	ΔUR	ΔlnHICP	ΔlnRPPI	ΔlnCPPI	ΔSTIR	ΔLTIR	ΔlnEX
Focus on retail banking	0.3113	-0.2300	0.0500	0.1763	0.1432	0.2650	0.1963	0.0712
Focus on commercial banking	0.3106	-0.1628	-0.0122	0.1606	0.1285	0.2022	0.0483	0.1037
Diversified	0.3208	-0.1715	0.0219	0.1600	0.0830	0.1300	-0.0523	0.1097

Table 2: Average correlations for banks divided by business areas.

Results divided by their business areas show a slightly higher negative correlation for banks focused on retail. For high levels of unemployment this could mean more households without any kind of income and increase in defaults for retail banking products. Stress tests use accounting information, so the exposure of each bank is much more detailed in the tests than what we could do in this work.

Our conclusion from all this would be that a simple increase in unemployment wouldn't necessary have negative effects and previous values, levels of unemployment and economic cycle should be taken into account. Especially since one of the variables of the stress test is stock prices, affected by the re-pricing of risks, but there is no adjustment for grows in UR.

HICP

For HICP results give little information. Only 10 out of 52 take absolute values higher than 0.15, and about half of those 10 are positive while the rest are negative.

Causes of this result could be that we're measuring association of the variable against returns, the direct effects have one sign but the indirect ones have the opposite effect. For example correlations between HICP and the other two prices are the three prices index of them (HICP, RPPI and CPPI) are positive for almost all of the countries in our study; if the sign of the direct effects of HICP are negative while positive for RPPI and CPPI the consequence is that direct and indirect effects could cancel each other. If this is the case we'll see different results using the multivariate models, in the next part of the results.

Another theory we'll consider is that the ideal grown in prices is one that is moderate, stable and predictable. There's a general agreement in the theory of optimal inflation that point to values about 2% yearly increase since is the long term average grown and thus predictable and stable. Thus, high levels of inflation and deflation both cause negative effects while low positive values close to predictions have positive effects. In terms of that analysis, the relationship is not linear and/or depends on the predictions in a way that penalizes divergence (positive or negative) from predictions more than proportionately. A simple analysis with correlations between returns and the square of inflation show mostly negative correlations, but the values are low in general. However, the Eurozone has clearly higher absolute values. The non-linearity of correlations shows interesting results and we'll further investigate it with a polynomial model in Part 5.2.

This last result regarding the Eurozone also points to another theory. Now regarding economic unions and monetary police. The issue is that monetary police can't affect inflation and unemployment independently, they can target low unemployment or low inflation, but not both. In the same fashion, reducing inflation by policy alone creates unemployment. This is the same for all countries, but in a monetary union it's also possible to have countries with low/high inflation and low/high unemployment at the same time. This matters to the point that, since no country in the Eurozone can individually devaluate/evaluate its currency as reaction to shocks in the economy, prerequisites to enter the Eurozone include converging inflation rates to the rest of the countries.

Following this two last theories, scenarios should account for the size of the unexpected growth or even by deviations from the Maastricht criteria (less than 1.5% higher than the three countries with less inflation excluding countries with deflation) but not the total growth, especially if the grow is expected, an issue not considered in the scenarios.

Also, the analysis might be better accounting to the fact that countries outside the Eurozone have more freedom to react to these kind of shocks while the decisions in the Eurozone affect all the monetary union. This won't be a problem if the shock are symmetric, since the situation of all the union are the same, but with asymmetric shocks no measure would favor everyone. On the scenarios, this could mean that assuming no country changes its monetary police generates biased results, or that symmetric shocks in HICP and UR are not adverse enough.

On the other hand, we have the results for lagged HICP that show mostly negative correlations, though not very strong and not for all countries. There's also a few positive correlations, also low in absolute value, in Greece and Italy. This results go against the previous theories and instead point that higher inflation is negative while deflation has positive results for bank stock prices.

RPPI

RPPI it's also a price index and has positive correlations with HICP and strong positive correlations with CPPI. However, the results are completely different from them, and show mostly high positive correlations with returns. It's a large contrast to the other price index. The sign of the correlation, again, seem to follow economic theory and scenarios. There are several cases of weak correlation, but those not centered in any country.

The few cases for negative correlation are mostly centered in Germany while the other one is in Portugal. A possible explanation for this is based on the fact that RPPI in Germany grew monotonously and very slow until 2008, the period of high returns, while for the rest of the countries it grew. After 2008, however, the RPPI in Germany accelerates its growth while the prices in the rest of Europe fell; this also coincides with the periods of negative returns. The correlation for banks in Germany with Eurozone RPPI is positive. Since the economy is mostly globalized and most banks in Germany are international, the values that affect German bank stocks are the ones that consider the whole EU economy. Another explanation, as always, could be simply that positive correlations are caused by indirect effects.

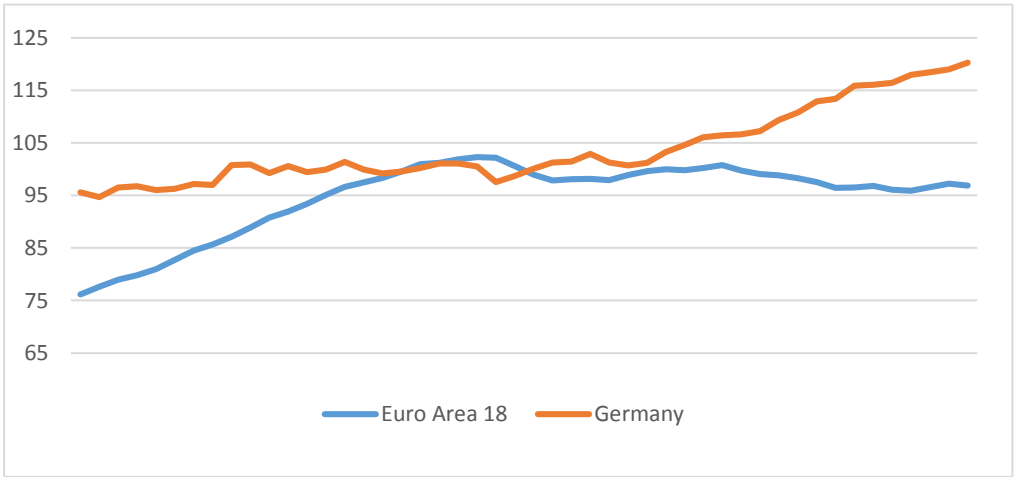

Figure 3: RPPI evolution 2003-2014 for Germany and an aggregate for the Euro Area

Also note that, though on the adverse scenarios RPPI falls, banks that don't mainly engage in operations related to real state in its country should be relatively independent. However, we should remember how the collateralization of mortgage-backed securities generated the phenomenon of ABSs, CDOs and CDO²s and its fast extension to banks that apparently weren't engaged in real state. From the average of correlations by business areas, the banks focused on retail are just slightly more correlated. The group of banks with lowest correlations in absolute value are: Erste Group (Retail and SME, international), Fortis (insurance and investment), IKB(loans, risk management, capital markets and advising), BBVA (multinational), Bankinter (commercial bank), Credito Emiliano (agriculture), Intesa Sanpaolo (international), Mediobanca (Commercial and investment bank), ING (multinational group), BCP (commercial bank and international) and Espirito Santo (retail, investment, insurance).

CPPI

For CPPI we find just about 13 cases of significant correlation, with just one among them negative. In any case, values close to zero are the norm. Added to correlations with other variables, for CPPI the cause of the low values could also be that the data we obtained is not relevant enough since it's just an average of the Eurozone. In that case values for Norway, Sweden or Hungary should be lower than those from the Eurozone, and values for UK should be higher, but this doesn't seem to be the case.

It's also interesting to note that the group of banks focused on retail and also the ones based in commercial banking have higher correlations, though not much, than more diversified banks.

The scenarios take increasing interest on prices index, giving detailed information for each country and adding CPPI for 2014's scenarios, but for now there's no evidence that they are relevant at all, and just a bit more for less diversified banks. Also, correlations between RPPI and CPPI are high and positive, so an increasing number of sectorial index of prices seems to give little value to the results.

STIR

As for STIR, most of the banks show positive correlations. There's only 5 negative correlations, and those are insignificant. Adverse scenario indicates an increase in short-term interbank rates, caused by the stressing of money markets and thus transmitting the stress to the financial sector and the banks. However, we see that the total effects are positive. It's obvious that a rapidly changing interbank interest rate generates frictions and uncertainty, and those increase risk. However, since we're not only measuring risk, it's perfectly possible that the benefits a company obtains by the increase in Euribor or Libor rates compensate a few periods of higher risks, and that agents in the economy perceive it this way. The benefits mostly come from indexed loans, where the interest the bank perceives increases with the Euribor/Libor and a higher STIR means wider margins of benefits between the lending rates and the borrowing rates. Our results show that for most banks the total effect is positive; in that case, a stable level of STIR might be more adverse for them.

Since the stress tests are centered on risk, it's acceptable a growth in interbank rates as an adverse scenario, however, it's important to account for the benefits the banks would get in the long term since that allows them to use these benefits to overcome the losses of

the indirect effects. On the results of the stress test, the EBA takes the possible benefits generated into account, and they compare the benefits and the losses, but they simply state in the test that the capacity for banks to translate the higher interest for financing to their clients. They, however, do not compare the direct benefits with the indirect losses. Also, the cause or limit to translate higher rates to their client it's not elaborated, just briefly stated.

Correlations with less diversified banks are stronger in average in this case. This could be the effect of the number of indexed products provided by each of the business areas. Once again, since tests use account information they acknowledge these results.

LTIR

LTIR shows a few values that aren't significant, and the rest are clearly polarized between high positive values and high negative values, so we'll focus on the differences by country and try to find the connection. Countries like Belgium, Germany, Denmark, Sweden and France are on the positives and Spain, Greece, Ireland and Italy on the negatives. The first group of countries are the ones with lower and stable LTIR, while the rest have the highest and changing LTIR, similar to what we found with the UR.

The possible cause this time is simpler. Long term sovereign yield used to be a measure of riskless interest rate. Since the sovereign bond crisis we mainly measure sovereign risk with the spread between risky yields and a riskless reference yield. Using LTIR as is we're measuring riskless rate + sovereign risk and can't distinguish each effect.

The theoretical correlation of riskless rate and stock returns is positive and the literature in this area is abundant: CAMP, APT and models proposed by Fama and French use returns as dependent variable and the riskless rate enters as intercept, thus perfectly positive correlated. Though the models usually work with cross-section data, there is no reason the conclusions of these works shouldn't apply to time series with a changing riskless rate. On the other hand, sovereign risk spread is expected to give negative correlations caused by the uncertainty and negative sentiment generated toward the banks of that country and its economy in general.

Taking the LTIR of Germany as the riskless rate, we repeated the analysis, this time against the riskless rate and the spread and the results are completely different. For the riskless rate correlations are positive and strong, while all correlations for the spread are negative and also strong. This provides a strong proof to our hypothesis. There are still a few odd cases, like Sweden and the UK, where we'll now consider correlations to be almost non-significant but still positive. More important is the case of the banks of Greece that don't show strong correlations, in spite of being the country in Europe with the higher risk spread.

We conclude that using the LTIR, as is, in the scenario is misguided since it's not really measuring the important factor that is the sovereign risk and instead gives too much relevance to the riskless rates, especially in countries with low yields. This could lead to wrong analysis of variables and proposal of scenarios.

					Threshold based in regime change results		Threshold based in UR series observation	
Country	Institution	Δr	Δspread	ΔlnHICP²	Threshold	ΔUR	Threshold	ΔUR
Austria	Erste Group Bank	0.53	-0.72	0.08	-	-	-	-
Belgium	Fortis	0.42	-0.61	0	-	-	-	-
	Dexia NV	0.51	-0.35	-0.03	-	-	-	-
Cyprus	Bank of Cyprus Public Company Ltd	0.48	-0.41	0.05	-	-	-	-
Germany	Aareal Bank AG	-	-	-0.16	8.3	-0.27	8	-0.26
	Commerzbank AG	-	-	-0.08	10.5	Not enough observations	8	-0.31
	Deutsche Bank AG	-	-	-0.08	8.3	-0.3	8	-0.29
	Hypo Real Estate Holding AG	-	-	0.27	10.3	Not enough observations	8	0.21
	IKB Deutsche Industrielbank AG	-	-	-0.23	7.3	0.2	8	0.17
	Wüstenrot & Würtembergische AG	-	-	-0.12	8.3	-0.45	8	-0.37
Denmark	Danske Bank	0.21	0.09	-0.11	5.4	0.15	6	0.41
	Jyske Bank	0.54	-0.27	0	4	-0.12	6	0.02
	Sydbank	0.45	-0.29	0	4	0.1	6	0.06
Spain	BBVA	0.22	-0.46	-0.15	-	-	-	-
	Banco Popular Español	0.23	-0.42	-0.18	-	-	-	-
	Banco Santander	0.29	-0.51	-0.21	-	-	-	-
	Banco Sabadell	0.18	-0.53	-0.19	-	-	-	-
	Bankinter	0.24	-0.32	-0.23	-	-	-	-
France	BNP Paribas	0.49	-0.53	-0.07	7.9	-0.08	8.5	-0.07
	Groupe Crédit Agricole	0.04	-0.11	-0.32	8.8	-0.16	8.5	0.05
	Natixis	0.36	-0.58	-0.14	8	-0.08	8.5	-0.07
	Société Générale	0.52	-0.45	-0.14	8.1	-0.16	8.5	-0.17
Greece	Alpha Bank	0.33	-0.14	-0.12	-	-	-	-
	Eurobank Eregasias	0.19	-0.04	-0.1	-	-	-	-
	National Bank of Greece	0.35	-0.11	-0.07	-	-	-	-
	Piraeus Bank	0.35	-0.2	-0.09	-	-	-	-
	Agricultural Bank of Greece SA	0.42	-0.43	-0.13	-	-	-	-
Hungary	OTP Bank Ltd	0.51	-0.73	0.31	-	-	-	-
Ireland	Allied Irish Banks plc	0.22	-0.53	0	-	-	-	-
	The Governor and Company of the Bank of Ireland	0.31	-0.5	0.01	-	-	-	-
Italy	Banca Carige SPA – CdR di Genova e Imperia	0.32	-0.05	-0.12	-	-	-	-
	Banca Monte dei Paschi di Siena SpA	0.42	-0.51	-0.28	-	-	-	-
	Banca Piccolo Credito Valtellinese	0.22	-0.47	-0.44	-	-	-	-
	Banca Popolare Dell'Emilia Romagna	0.35	-0.48	-0.17	-	-	-	-
	Banca Popolare Di Milano - SCRL	0.35	-0.55	-0.24	-	-	-	-
	Banco Popolare - Società Cooperativa	0.45	-0.58	-0.22	-	-	-	-
	Credito Emiliano SpA	0.55	-0.6	-0.17	-	-	-	-
	Intesa Sanpaolo SpA	0.52	-0.34	-0.08	-	-	-	-
	Mediobanca - Banca di Credito Finanziario SpA	0.34	-0.51	-0.21	-	-	-	-
	Unicredit SpA	0.56	-0.55	-0.07	-	-	-	-
Netherlands	ING Bank NV	0.47	-0.55	0.14	-	-	-	-
Portugal	Banco BPI	0.4	-0.57	-0.08	-	-	-	-
	Banco Comercial Português	0.46	-0.42	0	-	-	-	-
	Espirito Santo Financial Group SA	0.3	-0.3	-0.16	-	-	-	-
Sweden	Nordea Bank AB	0.45	0.14	-0.03	7.4	0.3	7.5	0.3
	Swedbank AB	0.37	0.17	0	7.4	0.16	7.5	0.16
	Svenska Handelsbanken AB	0.33	0.17	-0.05	7.4	0	7.5	0
UK	Barclays plc	0.21	-0.02	0	6.4	0.05	6	-0.05
	HSBC Holdings plc	0	-0.01	0.03	6.4	0.06	6	0.05
	Lloyds Banking Group plc	0.26	0.15	-0.07	5.4	-0.56	6	-0.57
	Royal Bank of Scotland Group plc	0.11	0.02	-0.02	6.4	-0.1	6	-0.21
	Standard Chartered	-0.03	-0.01	0	6.4	0.13	6	0.06

Table 3: Linear correlations between banks returns and riskless rate (r), sovereign risk spread, square change of HICP and correlation with ΔUR with data above a certain threshold for UR.

As example of this matter in the scenarios, we compared the baseline and adverse scenarios for in terms of yield and LTIR. Differences in yields are evident and give appearance of stress, but that doesn't happen with spreads. Even in the scenario is mentioned that yields are affected by a reopening of spreads, but in some cases the difference hardly matters. It's also a safe assumption that this differences won't have a relevant negative effect at all. Specially cases where the adverse scenario consist on, instead of a fall in spread of 20 bp, the fall is only 10 bp (Denmark).

Also note that countries with higher spreads see it reduced in the adverse scenario (though less reduced that in the baseline) while it countries with low spreads it increases in the adverse scenario.

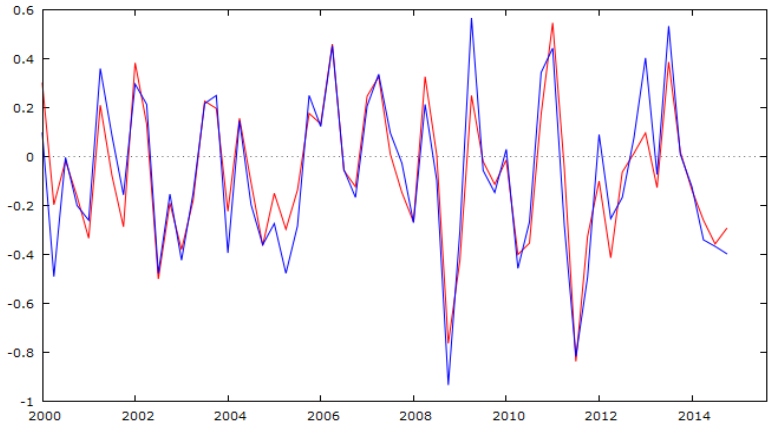

Figure 4: First differences of LTIR for Germany (Red) and Sweden (Blue).

LTIR	2013	2016	Position between min and max
Belgium	2.4	4	51%
Bulgaria	3.5	5.1	38%
Czech Republic	2.1	3.9	39%
Denmark	1.7	3.2	42%
Germany	1.6	3	38%
Ireland	3.8	4.9	15%
Greece	10.1	10.7	21%
Spain	4.6	5.6	58%
France	2.2	3.8	51%
Italy	4.3	5.8	65%
Latvia	3.3	5.2	14%
Lithuania	3.8	4.7	20%
Luxembourg	1.7	3.4	46%
Hungary	5.9	7.9	38%
Malta	3.4	4.6	43%
Netherlands	2	3.4	43%
Austria	2	3.5	44%
Poland	4	5.9	27%
Portugal	6.3	7.2	31%
Romania	5.4	6.8	23%
Slovenia	5.8	6.5	50%
Slovakia	3.2	4.1	34%
Finland	1.9	3.2	41%
Sweden	2.1	3.7	54%
United Kingdom	2	4.3	63%

Spread	2013	2016	Position between min and max
Belgium	0.8	1	34%
Bulgaria	1.9	2.1	44%
Czech Republic	0.5	0.9	39%
Denmark	0.1	0.2	26%
Germany	0	0	-
Ireland	2.2	1.9	20%
Greece	8.5	7.7	28%
Spain	3	2.6	47%
France	0.6	0.8	53%
Italy	2.7	2.8	56%
Latvia	1.7	2.2	20%
Lithuania	2.2	1.7	15%
Luxembourg	0.1	0.4	16%
Hungary	4.3	4.9	75%
Malta	1.8	1.6	59%
Netherlands	0.4	0.4	56%
Austria	0.4	0.5	34%
Poland	2.4	2.9	93%
Portugal	4.7	4.2	35%
Romania	3.8	3.8	65%
Slovenia	4.2	3.5	61%
Slovakia	1.6	1.1	32%
Finland	0.3	0.2	24%
Sweden	0.5	0.7	64%
United Kingdom	0.4	1.3	98%

Table 4: Yields and spreads for the 2014's scenarios. Third column indicates the distance between the value on 2016 and the minimum and maximum for that series since 2000. Low values are near minimum and higher near maximum.

EX

Both stress tests performed, in their scenarios, give little attention to the matter of EX. On the scenarios for 2011 there's only a depreciation of the Dollar against the rest of the currencies and the scenarios of 2014 only pay attention to the currencies of several countries like Croatia or Hungary. The results show there are a few significant positive correlations, but most absolute values are barely higher than the ones for HICP or CPPI. An exception to this would be London, where they are mostly positive. The rest of the countries with individual currencies, however, don't show this behavior, so it's not just a matter of being in the Eurozone.

In general a depreciation of the domestic currency would have negative total effects on the stock prices, so it's consistent with scenarios. Also, correlations are weak for most cases, so it shouldn't be necessary to pay more attention to domestic currencies in the scenarios.

5.2. Multivariate model analysis.

With these models we'll try to find the relevance and sign of the direct effect of each variable. This doesn't mean that the previous results are rejected just because they measured total effects. If UR is correlated with GDP and GDP is also correlated with returns, the linear correlation found for UR will account for this effect; but if an increase in UR decreases GDP and that produces, indirectly, negative returns, the conclusions are totally valid. The usefulness of these models is to contrast the results of the previous part, comparing the direct effects with the total effects, and provide a tool to predict stock prices under the combined effect of the whole scenario.

In Appendix C we provide the results for the estimation of the three different specifications we discussed in part 2. Before discussing the results for the variables, some notes on the estimation process itself and the properties of the estimations:

The first model is the simplest one, and though some of the regressions had autocorrelated residuals, the only consequence is the inefficiency of the parameters. This doesn't automatically makes estimations with high variance, just higher than the variance of the efficient method of estimation. The estimations aren't biased or inconsistence, so we'll mostly ignore it. However, we'll use narrow confidence interval for tests of significance as a precaution since we already have a low number of observations for each estimation. This specification, for a lot of the banks returns, reject the whole model as not significant, using F-tests, as consequence of the large number of variables that turned out not significant in the model. Those results improve vastly if we decompose LTIR in its two components.

For the second model what we said about autocorrelations is still valid. Adding lags quickly elevates the VIF and thus begins to generate collinearity. The consequence is a higher volatility of the parameters estimated for near-collinear variables. We asses this problem by sequentially omitting insignificant variables. Though this greatly reduces the number of parameters to estimate and the multicollinearity, the parameters obtained could have a bias generated by the omitted variables. Comparing the results before and after omission showed that almost all the parameters before omission were in the 90% confidence interval of the parameters after omission, so we chose the models after omission since the coefficients doesn't change significantly as effect of the omission.

For the third model autocorrelation of residuals in one of the equations generates bias and inconsistency, and this bias can't be checked like we did for the second model. Only the specifications, in terms of number of lags and range of the co-integration matrix, that

don't have autocorrelated residuals are acceptable. The models we found that fulfilled this condition, however, didn't have good properties: the results heavily change depending on the specification chosen (number of lags and number of co-integration vectors), at least one inverse root of the VAR wasn't strictly inside the unit circle and/or the whole model is rejected. A few of the variables weren't stationary in first differences and that could be the cause of the unit root in the VAR. However, even if we estimated those models with the problematic variables as exogenous or without them, the results were the same. Only for a low number of lags and a vastly reduced amount of variables we would be able to obtain stable models. The results for the model chosen in terms of adjusted R^2, Akaike criterion and Bayesian criterion are shown on the appendix, but we'll barely comment the results.

R^2 results.

First we'll discuss the adjustment of the different models to data. Models use an increasing number of variables, so it's expected that values grew; but our interest is not on finding the better specification, just finding how much of the returns can be explained by the variables of the scenarios. We won't also expect, or even want, very high values since we assume returns have an idiosyncratic part that we shouldn't be able to explain by factors only dependent of the country.

For the first model, most of the values ranged between 0'2 and 0'4. This means a relatively low adjustment for a model with as much as 8 explanatory variables, but from what we saw on the correlation analysis, it's expected since there were few variables with high correlations in absolute value and some weren't even significantly correlated (HICP, CPPI, EX). Also, the variables we used are correlated between them and that means the new information they add can be small. However, if we separate LTIR in its two components like we did with correlations, the change in the adjustment is notable. The general impression was that it was a good model just for some of the banks, but now shows it was just a poorly chosen variable. There's still Bankinter (R^2=0'21) and Dexia NV (R^2=0'75) on the extremes, but those are exceptions. Values of 0'4 to 0'6 are a good enough adjustment to consider that the scenarios would have a substantial amount of effect.

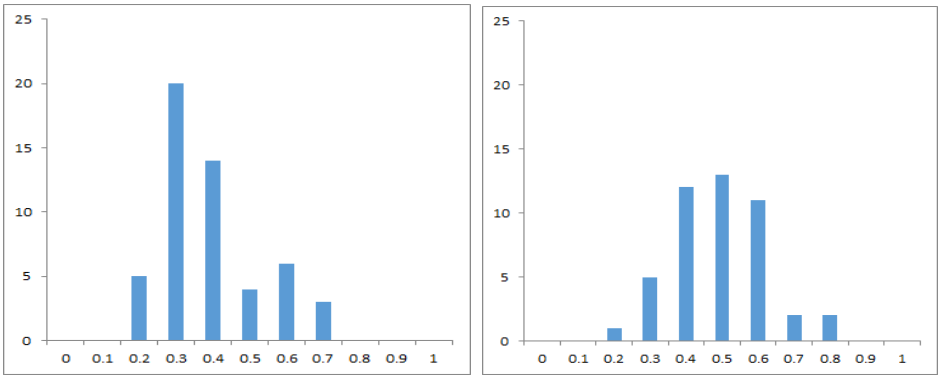

Figure 5: Frequency of R^2 for the model in differences with LTIR (left) and with riskless rate and sovereign risk spread (right)

For the second model, the improvement is also considerable, but we're introducing a high number of variables, even after the sequential omission. Also, as we'll see later, some of the signs obtained are counter-intuitive. It's an interesting result that points out to consider lags of some variables instead or in addition to the contemporary, but the model appears to star overfitting and modeling the idiosyncratic component, especially for R^2 values above 0'8.

The same reasoning goes to the VECM, which adds the effects of error correction terms, where R^2 are even higher. Also note that the number of variables in the VECM are way higher that that previous model since non-significant variables weren't omitted.

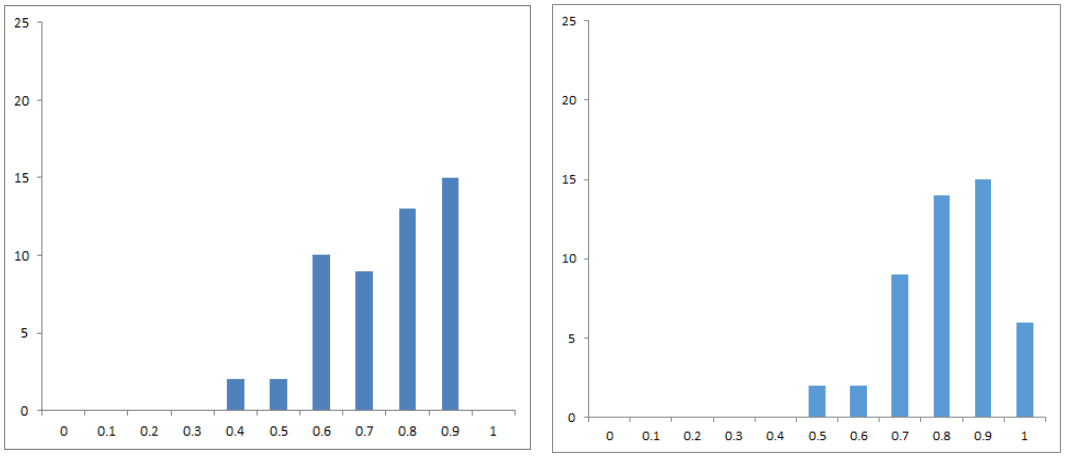

Figure 6: Frequency of R^2 for the model in differences with lags (left) and VECM (right).

Variable significance, error correction terms and Granger-causality.

For the first model results show that the variables that appear significant in most cases are GDP, STIR and LTIR. All these three already appeared as strongly correlated, so the conclusions are the same. The countries where UR seems significant are, again, the ones with higher values of unemployment; and we can also see a pattern with UR and GDP: they alter between countries. Germany, France, Greece, Portugal and the UK show significant coefficients for GDP while Spain and Italy show them for UR. This makes us consider that a large portion of the correlation with returns observed for GDP and UR is common, and in a multivariate model the most important variable makes the other insignificant. However, since we couldn't effectively explain the correlation behaviors for UR in countries with low UR the direct effects could be affected by the same problem and thus the conclusions aren't clear.

The price index show again little importance, but changing to direct effects improved the two with worst results (HICP and CPPI) while RPPI remained significant only for the two countries where correlations were stronger: Denmark and Sweden. Results for EX are also the same with the exception of the UK, where the direct effect is not significant while the total effects were.

We also estimated a model there the LTIR was separated into its two components, since it's the only change of variables that was proven really effective for correlations. Results are also the same: GDP, STIR and LTIR (now riskless rate and spread) are in general significant and the rest are not. Denmark, Greece, Sweden and the UK weren't correlated with the spread and now their coefficients aren't significant. Most notable differences are two: EX became again significant for the UK, but remained the same for the rest of the countries inside and outside the Eurozone; and STIR lost relevance.

As for the model with lags and sequential variable omission, it's important to note that the procedure we're using forces the final model to find significant variables, so we shouldn't be surprised to find that most variables have at least one significant lag for most of the models. As we'll discuss soon, most of the coefficients have the sign we would expect in theory, so not all results are just the result of adding a high number of irrelevant variables and forcing them to model something, be it systematic or idiosyncratic. Finding significant lags has no direct effect on the scenarios or stress tests more than to acknowledge that the effects of some of the variables could take more time and since the testing centers on the end of the scenario (2 or 3 years in the future) it's mostly irrelevant. However, it's indeed important to further on the analysis that we're doing in this work since conclusions about the effects of the variables could be dependent on the lags chosen.

In the VECM, instead of significance of individual variables, we'll use group significance tests for whole blogs of lags of the same variable to contrast Granger causality hypothesis. Results show that causality was accepted for several cases and distributed equally by variables and countries, the same that happened with the model with lags but with less positive results since granger causality is stricter than finding just one lag significant.

Causality in the opposite sense is almost always rejected, which is expected since just the stock price of one bank shouldn't affect macroeconomic variables referring to the whole country or even the EU. In some cases it would be acceptable, for the biggest banks and STIR or LTIR, but results are scarce and make for a poor analysis.

As for the error correction terms, in most cases we were able to find co-integration vectors. Since we're using several macroeconomic variables we expected to find some co-integration vectors. What is interesting is that error corrections terms obtained with those vectors appear significant for stock returns. This means error correction terms have potential for this analysis, but as we discussed earlier, the properties of the models we found are far from ideal and a thorough analysis with fewer variables is recommended.

Sign of coefficients.

Lastly we'll discuss the sign of the direct effects. Estimating these models we found that the signs are what we should expect according to the theory and also similar to the results we found using just the correlation coefficients. For variables whose effects were clear, these results only confirmed our conclusions. For the rest now we have more insight in their effects.

The first model had just a few significant variables, mostly GDP, STIR and LTIR. For GDP all the coefficients are positive, as expected. For UR, however, a few results in Germany showed positive coefficients. This is consistent with one of the theories we appointed before: High unemployment for Germany gives information to the market and the expectations of benefits are higher than expectations of risks.

Significant variables of HICP, RPPI and CPPI are few and we shouldn't conclude anything about their signs.

For STIR the direct effects show mixed results since for Germany and Belgium the effects are negative but for the rest of the countries are positive or zero. The pattern of results for the STIR is still undefined, but it could again be caused by the net outcome from higher margins against harder conditions for financing in the interbank money markets.

For LTIR the results are the same than for correlations: signs change depending on the country; and if we use the riskless rate and the yield spread instead, the coefficients are positive and negative, respectively. Last, for EX there isn't enough results to be worth mentioning.

For the second model we've added lags and most variables are significant. Also note that since there could be more than one lag of a certain variable, the signs we're talking about are of the net effect of a change in just one period of time.

Most of the coefficients for GDP, RPPI, CPPI and EX are positive, which are what we would expect according to economic theory and the scenarios of the EBA.

STIR and LTIR show again the same results we've seen already with correlations and with the first model: STIR changes from positive to negative and we could find the cause while LTIR changes from positive to negative depending on the risk spread of the country.

Once again we find positive coefficients for UR in Germany like with correlations and the first model.

As for the HICP, results are now similar to those found with lagged correlations and contrary to the theories of optimal inflation and monetary unions.

For this mode there are several coefficients with odd signs like negative effects of GDP. This could be the effects of overfitting and the large number of variables. Since most are distributed randomly they shouldn't hinder our analysis. However, motivated by the method of estimation and the issue of overfitting and odd signs appearing for all variables, we'll take conclusions with caution.

The VECM could provide us with an interesting tool to analyze the direct and indirect effects of a change in one of the variables: an impulse-response function. However, since models are unstable, we won't use that results.

As for the signs of the significant coefficients in the models, they are mostly the same we found with the second model and differences could be caused simply by the inclusion of lags of the dependent variable or the absence of contemporary macroeconomic variables.

Signs for the components of the error correction terms, doesn't seem to follow any logic and change from positive no negative with each bank. The only constant seems to be the HICP being positive; with is expected since as HICP grows, prices of assets grow, including stocks. That is purely a long-term price effect and unrelated to the profitability or solvency of the bank. One again, error correction terms should be better investigated with variables separately.

A polynomial model for HICP.

We saw that correlation between returns and HICP was positive in some case, negative in others and in general wasn't significant. We also used correlations with the square of changes and correlations turned negative for most of the countries while for others it remained uncorrelated. Now we propose a model using just the HICP and its square, expecting the first to have a positive impact and the second to have it negative if our theory is correct. Results not only confirm this but it's again the continental Eurozone the cluster where these two variables appear significant in most cases.

For the models with both coefficients significant we also obtained a threshold beyond which the level of inflation affects negatively. With so little data, conclusions are partial, but we can see that quarterly inflation levels around or higher than 1% start having negative effects. It's a bit higher that what we expected, but are verisimilar.

Country	Institution	ΔlnHICP	ΔlnHICP²	Inflation negative effects threshold	Optimal inflation
Austria	Erste Group Bank	+	-	0.0157	0.0078
Belgium	Fortis				
	Dexia NV	+			
Cyprus	Bank of Cyprus Public Company Ltd				
Germany	Aareal Bank AG	+	-	0.0070	0.0035
	Commerzbank AG	+	-	0.0086	0.0043
	Deutsche Bank AG	+	-	0.0088	0.0044
	Hypo Real Estate Holding AG	+	-	0.0130	0.0065
	IKB Deutsche Industrielbank AG		-		
	Wüstenrot & Würtembergische AG				
Denmark	Danske Bank				
	Jyske Bank				
	Sydbank				
Spain	BBVA	+	-	0.0109	0.0054
	Banco Popular Español		-		
	Banco Santander	+	-	0.0140	0.0070
	Banco Sabadell				
	Bankinter		-		
France	BNP Paribas	+	-	0.0113	0.0056
	Groupe Crédit Agricole				
	Natixis	+	-	0.0105	0.0053
	Société Générale	+	-	0.0102	0.0051
Greece	Alpha Bank				
	Eurobank Eregasias		-		
	National Bank of Greece				
	Piraeus Bank				
	Agricultural Bank of Greece SA				
Hungary	OTP Bank Ltd				
Ireland	Allied Irish Banks plc				
	The Governor and Company of the Bank of Ireland				
Italy	Banca Carige SPA - Cassa di Risparmio di Genova e Imperia				
	Banca Monte dei Paschi di Siena SpA		-		
	Banca Piccolo Credito Valtellinese		-		
	Banca Popolare Dell'Emilia Romagna		-		
	Banca Popolare Di Milano - SCRL				
	Banco Popolare - Società Cooperativa		-		
	Credito Emiliano SpA				
	Intesa Sanpaolo SpA				
	Mediobanca - Banca di Credito Finanziario SpA				
	Unicredit SpA				
Netherlands	ING Bank NV				
Portugal	Banco BPI				
	Banco Comercial Português				
	Espirito Santo Financial Group SA				
Sweden	Nordea Bank AB				
	Swedbank AB				
	Svenska Handelsbanken AB				
United Kingdom	Barclays plc				
	HSBC Holdings plc				
	Lloyds Banking Group plc	+	-	0.0131	0.0065
	Royal Bank of Scotland Group plc				
	Standard Chartered				

Table 5: Variable significance and coefficient sign for a model with HICP and square HICP. Maximum level of quarterly inflation that affects returns non-negatively. On last column, level of quarterly inflation that generates highest returns.

We also found the level of inflation that maximizes the returns according to this model. Unsurprisingly, values show that yearly inflation between 1'6% and 2'8% give the optimal results. If we accounted for the volatility of coefficients, the 2% value for theoretical optimal inflation would fall in that range

Even with these results, the R^2 of those regression ranged between 0.05 and 0.1 for the models where both coefficients were significant. Even if significant, the effects of HICP have still little effect.

Results for linear correlation, correlation with squared inflation and this model all point in the direction of one theory. However, correlations with lagged HICP and the model with lags point in another direction. This could be caused by the difference in expected inflation against unexpected inflation, but we have no proof of it. This matter has been discussed for a long time in several studies and we weren't expecting to settle the issue, so we'll leave the matter at this point.

A note on the residual correlations.

While estimating all these models we obtained the residuals of each of the banks. Since returns were highly correlated with each another inside and outside their country, it's interesting to see if the variables selected for the scenarios are the only cause of that correlation. With the correlation of residuals we can see how the correlations between banks evolve when we remove the effects of these variables.

On Appendix D we show the correlations for returns and residuals for each of the three models, including also the model with lags before the sequential omission. Results showed that with the first model the correlations for banks in different countries drastically reduced and even more with the second model. The VECM didn't add much more. What is important is that correlations in the same country remained high for each of the models, even the ones with R^2 that high that we consider the model is overfitting the data. To explain this result we have some possibilities.

It could be the effect of variables that appear in scenarios and we omitted, but the ones we didn't add should have little impact or be strongly correlated with the rests of the variables. Anyway, it's a possibility.

It could also be a matter of the specification of the model, especially the linearity on variables like UR and HICP. Even if it's a possibility, knowing the exact specification for each of the banks it's impossible.

The third explanation is that the residuals are indeed correlated: there is a common randomness in each of the countries that makes the returns go in the same direction and it's not caused by any variable but by pertaining to the banking sector of a certain country. If this is the case, and our results point in that direction, this should be taken into account on the scenarios: a variable that it's the banks affecting each other. Of course accounting for the continuous interactions between banks in the same country until the horizon of the scenario would be impossible. But, if the banks move at least in part at unison, when one of the banks reaches CET1 ratios below the mandatory, what would happen to the rest of the banks?

Stress tests reach conclusions on which could be the CET1 ratios under the adverse scenarios for each bank and if they pass the test or not. If those previsions turned true, the banks that didn't pass the test would be in difficulties, would need rescue or will go bankrupt. It's hardly possible that those events won't worsen the solvency for the rest of the banks. It should be interesting to account for that effect if the banks failing the test represent a high part of the sector

5.3. Predictive power and simulation results.

As the last part of this work we would want to have a prediction of the results for each of the stock prices in banks analyzed under the adverse scenarios. Since we have 3 groups of models, one for each of the specifications we chose, we'll use the RMSD (Root mean square deviations) and U-Theil statistics to compare the predictive power of the models. Since the VECM suffers from instability and overfitting, we'll reject it directly. For the rest, we estimated the models again with a sample until 2010Q4 and use that to perform an out-of-sample prediction for 2011Q1-2014Q4.

From the model without lags, the model with lags and the model with lags after sequential omission, the results show that in general the best predictor is the first one. Be it for overfitting, biased estimators or volatile coefficients, the other two are worse. We also repeated the test for different samples with the first model. Though the results change with the period or if we predict returns instead of prices, the conclusions are mostly the same.

On Table 6 and 7 on next pages, we show the results from the simulation process. On appendix we provide graphs showing the evolution under the adverse and baseline scenarios and the real evolution of stock prices until 2014Q4.

On the simulation process we've ignored the positive coefficients for UR in Germany since, though plausible under certain theories, is doubtful. We've kept them for LTIR and STIR, since it seems reasonable enough.

This prediction is, of course, far from stress testing. We're using stock prices instead of CET1 ratios, the parameters are the same for both exercises but the composition and state of the banks could've change drastically from 2011 to 2014 and the model we're using is the simplest one. Also, we're using data from 2011 to 2014 while estimating the coefficients. However, results are surprisingly accurate. Our criteria to "pass" the test for stock prices would be a fall of more than 30% for expected price or more than 60% for 10^{th} percentile.

From the results we can divide the banks in three broad categories:

- Banks where the positive effects of riskless interest rate and/or benefits from an increase in STIR makes stock prices to grow even under the adverse scenario. This happens mostly in countries with small sovereign risk spread
- Banks where the variables have little or no effect, or the negative effects cancel out the positives. These one maintain the same prices under any scenario.
- Banks where the negative effects are greater than positive effects and the price falls.

First two groups could be considered healthy in our analysis and the third group is the one that we would consider at risk.

2011	Average
HSBC Holdings plc	1.44
Swedbank AB	1.38
Commerzbank AG	1.35
Intesa Sanpaolo SpA	1.23
BBVA	1.21
Barclays plc	1.20
BNP Paribas	1.19
Erste Group Bank	1.10
Svenska Handelsbanken AB	1.09
Bankinter	1.09
Unicredit SpA	1.06
Banco Santander	1.04
Deutsche Bank AG	1.04
Société Générale	1.03
Nordea Bank AB	0.99
Banco Sabadell	0.92
Banco Popolare - Società Cooperativa	0.89
Alpha Bank	0.84
Jyske Bank	0.84
Sydbank	0.83
Piraeus Bank	0.74
The Governor and Company…	0.74
OTP Bank Ltd	0.70
Banco BPI	0.64
Danske Bank	0.63
Banco Popular Español	0.62
Lloyds Banking Group plc	0.59
Royal Bank of Scotland Group plc	0.56
Espirito Santo Financial Group SA	0.51
Banca Monte dei Paschi di Siena SpA	0.50
Allied Irish Banks plc	0.44
Groupe Crédit Agricole	0.38
National Bank of Greece	0.38
Banco Comercial Português	0.32
Agricultural Bank of Greece SA	0.22
Eurobank Eregasias	0.17
Dexia NV	0.11

2011	10th percentile
HSBC Holdings plc	0.91
Swedbank AB	0.86
Svenska Handelsbanken AB	0.83
Intesa Sanpaolo SpA	0.80
Commerzbank AG	0.77
BBVA	0.73
BNP Paribas	0.69
Banco Santander	0.68
Nordea Bank AB	0.67
Barclays plc	0.65
Unicredit SpA	0.63
Bankinter	0.63
Société Générale	0.62
Sydbank	0.58
Jyske Bank	0.57
Erste Group Bank	0.55
Banco Sabadell	0.53
Banco Popolare - Società Cooperativa	0.47
Deutsche Bank AG	0.44
OTP Bank Ltd	0.42
Banco Popular Español	0.39
Banco BPI	0.37
Danske Bank	0.37
Lloyds Banking Group plc	0.34
The Governor and Company…	0.29
Espirito Santo Financial Group SA	0.28
Banca Monte dei Paschi di Siena SpA	0.28
Piraeus Bank	0.28
Royal Bank of Scotland Group plc	0.28
Alpha Bank	0.27
Groupe Crédit Agricole	0.19
Banco Comercial Português	0.15
National Bank of Greece	0.14
Allied Irish Banks plc	0.14
Agricultural Bank of Greece SA	0.09
Eurobank Eregasias	0.08
Dexia NV	0.07

2011	CET1 ratio
Sydbank	12.40
OTP Bank Ltd	12.30
Dexia NV	12.10
Jyske Bank	12.10
National Bank of Greece	11.90
Alpha Bank	10.80
HSBC Holdings plc	10.50
Lloyds Banking Group plc	10.20
Commerzbank AG	10.00
Danske Bank	10.00
Barclays plc	10.00
Royal Bank of Scotland Group plc	9.70
BNP Paribas	9.20
Eurobank Eregasias	9.00
Nordea Bank AB	8.90
Deutsche Bank AG	8.80
Erste Group Bank	8.70
Swedbank AB	8.70
The Governor and Company…	8.40
Groupe Crédit Agricole	8.20
Banco BPI	8.20
Société Générale	8.10
BBVA	8.00
Piraeus Bank	8.00
Intesa Sanpaolo SpA	7.90
Unicredit SpA	7.80
Svenska Handelsbanken AB	7.70
Banco Popular Español	7.10
Banco Santander	7.10
Espirito Santo Financial Group SA	6.40
Agricultural Bank of Greece SA	6.30
Banco Sabadell	6.20
Bankinter	6.20
Banco Comercial Português	5.90
Banca Monte dei Paschi di Siena SpA	5.80
Banco Popolare - Società Cooperativa	5.80
Allied Irish Banks plc	3.70

Table 6: Ranking of banks by the expected price at the horizon of the adverse 2014's scenario, the 10th percentile of the confidence interval under the same conditions and by CET1 ratio results of the stress test.

2014	Average
Commerzbank AG	3.63
IKB Deutsche Industrielbank AG	2.66
Piraeus Bank	2.29
Alpha Bank	2.26
Sydbank	1.85
Deutsche Bank AG	1.74
ING Bank NV	1.68
Bankinter	1.55
BNP Paribas	1.53
Jyske Bank	1.49
Swedbank AB	1.41
Svenska Handelsbanken AB	1.35
Banco Santander	1.34
HSBC Holdings plc	1.32
Intesa Sanpaolo SpA	1.30
BBVA	1.26
Nordea Bank AB	1.23
Société Générale	1.21
Mediobanca	1.13
Banco Sabadell	1.11
Credito Emiliano SpA	1.07
Erste Group Bank	1.06
Unicredit SpA	0.93
Barclays plc	0.87
Danske Bank	0.85
Aareal Bank AG	0.82
Bank of Cyprus Public Company Ltd	0.82
Banca Popolare Dell'Emilia Romagna	0.82
The Governor and Company…	0.77
Banca Popolare Di Milano - SCRL	0.77
Banco Popular Español	0.75
OTP Bank Ltd	0.72
Banco Popolare - Società Cooperativa	0.69
Banco BPI	0.68
National Bank of Greece	0.58
Banca Piccolo Credito Valtellinese	0.58
Banca Carige SPA	0.49
Groupe Crédit Agricole	0.38
Allied Irish Banks plc	0.36
Banco Comercial Português	0.35
Banca Monte dei Paschi di Siena SpA	0.31
Lloyds Banking Group plc	0.29
Eurobank Eregasias	0.19
Royal Bank of Scotland Group plc	0.17
Dexia NV	0.00

2014	10th percentile
Commerzbank AG	1.74
Sydbank	1.15
IKB Deutsche Industrielbank AG	0.94
Svenska Handelsbanken AB	0.93
Jyske Bank	0.92
Banco Santander	0.79
ING Bank NV	0.78
Nordea Bank AB	0.75
BNP Paribas	0.73
Credito Emiliano SpA	0.73
Swedbank AB	0.73
HSBC Holdings plc	0.72
Intesa Sanpaolo SpA	0.71
Bankinter	0.71
Société Générale	0.67
Mediobanca	0.66
BBVA	0.65
Piraeus Bank	0.64
Banco Sabadell	0.56
Deutsche Bank AG	0.54
Alpha Bank	0.51
Unicredit SpA	0.47
Aareal Bank AG	0.47
Erste Group Bank	0.45
Danske Bank	0.44
Banco Popular Español	0.43
Banca Popolare Dell'Emilia Romagna	0.43
Barclays plc	0.41
OTP Bank Ltd	0.38
Banca Popolare Di Milano - SCRL	0.36
Bank of Cyprus Public Company Ltd	0.36
Banco Popolare - Società Cooperativa	0.34
Banca Piccolo Credito Valtellinese	0.33
Banca Carige SPA	0.31
Banco BPI	0.30
The Governor and…	0.22
National Bank of Greece	0.19
Groupe Crédit Agricole	0.16
Lloyds Banking Group plc	0.15
Banca Monte dei Paschi di Siena SpA	0.15
Banco Comercial Português	0.13
Allied Irish Banks plc	0.11
Royal Bank of Scotland Group plc	0.06
Eurobank Eregasias	0.06
Dexia NV	0.00

2014	CET1 ratio
Svenska Handelsbanken AB	16.90
Swedbank AB	16.30
Jyske Bank	13.60
Sydbank	12.90
Nordea Bank AB	12.00
OTP Bank Ltd	11.90
Aareal Bank AG	11.80
Danske Bank	11.70
Banco BPI	11.60
Bankinter	11.00
The Governor and Company…	9.30
HSBC Holdings plc	9.30
BBVA	9.00
Deutsche Bank AG	8.90
Banco Santander	8.90
Credito Emiliano SpA	8.90
Groupe Crédit Agricole	8.80
ING Bank NV	8.70
Erste Group Bank	8.50
Banco Sabadell	8.30
Intesa Sanpaolo SpA	8.30
BNP Paribas	8.10
Société Générale	8.10
Alpha Bank	8.10
Commerzbank AG	8.00
Banco Popular Español	7.60
Barclays plc	7.10
Allied Irish Banks plc	6.90
Unicredit SpA	6.80
Royal Bank of Scotland Group plc	6.70
IKB Deutsche Industrielbank AG	6.50
Mediobanca	6.20
Lloyds Banking Group plc	6.20
Banca Popolare Dell'Emilia Romagna	5.20
Dexia NV	5.00
Banco Popolare - Società Cooperativa	4.70
Piraeus Bank	4.40
Banca Popolare Di Milano - SCRL	4.00
Banca Piccolo Credito Valtellinese	3.50
Banco Comercial Português	3.00
Bank of Cyprus Public Company Ltd	1.50
Banca Monte dei Paschi di Siena SpA	-0.10
National Bank of Greece	-0.40
Banca Carige SPA	-2.40
Eurobank Eregasias	-6.40

Table 7: Ranking of banks by the expected price at the horizon of the adverse 2014's scenario, the 10th percentile of the confidence interval under the same conditions and by CET1 ratio results of the stress test.

Now, focusing on the banks at risk. Allied Irish Banks was the only one not to pass the test on 2011, and it's one of banks with worst results by both expected value and percentile and didn't pass out test.

These are very accurate results, but now we'll see it from the other perspective. Our model predicts 14 banks failing the test for 2011 using the expected value. And only one of them fails the stress test. In general, our predictions tend to give worse results for banks, and it's also insensible to the different periods and give similar results for 2011 and 2014's tests since measures taken from 2011 to 2014 by banks to improve their solvency aren't reflected in our model.

However, from these 14 banks that "fail", 6 are also on the 14 worst results for the test, and the others fall near or revealed to be less solvent on the 2014 test. For example Dexia gets the worst results for our 2011 test, while it's the 3rd more solvent by the EBA. On the second half of 2011, however, its CET1 ratio became negative. Another example would be Eurobank Ergasias: fails our tests, but it's on the average for the 2011 stress test with a CET1 of 9%; however, on 2012 it was sold and for the 2014 tests it's ratio was -6.4%. Lloyds is another example: One of the worst results for our prediction while being the 8th most solvent, on the 2014 test it was 70bp away from failing the test.

For the 2014 scenarios, 14 banks in our sample didn't pass the test. 10 of those also didn't pass our test for the percentile and 8 for the expected value.

Changing the perspective, 13 banks didn't pass our test for the 2014 scenario. From those, 9 are in the group of 13 banks with worse solvency. From the other 4, Allied Irish Bank passed the test with 140bp above the threshold and Royal Bank of Scotland with 120bp of margin. Both don't reach the new ratio of 8% required for Basel III.

These are just some of the similitudes, and of course our test gives bad results for perfectly solvent banks, and vice-versa. We aren't concluding our prediction is better in any way. However, the principal obstacle to assume the conclusions of this work would be that our analysis is too different from a stress test. These results show signs that the results are not that different and our conclusions could be translated to stress testing.

2011	GDP	UR	RPPI	STIR	LTIR
Banco BPI	32%	0%	0%	0%	68%
Lloyds Banking Group plc	100%	0%	0%	0%	0%
Royal Bank of Scotland Group plc	100%	0%	0%	0%	0%
Espirito Santo Financial Group SA	117%	0%	0%	-17%	0%
Banca Monte dei Paschi di Siena SpA	0%	37%	0%	0%	63%
Allied Irish Banks plc	0%	0%	0%	17%	83%
Banco Comercial Português	85%	0%	0%	0%	15%
Dexia NV	12%	0%	15%	73%	0%

2014	GDP	UR	RPPI	CPPI	STIR	LTIR
Banco Popolare - Società Cooperativa	0%	0%	0%	0%	-28%	128%
Banco BPI	15%	0%	0%	0%	0%	85%
Banca Piccolo Credito Valtellinese	0%	24%	0%	0%	76%	0%
Banca Carige SPA - CdR di Genova e Imperia	0%	76%	0%	0%	24%	0%
Allied Irish Banks plc	0%	0%	0%	0%	-14%	114%
Banco Comercial Português	71%	0%	0%	0%	0%	29%
Banca Monte dei Paschi di Siena SpA	0%	33%	0%	0%	0%	67%
Lloyds Banking Group plc	108%	0%	0%	23%	0%	-31%
Royal Bank of Scotland Group plc	83%	0%	0%	26%	0%	-9%
Dexia NV	14%	0%	28%	0%	58%	0%

Table 8: Percentage of negative effect on the prices at the horizon of the scenario for banks at risk with more than one significant variable.

For the banks that see their stock prices rising in the adverse scenarios the variables making this are clear seeing the model. STIR, LTIR or both, just seeing the significance and sign of the coefficients and don't require further analysis.

For the banks that failed our test it could prove interesting to see which variables did have more responsibility in the fall of its stock price.

Causes of the fall in prices are polarized between the real economy and the interest rates. We already knew that price index we're mostly insignificant, but in the adverse scenarios, even with falls of around 15% in some cases for RPPI and CPPI, the importance of the price index is small.

Also note that in the cases where STIR affects negatively, the effects represent most of the fall (73% in Dexia, 76% in Piccolo Credito Valtellinese) while positive effects are small (-17% in Espirito Santo and -14% in Allied Irish Banks). Since STIR could provide benefits but it also generated difficulties for banks to finance themselves in the money market, this results make sense. When it provides benefits, the effects are small since those are just adjustment in some of the products the banks offer. On the other hand, lack of financing doesn't just generate less benefits, it could prove fatal for a bank.

6. Conclusion

In this work we have briefly analyzed the effects, direct and indirect, of some of the most important variables used in the EBA stress tests on stock prices. For the Gross Domestic Product we have seen the total effects are positive, linear and significant; but the direct effects lose importance in a multivariate model. The effects of an increase in unemployment aren't certain and seem to depend on several factors: country, economic cycle or level of unemployment make the agents assume different information from an increase in unemployment. The consumer price index also has uncertain effects on the stock prices but our results point more in the direction of an optimal value for inflation, non-linear effects and importance of the monetary unions. Residential property prices have a strong positive total effect, but the direct effect loses importance. Commercial property prices not only have little direct and total effect, but if they also behave similarly to residential prices. Interbank rates have both positive and negative effects for banks and both translate on stock prices: more risk caused by harder conditions to finance themselves in the money market but higher benefits from indexed loans. Sovereign yields have also distinct effects if the increase or decrease comes from a general change in the riskless rates or by a change in sovereign risk premium. Last, the value of the domestic currency seem to have little effect.

From these we can draw conclusions regarding scenario planning for bank stress tests. GDP, unemployment and interest rates seem to be the most important variables, so the specifications for the behavior under the scenarios should be planned carefully. On the other hand, exchange rates and sectorial prices index are not that important, especially with the redundancy that seem to exist for commercial property and residential property.

Also for unemployment, consumer price index, interbank rates and sovereign yields the planning of the scenario should take into account several factors. A higher unemployment affects negatively GDP and payment defaults, but it could increase stock prices and generate expectations regarding interest rates or monetary policy that should be taking into account if the scenario also incorporates this variables. As for consumer prices, even if a lower inflation is the natural consequence of decrease in consumption, the risks of continuous deflation must be taken into account and, again, the expectations of monetary policy, the divergence from the optimal inflation and the differences between inflation of different countries in the same monetary union. The effects of interbank rates could benefit the result of some banks over others based on their dependence for liquidity on the money market and the capacity to generate benefits, so an increase in interbank rates could not be adverse at all for some banks. Last, since increases in sovereign yield are only adverse if they represent risk spread, it could be more interesting to directly use the risk premium for the scenario, not the sovereign bond yields.

We can also draw a lesson from the correlations of prices, returns and model residuals: feedback between banks. If tests stop at concluding which banks are solvent and which are not, all this feedback is ignored. It could prove interesting to revisit results for banks based on the results for the rest of the banks, especially in the same country.

Last, our simulation exercise provided us with some more information. Since the results are similar to those of the stress test, the differences in methodologies are salvable to apply our conclusions to scenario planning. It also showed that the specific scenario for a country, specifically regarding interbank rates and sovereign yields, could be the cause of the good results of certain banks.

In our opinion, the most important features that lack the recent stress tests are accounting for the expectations and actions of the private agents and public sector during the scenarios, especially if the horizon is for several years; and ignoring self-reinforcing feedback loops, both positive and negative, especially caused by the solvency of other banks.

Future research areas.

First, the effects of several variables are still uncertain, like HICP and UR. For STIR further investigation could be interesting to prove when or why for some banks an increase in rates is detrimental but it benefits others.

Most of the conclusion were reached with the simplest approaches and more sophisticated models just helped us contrast the results. However, adding error correction terms to simpler models than a VECM and using less variables at a time could provide another view in the effects of the variables.

Though we have theoretical reasons to apply conclusions regarding stock prices to stress testing and the simulation exercise adds some empirical prove, it's not enough to cross the bridge between the two. Investigations regarding the relationship between solvency and stock prices could solve this issue, be it to prove or disprove it.

Last, the focus of this work has been stock returns, but a change of focus could also add some insight for scenario building. Using returns' volatility could be useful to see which variables add volatility to the markets and then see the effects of volatility on the solvency of banks. Using financial instruments that directly measure risk of an entity, CDS for example, could provide results that make more sense to apply to stress tests. In the same fashion, volatility of CDS spreads could be the next step.

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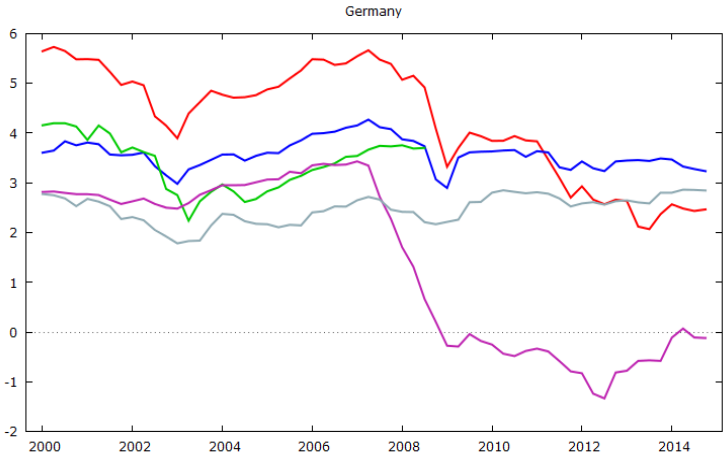
Appendix A

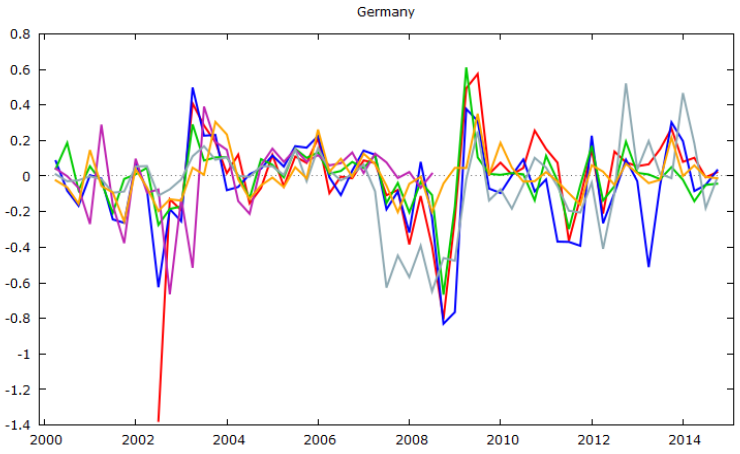
List of the banks that appeared on the 2011 and 2014 stress tests by the EBA, in addition to the ones used as sample for the descriptive part of this work.

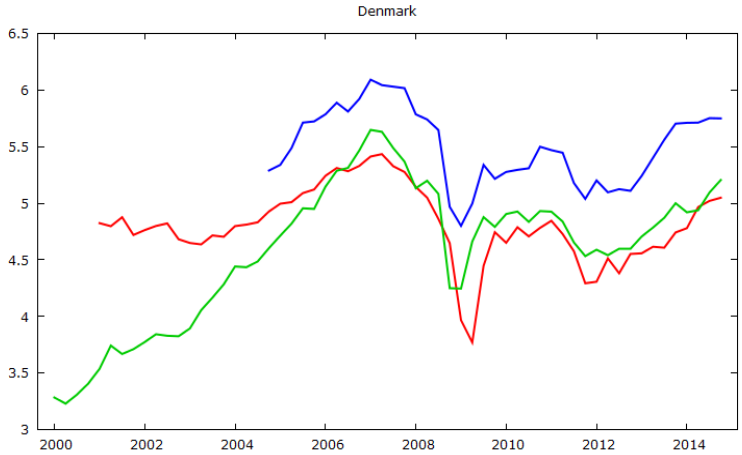
Country	Institution	EBA 2011	EBA 2014	Obtained Data
Austria	BAWAG P.S.K.		X	
	Erste Group Bank	X	X	X
	Raiffeisen Zentralbank Österreich		X	
	Raiffeisenlandesbank Niederösterreich-Wien		X	
	Raiffeisen Bank International (RBI)	X		
	Österreichische Volksbanken-AG	X	X	
Belgium	AXA Bank Europe SA		X	
	Belfius Banque SA		X	
	Fortis			X
	Dexia NV	X	X	X
	Investar		X	
	KBC Group	X	X	
Cyprus	Bank of Cyprus Public Company Ltd		X	X
	Co-operative Central Bank Ltd		X	
	Hellenic Bank Public Company LTd		X	
Germany	Aareal Bank AG		X	X
	Bayerische Landesbank	X	X	
	Commerzbank AG	X	X	X
	DZ Bank AG Deutsche Zentral-Genossenschaftsbank	X	X	
	DekaBank Deutsche Girozentrale	X	X	
	Deutsche Apotheker-und Ärztebank eG		X	
	Deutsche Bank AG	X	X	X
	HASPA Finanzholding		X	
	HSH Nordbank AG	X	X	
	Hypo Real Estate Holding AG	X	X	X
	IKB Deutsche Industrielbank AG		X	X
	KfW IPEX-Bank GmbH		X	
	Landesbank Baden-Württemberg	X	X	
	Landesbank Berlin Holding AG	X	X	
	Landesbank Hessen-Thüringen Girozentrale		X	
	Landeskreditbank Baden-Würtemberg-Förderbank		X	
	Lanwirtschaftliche Rentenbank		X	
	Müchener Hypothekenbank eG		X	
	NRW		X	
	Norddeutsche Landebank-Girozentrale	X	X	
	Volskwagen Financial Services AG		X	
	Westlandesbank AG	X		
	WGZBank AG Westdeutsche Genossenschafts	X	X	
	Wüstenrot Bank AG Pfandbriefbank		X	
	Wüstenrot Bausparkasse AG		X	
	Wüstenrot & Würtembergische AG			X
Denmark	Danske Bank	X	X	X
	Jyske Bank	X	X	X
	Nykredit	X	X	
	Sydbank	X	X	X
Spain	BBVA	X	X	X
	Banca March SA	X		
	Banco Financiero y de Ahorros	X	X	
	Banco Mare Nostrum (Grupo BMN on 2011)		X	
	Banco Pastor	X		
	Banco Popular Español	X	X	X
	Banco Santander	X	X	X
	Banco Sabadell	X	X	X
	Bankinter	X	X	X
	Caixa d'Estalvis de Catalunya, Tarragona i Manresa	X		
	Caixa d'Estalvis de Manlleu, Sabadell i Terrassa	X		
	Caixa de Aforros de Galicia, Vigo, Ourense e Pontevedra	X		
	Caja de Ahorros de Vitoria y Álava	X		
	Caja de Ahorros del Mediterraneo	X		
	Caja de Ahorros y MP de Guipuzkoa y San Sebastian	X		
	Caja de Ahorros y MP de Ontinyent	X		
	Caja de Ahorros y MP de Zaragoza	X	X	
	Caja de Ahorros y Pensiones de Barcelona	X	X	
	Caja España de Inversiones, Salamanca, Soria, CA y MP			
	Cajas Rurales Unidas		X	
	Catalunya Banc		X	
	Colonia - Caixa d'Estalvis de Pollensa	X		
	Grupo Banca Civica	X		

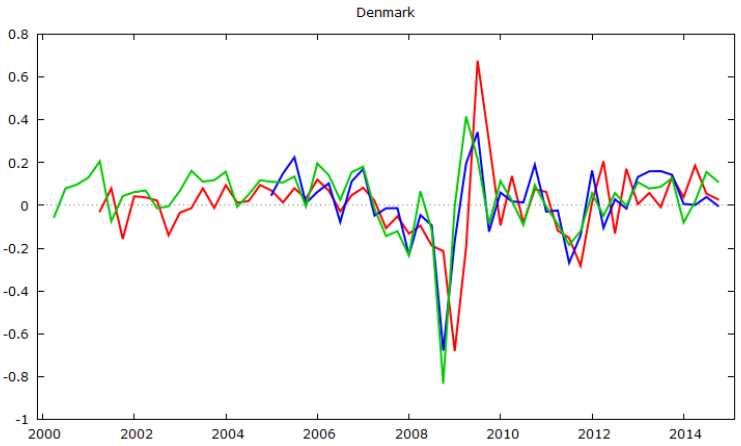
	Grupo BBK	X		
	Grupo Caja3	X		
	Kutxabank		X	
	Liberbank (Effibank on 2011)	X	X	
	MPCA Ronda		X	
	NCG Banco		X	
Finland	OP-Pohjola Group		X	
France	BNP Paribas	X	X	X
	Banque Publique d'Investment		X	
	Banque PSA Finance		X	
	Caisse de Refinancement de l'Habitat		X	
	Groupe BPCE	X	X	
	Groupe Crédit Agricole	X	X	X
	Groupe Crédit Mutuel		X	
	La Banque Postale		X	
	Natixis			X
	RCI Banque		X	
	Société Générale	X	X	X
	Société de Financement Local		X	
Greece	Alpha Bank	X	X	X
	Eurobank Eregasias	X	X	X
	National Bank of Greece	X	X	X
	Piraeus Bank	X	X	X
	Agricultural Bank of Greece SA	X		X
	TT Hellenic Postbank SA	X		
Hungary	OTP Bank Ltd	X	X	X
Ireland	Allied Irish Banks plc	X	X	X
	Permanent tbs plc.	X	X	
	The Governor and Company of the Bank of Ireland	X	X	X
Italy	Banca Carige SPA - Cassa di Risparmio di Genova e Imperia		X	X
	Banca Monte dei Paschi di Siena SpA	X	X	X
	Banca Piccolo Credito Valtellinese		X	X
	Banca Popolare Dell'Emilia Romagna		X	X
	Banca Popolare Di Milano - SCRL		X	X
	Banca Popolare di Sondrio		X	
	Banca Popolare di Vicenza - SCperA		X	
	Banco Popolare - Società Cooperativa	X	X	X
	Credito Emiliano SpA		X	X
	Iccrea Holding SpA		X	
	Intesa Sanpaolo SpA	X	X	X
	Mediobanca - Banca di Credito Finanziario SpA		X	X
	Unicredit SpA	X	X	X
	Unione Di Banche Italiane SCperA	X	X	
	Beneto Banca SCperA		X	
Luxemburg	Banque et Caisse s'Epargne de l'Etat	X	X	
	Precision Capital SA		X	
Latvia	ABLV Bank		X	
Malta	Bank of Valletta plc	X	X	
Netherlands	ABN AMRO Bank NV	X	X	
	Bank Nederlandse Gemeenten NV		X	
	Rabobank Nederland	X	X	
	ING Bank NV		X	X
	Nederlandse Waterschapsbank NV		X	
	SNS Bank NV	X	X	
Norway	DBN Bank Group	X	X	
Poland	Alior Bank SA		X	
	Bank BPH SA		X	
	Bank Handlowy W Warszawie SA		X	
	Bank Ochrony Srodowinska SA		X	
	Getin Noble Bank SA		X	
	Powszechna Kasa Oszczednosci Bank Polski SA	X	X	
Portugal	Banco BPI	X	X	X
	Banco Comercial Português	X	X	X
	Caixa Geral de Depósitos	X	X	
	Espirito Santo Financial Group SA	X		X
Sweden	Nordea Bank AB	X	X	X
	Skandinaviska Enskilda Banken AB	X	X	
	Svenska Handelsbanken AB	X	X	X
	Swedbank AB	X	X	X
Slovenia	Nova Kreditna Banka Maribor dd	X	X	
	Nova Ljubljanska banka dd	X	X	
	SID - Slovenska izvozna in razvojna banka		X	
United Kingdom	Barclays plc	X	X	X
	HSBC Holdings plc	X	X	X
	Lloyds Banking Group plc	X	X	X
	Royal Bank of Scotland Group plc	X	X	X
	Standard Chartered			X

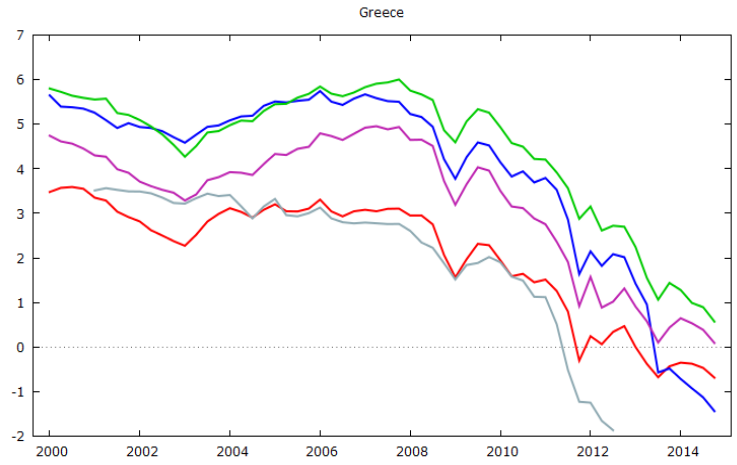
Graphs representing logarithms of stock prices (left) and logarithmic returns (right) for the period 2000-2014 for all the countries with 3 or more banks in our sample.

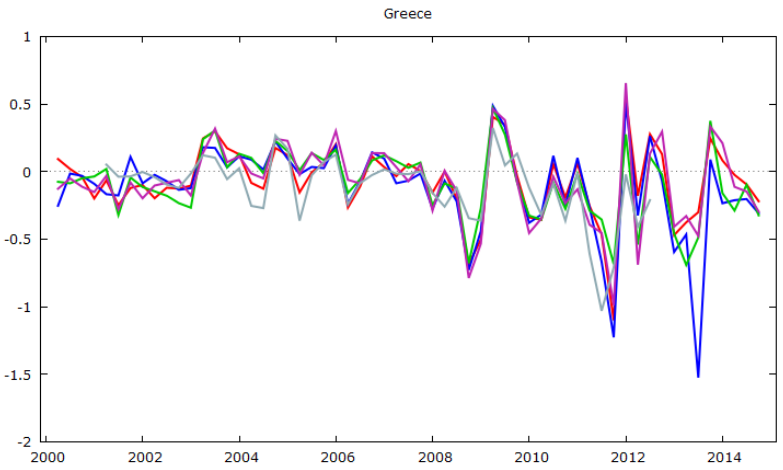


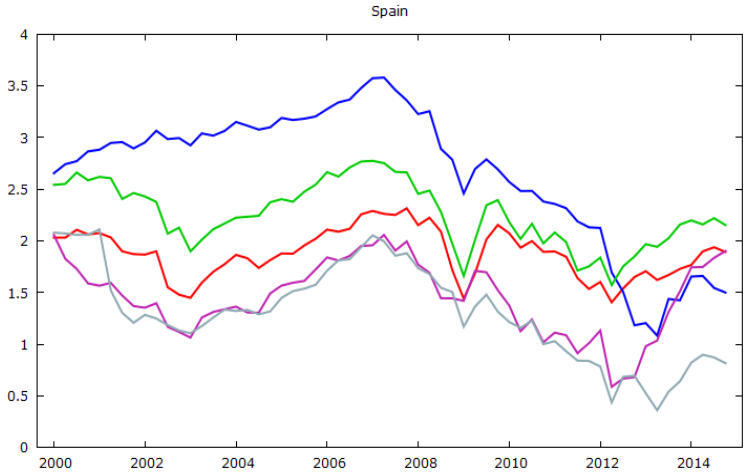








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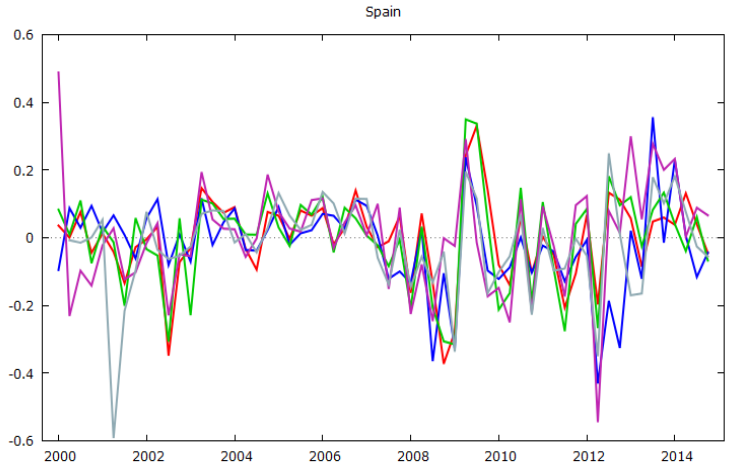
3.5
3
2.5
2
1.5
1
0.5
0
2000
2002
2004
2006
2008
2010
2012
2014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0.2
0
-0.2
-0.4
-0.6
2000
2002
2004
2006
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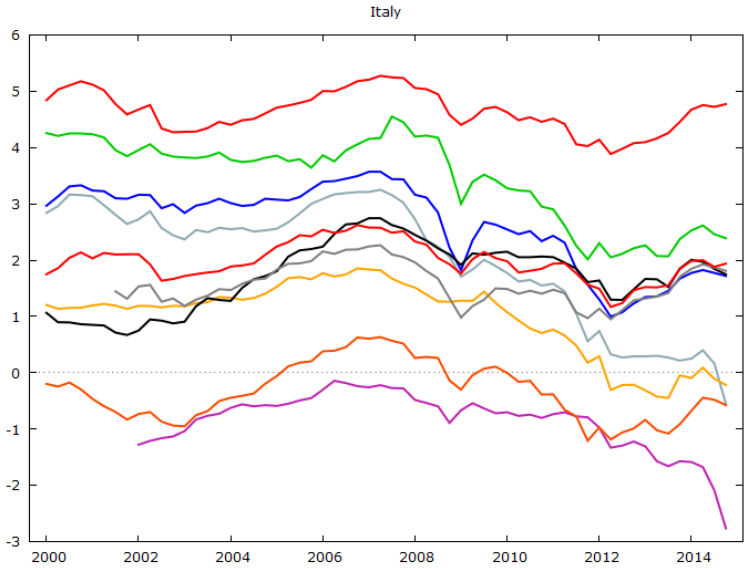
2010
2012
2014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-3
2000
2002
2004
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2012
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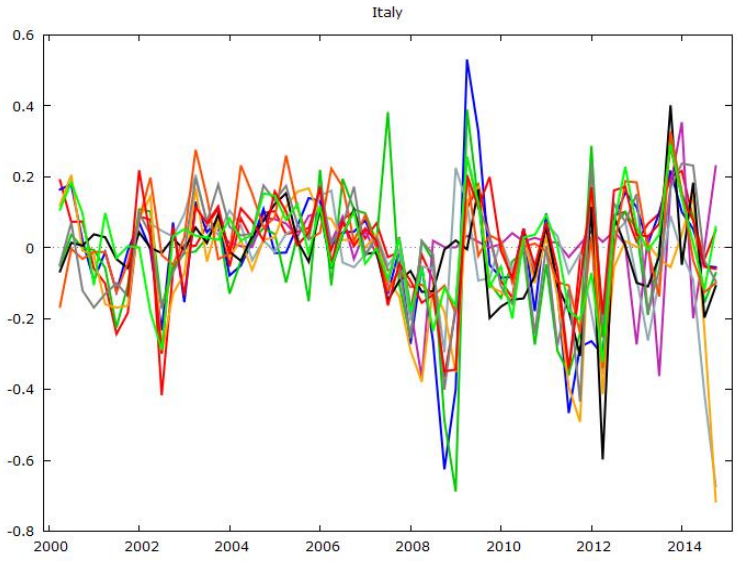
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0.2
0
-0.2
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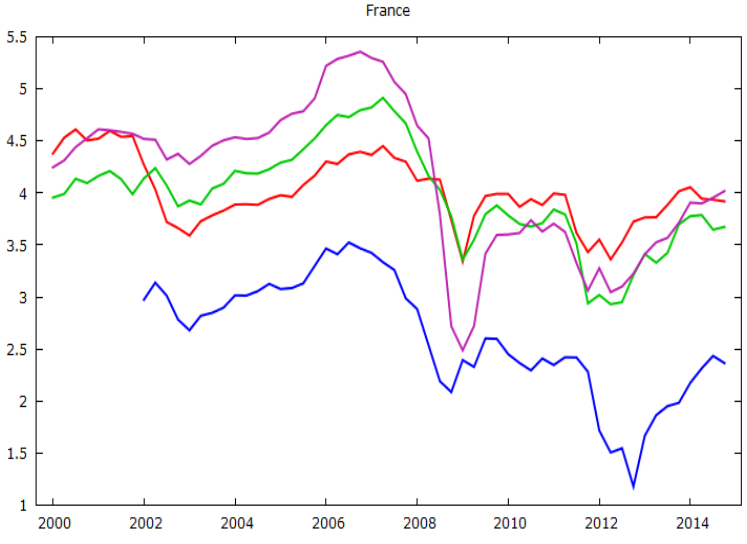
-0.6
-0.8
2000
2002
2004
2006
2008
2010
2012
2014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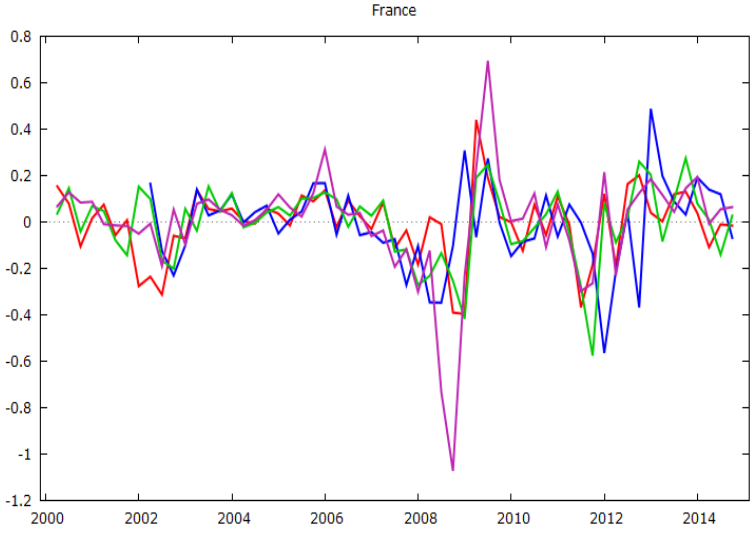
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
2000
2002
2004
2006
2008
2010
2012
2014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0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
2000
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2004
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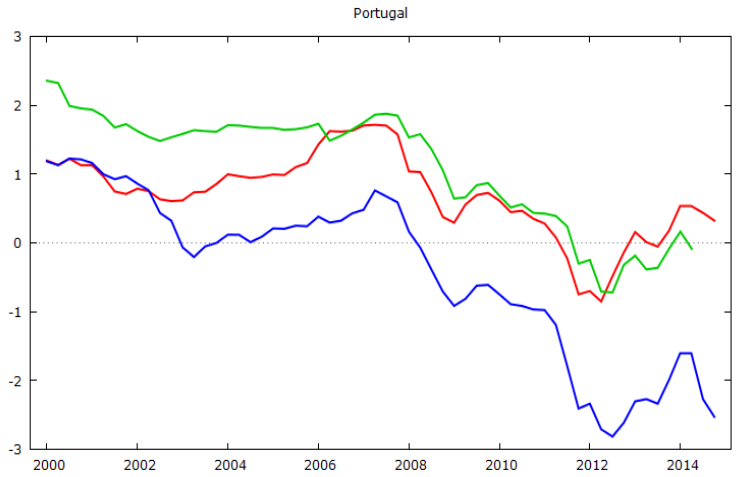
2008
2010
2012
2014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3
2
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0
-1
-2
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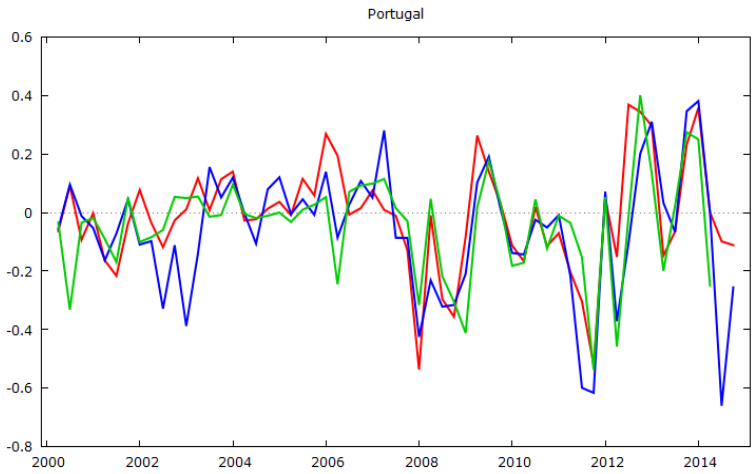
2008
2010
2012
2014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0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
2000
2002
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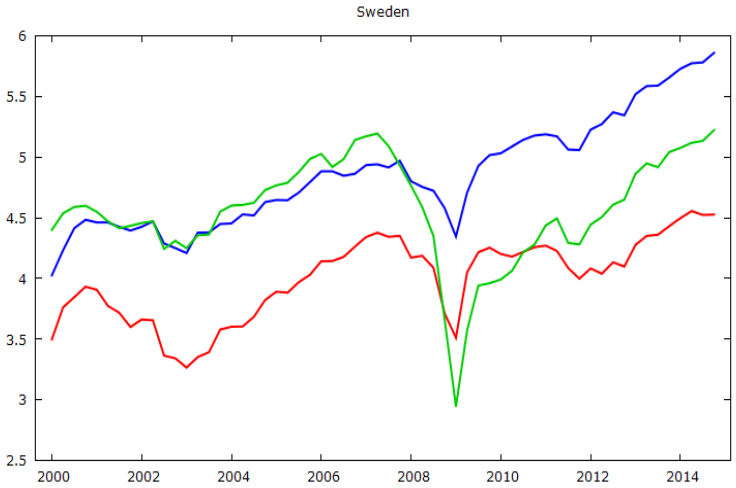
2008
2010
2012
2014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2010
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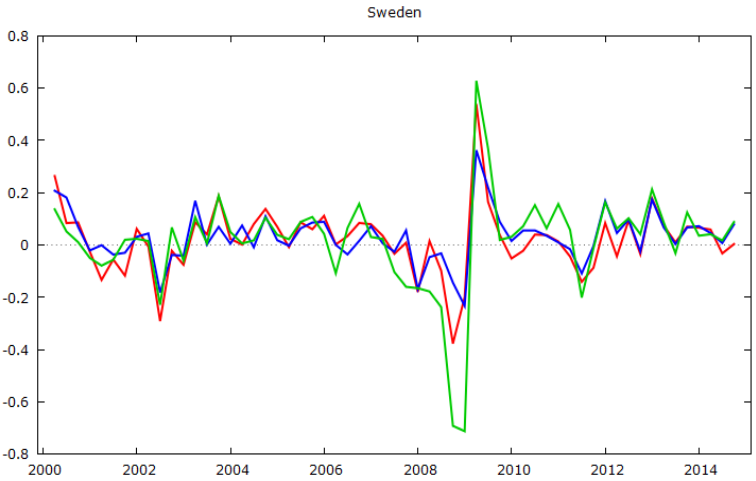
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-0.6
-0.8
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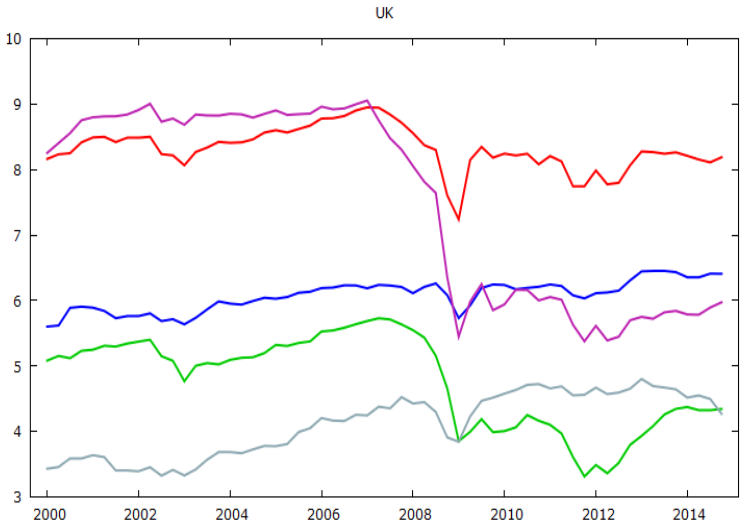
UK
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9
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7
6
5
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2000
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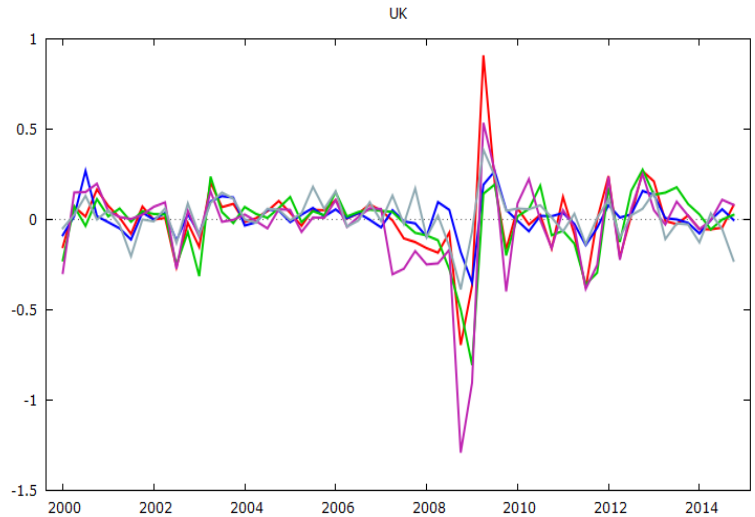
2012
2014


UK
1
0.5
0
-0.5
-1
-1.5
2000
2002
2004
2006
2008
2010
2012
2014

Returns' principal statistics and normality test.

Country	Institution	St. Dev	Assymetry	Ex. Kurtosis	Doornik Hansen test p-values
Austria	Erste Group Bank	0.20889	-1.2633	3.7009	0.0009
Belgium	Fortis	0.36395	-4.1007	22.151	0
	Dexia NV	0.21283	-2.3532	6.1583	0
Cyprus	Bank of Cyprus Public Company Ltd	0.2603	-0.36533	1.5248	0.0044
Germany	Aareal Bank AG	0.301296	-2.07518	7.634	0
	Commerzbank AG	0.254455	-0.818164	1.25826	0.0355
	Deutsche Bank AG	0.167385	-0.278343	5.25762	0
	Hypo Real Estate Holding AG	0.211697	-1.14953	1.79996	0.0224
	IKB Deutsche Industrielbank AG	0.225474	-0.646598	1.29134	0.0475
	Wüstenrot & Würtembergische AG	0.120266	0.642526	0.945012	0.0868
Denmark	Danske Bank	0.172228	-0.120538	6.65929	0
	Jyske Bank	0.1695	-1.59974	5.2211	0.0006
	Sydbank	0.160731	-2.56309	12.728	0
Spain	BBVA	0.148411	-0.251394	0.457203	0.2935
	Banco Popular Español	0.13116	-0.561052	1.8682	0.0046
	Banco Santander	0.134336	-0.398917	1.01289	0.0622
	Banco Sabadell	0.142063	-1.2842	3.30975	0.0012
	Bankinter	0.150472	-0.405236	2.24068	0.0004
France	BNP Paribas	0.151566	-0.528248	1.28527	0.0432
	Groupe Crédit Agricole	0.183473	-0.332648	1.18039	0.0455
	Natixis	0.232928	-1.75988	8.14337	0
	Société Générale	0.15956	-1.05777	1.81411	0.0063
Greece	Alpha Bank	0.269362	-0.86854	2.60099	0.0031
	Eurobank Eregasias	0.341247	-1.69628	4.91005	0
	National Bank of Greece	0.255824	-0.374888	0.00448747	0.4483
	Piraeus Bank	0.298911	-0.448862	0.895391	0.1101
	Agricultural Bank of Greece SA	0.248166	-1.37538	2.88948	0.0017
Hungary	OTP Bank Ltd	0.23273	-1.2026	4.0508	0.0006
Ireland	Allied Irish Banks plc	0.32621	-1.7599	5.3928	0
	The Governor and Company of the Bank of Ireland	0.33819	-1.068	4.3421	0
Italy	Banca Carige SPA - Cassa di Risparmio di Genova e Imperia	0.156918	-1.78596	4.61056	0
	Banca Monte dei Paschi di Siena SpA	0.183683	-1.17875	1.69601	0.0008
	Banca Piccolo Credito Valtellinese	0.135601	-0.856394	5.155	0
	Banca Popolare Dell'Emilia Romagna	0.134263	0.183283	-0.0519551	0.7429
	Banca Popolare Di Milano - SCRL	0.156379	-0.498967	-0.0253629	0.2292
	Banco Popolare - Società Cooperativa	0.189261	-0.571492	1.81943	0.0094
	Credito Emiliano SpA	0.145728	-0.692492	0.208409	0.073
	Intesa Sanpaolo SpA	0.13657	-1.15952	1.20114	0.0001
	Mediobanca - Banca di Credito Finanziario SpA	0.128548	-0.356854	0.0531007	0.4691
	Unicredit SpA	0.185623	-0.532615	1.97076	0.0047
Netherlands	ING Bank NV	0.21234	-1.8381	8.0349	0
Portugal	Banco BPI	0.184027	-0.340008	0.962367	0.0842
	Banco Comercial Português	0.218058	-0.638357	0.700824	0.1114
	Espirito Santo Financial Group SA	0.172098	-0.561889	1.01361	0.0878
Sweden	Nordea Bank AB	0.128829	0.419224	4.61893	0
	Swedbank AB	0.190509	-1.23132	6.37958	0.0013
	Svenska Handelsbanken AB	0.0977516	0.271309	2.01764	0
UK	Barclays plc	0.164296	0.493133	9.9743	0
	HSBC Holdings plc	0.121151	-0.501116	0.628629	0.09
	Lloyds Banking Group plc	0.174536	-1.79504	5.29917	0
	Royal Bank of Scotland Group plc	0.218677	-2.52468	12.18700	0
	Standard Chartered	0.143003	-0.549349	0.801728	0.0563

Results of Unit root and stationarity for both stock prices and logarithmic returns. Conclusions are based on a 95% confidence interval for both Augmented Dickey Fuller and KPSS. Both tests with a constant and without trend as general rule

		Series in prices		Series in returns		
Country	Institution	ADF	KPSS	ADF	KPSS	Conclusion
Austria	Erste Group Bank	>0.1	>0.1	<0.01	>0.1	Stationary returns
Belgium	Fortis	>0.1	<0.01	>0.1	>0.1	Prices at least I(1)
	Dexia NV	>0.1	>0.1	>0.1	0.03	-
Cyprus	Bank of Cyprus Public Company Ltd	>0.1	<0.01	0.08	>0.1	I(1) time series
Germany	Aareal Bank AG	>0.1	>0.1	<0.01	>0.1	Stationary returns
	Commerzbank AG	>0.1	<0.01	0.04	>0.1	I(1) time series
	Deutsche Bank AG	>0.1	>0.1	<0.01	>0.1	Stationary returns
	Hypo Real Estate Holding AG	>0.1	>0.1	0.02	>0.01	Stationary returns
	IKB Deutsche Industrielbank AG	>0.1	<0.01	>0.1	0.04	Prices at least I(1)
	Wüstenrot & Würtembergische AG	>0.1	0.05	<0.01	>0.1	I(1) time series
Denmark	Danske Bank	>0.1	0.04	<0.01	>0.1	I(1) time series
	Jyske Bank	>0.1	0.09	0.02	>0.1	Stationary returns
	Sydbank	>0.1	<0.01	<0.01	>0.1	I(1) time series
Spain	BBVA	>0.1	>0.1	0.05	>0.1	Stationary returns
	Banco Popular Español	>0.1	0.05	<0.01	>0.1	I(1) time series
	Banco Santander	0.08	0.04	<0.01	>0.1	I(1) time series
	Banco Sabadell	>0.1	0.02	>0.1	>0.1	Prices at least I(1)
	Bankinter	>0.1	0.09	>0.1	>0.1	-
France	BNP Paribas	0.05	0.04	<0.01	>0.1	I(1) time series
	Groupe Crédit Agricole	>0.1	<0.01	<0.01	>0.1	I(1) time series
	Natixis	>0.1	0.04	<0.01	>0.1	I(1) time series
	Société Générale	>0.1	0.04	0.02	>0.1	I(1) time series
Greece	Alpha Bank	>0.1	<0.01	>0.1/<0.01*	>0.1	I(1) time series
	Eurobank Eregasias	>0.1	<0.01	>0.1/<0.01*	>0.1	I(1) time series
	National Bank of Greece	>0.1	<0.01	>0.1/<0.01*	0.05	I(1) time series
	Piraeus Bank	>0.1	0.02	>0.1	>0.1	-
	Agricultural Bank of Greece SA	>0.1	<0.01	>0.1/<0.01*	>0.1	I(1) time series
Hungary	OTP Bank Ltd	>0.1	<0.01	<0.01	<0.1	I(1) time series
Ireland	Allied Irish Banks plc	>0.1	0.07	>0.01	>0.01	-
	The Governor and Company of the Bank of Ireland	>0.1	<0.01	0.06	>0.1	Prices at least I(1)
Italy	Banca Carige SPA	>0.1	<0.01	>0.1/<0.01*	>0.1	I(1) time series
	Banca Monte dei Paschi di Siena SpA	>0.1	0.03	0.08/<0.01*	>0.1	I(1) time series
	Banca Piccolo Credito Valtellinese	>0.1	<0.01	<0.01	>0.1	I(1) time series
	Banca Popolare Dell'Emilia Romagna	>0.1	<0.01	>0.1	>0.1	Prices at least I(1)
	Banca Popolare Di Milano - SCRL	>0.1	<0.01	>0.1	>0.1	Prices at least I(1)
	Banco Popolare - Società Cooperativa	>0.1	<0.01	0.06	>0.1	Prices at least I(1)
	Credito Emiliano SpA	>0.1	0.03	0.02	>0.1	I(1) time series
	Intesa Sanpaolo SpA	0.08	<0.01	>0.1	>0.1	Prices at least I(1)
	Mediobanca - Banca di Credito Finanziario SpA	>0.1	<0.01	<0.01	>0.1	I(1) time series
	Unicredit SpA	>0.1	<0.01	<0.01	>0.1	I(1) time series
Netherlands	ING Bank NV	>0.1	<0.01	0.06	>0.1	Prices at least I(1)
Portugal	Banco BPI	0.09	<0.01	<0.01	>0.1	I(1) time series
	Banco Comercial Português	>0.1	<0.01	0.03	>0.1	I(1) time series
	Espirito Santo Financial Group SA	>0.1	0.04	0.04	>0.1	I(1) time series
Sweden	Nordea Bank AB	>0.1	>0.1	<0.01	>0.1	Stationary returns
	Swedbank AB	>0.1	0.08	0.02	>0.1	Stationary returns
	Svenska Handelsbanken AB	>0.1	<0.01	<0.01	>0.1	I(1) time series
United Kingdom	Barclays plc	>0.1	0.03	<0.01	>0.1	I(1) time series
	HSBC Holdings plc	>0.1	<0.01	0.01	>0.1	I(1) time series
	Lloyds Banking Group plc	>0.1	0.03	<0.01	>0.1	I(1) time series
	Royal Bank of Scotland Group plc	>0.1	0.05	>0.1	>0.1	Prices at least I(1)
	Standard Chartered	>0.1	<0.01	0.03	>0.1	I(1) time series

**Some of the series in returns seem to present a linear trend. Numbers after slash are the results with a linear time trend.*

Appendix B

Results for unit root and stationarity tests for scenario variables. Conclusions are based on a 95% confidence interval for both ADF and KPSS.

	GDP	UR	HICP	RPPI	LTIR
Austria	I(1) time series	Stationary differences	Non stationary levels	I(1) time series	I(1) time series
Belgium	I(1) time series	I(1) time series	I(1) time series	I(1) time series	Stationary differences
Cyprus	I(2) time series	I(1) time series	I(1) time series	I(1) time series	Non stationary levels
Germany	Trend-stationary	I(1) time series	I(1) time series	Non stationary levels	I(1) time series
Denmark	I(1) time series	I(1) time series	Non stationary levels	I(1) time series	Stationary differences
Spain	I(2) time series	Non stationary levels	Non stationary levels	I(2) time series	Non stationary levels
France	Non stationary levels	I(1) time series	I(1) time series	I(2) time series	I(1) time series
Greece	I(2) time series	Non stationary levels	Non stationary levels	I(2) time series	I(1) time series
Hungary	I(2) time series	Non stationary levels	I(2) time series	Non stationary levels	Stationary differences
Ireland	I(2) time series	Non stationary levels	I(2) time series	Non stationary levels	I(1) time series
Italy	I(1) time series	Non stationary levels	Non stationary levels	I(2) time series	I(1) time series
Netherlands	I(1) time series	I(1) time series	Non stationary levels	Non stationary levels	Stationary differences
Portugal	I(1) time series	I(1) time series	Non stationary levels	I(2) time series	I(1) time series
Sweden	I(1) time series	I(1) time series	Non stationary levels	Non stationary levels	I(1) time series
UK	Non stationary levels	I(1) time series	Non stationary levels	I(2) time series	I(1) time series

STIR	
3-months Euribor	I(1) time series
3-months Libor	I(1) time series

CPPI	
UK	I(1) time series
Europe	Non stationary levels

EX	
Euro	I(1) time series
Dollar	Non stationary levels
Danish crown	I(1) time series
Swdish krona	I(1) time series
Hungarian florint	I(1) time series

Results for GPH tests for fractional integration on variables that were I(2) or Non-stationary in levels for ADF and KPSS tests. GPH was used with variables in first differences.
Values represent: Order of integration (standard deviation) / p-value for H0: Stationarity

	GDP	UR	HICP	RPPI	LTIR
Austria			0.3 (0.18) / 0.109		
Belgium					
Cyprus	0.7 (0.15) / 0.000				0.3 (0.2) / 0.169
Germany				-0.05(0.18) / 0.775	
Denmark			0.18(0.19) / 0.3421		
Spain	0.85 (0.11) / 0.000	0.93 (0.17) / 0.000	-0.19 (0.35) / 0.611	1.38 (0.18) / 0.000	0.67 (0.32) / 0.064
France	0.47 (0.19) / 0.025			0.77 (0.15) / 0.000	
Greece	0.58 (0.15) / 0.001	0.88 (0.13) / 0.000	0.49 (0.15) / 0.004	0.86 (0.21) / 0.001	
Hungary	0.47 (0.18) / 0.019	0.51 (0.18) / 0.01	0.63 (0.19) / 0.005	0.02 (0.19) / 0.912	
Ireland	0.33 (0.19) / 0.096	0.53 (0.16) / 0.004	0.47 (0.15) / 0.007	0.7 (0.19) / 0.003	
Italy		0.47 (0.12) / 0.002	0.54 (0.32) / 0.111	0.68 (0.16) / 0.000	
Netherlands			0.42 (0.24) / 0.106	1.22 (0.17) / 0.000	
Portugal			0.53 (0.18) 0.009	0.86 (0.18) / 0.000	
Sweden			0.51 (0.24) / 0.048	0.52 (0.17) / 0.009	
UK	0.28 (0.13) / 0.05		0.75 (0.15) / 0.000	0.48 (0.26) / 0.088	

STIR	
3-months Euribor	
3-months Libor	

CPPI	
UK	
Rest of europe	0.91 (0.28) / 0.005

EX	
Euro	
Dollar	0.25 (0.16) / 0.147
Danish crown	
Swdish krona	
Hungarian florint	

Variance inflation factors (VIF) between macroeconomic variables in the same country. VIF takes values in [1, +inf). Values over 10 indicate a possible multicolinearity problem.

Levels	GDP	UR	HICP	RPPI	CPPI	STIR	LTIR	EX
Austria	50.42	5.75	176.13	42.56	34.27	8.01	10.6	7.23
Belgium	228.28	5.17	117.94	352.51	128.1	11.45	4.41	6.42
Cyprus	101.86	45.67	66.27	88.83	41.26	10.65	5.28	6.663
Germany	36.88	24.09	89	44.59	42.67	6.79	35.91	5.86
Denmark	39.76	9.16	35.84	22.29	23.12	17.71	8.03	5.42
Spain	217.76	150.83	137.81	147	128.92	21.06	4.2	7.30
France	161.6	8.9	152.79	50.51	67.23	12.22	13.86	6.19
Greece	60.89	64.08	67.6	49.32	39.87	3.91	9.92	5.89
Hungary	10.96	8.45	21.7	5.67	10.23	4.33	2.69	5.68
Ireland	75.97	26.2	84.33	19.29	34.27	3.9	3.17	8.17
Italy	21.1	44.72	79.69	83.27	56.17	8.53	3.38	7.14
Netherlands	48.15	9.96	63.56	15.27	13.84	8.94	11.71	2.42
Portugal	14.78	36.21	58.41	40.58	31.81	4.7	4.08	6.85
Sweden	94.12	4.97	172.84	91.53	103.62	35.78	10.75	3.08
UK	203.8	15.46	49.03	51.47	39.95	15.6	24.58	2.71

Variables in levels

Differences	GDP	UR	HICP	RPPI	CPPI	STIR	LTIR	EX
Austria	1.34	1.62	1.27	1.14	1.66	1.82	1.16	1.71
Belgium	4.71	1.45	1.79	2.14	1.81	3.95	1.39	1.95
Cyprus	2.35	1.7	1.19	1.84	2.25	1.86	1.22	2.63
Germany	3.43	1.97	1.43	1.15	3.49	3.02	1.87	2.21
Denmark	1.71	1.6	1.16	2.2	1.69	1.39	1.43	1.98
Spain	4.73	4.49	1.18	1.88	2.80	1.59	1.55	2.67
France	2.5	2.01	1.36	1.61	2.10	2.43	1.47	1.70
Greece	2.52	2.24	1.14	2.25	4.11	1.28	1.26	4.40
Hungary	1.96	1.5	1.45	1.17	1.74	1.91	1.35	2.05
Ireland	1.33	1.99	1.32	1.76	1.64	1.71	1.32	1.50
Italy	2.67	1.72	1.1	1.53	5.94	2.04	1.3	5.95
Netherlands	2.7	1.89	1.17	1.82	1.47	1.6	1.23	1.35
Portugal	1.71	1.42	1.45	1.7	1.95	1.64	1.18	1.84
Sweden	2.18	1.3	1.12	1.65	1.83	1.39	1.49	1.82
UK	1.82	1.91	1.27	1.67	1.79	2.19	1.44	1.59

Variables in first differences

Differences +3 lags	GDP	UR	HICP	RPPI	CPPI	STIR	LTIR	EX
Austria	4.9	2.8	4.34	3.5	9.75	5.89	2.978	2.40
Belgium	8.5	3.65	4.92	4.67	10.21	11.77	2.71	2.92
Cyprus	23.23	7.3	14.04	12.27	16.90	14.6	2.73	4.36
Germany	22.88	17.64	6.18	4.8	26.72	21.92	12.61	10.71
Denmark	5.8	4.5	6.01	15.2	9.10	6.12	3.5	2.96
Spain	56.23	17.57	11.05	12.15	8.76	8.49	3.72	2.98
France	9.95	7.72	9.27	17.23	10.62	14.23	3.54	6.31
Greece	5.59	10.39	13.74	11.2	10.98	7	4.83	2.78
Hungary	6.89	4.03	6.92	2.98	8.91	8.18	3.8	2.85
Ireland	8.4	6.71	6.33	15.74	12.48	17.39	6.01	4.19
Italy	6.96	6.17	17.58	8.01	9.53	7.39	2.49	2.46
Netherlands	6.05	7.07	3.13	8.85	8.20	8.53	3.28	3.02
Portugal	5.05	6.06	3.79	6.97	6.55	5.72	4.95	3.50
Sweden	7.06	6.78	7.83	5.53	11.43	11.01	3.45	3.60
UK	8.72	7.59	7.9	8.18	7.59	8.67	5.18	4.96

Maximum value for each group of lags for variable in differences and 3 lags.

Correlations between real variables and between price variables for each country. Variables in first differences.

	GDP - UR		HICP - RPPI	HICP - CPPI	RPPI -CPPI
Austria	-0.2		-0.16	0.02	-0.02
Belgium	-0.23		-0.02	0.22	0.49
Cyprus	-0.6		0.1	0.11	0.41
Germany	-0.37		0.11	0.24	0.06
Denmark	-0.28		0.17	0.12	0.55
Spain	-0.82		0.27	0.14	0.35
France	-0.53		0.19	0.15	0.56
Greece	-0.64		0.3	0.12	0.44
Hungary	-0.34		0.19	0.17	0.04
Ireland	-0.34		0.37	0.43	0.53
Italy	-0.43		0.1	0.04	0.41
Netherlands	-0.6		0.04	0.05	0.58
Portugal	-0.5		0.27	0.32	0.38
Sweden	-0.36		-0.01	-0.01	0.41
UK	-0.53		0.07	0.03	0.29

Appendix C

Correlations between stock returns and variables in differences lagged one period.

Country	Institution	ΔlnGDP(-1)	ΔUR(-1)	ΔlnHICP(-1)	ΔlnRPPI(-1)	ΔlnCPPI(-1)
Austria	Erste Group Bank	0.12	0.22	-0.08	-0.13	-0.13
Belgium	Fortis	-0.1	-0.07	-0.23	-0.12	-0.09
	Dexia NV	0.26	-0.11	-0.25	0.18	0.34
Cyprus	Bank of Cyprus Public Company Ltd	0.07	-0.12	-0.17	0.15	0.05
Germany	Aareal Bank AG	-0.09	0.17	-0.11	-0.14	-0.11
	Commerzbank AG	0	0.21	-0.02	-0.16	-0.01
	Deutsche Bank AG	-0.26	0.24	-0.17	-0.13	-0.06
	Hypo Real Estate Holding AG	0.43	-0.34	-0.16	-0.24	0.13
	IKB Deutsche Industrielbank AG	0.05	0.37	-0.24	-0.17	-0.03
	Wüstenrot & Würtembergische AG	0.03	-0.06	-0.22	-0.34	-0.20
Denmark	Danske Bank	0.2	-0.04	0.05	0.44	-0.02
	Jyske Bank	0.02	0.02	-0.29	0.27	-0.09
	Sydbank	-0.02	0.08	-0.2	0.18	-0.07
Spain	BBVA	0.09	-0.13	-0.04	-0.03	-0.02
	Banco Popular Español	0.32	-0.33	-0.01	0.23	0.15
	Banco Santander	0.12	-0.19	-0.06	-0.01	-0.02
	Banco Sabadell	0.14	-0.08	0.1	0.14	0.08
	Bankinter	0.03	-0.13	-0.08	-0.03	-0.07
France	BNP Paribas	0.11	0.2	-0.05	-0.03	-0.08
	Groupe Crédit Agricole	-0.09	0.27	-0.16	-0.06	-0.06
	Natixis	0.16	0.14	-0.14	-0.01	-0.07
	Société Générale	0.15	0.18	-0.17	-0.01	-0.05
Greece	Alpha Bank	0.17	-0.07	0.07	0.02	-0.08
	Eurobank Eregasias	0.18	-0.11	0.08	0.23	0.04
	National Bank of Greece	0.25	-0.15	0.09	0.21	0.00
	Piraeus Bank	0.2	-0.12	0.06	0.1	-0.04
	Agricultural Bank of Greece SA	0.29	-0.4	0.04	0.28	-0.06
Hungary	OTP Bank Ltd	0.11	0.14	0.24	-0.09	-0.13
Ireland	Allied Irish Banks plc	0.28	-0.23	0.01	0.34	0.01
	The Governor and Company of the Bank of Ireland	0.32	-0.25	-0.05	0.24	-0.04
Italy	Banca Carige SPA - Cassa di Risparmio di Genova e Imperia	0.09	-0.32	0.07	0.28	0.02
	Banca Monte dei Paschi di Siena SpA	0.15	-0.26	0.1	0.24	-0.05
	Banca Piccolo Credito Valtellinese	0.06	-0.35	0.04	0.15	0.05
	Banca Popolare Dell'Emilia Romagna	0.09	-0.2	-0.1	0.19	-0.02
	Banca Popolare Di Milano - SCRL	-0.02	0.04	0.1	0.08	0.07
	Banco Popolare - Società Cooperativa	0.11	0.05	0.08	0.11	-0.02
	Credito Emiliano SpA	0.1	0.03	-0.09	-0.03	-0.07
	Intesa Sanpaolo SpA	0.14	-0.04	-0.09	-0.04	-0.12
	Mediobanca - Banca di Credito Finanziario SpA	0.07	-0.21	-0.14	-0.07	-0.08
	Unicredit SpA	0.11	-0.05	-0.15	0.05	0.01
Netherlands	ING Bank NV	0.01	0.03	0.07	-0.03	0.00
Portugal	Banco BPI	-0.15	0.11	-0.15	-0.22	-0.14
	Banco Comercial Português	0.04	0.08	-0.24	-0.06	-0.03
	Espirito Santo Financial Group SA	0.06	0.02	0.01	-0.22	-0.09
Sweden	Nordea Bank AB	0	0.09	-0.15	0.02	-0.10
	Swedbank AB	0.07	0.14	-0.14	0.09	-0.16
	Svenska Handelsbanken AB	0.24	0.09	-0.09	0.11	-0.04
UK	Barclays plc	0.06	0	-0.13	0.04	-0.13
	HSBC Holdings plc	0.08	0.13	-0.05	-0.01	0.00
	Lloyds Banking Group plc	0.4	-0.31	-0.19	0.22	0.08
	Royal Bank of Scotland Group plc	0.33	-0.15	-0.16	0.16	0.00
	Standard Chartered	0.11	0.15	-0.09	-0.09	0.00

Results of the OLS model in differences, showing the R^2 of regression and significance of individual variables at a 90% confidence interval and the sign of the coefficient. Column Rho indicates the value of the first order autocorrelation of residuals. Last column indicates the p-value of a F-test for global significance of the model.

Country	Institution	R^2	Rho	GDP	UR	HICP	RPPI	CPPI	STIR	LTIR	EX	Global significance p-value
Austria	Erste Group Bank	0.2	0.14	+								0.170
Belgium	Fortis	0.47	0.14	+					-			0.000
	Dexia NV	0.7	0.07	+			+		-			0.001
Cyprus	Bank of Cyprus Public Company Ltd	0.25	0.11							-		0.105
Germany	Aareal Bank AG	0.62	-0.06	+	+				-	+		0.000
	Commerzbank AG	0.57	0.06	+	+					+		0.000
	Deutsche Bank AG	0.58	-0.14	+	+		-		-	+		0.000
	Hypo Real Estate Holding AG	0.25	-0.1									0.810
	IKB Deutsche Industrielbank AG	0.44	0.19	+	+	-				+		0.003
	Wüstenrot & Würtembergische AG	0.28	-0.17	+		-			-	+		0.104
Denmark	Danske Bank	0.33	0				+					0.016
	Jyske Bank	0.53	-0.08				+					0.002
	Sydbank	0.51	-0.12				+		+	+		0.000
Spain	BBVA	0.23	0.03		-							0.086
	Banco Popular Español	0.34	-0.14			-						0.004
	Banco Santander	0.25	0.22		-							0.053
	Banco Sabadell	0.19	0.07						+			0.182
	Bankinter	0.25	-0.1		-							0.059
France	BNP Paribas	0.19	0.16									0.191
	Groupe Crédit Agricole	0.27	0.07			-					+	0.080
	Natixis	0.3	0.24	+								0.015
	Société Générale	0.27	0.15	+								0.030
Greece	Alpha Bank	0.22	0.04	+								0.020
	Eurobank Eregasias	0.17	0	+								0.250
	National Bank of Greece	0.18	0.07	+								0.223
	Piraeus Bank	0.24	-0.11	+								0.073
	Agricultural Bank of Greece SA	0.38	0.15									0.013
Hungary	OTP Bank Ltd	0.64	0.02	+		+			+	-	-	0.000
Ireland	Allied Irish Banks plc	0.35	0.17						+	-		0.005
	The Governor and Company of the Bank of Ireland	0.33	0.14						+	-		0.015
Italy	Banca Carige SPA - CdR di Genova e Imperia	0.36	0.01		-				-		+	0.002
	Banca Monte dei Paschi di Siena SpA	0.36	0.14		-					-		0.003
	Banca Piccolo Credito Valtellinese	0.3	-0.26		-					-		0.019
	Banca Popolare Dell'Emilia Romagna	0.22	0.17							-		0.122
	Banca Popolare Di Milano - SCRL	0.23	0.09							-		0.084
	Banco Popolare - Società Cooperativa	0.34	0.09					-	+	-		0.000
	Credito Emiliano SpA	0.32	0.04	+						-	-	0.001
	Intesa Sanpaolo SpA	0.22	0.12						+			0.122
	Mediobanca - Banca di Credito Finanziario SpA	0.22	0.21		-					-		0.111
	Unicredit SpA	0.33	0.19	+								0.008
Netherlands	ING Bank NV	0.3	0.14							+		0.000
Portugal	Banco BPI	0.32	0.09	+						-		0.011
	Banco Comercial Português	0.3	0.16	+						-		0.017
	Espirito Santo Financial Group SA	0.28	-0.2	+				+	+			0.037
Sweden	Nordea Bank AB	0.4	0.18				+		+	+		0.001
	Swedbank AB	0.44	0.07						+	+		0.000
	Svenska Handelsbanken AB	0.35	0.09				+	-	+	+		0.004
UK	Barclays plc	0.44	0.02	+				+		+		0.000
	HSBC Holdings plc	0.32	0.22							+		0.008
	Lloyds Banking Group plc	0.52	0.07	+				+		+		0.000
	Royal Bank of Scotland Group plc	0.57	0.06	+				+		+		0.000
	Standard Chartered	0.25	0.08	+								0.058

Results of the OLS model in differences separating riskless rate and sovereign rate premium, showing the R^2 of regression and significance of individual variables at a 90% confidence interval and the sign of the coefficient. Column Rho indicates the value of the first order autocorrelation of residuals. Last column indicates the p-value of a F-test for global significance of the model.

Country	Institution	R^2	Rho	GDP	UR	HICP	RPPI	CPPI	STIR	r	Spread	EX	Global significance p-value
Austria	Erste Group Bank	0.65	-0.01							+	-		0.000
Belgium	Fortis	0.57	0.13	+					-	+			0.000
	Dexia NV	0.75	0.05	+					-	+			0.000
Cyprus	Bank of Cyprus Public Company Ltd	0.38	0.09										0.013
Denmark	Danske Bank	0.35	0.04				+						0.017
	Jyske Bank	0.6	-0.1				+			+			0.001
	Sydbank	0.63	-0.17		+		+			+	-		0.000
Spain	BBVA	0.4	-0.03		-					+			0.002
	Banco Popular Español	0.45	0.14			-				+			0.001
	Banco Santander	0.4	0.24		-					+			0.000
	Banco Sabadell	0.21	0.07						+				0.185
	Bankinter	0.43	-0.12								-		0.001
France	BNP Paribas	0.45	0.15							+	-		0.000
	Groupe Crédit Agricole	0.27	0.07			-						+	0.123
	Natixis	0.43	0.22	+							-		0.001
	Société Générale	0.55	-0.05	+						+	-		0.000
Greece	Alpha Bank	0.3	0.01	+						+			0.027
	Eurobank Eregasias	0.2	-0.02	+									0.220
	National Bank of Greece	0.28	0.05	+						+			0.047
	Piraeus Bank	0.32	-0.13	+						+			0.017
	Agricultural Bank of Greece SA	0.47	0.09							+			0.003
Hungary	OTP Bank Ltd	0.74	-0.06	+		+					-		0.000
Ireland	Allied Irish Banks plc	0.52	0.11							+	-	+	0.000
	The Governor and Company	0.43	0.03								-		0.000
Italy	Banca Carige SPA	0.41	0.09						-	+		+	0.006
	Banca Monte dei Paschi di Siena SpA	0.55	0.13								-		0.000
	Banca Piccolo Credito Valtellinese	0.36	-0.22		-						-		0.006
	Banca Popolare Dell'Emilia Romagna	0.33	0.17								-		0.017
	Banca Popolare Di Milano - SCRL	0.41	0.07								-		0.001
	Banco Popolare - Società Cooperativa	0.52	-0.04						+		-		0.000
	Credito Emiliano SpA	0.57	0.03	+						+	-		0.000
	Intesa Sanpaolo SpA	0.49	0.16							+	-		0.000
	Mediobanca	0.32	0.23								-		0.009
	Unicredit SpA	0.57	0.13	+						+	-		0.000
Netherlands	ING Bank NV	0.59	0.08							+	-		0.000
Portugal	Banco BPI	0.48	0.02							+	-		0.000
	Banco Comercial Português	0.46	0.02	+						+	-		0.000
	Espirito Santo Financial Group SA	0.33	-0.24			-						+	0.017
Sweden	Nordea Bank AB	0.39	0.14						+	+			0.003
	Swedbank AB	0.42	0.1						+	+			0.001
	Svenska Handelsbanken AB	0.34	0.13						+	+		+	0.014
UK	Barclays plc	0.46	0.06	+						+		+	0.000
	HSBC Holdings plc	0.33	0.22							+			0.012
	Lloyds Banking Group plc	0.53	0.04	+	-					+		+	0.000
	Royal Bank of Scotland Group plc	0.57	0.07	+						+		+	0.000
	Standard Chartered	0.29	0.11	+						+			0.038

Results of the OLS model in differences with lags and sequential omission. Models with 0, 1, 2 and 3 lags after sequential omission of variables. Better model by different criteria. For the chosen number of lags we show R^2 of regression and significance of individual variables at a 90% confidence interval. Column Rho indicates the value of the first order autocorrelation of residual.

		Number of lags (0-3)			
		Adjusted R^2	Akaike Criterion	Schwarz Criterion	Decision
Austria	Erste Group Bank	3	3	2	3
Belgium	Fortis	2	3	3	3
	Dexia NV	2	2	1	2
Cyprus	Bank of Cyprus Public Company Ltd	3	3	3	3
Germany	Aareal Bank AG	3	3	2	3
	Commerzbank AG	3	3	3	3
	Deutsche Bank AG	2	2	2	2
	IKB Deutsche Industrielbank AG	3	3	3	3
	Wüstenrot & Würtembergische AG	3	3	3	3
Denmark	Danske Bank	3	3	3	3
	Jyske Bank	3	3	2	3
	Sydbank	3	3	2	3
Spain	BBVA	2	2	1	2
	Banco Popular Español	3	3	0	3
	Banco Santander	3	3	3	3
	Banco Sabadell	3	3	2	3
	Bankinter	3	1	1	1
France	BNP Paribas	3	3	2	3
	Groupe Crédit Agricole	3	3	3	3
	Natixis	3	3	3	3
	Société Générale	3	3	2	3
Greece	Alpha Bank	2	2	2	2
	Eurobank Eregasias	3	3	3	3
	National Bank of Greece	2	3	3	3
	Piraeus Bank	2	2	2	2
	Agricultural Bank of Greece SA	3	3	2	3
Hungary	OTP Bank Ltd	3	3	2	3
Ireland	Allied Irish Banks plc	2	2	2	2
	The Governor and Company of the Bank of Ireland	3	3	2	3
Italy	Banca Carige SPA - CdR di Genova e Imperia	2	2	2	2
	Banca Monte dei Paschi di Siena SpA	3	3	3	3
	Banca Piccolo Credito Valtellinese	3	3	3	3
	Banca Popolare Dell'Emilia Romagna	3	3	2	3
	Banca Popolare Di Milano - SCRL	2	2	1	2
	Banco Popolare - Società Cooperativa	3	3	1	3
	Credito Emiliano SpA	2	2	2	2
	Intesa Sanpaolo SpA	3	3	3	3
	Mediobanca - Banca di Credito Finanziario SpA	2	2	2	2
	Unicredit SpA	2	2	2	2
Netherlands	ING Bank NV	3	3	2	3
Portugal	Banco BPI	3	3	0	3
	Banco Comercial Português	3	3	2	3
	Espirito Santo Financial Group SA	3	3	1	3
Sweden	Nordea Bank AB	3	3	2	3
	Swedbank AB	3	3	3	3
	Svenska Handelsbanken AB	3	3	2	3
United Kingdom	Barclays plc	3	3	1	3
	HSBC Holdings plc	3	3	2	3
	Lloyds Banking Group plc	3	3	3	3
	Royal Bank of Scotland Group plc	3	3	2	3
	Standard Chartered	3	3	3	3

Results of the OLS model in differences with lags and sequential omission. Models with 0, 1, 2 and 3 lags after sequential omission of variables. For the chosen number of lags we show R^2 of regression and significance of individual variables at a 90% confidence interval. Column Rho indicates the value of the first order autocorrelation of residual.

		R^2	Rho	GDP	UR	HICP	RPPI	CPPI	STIR	LTIR	EX
Austria	Erste Group Bank	0.81	-0.03	+	+	-		-	+	-	+
Belgium	Fortis	0.72	-0.04	+	-		-	0	0	-	0
	Dexia NV	0.82	0.1		-	-	-	0	0	-	0
Cyprus	Bank of Cyprus Public Company Ltd	0.76	-0.37			-	+	+	-	-	
Germany	Aareal Bank AG	0.81	0.09	-	+	-	-	-	+	-	-
	Commerzbank AG	0.78	-0.01	+	+	-		+	+	0	+
	Deutsche Bank AG	0.71	-0.19	+		-	+	+	-	+	
	IKB Deutsche Industrielbank AG	0.7	-0.03	+	+	-	+			+	-
	Wüstenrot & Würtembergische AG	0.86	-0.06	+	+	-	+	+	-	+	+
Denmark	Danske Bank	0.57	-0.07		+	-	+				+
	Jyske Bank	0.76	-0.16	0	+	-	+	-	+	-	+
	Sydbank	0.84	-0.16	0	+	-	+		0	-	+
Spain	BBVA	0.53	-0.1	+	-		-		-		
	Banco Popular Español	0.71	-0.31	-	0	-	+	+	+	-	+
	Banco Santander	0.69	0.23	+	-	-	-	+	-	0	
	Banco Sabadell	0.32	-0.01		0		+		+	-	
	Bankinter	0.54	-0.2		-	-	0		0	0	
France	BNP Paribas	0.53	0.03		+	-			+	-	+
	Groupe Crédit Agricole	0.57	-0.12			-	0	-		+	+
	Natixis	0.85	0.47	-	-	-	+	+			+
	Société Générale	0.62	0.09	+		-	0		-	-	
Greece	Alpha Bank	0.56	0.02	+	-		-	+	-	+	0
	Eurobank Eregasias	0.61	-0.7	+	-				-	+	-
	National Bank of Greece	0.51	0.2		-			0	-	+	
	Piraeus Bank	0.5	0	+	0			+	-		-
	Agricultural Bank of Greece SA	0.73	0.22	+	-	+	-	+	+	-	-
Hungary	OTP Bank Ltd	0.85	0.11	+		+	+		-	-	0
Ireland	Allied Irish Banks plc	0.82	-0.02	+	-	-	+	0	-	-	+
	The Governor and Company of the Bank of Ireland	0.86	0	-	0	-	+	+	-	-	
Italy	Banca Carige SPA - CdR di Genova e Imperia	0.61	-0.05	+	-			+	-	+	+
	Banca Monte dei Paschi di Siena SpA	0.81	0.09		-	0	0	+		-	
	Banca Piccolo Credito Valtellinese	0.63	-0.34	0	-	-			+	-	+
	Banca Popolare Dell'Emilia Romagna	0.35	0.1			-	+		0	-	
	Banca Popolare Di Milano - SCRL	0.61	0			-	+	+	0	-	
	Banco Popolare - Società Cooperativa	0.82	0.03	+	+	-	+	+	0	+	+
	Credito Emiliano SpA	0.74	-0.08	+	+	-	+	+	-	+	+
	Intesa Sanpaolo SpA	0.75	0.08	-	+	-	+	+	+	+	+
	Mediobanca - Banca di Credito Finanziario SpA	0.84	0.19		-	-			0	-	+
	Unicredit SpA	0.84	-0.03		-	-		+	-	-	+
Netherlands	ING Bank NV	0.78	-0.24		+	-	0	+	+	+	0
Portugal	Banco BPI	0.74	0	0	0	-	0	+	0	-	0
	Banco Comercial Português	0.45	0.04	+		-					+
	Espirito Santo Financial Group SA	0.58	0	+	+	-	0	+	+	0	+
Sweden	Nordea Bank AB	0.68	-0.03			-			-	-	+
	Swedbank AB	0.84	-0.08	+	+	-	-		+	-	
	Svenska Handelsbanken AB	0.73	0	-	-	-			+	-	
United Kingdom	Barclays plc	0.67	-0.03			-	-		-		+
	HSBC Holdings plc	0.74	0.06		-		-	-	+	-	
	Lloyds Banking Group plc	0.6	0.12	+	0	-	-			+	+
	Royal Bank of Scotland Group plc	0.81	-0.11	+		-	0		-	-	+
	Standard Chartered	0.58	-0.06	+	+	-	-	-	+		-

Results of individual VECM models. Marked variables indicate significance at a 90% confidence interval for error correction terms that include said variable.

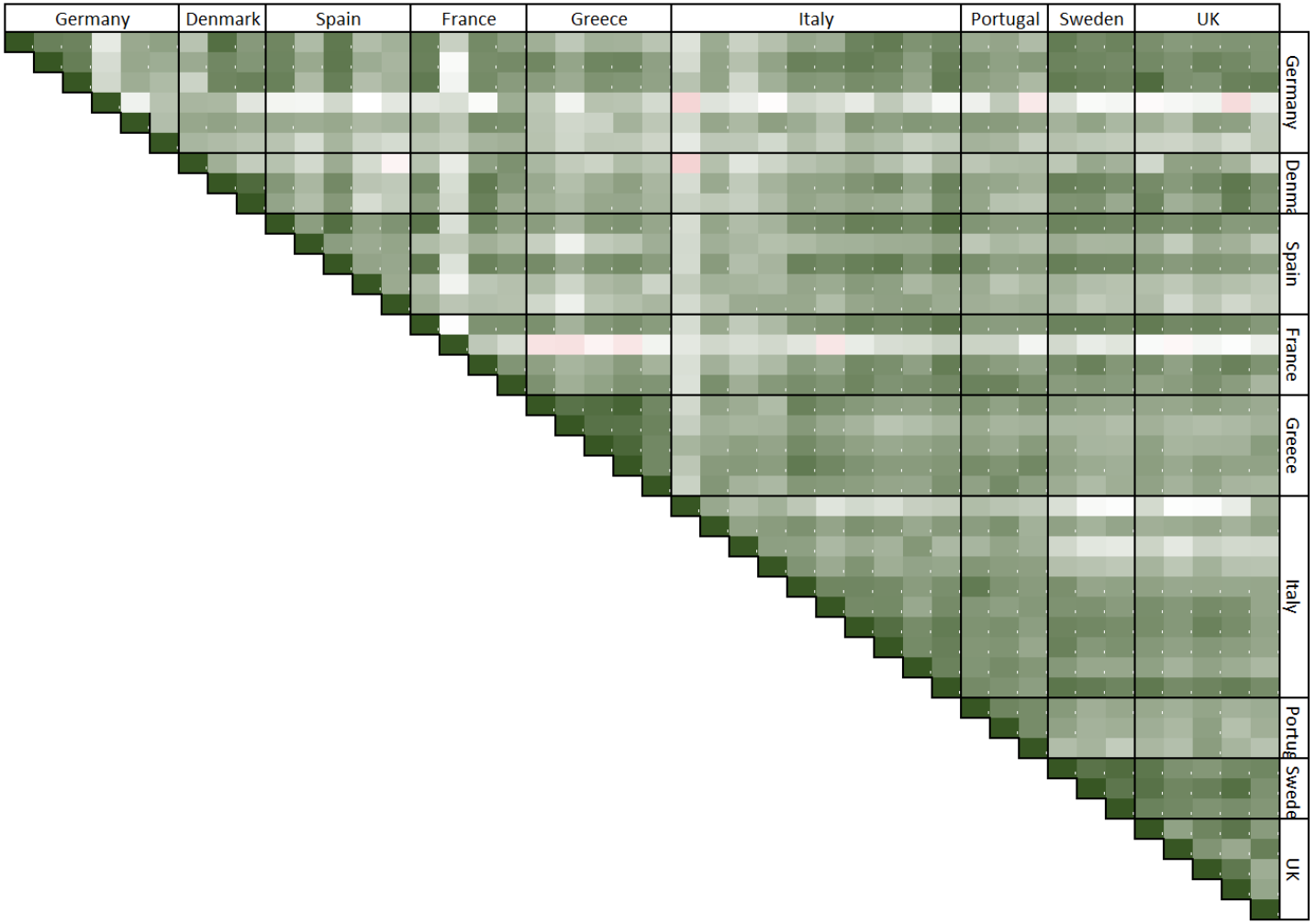
Country	Institution	Matrix range	#lags		GDP	UR	HICP	RPPI	CPPI	STIR	LTIR	EX
Austria	Erste Group Bank	1	3		-		+				-	+
Belgium	Fortis	1	4				+		+	+		
Cyprus	Bank of Cyprus Public Company Ltd	3	4			+			+	-	-	+
Germany	Aareal Bank AG	6	3		+	+	+				+	
	Commerzbank AG	4	3		-	-		+				+
	Deutsche Bank AG	2	3			-	+	+	-			-
	IKB Deutsche Industrielbank AG	2	3		-	-	+				-	+
	Wüstenrot & Würtembergische AG	3	4		-	+		-				
Denmark	Danske Bank	2	4		+	-			-		+	-
	Sydbank	6	2					-				-
Spain	BBVA	2	4							+	-	
	Banco Popular Español	5	2				-	+	+	+		
	Banco Santander	3	4							-	+	
	Banco Sabadell	4	4			+				-	+	
	Bankinter	8	3		-	+	+					
France	BNP Paribas	6	4		+	+	+		-		-	-
	Groupe Crédit Agricole	3	3		+		+		+		+	-
	Natixis	5	1			-					-	
	Société Générale	2	4		-	+	+					-
Greece	Alpha Bank	4	3		-		+			+	+	-
	Eurobank Eregasias	5	4				-	+			+	
	National Bank of Greece	3	3							-	-	
	Piraeus Bank	5	3		+					+	-	+
	Agricultural Bank of Greece SA	3	3					+	+		-	
Hungary	OTP Bank Ltd	5	3				+	+		+	+	+
Ireland	Allied Irish Banks plc	3	3		+			-			-	-
	The Governor and Company of the Bank of Ireland	3	3				-	+			-	
Italy	Banca Carige SPA - CdR di Genova e Imperia	5	2		+	-	+	-	-		+	+
	Banca Monte dei Paschi di Siena SpA	5	2			-	+	-		+	-	
	Banca Piccolo Credito Valtellinese	4	4				+			-		
	Banca Popolare Dell'Emilia Romagna	1	4									
	Banca Popolare Di Milano - SCRL	5	4					+	+	+	-	-
	Banco Popolare - Società Cooperativa	4	2		-	+	+	+		-	-	
	Credito Emiliano SpA	5	3		+				-	-		
	Unicredit SpA	4	5		-			-				+
Netherlands	ING Bank NV	3	2		-	-	+				+	
Portugal	Banco BPI	4	1		+	+	+		-	+	-	
	Banco Comercial Português	3	4		+		+			-		
	Espirito Santo Financial Group SA	4	2				+		+	-	-	-
Sweden	Nordea Bank AB	4	4		+	-						
	Swedbank AB	2	4			-		-				
UK	Barclays plc	6	4		-		+	+		+	+	+
	HSBC Holdings plc	6	4		-		+	-				
	Lloyds Banking Group plc	3	3		-		+	+			+	+
	Royal Bank of Scotland Group plc	7	4		+		+	+			+	
	Standard Chartered	4	4		+		+	-	-			

Results of individual VECM models. Marked variables for lags indicate group significance for all lags at a 90% confidence interval. Column AR refers to stock returns' lags. Right arrows indicates the variable granger-causes returns, left arrows indicate returns cause the variable.

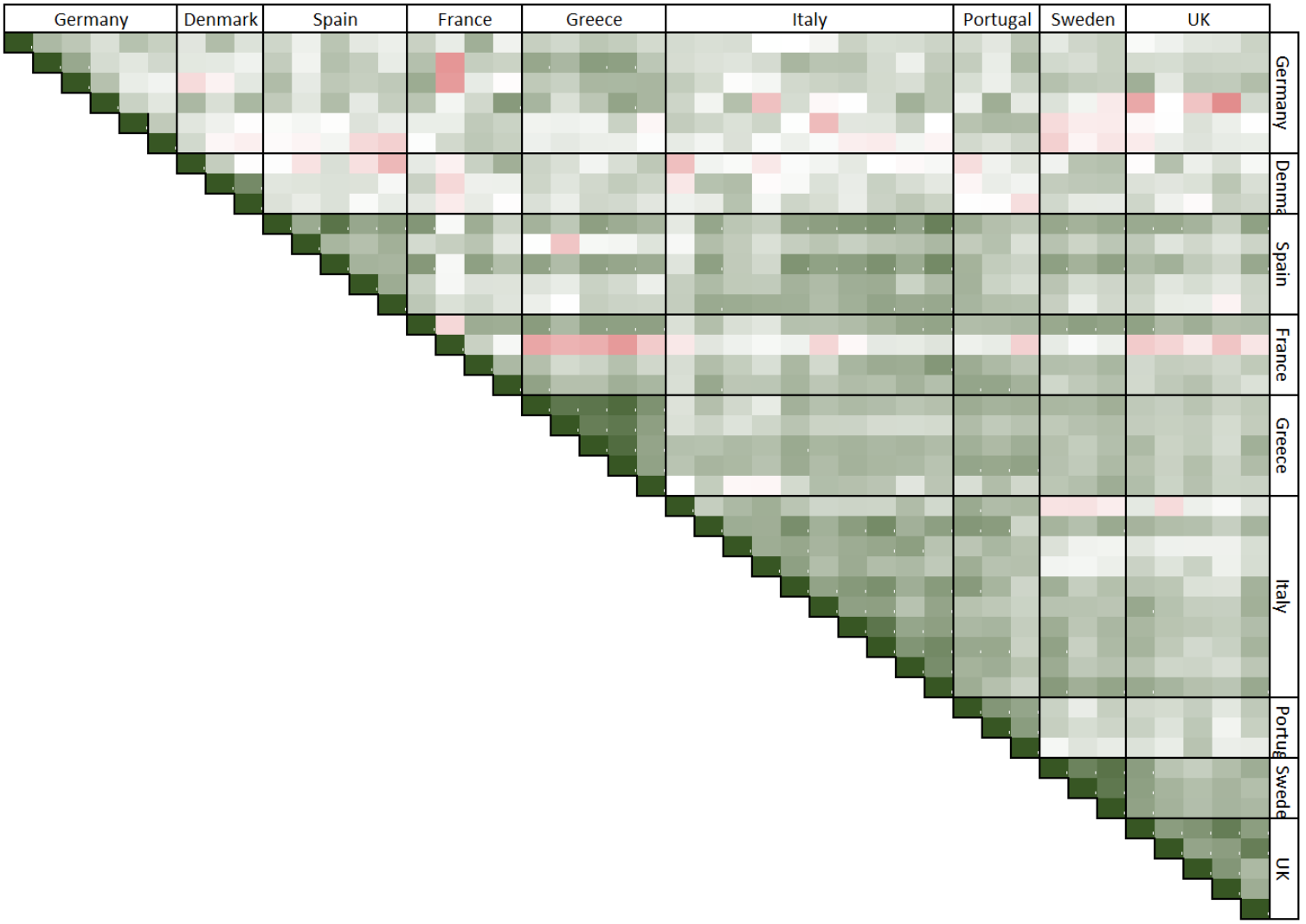
Country	Institution	R^2		GDP	UR	HICP	RPPI	STIR	LTIR	CPPI	EX	Rho
Austria	Erste Group Bank	0.71			->		->	->	->			-0.02
Belgium	Fortis	0.87				->	<-	->		->		-0.08
Cyprus	Bank of Cyprus Public Company Ltd	0.76							->	->	->	0.07
Germany	Aareal Bank AG	0.88										-0.05
	Commerzbank AG	0.8		->				->	->			0.03
	Deutsche Bank AG	0.87		->			->				->	-0.02
	IKB Deutsche Industrielbank AG	0.58			<->							0
	Wüstenrot & Würtembergische AG	0.93		->	->		->	->	->			-0.06
Denmark	Danske Bank	0.87		->	->			->			->	-0.16
	Sydbank	0.82		->	->	->	->	->				0.08
Spain	BBVA	0.61		->						->		0
	Banco Popular Español	0.64		->	->		->			->		0.04
	Banco Santander	0.72		->		->						0
	Banco Sabadell	0.73			->			->	->	->		-0.03
	Bankinter	0.47				->		->	<-			-0.04
France	BNP Paribas	0.88			->	->		->		->	->	-0.09
	Groupe Crédit Agricole	0.62		->		->		->		->	->	-0.05
	Natixis	0.63					->			->	->	-0.02
	Société Générale	0.79		->		->					->	-0.04
Greece	Alpha Bank	0.71		->					->		->	0.05
	Eurobank Eregasias	0.84				->	->			->		-0.02
	National Bank of Greece	0.53		->					->	->		-0.07
	Piraeus Bank	0.74		<-					->	->	->	-0.07
	Agricultural Bank of Greece SA	0.87						->		->		-0.02
Hungary	OTP Bank Ltd	0.85			->	->	->		->	->		-0.09
Ireland	Allied Irish Banks plc	0.78		->		->	<->			<->	->	-0.08
	The Governor and Compan<- of the Bank of Ireland	0.86			->		->			->		-0.06
Italy	Banca Carige SPA - CdR di Genova e Imperia	0.78			->	->		->			->	-0.05
	Banca Monte dei Paschi di Siena SpA	0.76				->	->	->	->		->	0.06
	Banca Piccolo Credito Valtellinese	0.92		->	->	->		->				0.06
	Banca Popolare Dell'Emilia Romagna	0.61							->			-0.08
	Banca Popolare Di Milano - SCRL	0.97				->		->	->	->	->	-0.11
	Banco Popolare - Società Cooperativa	0.69		->	<->			->	->	->	->	-0.06
	Credito Emiliano SpA	0.84							->			-0.08
	Unicredit SpA	0.81		->			->					0.03
Netherlands	ING Bank NV	0.61		->						->	->	-0.02
Portugal	Banco BPI	0.46		->				->		->		-0.03
	Banco Comercial Português	0.83		->	->	->			->			-0.07
	Espirito Santo Financial Group SA	0.67						->	->			-0.02
Sweden	Nordea Bank AB	0.75		->	<->				<-			-0.07
	Swedbank AB	0.92				->				->	->	0
United Kingdom	Barclays plc	0.84			->	->	->		->	->	->	0
	HSBC Holdings plc	0.89					->					-0.06
	Lloyds Banking Group plc	0.66		->		->					->	-0.08
	Royal Bank of Scotland Group plc	0.92				<-	->	->			->	0
	Standard Chartered	0.73		->				->				0

Appendix D

Correlation between returns, countries with 3 or more banks.
Green: Positive correlation.
Red: Negative correlation.
White: No correlation.



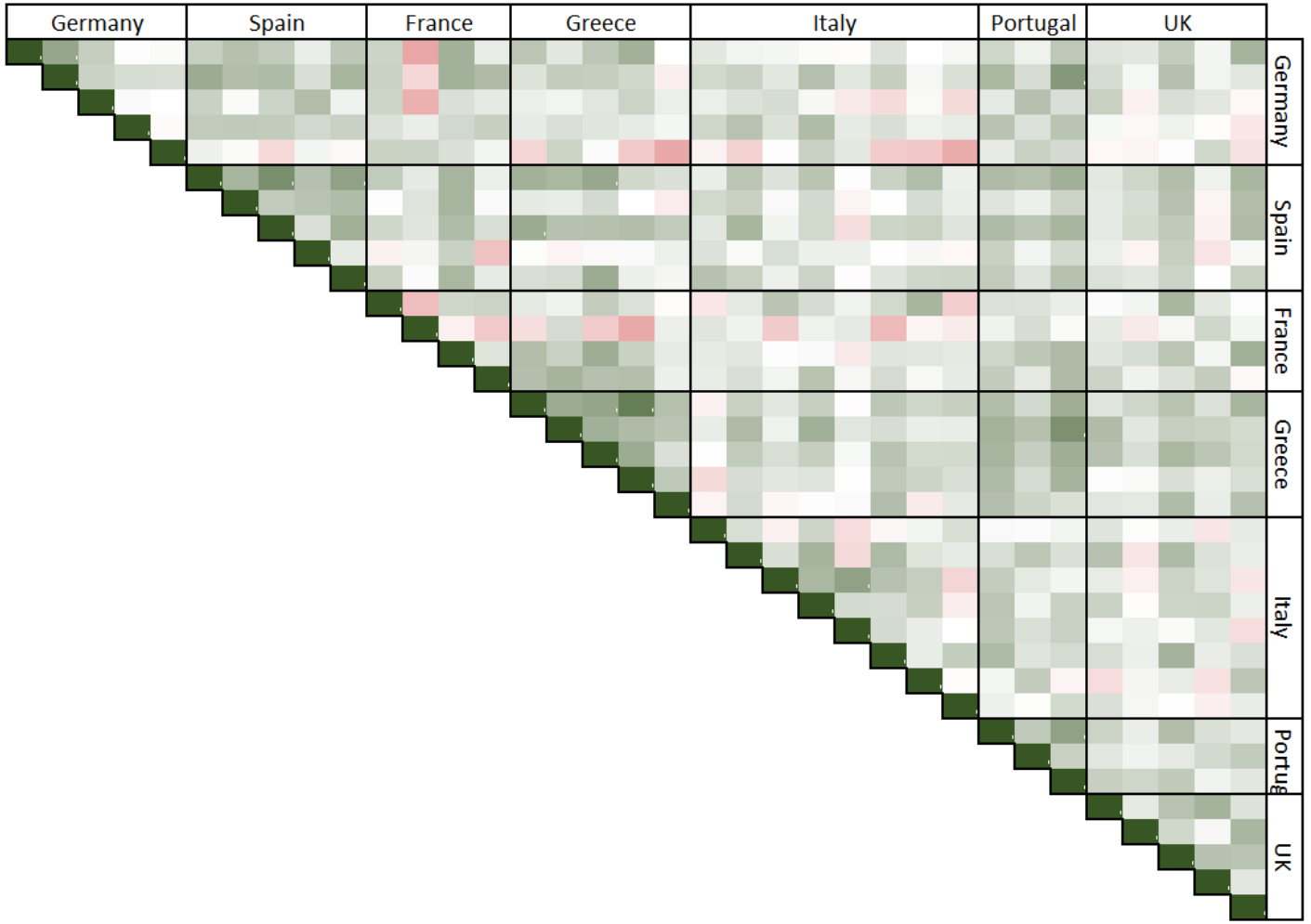
Correlation between residuals for the OLS in first differences with no lags. Countries with 3 or more banks.
Green: Positive correlation.
Red: Negative correlation.
White: No correlation.



Correlation between residuals for the OLS in first differences with lags after sequential omission. Countries with 3 or more banks.
Green: Positive correlation.
Red: Negative correlation.
White: No correlation.

Correlation between residuals for the OLS in first differences with lags before sequential omission. Countries with 3 or more banks.
Green: Positive correlation.
Red: Negative correlation.
White: No correlation

Correlation between residuals for the VECM. Countries with 3 or more banks.
Green: Positive correlation.
Red: Negative correlation.
White: No correlation.



Appendix E

Results for predictive power of models using RMSD (Root mean square deviation) and U-Theil for predicting variables in levels. Model estimated with data until 2010Q4 and predictions made from 2011Q1 to 2014Q4

			No lags		Lags		Lags and omission	
Country	Institution	St. Dev	RMSD	Theil U	RMSD	Theil U	RMSD	Theil U
Austria	Erste Group Bank	0.21	0.24	0.73	0.39	7.48	0.48	8.08
Belgium	Fortis	0.36	0.42	2.90	0.91	6.03	0.94	5.05
	Dexia NV	0.21	-	-	-	-	-	-
Cyprus	Bank of Cyprus Public Company Ltd	0.26	0.38	1.14	0.65	1.32	0.44	1.28
Germany	Aareal Bank AG	0.30	0.16	0.65	0.31	6.39	0.32	4.38
	Commerzbank AG	0.25	0.21	0.88	0.33	0.85	0.24	0.82
	Deutsche Bank AG	0.21	0.10	1.23	0.32	3.06	0.14	1.24
	IKB Deutsche Industrielbank AG	0.23	0.27	0.96	0.31	0.65	0.29	0.87
	Wüstenrot & Würtembergische AG	0.12	0.07	1.04	0.14	0.88	0.12	0.20
Denmark	Danske Bank	0.17	0.15	1.11	0.31	2.16	0.12	0.89
	Jyske Bank	0.17	0.13	1.08	-	-	-	-
	Sydbank	0.16	0.13	1.41	0.16	1.41	0.08	0.75
Spain	BBVA	0.15	0.15	1.07	0.26	2.11	0.19	1.51
	Banco Popular Español	0.13	0.19	1.03	0.27	1.50	0.26	1.46
	Banco Santander	0.13	0.12	1.17	0.21	2.09	0.15	1.46
	Banco Sabadell	0.14	0.14	1.05	0.44	2.77	0.26	1.47
	Bankinter	0.15	0.24	1.18	0.24	1.40	0.24	1.30
France	BNP Paribas	0.15	0.14	0.97	0.50	3.46	0.23	3.05
	Groupe Crédit Agricole	0.18	0.21	1.12	-	-	-	-
	Natixis	0.23	0.16	1.00	0.68	4.39	0.65	4.16
	Société Générale	0.16	0.21	1.05	0.22	1.14	0.43	1.17
Greece	Alpha Bank	0.27	0.47	1.24	1.04	2.40	1.21	2.31
	Eurobank Eregasias	0.34	0.60	1.15	1.19	2.32	1.48	2.56
	National Bank of Greece	0.26	0.55	1.32	1.32	5.07	1.46	3.91
	Piraeus Bank	0.30	0.49	0.59	1.50	2.37	1.45	2.69
	Agricultural Bank of Greece SA	0.25	0.43	0.79	1.33	1.04	1.18	0.93
Hungary	OTP Bank Ltd	0.23	0.22	1.41	-	-	-	-
Ireland	Allied Irish Banks plc	0.33	0.45	1.15	0.27	0.05	0.37	0.74
	The Governor and Company of the Bank of Ireland	0.34	0.35	1.16	0.53	1.81	0.56	1.89
Italy	Banca Carige SPA - CdR di Genova e Imperia	0.16	0.16	0.87	-	-	-	-
	Banca Monte dei Paschi di Siena SpA	0.18	0.19	1.17	0.84	6.96	0.76	5.94
	Banca Piccolo Credito Valtellinese	0.14	0.20	0.90	0.22	1.14	0.18	1.01
	Banca Popolare Dell'Emilia Romagna	0.13	0.21	1.30	0.27	1.33	0.28	1.25
	Banca Popolare Di Milano - SCRL	0.16	0.20	1.05	0.66	2.27	0.56	2.24
	Banco Popolare - Società Cooperativa	0.19	0.20	0.94	0.47	2.50	0.38	2.21
	Credito Emiliano SpA	0.15	0.16	1.12	0.23	1.59	0.19	1.53
	Intesa Sanpaolo SpA	0.14	0.19	1.23	0.88	6.19	0.77	5.65
	Mediobanca - Banca di Credito Finanziario SpA	0.13	0.14	0.89	0.45	2.91	0.35	2.54
	Unicredit SpA	0.19	0.20	1.03	0.80	5.25	0.74	4.14
Netherlands	ING Bank NV	0.21	0.14	0.88	0.32	2.11	0.25	1.69
Portugal	Banco BPI	0.18	0.25	0.90	0.64	11.95	0.66	12.39
	Banco Comercial Português	0.22	0.31	0.88	1.06	2.63	1.00	2.22
	Espirito Santo Financial Group SA	0.17	0.27	0.94	0.69	2.27	0.58	2.04
Sweden	Nordea Bank AB	0.13	0.06	0.75	0.28	3.20	0.26	2.52
	Swedbank AB	0.19	0.11	0.92	0.22	2.04	0.22	1.94
	Svenska Handelsbanken AB	0.10	0.08	0.96	0.22	2.49	0.22	2.18
United Kingdom	Barclays plc	0.16	0.17	1.10	0.23	1.47	0.24	1.30
	HSBC Holdings plc	0.12	0.11	1.51	0.16	2.17	0.14	1.90
	Lloyds Banking Group plc	0.17	0.19	1.04	0.23	1.31	0.18	1.21
	Royal Bank of Scotland Group plc	0.22	0.19	1.20	0.30	1.87	0.27	1.92
	Standard Chartered	0.14	0.14	1.36	0.19	1.91	0.19	1.82

Results for predictive power of the first model using RMSD (Root mean square deviation) and U-Theil for predicting variables in levels. Model estimated for different ranges of data.

		2011-2014		2010-2014		2012-2014	
Model with no lags, U-Theil over log of prices	St. Dev	RMSD	Theil U	RMSD	Theil U	RMSD	Theil U
Aareal Bank AG	0.30	0.16	0.65	0.16	1.03	0.12	3.35
Commerzbank AG	0.25	0.21	0.88	0.28	1.24	0.27	1.16
Deutsche Bank AG	0.17	0.1	1.23	0.17	1.55	0.20	2.23
IKB Deutsche Industrielbank AG	0.23	0.27	0.96	0.21	1.17	0.24	0.86
Wüstenrot & Würtembergische AG	0.12	0.07	1.04	0.12	1.56	0.08	1.08
BBVA	0.15	0.15	1.07	0.20	1.37	0.14	1.15
Banco Popular Español	0.13	0.19	1.03	0.18	1.08	0.22	1.06
Banco Santander	0.13	0.12	1.17	0.16	1.48	0.11	1.10
Banco Sabadell	0.14	0.14	1.05	0.14	0.99	0.15	1.00
Bankinter	0.15	0.24	1.18	0.24	1.30	0.26	1.26
BNP Paribas	0.15	0.14	0.97	0.14	0.99	0.11	0.98
Groupe Crédit Agricole	0.18	0.21	1.12	0.24	1.15	0.28	1.12
Natixis	0.23	0.16	1.00	0.14	0.96	0.17	1.29
Société Générale	0.16	0.21	1.05	0.20	1.10	0.19	1.28
Alpha Bank	0.27	0.47	1.24	0.53	1.85	0.49	1.32
Eurobank Eregasias	0.34	0.60	1.15	0.67	1.29	0.64	1.19
National Bank of Greece	0.26	0.55	1.32	0.55	1.35	0.58	1.28
Piraeus Bank	0.30	0.49	0.59	0.48	0.55	0.54	0.51
Agricultural Bank of Greece SA	0.25	0.43	0.79	0.47	0.92	0.39	0.27
Banca Carige SPA - Cassa di Risparmio di Genova e Imperia	0.16	0.16	0.87	0.15	0.89	0.18	0.95
Banca Monte dei Paschi di Siena SpA	0.18	0.19	1.17	0.21	1.16	0.15	1.04
Banca Piccolo Credito Valtellinese	0.14	0.20	0.90	0.20	1.06	0.22	0.89
Banca Popolare Dell'Emilia Romagna	0.13	0.21	1.30	0.22	1.43	0.23	1.27
Banca Popolare Di Milano - SCRL	0.16	0.20	1.05	0.22	1.24	0.14	0.87
Banco Popolare - Società Cooperativa	0.19	0.20	0.94	0.21	1.04	0.15	0.88
Credito Emiliano SpA	0.15	0.16	1.12	0.16	1.16	0.16	1.03
Intesa Sanpaolo SpA	0.14	0.19	1.23	0.21	1.41	0.15	1.06
Mediobanca - Banca di Credito Finanziario SpA	0.13	0.14	0.89	0.19	1.18	0.14	0.84
Unicredit SpA	0.19	0.20	1.03	0.22	1.22	0.14	0.90
Banco BPI	0.18	0.25	0.90	0.32	1.06	0.22	1.35
Banco Comercial Português	0.22	0.31	0.88	0.32	1.06	0.35	1.22
Espirito Santo Financial Group SA	0.17	0.27	0.94	0.26	0.99	0.27	0.92
Nordea Bank AB	0.13	0.06	0.75	0.07	0.80	0.07	0.83
Swedbank AB	0.19	0.11	0.92	0.14	1.24	0.09	0.83
Svenska Handelsbanken AB	0.10	0.08	0.96	0.08	1.06	0.09	0.97

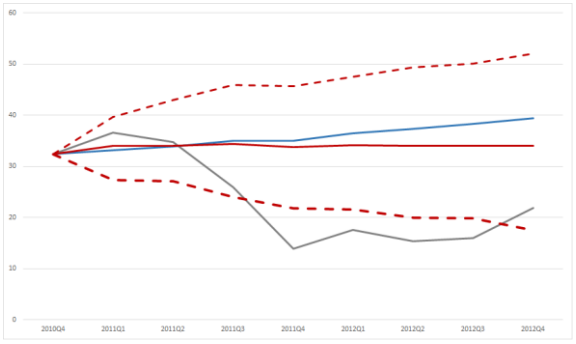
Results for predictive power of the first model using RMSD (Root mean square deviation) and U-Theil for predicting variables in levels. Model estimated for different ranges of data.

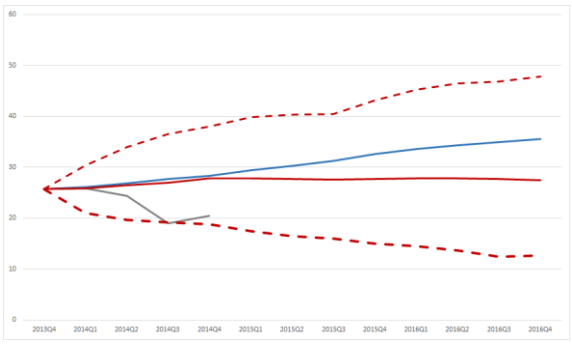
	2011-2014	2010-2014	2012-2014
Model with no lags, log returns	Theil U	Theil U	Theil U
Aareal Bank AG	2.93	4.06	4.90
Commerzbank AG	1.16	3.19	1.40
Deutsche Bank AG	1.62	1.70	2.61
IKB Deutsche Industrielbank AG	0.82	0.77	0.80
Wüstenrot & Würtembergische AG	0.15	0.50	0.30
BBVA	1.07	1.23	1.02
Banco Popular Español	0.94	0.86	0.95
Banco Santander	2.13	3.04	0.94
Banco Sabadell	0.96	0.98	0.87
Bankinter	1.18	1.22	1.05
BNP Paribas	0.89	1.09	0.73
Groupe Crédit Agricole	0.30	0.30	1.18
Natixis	0.87	1.76	1.27
Société Générale	1.15	1.27	1.04
Alpha Bank	1.24	1.34	1.84
Eurobank Eregasias	1.24	1.82	1.28
National Bank of Greece	1.78	1.89	2.19
Piraeus Bank	1.16	1.40	1.28
Agricultural Bank of Greece SA	0.72	0.67	0.29
Banca Carige SPA - Cassa di Risparmio di Genova e Imperia	0.70	0.67	1.02
Banca Monte dei Paschi di Siena SpA	3.66	1.19	6.34
Banca Piccolo Credito Valtellinese	0.70	0.65	0.71
Banca Popolare Dell'Emilia Romagna	1.23	1.30	1.27
Banca Popolare Di Milano - SCRL	0.69	1.16	0.70
Banco Popolare - Società Cooperativa	0.69	0.65	0.71
Credito Emiliano SpA	0.91	2.13	0.91
Intesa Sanpaolo SpA	1.06	1.09	0.90
Mediobanca - Banca di Credito Finanziario SpA	0.67	0.93	1.14
Unicredit SpA	0.88	0.71	1.31
Banco BPI	0.87	1.12	1.29
Banco Comercial Português	0.99	1.14	1.44
Espirito Santo Financial Group SA	0.89	0.96	0.91
Nordea Bank AB	0.47	0.64	0.52
Swedbank AB	0.87	1.09	0.81
Svenska Handelsbanken AB	0.92	0.98	0.67

Appendix F

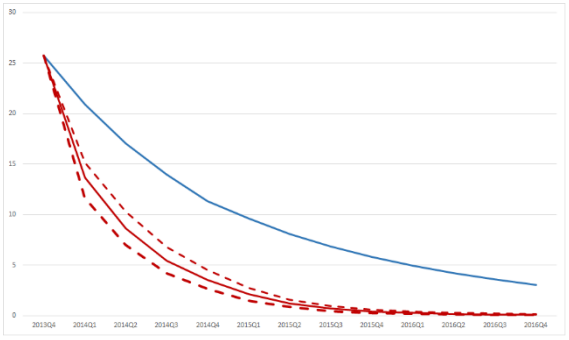
Simulation for baseline (blue) and adverse (red) scenarios for 2011 (left) and 2014 (right) stress tests.

Erste Group (Austria)

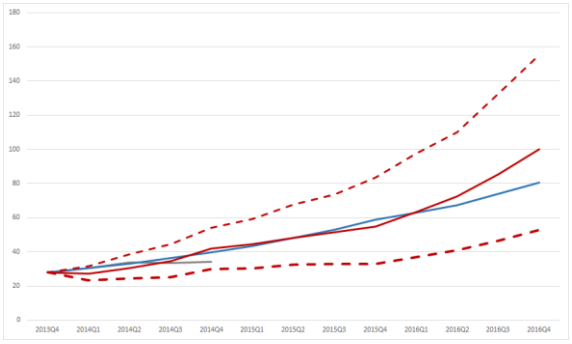




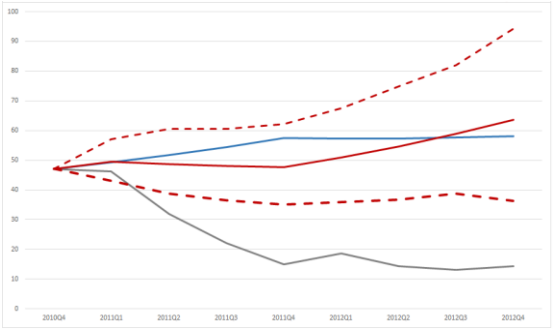
Dexia NV (Belgium)

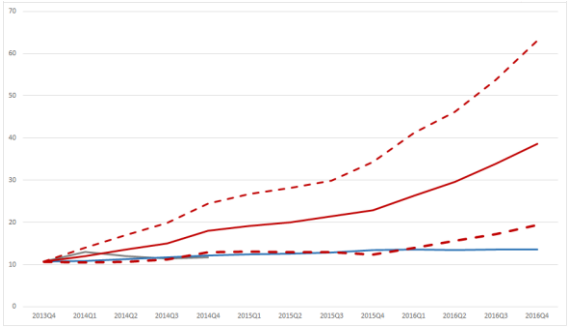


Aareal Bank (Germany)

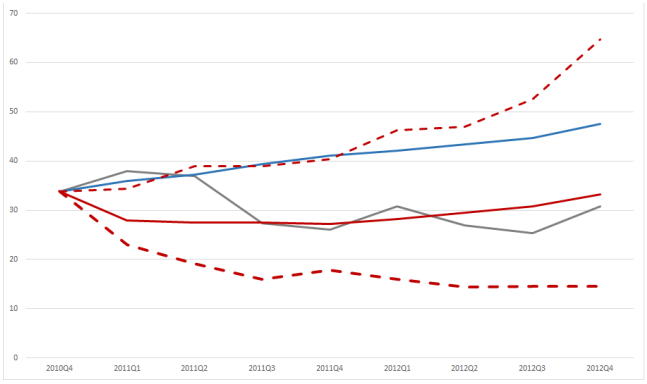


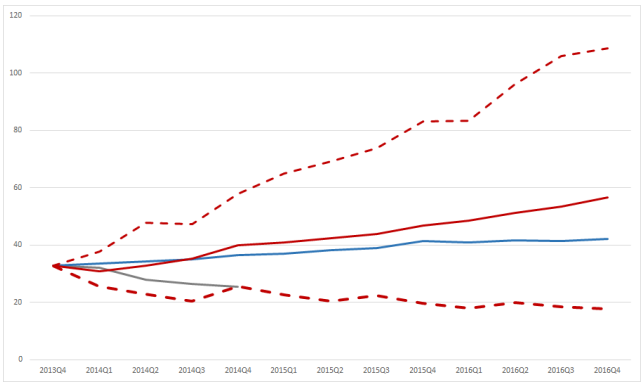
Commerzbank (Germany)



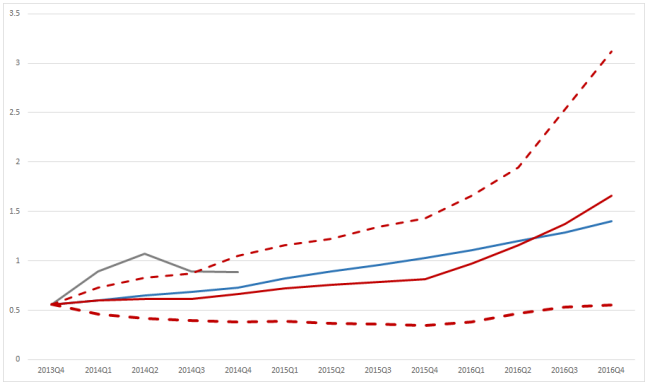


Deutsche Bank (Germany)

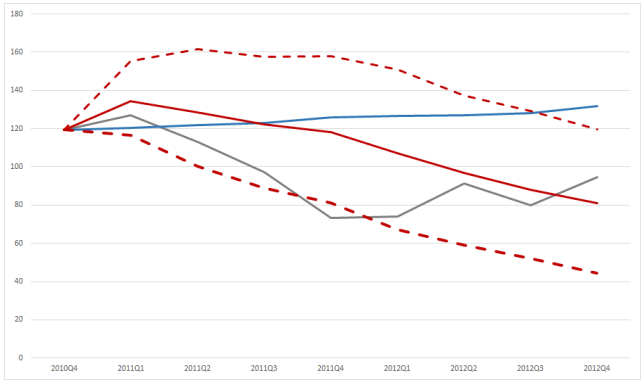




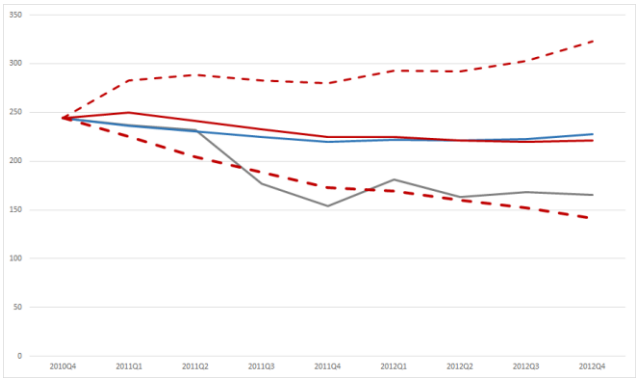
IKB Deutsche Industrielbank (Germany)



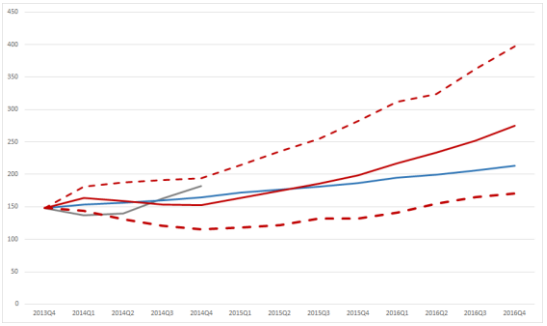
Danske Bank (Denmark)



Jyske Bank (Denmark)

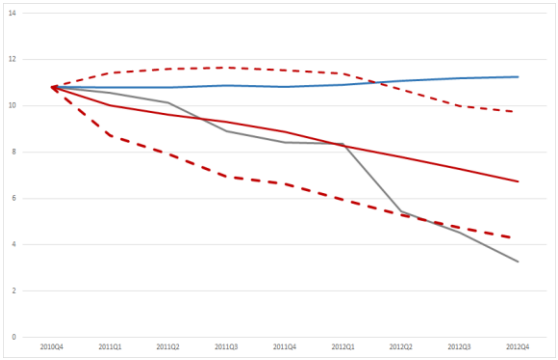


Sydbank (Denmark)

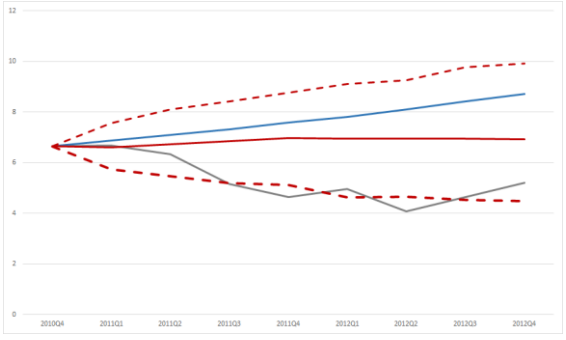


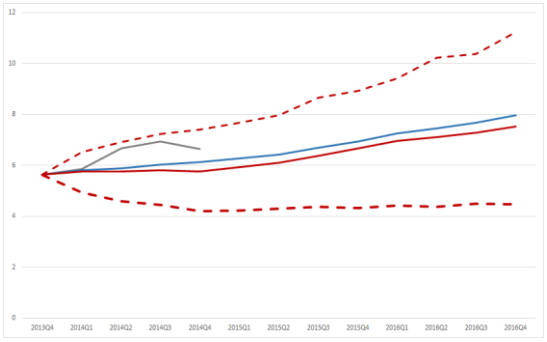
BBVA (Spain)

Banco Popular (Spain)

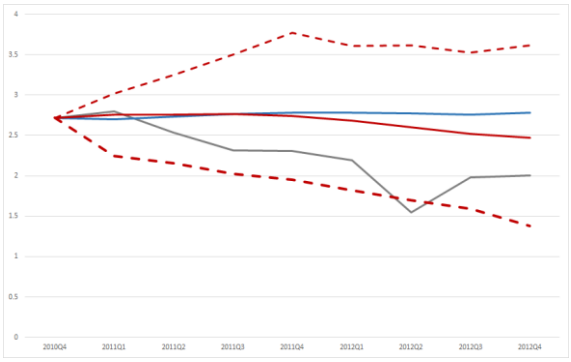


Banco Santander (Spain)

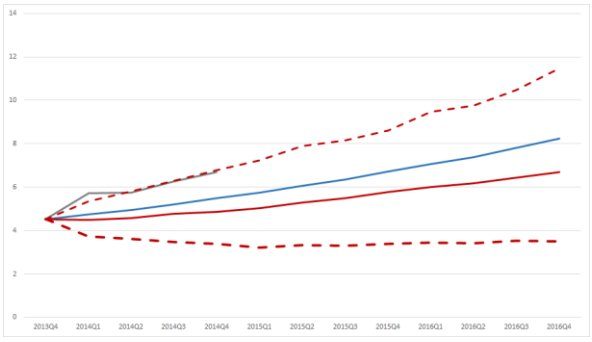




Banco Sabadell (Spain)

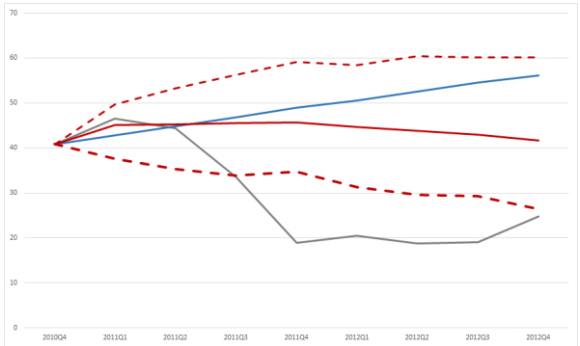


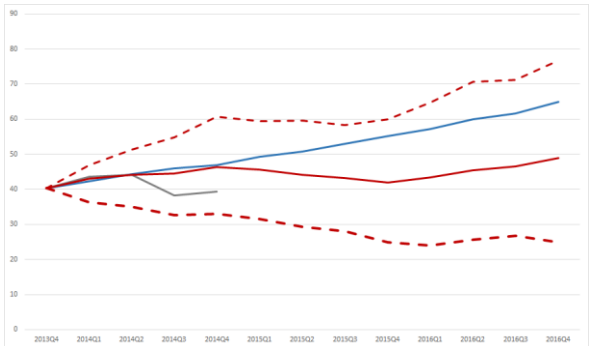
Bankinter (Spain)



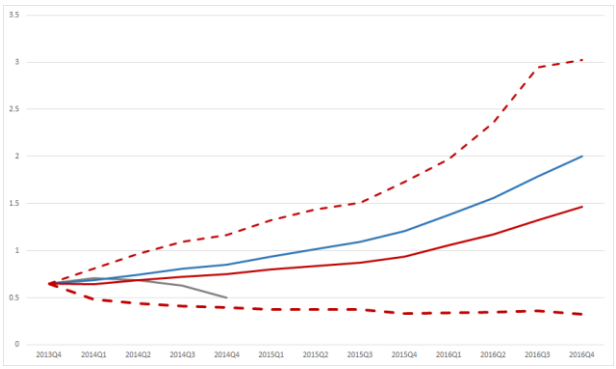
Groupe Credit Agricole (France)

Societé Generalé (France)

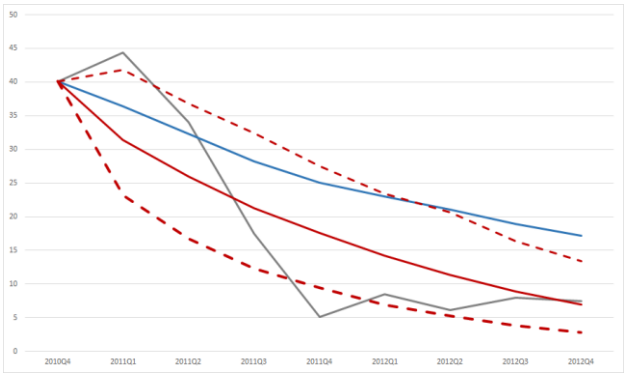


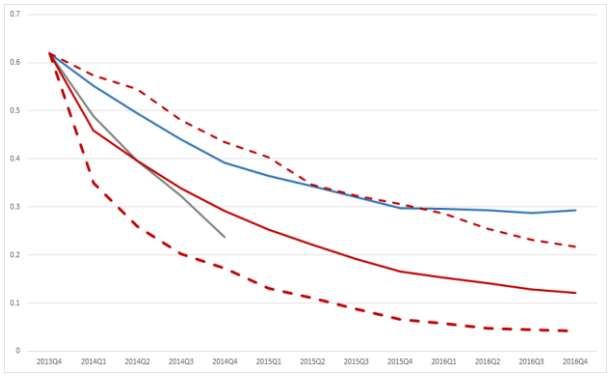


Alphabank (Greece)

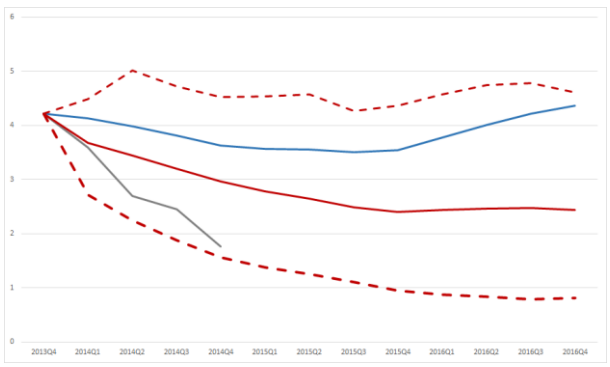


Eurobank Ergasias (Greece)

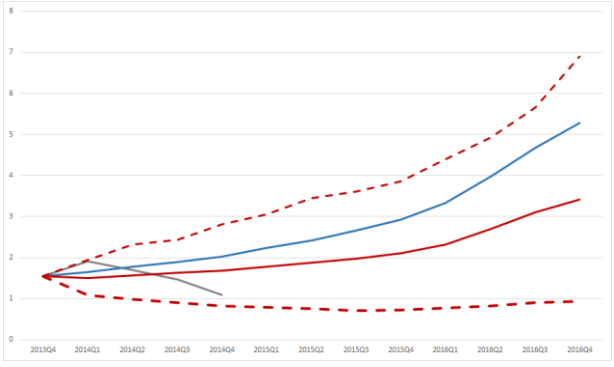




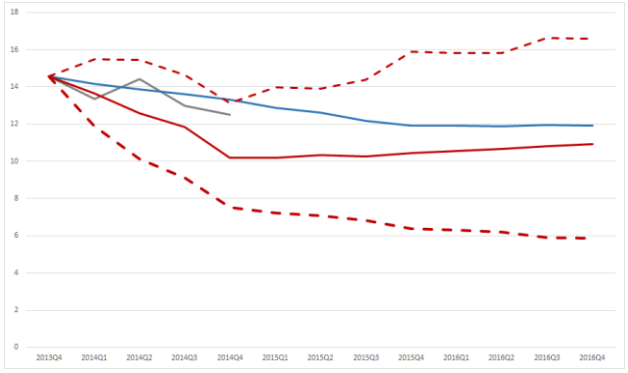
National Bank of Greece (Greece)



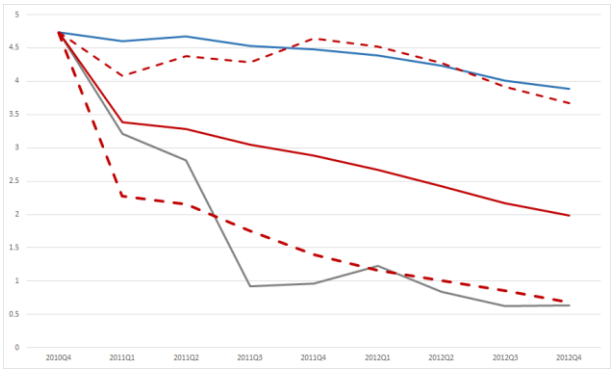
Piraeus Bank (Greece)



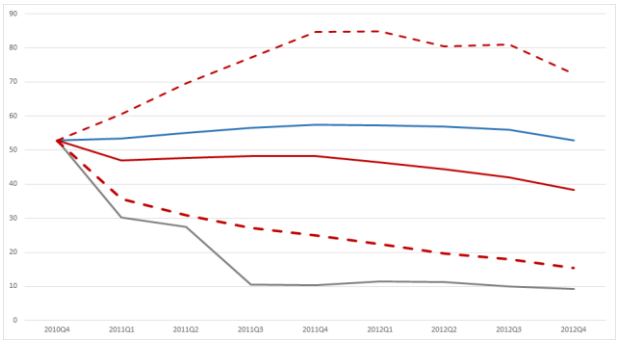
OTP Bank (Hungary)



Allied Irish Banks (Ireland)



The Governor and Company of the Bank of Ireland (Ireland)

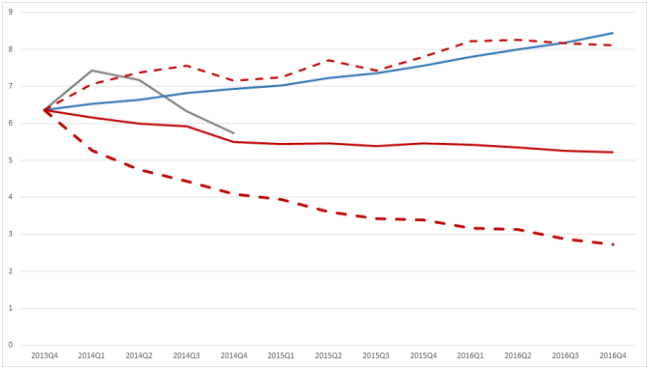


Banca Carigue SPA (Italy)

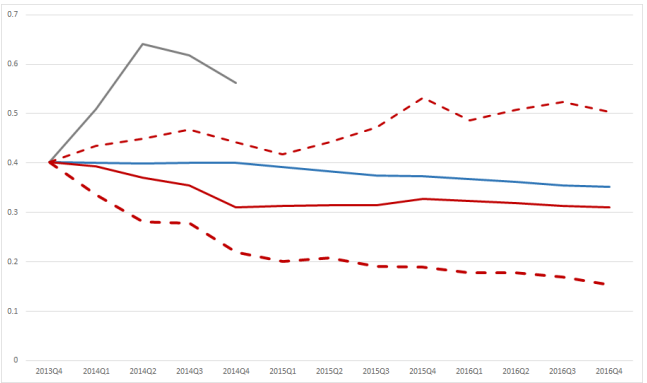
Banca Monte dei Paschi di Siena (Italy)

Banca Piccolo Credito Valtellinese (Italy)

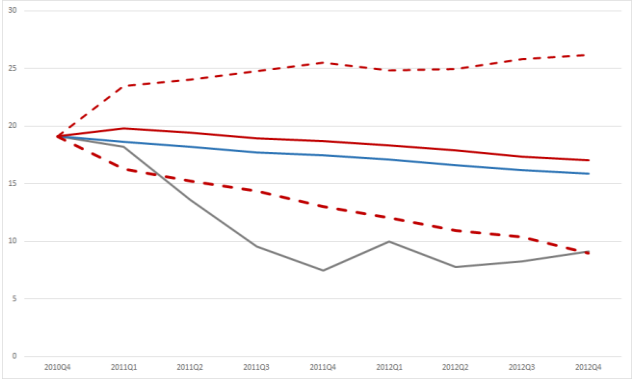
Banca Popolare dell'Elmilia Romagna (Italy)



Banca Popolare di Milano (Italy)

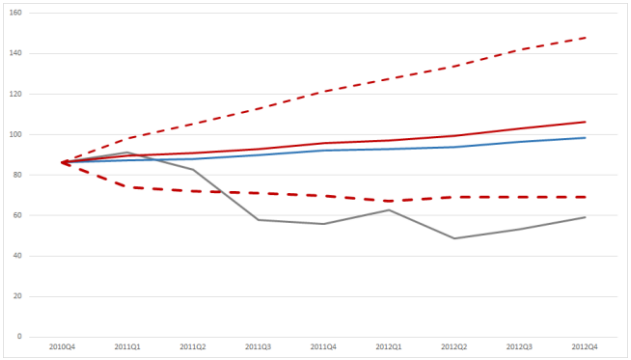


Banco Popolare – Società Cooperativa (Italy)

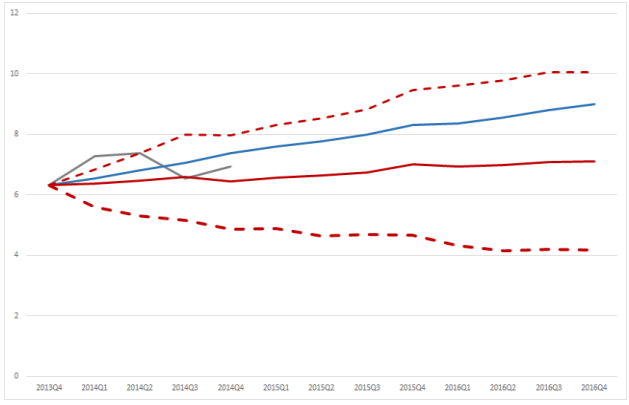



Credito Emiliano (Italy)


Intesa Sanpaolo (Italy)

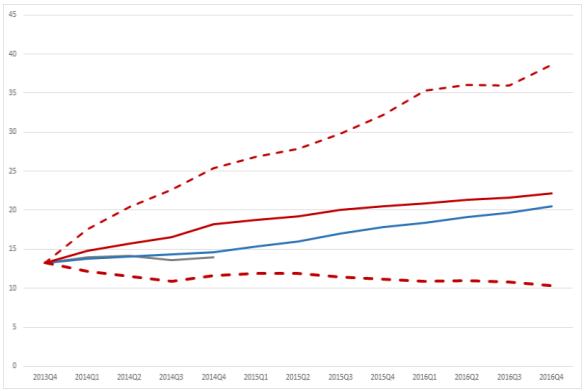



Mediobanca – Banca di Credito Finanziario (Italy)

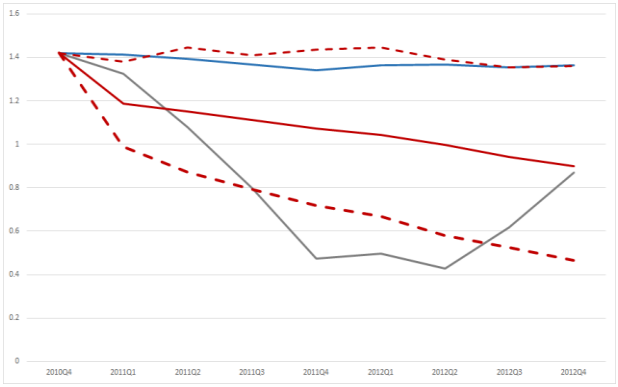


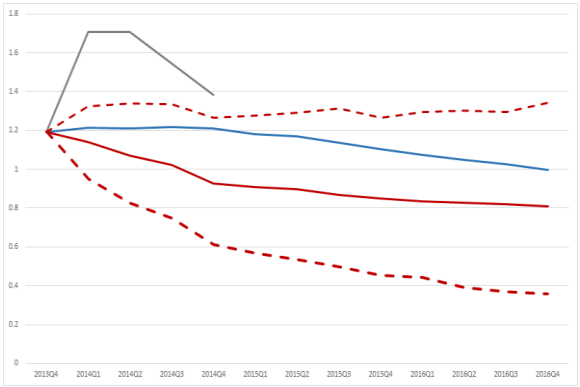
Unicredit (Italy)

ING (Netherlands)

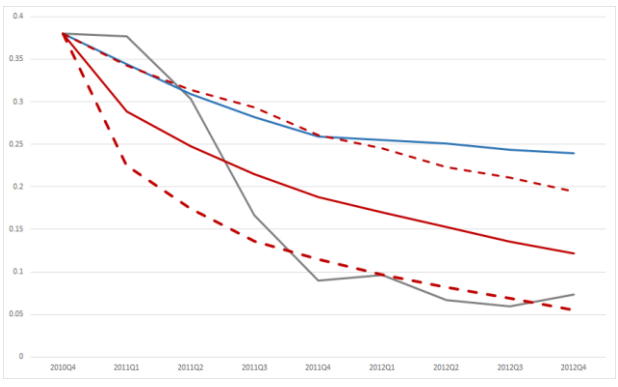


Banco BPI (Portugal)

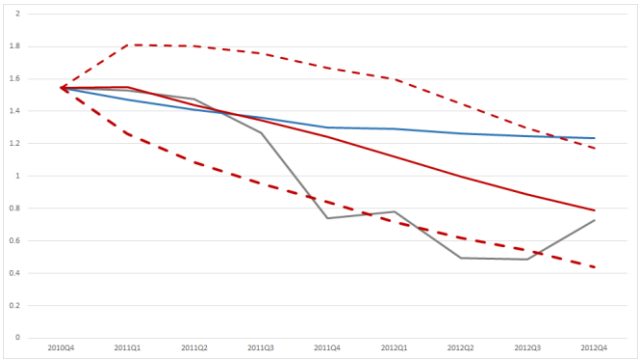




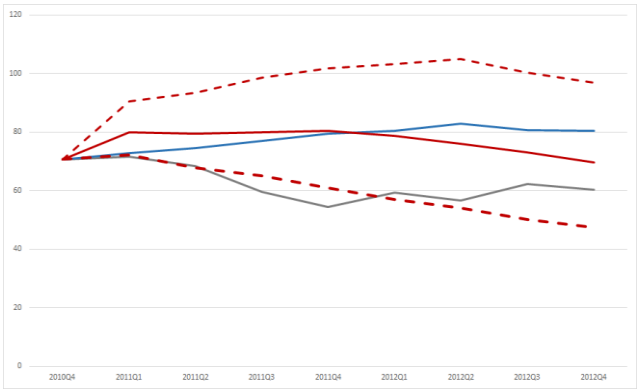
Banco Comercial Português (Portugal)

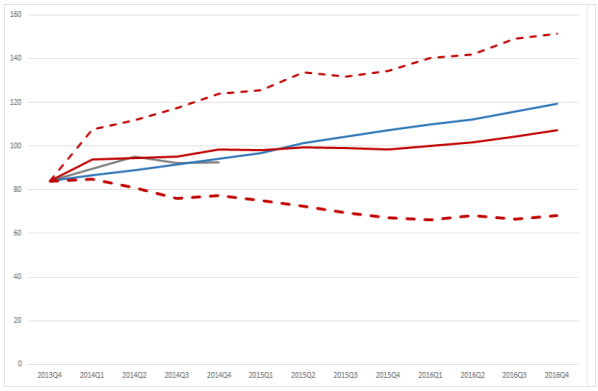


Espirito Santo Financial Group (Portugal)

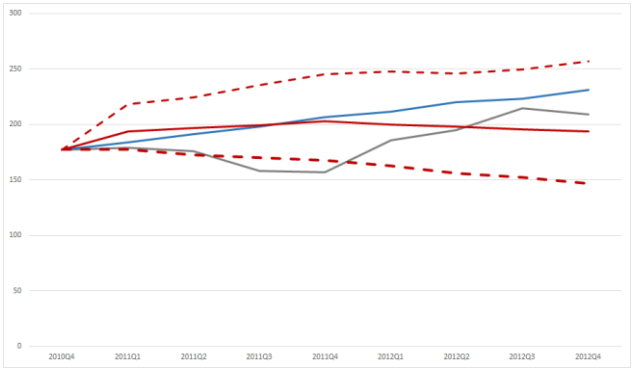


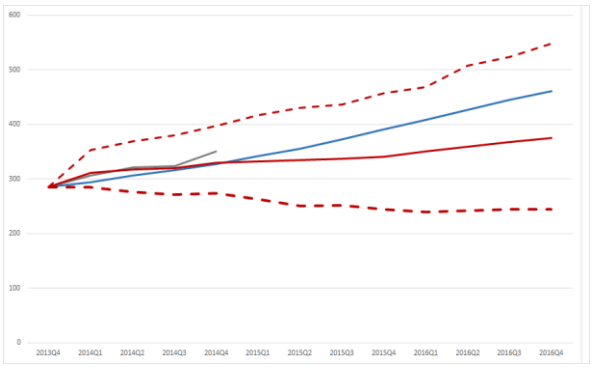
Nordea Bank (Sweden)



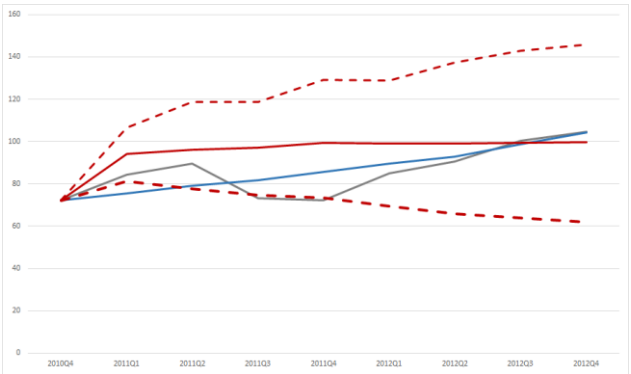


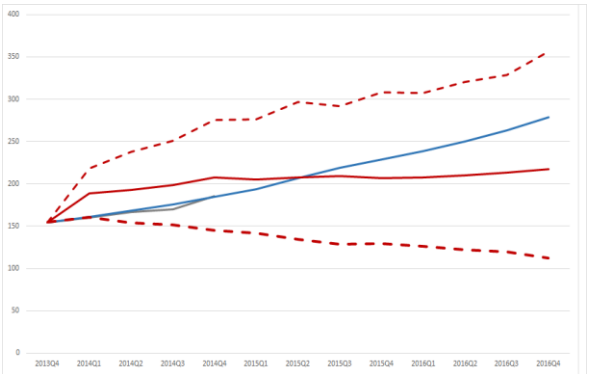
Svenska Handelsbanken (Sweden)





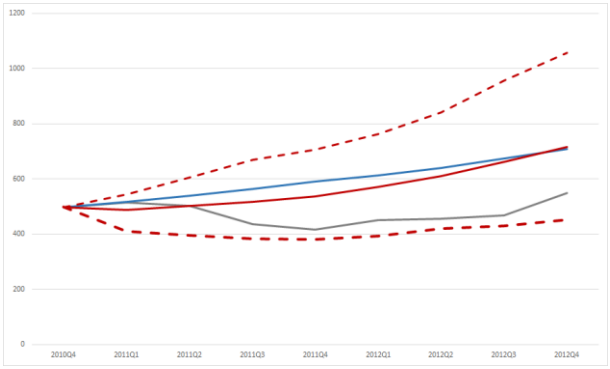
Swedbank (Sweden)



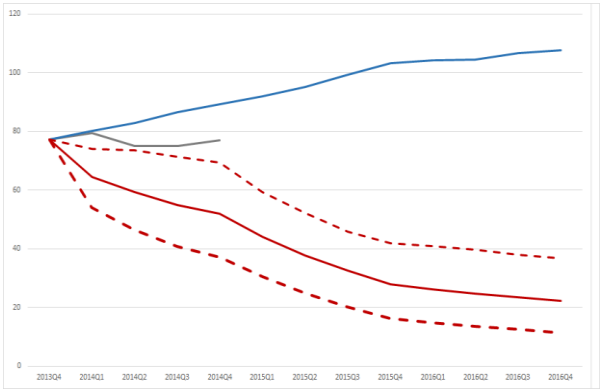


Barclays (UK)


HSBC Holdings (UK)




Lloyds Banking Group (UK)

Royal Bank of Scotland (UK)