universität wien

MASTER'S THESIS

Title of the Master's Thesis

„Real Determinants of Government Bond Yields"

submitted by

Steffen Christoph Megner

in partial fulfilment of the requirements for the degree of

Master of Sciene (MSc)

Vienna 2016

degree programme code as it appears on the student record sheet:	A 066 915
degree programme as it appears on the student record sheet:	Masterstudium Betriebswirtschaft UG2002
Supervisor:	a.o. Univ.-Prof. Mag. Dr. Christian Keber

Contents

List of Figures

1. Introduction and Problem Statement

During the last couple of years the yields to maturity of ten-year government bonds in the euro area of different countries began to diverge significantly. In 2006 and 2007 the yields were on a similar level, but starting in 2008 the divergence began. While countries like Germany and Austria profited from a steady downwards trend, others (Italy, Spain, or Greece) suffered from stagnating or rising yield levels as depicted by Figure 1. Since these countries are all part of the European Union and use the euro as currency, other factors have to be responsible for the divergence in the yield performance. An in depth analysis of possible determinants might render some key factors which can be used to explain government bond yields.

Several possible variables might provide an explanation for the yields. In a first step, as many as possible and plausible factors have to be rounded up. Section 2 lists all of these factors and illustrates their nature and the reason for their inclusion in the selection process.

Out of this spectrum of possibilities, the main determinants have to be found. In order to be as certain as possible the right variables have been selected, several selection procedures are beneficial. The procedures are explained and underlined with some examples in section 3. Also included in this section is a detailed list of all the necessary data adjustments, like correlation adjustments or exclusion of never changing variables, and data segmentation. The data has been divided in several sub-sets in order to ensure a successful variable selection throughout all data segments. Furthermore, it has to be verified that the chosen determinants are responsible for the yield values throughout the entire test period and at every relative and absolute yield level.

The empirical results of the aforementioned methods and processes, together with the corresponding interpretation and presentation of the real determinants of government bond yields, are highlighted in section 5.

A last check for the correctness of the determinants, which can be examined in section 6, is to calculate the future yields with the selected variables and compare the results with the actual yield curve that occurred.

The diverging yield curves for different countries in an economical union poses an interesting phenomenon and in recent years, several articles tackled the topic of determining government bond yields. *Aßmann and Boysen-Hogrefe* investigated a similar time period, their focus, however, was on solvency and liquidity risks and they concluded the expected debt-to-GDP ratio is the main force behind government bond spreads.[1] A different approach is used by *Codogno, Favero, and Missale.* They argue that euro zone government bonds, especially issued by Italy or Spain, are more likely to be influenced by risk premiums in the United States than by domestic European factors.[2] Those are only two examples out of several attempts to determine the main factors behind government yields.

This thesis focuses on a wider spread of possible determinants, while relying on mostly

[1] see Aßmann and Boysen-Hogrefe (2011)

[2] see Codogno et al. (2003)

European factors, in order to find the determinants behind a government bond yield curve and to explain why some countries profit from falling yields while others have to pay higher rates to refinance their public budget.

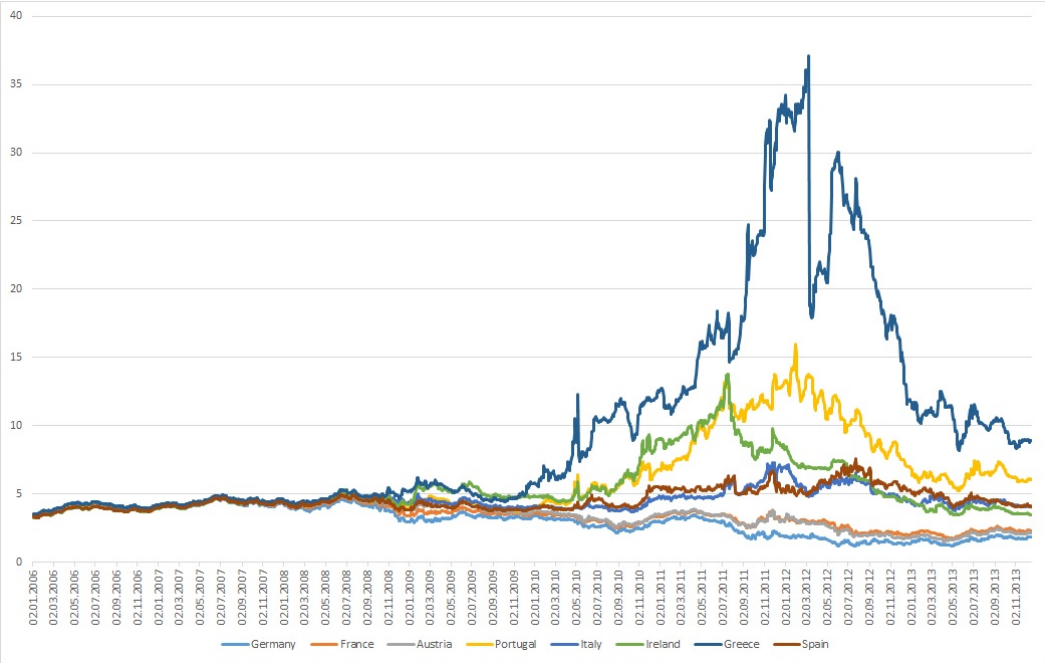


Figure 1: 10-year YTM for the eight analyzed countries 2006-2013

2. Government Bond Yields and Possible Determining Factors

In this section an overview of the selected countries and the possible determinants is provided. The variables are divided into sub-categories:

- Stock markets
- Ratings
- Economical information
- Commodities and precious metals
- Indicators
- Key interest rates
- *Target2* Balances

These categories cover the entire spectrum of possible quantifiable variables. Non-quantifiable variables, like the political situation, were not included in the analysis.

2.1. The Analyzed Countries

The government bond yields of eight countries have been analyzed in detail: Germany, France, Austria, Portugal, Italy, Ireland, Greece, and Spain. All are member states of the euro area and therefore, also members of the European Union. The reasons behind choosing those specific countries are quite simple. First of all, Germany and France are the two largest economies in Europe in regards of GDP (Gross Domestic Product), as presented in Figure 2, which provides an overview of the GDP values of the eight countries in the analyzed time period of 2006 to 2013.[3]

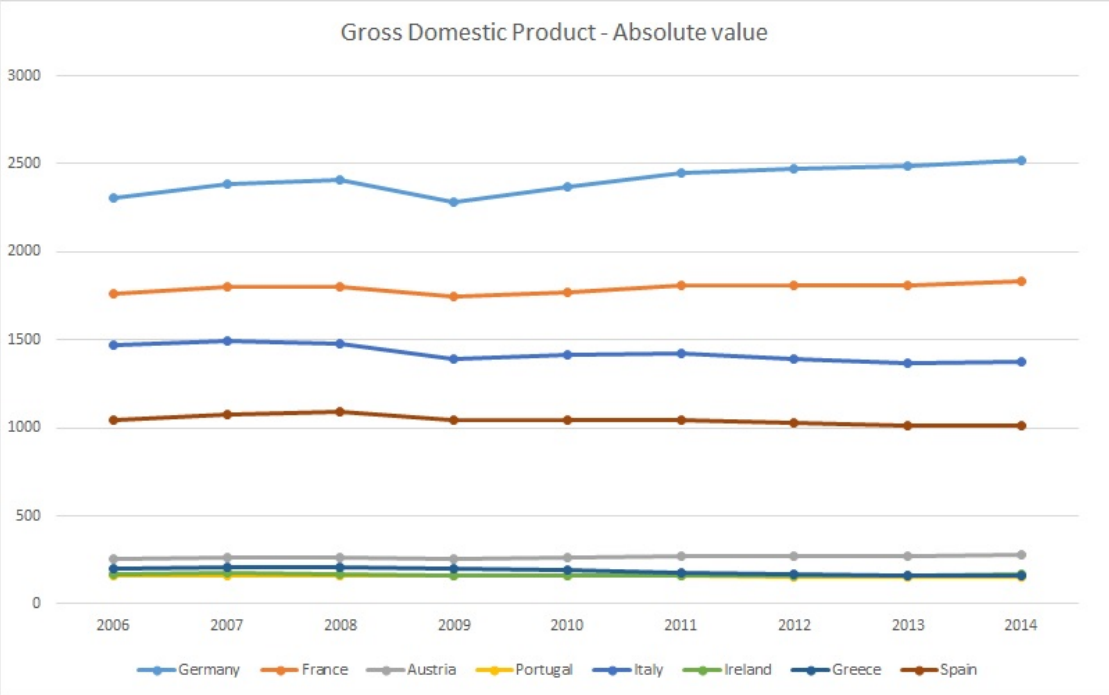


Figure 2: Gross domestic product, constant prices (in billions of euro)

Austria is added as a third country that maneuvered more or less successfully through the recent debt crisis starting in 2008. Figure 3 shows that Austria's GDP in 2013 is around 7 % higher compared to 2006. In contrast to Germany and France, Austria is not one of the leading European countries in terms of GDP with being ranked on the 9^{th} place.[4] Therefore, it provides a valid alternative to Germany and France considering its relatively small size but still successful economic performance.
This cannot be said for the well-known PIIGS countries. PIIGS is an acronym for Portugal, Italy, Ireland, Greece, and Spain, which are the other five countries to be analyzed. Those countries are said to have suffered the most in the debt crises, which

[3] 2014 is also included, however, the 2014 data is only used for comparing the generated results with the real development of the bond yields; Source: International Monetary Fund
[4] see Worldbank (2015)

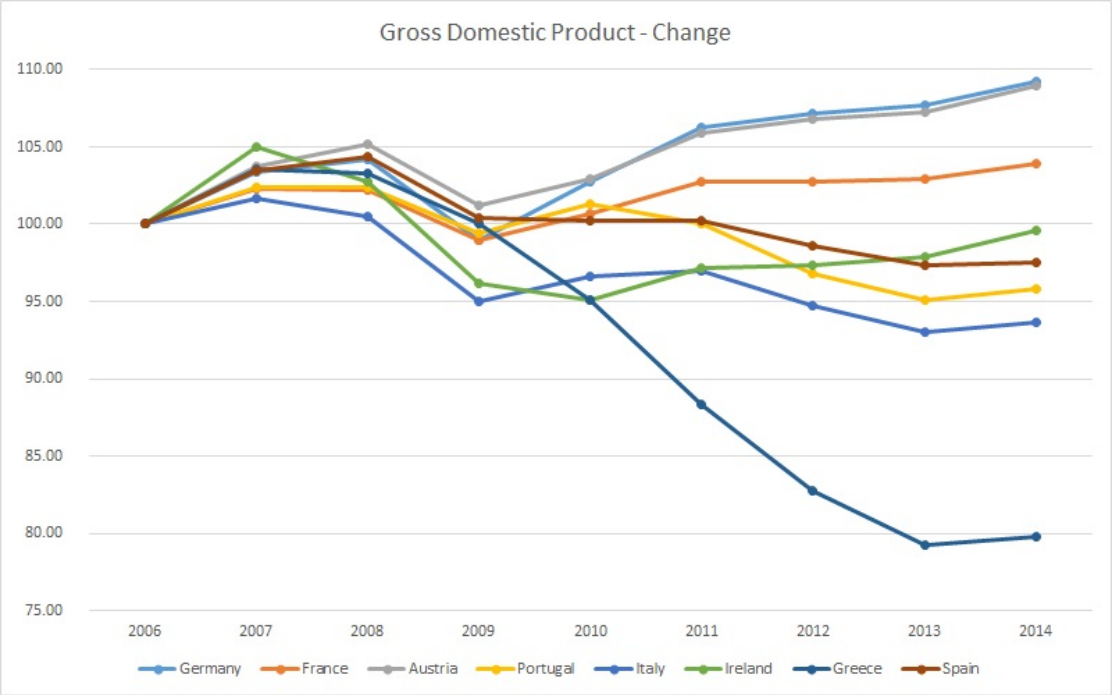


Figure 3: Gross domestic product, relative change (2006 = 100)

is also represented in Figure 3. In 2013 the GDP of all five is still below the 2006 benchmark level. In the case of Greece, the decrease is even more than 20 % compared to 2006. Another reason for choosing the PIIGS countries is that those five countries are very different from each other in terms of economic size. While Italy and Spain are ranked 4^{th} and 5^{th} in the European GDP ranking, Ireland, Greece, and Portugal take the places 13,14, and 15.[5] The combination of the successful countries and the PIIGS states results in a wide spectrum of country sizes, in economic terms, and in economic performances. Furthermore, all selected countries are members of the euro zone and therefore under the supervision of the ECB. This eliminates any currency or central bank related divergences and the data is more comparable.
With this country selection and their corresponding government bond yields, it is possible to determine the main driving factors behind the yields of "successful" countries as well as for countries which hit kind of a rough patch in their recent history.

2.2. Government Bond Yields

The government bond yields are the depended variable in all following regressions and finding their main determinants is the goal of this thesis. The yield to maturity for the 10-year government benchmark bond provided by Thomson Reuters was selected as yield value. Those benchmark bonds represent an active government bond, whose

[5] see Worldbank (2015)

maturity is currently the closest to 10 years. During the passage of time, the underlying bonds of the benchmark are getting closer to their maturity and therefore, veer away from the 10-year mark. However, other bonds with an originally longer remaining time until maturity are approaching this 10-year mark simultaneously. When the approaching bond is closer to 10 years as the currently underlying bond, the benchmark gets rolled to the new underlying bond. Since the maturity for the benchmark yields was selected as 10 years, this rolling has a negligible effect on the yield.[6]
The second reason for choosing this maturity is the relatively non-affectiveness to short term political or economic events. Furthermore, the ten year maturity is the most often referred maturity in terms of government bond yields and therefore the most logical choice to be selected as yield to be analyzed. For example, the ten-year US yield is used as proxy regularly for a series of financial instruments like mortgage rates etc. and the same applies for European bond yields.[7]

2.3. Stock Markets

A widely accepted assumption is a negative correlation between equity prices and bond yields.[8] Therefore, the stock market performances in each of the eight countries have to be included as potential factors in determining government bond yields.
In the stock market category are three different data sets: The main index of the analyzed country in absolute value, the trade volume of this index, and the relative day-to-day change of the index.
Also linked to stock markets is the *EURO STOXX 50 Volatility (VSTOXX) EUR Price Index*, more commonly referred to as *volatility index*. It represents the expected 30-day stock market volatility. Usually, there is a negative correlation between the volatility index and the corresponding stock markets.[9] An increase of value indicates a higher level of nervousness in the market, which leads to the additional nickname "Investor fear gauge".[10]

2.4. Ratings

There are three big Rating Agencies: *Standard&Poor's*, *Moody's*, and *Fitch*. Usually, their ratings (for governments) are highly correlated. A change in a country's rating representing its credit worthiness might have an impact on this country's bond yields.
In this thesis, only the ratings of Standard&Poor's will be part of the analysis. Due to the high correlation and similar structure of rating systems of the three rating agencies, taking only one of the agencies should be enough in representing the rating factor of government bond yields.

[6] Appendix E provides all benchmark rolling dates and shows the relative and absolute changes for the first five rolls of the German benchmark bond
[7] see The New York Times (2008)
[8] see Rankin and Idil (2014)
[9] see Money Morning (2014b)
[10] see Forbes (2014)

2.5. Economical Information

Four different economical information are also part of the regression models used in this thesis. The first values are the GDP of the analyzed country and the GDPs of the other seven countries as well. A rise or decrease of the own GDP might effect the yield rate, but this might also be true if the GDPs of neighboring countries experience some relevant movements. A decreasing GDP might be an indicator for economical troubles in a country. If the domestic GDP is dropping, this might lead to an increase of the yield, while a reduced foreign GDP might result in a lower yield level since investors might look for a safer investment opportunity.
Second, the government debt situation is a factor as well. Similar to the GDP, the domestic and the foreign debt levels are analyzed with the same reasoning. Changes in the debt level might indicate economical hardships for a country. The debt is represented as a percentage of the national GDP.
Third, the unemployment rate of the country. Here, only the domestic unemployment rate is part of the regression. It seemed too far fetched to assume that foreign unemployment rates might influence the domestic yield levels of government bonds. Nevertheless, it could be argued that the foreign unemployment levels might represent the foreign countries economical situation. This might be true, but in order to capture the possible economical distress of foreign entities, the GDP and debt levels of these are already part of the models.
The fourth and the last economical factor is the inflation rate. Two different inflation rates were implemented. Since all of the eight countries in scope are members of the European Union and the euro zone, the rate of the euro area (17 countries) was used as well as the domestic inflation rate of the individual countries.[11]

2.6. Commodities and Precious Metals

It is commonly accepted that oil, or more precisely the oil price is playing a key role for the economic situation of industrialized countries. A low oil price stands for cheaper production costs and the economy flourishes, while negative oil price shocks hurt the economy.[12] Therefore, the oil price had to be included to analyze the effects it has not only on the economy but on the government bond yields as well.
Gold is, and has been for a very long time, the backup currency and a safe haven for investors. If there is fear of a high inflation or unstable markets, they buy gold. Every time the economy begins to waiver investors flee to gold for safety.[13]
The second most widely used precious metal is silver. In recent years, the silver price increased significantly from around 10 USD to over 40 USD, just to fall back to around 20 USD as displayed by Figure 4. In light of those numbers, silver had to be analyzed as a possible determinant of the yield as well.

[11] The analyzed time frame starts in 2006. At this time the euro area consisted of 17 member-states
[12] see Jiménez-Rodríguez and Sánchez (2004)
[13] see Money Morning (2014a)

Figure 4: Development silver price 2006-2014

2.7. Indicators

So far, there are stock market performance, ratings, economical information, the oil price, and precious metals as potential determinants. All of these have in common that they rely on hard facts, market data or other observable information. Since the world is not a completely logical place, feelings and opinions might influence the yield levels as well.[14] Therefore, the economical indicators have been included. The first indicator represents the economic sentiment in the European Union and the second indicator the economic sentiment for the domestic situation.

Thomson Reuters Eikon provides the composition of the indicator as following: "the European economic sentiment indicator is composed of the industrial confidence indicator (40 %), the service confidence indicator (30 %), the consumer confidence indicator (20 %), the construction confidence indicator (5 %), and the retail trade confidence indicator (5 %)."[15]

Quite similar to the European indicator is the domestic sentiment indicator. The weights and factors are identical, which makes those two indicators ideal for comparison and it is ensured that differences of the indicator values are indeed due to different confidence levels and not due to different evaluation methods.

A third indicator is also part of this study - the HSBC Chinese factory production indicator. It is not a confidence indicator like the previous two indicators, but depicts the degree of capacity utilization in Chinese factories.

[14] see Tversky and Kahneman (1986)
[15] Thomson Reuters (2015)

2.8. Key Interest Rates

There are several interest rate fixings which might influence the government bond yield. After all, the yield is basically an interest rate itself. It represents the annual rate one would receive after buying a certain bond at the current price and holding it until its maturity. The fixings chosen to be part of the regression models are:

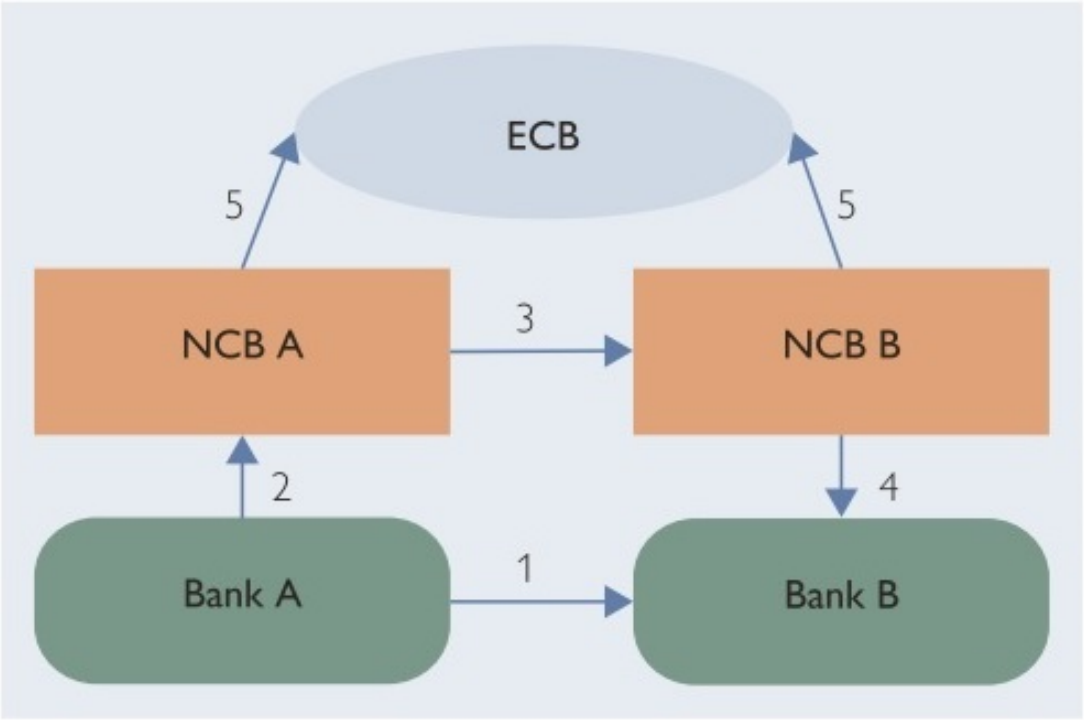
- The regular weekly main refinancing operations with maturity of one week offered by the ECB.[16]
- The federal funds rate, which is the interest rate at which depository institutions lend balances to each other overnight. The Federal Open Market Committee establishes the target rate for trading in the federal funds market.[17]
- The "**E**uro **O**ver**N**ight **I**ndex **A**verage" - short *Eonia*. It is an overnight interest average generated as the weighted average of all overnight lending activities in the interbank market in euro. Unlike the later explained *Euribor*, it only uses actual trades. All member institutions quote their trade volume and average interest rate to the ECB, which calculates the overall average and publicizes the result as the *Eonia* rate.[18]
- The "**L**ondon **I**nter**B**ank **O**ffered **R**ate", most commonly known as *Libor*, is the benchmark rate which leading banks would charge each other for short-term loans.[19] Of high importance is the word "would" in the previous definition. Unlike the *Eonia*, the *Libor* rates are just theoretical and not based on real trades. This fact makes the *Libor* and also the *Euribor*, which is calculated similarly, vulnerable to manipulation if the contributing banks co-conspire.[20] It is administered by the ICE Benchmark Administration and is the basis for the calculation of most of the worlds loan agreements and other financial instruments. The most commonly quoted rate is the three-month U.S. dollar rate and this rate was used in the calculations.[21]
- The *Eulibor*: the three-month *Libor* fixing. Similar to *Libor*, however in euro.
- The **Eu**ro **I**nter**B**ank **O**ffered **R**ate (*Euribor*) is closely related to the *Libor*. The idea and calculations methods are quite similar to each other. However, while the *Libor* is the key interest rate in most of the world, in the euro zone the *Euribor* takes its place.[22] For better comparison possibilities, the three-month *Euribor* was selected out of the possible *Euribor* rates.

[16] Fixed rate tenders; commonly known as the ECB interest rate
[17] Federal Reserve Bank of New York (2015)
[18] see ECB (2015)
[19] see ARD Boerse (2015)
[20] see The Economist (2012)
[21] see The New York Times (2012)
[22] see Euribor-Rates (2015)

2.9. Target2 Balances

The "**T**rans-European **A**utomated **R**eal-time **G**ross settlement **E**xpress **T**ransfer **S**ystem **2**" operated by the Eurosystem ensures an efficient settlement of cross-border transactions in euro.[23] Every *TARGET2* cross-border transaction requires two banks and two central banks of the Eurosystem and generates claims and liabilities for each national central bank to the counterpart national bank. Figure 5 helps with explaining the procedure graphically.[24]

Bank A, located in the jurisdiction of National Central Bank(NCB) A, wants to transfer



Source: OeNB.

Figure 5: Transaction process via *TARGET2*

money to bank B, whose corresponding NCB is NCB B. This transfer is executed via *TARGET2*. In order for the transaction to take place, NCB A debits the amount from bank A and reports the liability to the receiving party: NCB B. NCB B then reports the claim on NCB A and transfers the amount of funds to bank B.[25]

Of course, there are a numerous transactions between NCB A and NCB B in both directions during the day. Those transactions are summarized and result in a final net asset

[23] see Jobst et al. (2012), p. 81

[24] The role of S.W.I.F.T. will be neglected in this explanation.

[25] see Jobst et al. (2012), p.83-84

or liability position. The ECB takes on the role of a central clearing house. However, the net assets and liabilities are not cleared after the end of the day, but carried forward to the next day, which creates the *TARGET2* balances of the NCBs.[26] Logically, the sum of all balances of all NCBs equals zero. A highly positive balance indicates a huge amount of funds being transferred into the country, while an extremely negative balance represents a flight of capital.
This effect of capital being transferred into or out of a country might influence the bond yields of the associated governments. Therefore, the *TARGET2* balances of the eight analyzed countries are included as possible determinants for the bond yields.

2.10. Overview Possible Determining Factors

In total there are 44 possible determinants for each country's yield rate. Some of the variables are country specific and only applied for one specific country, while others are used for all countries. An overview which variable is deemed relevant for each country is provided by Figures 6 and 7.[27]

[26] see Jobst et al. (2012), p. 83-84

[27] Appendix C shows the mapping of the possible determinants and their corresponding short-names used in the rest of the thesis

	Germany	France	Austria	Portugal	Italy	Ireland	Greece	Spain
DAX	1							
TVDAX	2							
DAXChange	3							
CAC40		1						
TVCAC40		2						
CAC40Change		3						
ATX			1					
TVATX			2					
ATXChange			3					
PSI20				1				
TVPSI20				2				
PSI20Change				3				
FTMIB					1			
TVFTMIB					2			
FTMIBChange					3			
ISEQ						1		
TVISEQ						2		
ISEQChange						3		
ATG							1	
TVATG							2	
ATGChange							3	
IBEX								1
TVIBEX								2
IBEXChange								3
SPGER	4	4	4	4	4	4	4	4
SPFRA	5	5	5	5	5	5	5	5
SPAUT	6	6	6	6	6	6	6	6
SPPOR	7	7	7	7	7	7	7	7
SPITA	8	8	8	8	8	8	8	8
SPIRL	9	9	9	9	9	9	9	9
SPGRE	10	10	10	10	10	10	10	10
SPESP	11	11	11	11	11	11	11	11
GDPGER	12	12	12	12	12	12	12	12
GDPFRA	13	13	13	13	13	13	13	13
GDPAUT	14	14	14	14	14	14	14	14
GDPPOR	15	15	15	15	15	15	15	15
GDPITA	16	16	16	16	16	16	16	16
GDPIRE	17	17	17	17	17	17	17	17
GDPGRE	18	18	18	18	18	18	18	18
GDPESP	19	19	19	19	19	19	19	19
DEBTGER	20	20	20	20	20	20	20	20
DEBTFRA	21	21	21	21	21	21	21	21
DEBTAUT	22	22	22	22	22	22	22	22
DEBTPOR	23	23	23	23	23	23	23	23
DEBTITA	24	24	24	24	24	24	24	24
DEBTIRE	25	25	25	25	25	25	25	25
DEBTGRE	26	26	26	26	26	26	26	26
DEBTESP	27	27	27	27	27	27	27	27

Figure 6: Overview of factors used for each indiviual country I

	Germany	France	Austria	Portugal	Italy	Ireland	Greece	Spain
UNEMPGER	28							
UNEMPFRA		28						
UNEMPAUT			28					
UNEMPPOR				28				
UNEMPITA					28			
UNEMPIRE						28		
UNEMPGRE							28	
UNEMPESP								28
EURINF	29	29	29	29	29	29	29	29
GERINF	30							
FRAINF		30						
AUTINF			30					
PORINF				30				
ITAINF					30			
IREINF						30		
GREINF							30	
ESPINF								30
LCOc1	31	31	31	31	31	31	31	31
XAU	32	32	32	32	32	32	32	32
XAG	33	33	33	33	33	33	33	33
ECOINDEU	34	34	34	34	34	34	34	34
ECOINDGER	35							
ECOINDFRA		35						
ECOINDAUT			35					
ECOINDPOR				35				
ECOINDITA					35			
ECOINDIRE						35		
ECOINDGRE							35	
ECOINDESP								35
CHIMAN	36	36	36	36	36	36	36	36
ECB	37	37	37	37	37	37	37	37
FED	38	38	38	38	38	38	38	38
EONIA	39	39	39	39	39	39	39	39
EULIBOR	40	40	40	40	40	40	40	40
LIBOR	41	41	41	41	41	41	41	41
EURIBOR	42	42	42	42	42	42	42	42
TARGER	43							
TARFRA		43						
TARAUT			43					
TARPOR				43				
TARITA					43			
TARIRE						43		
TARGRE							43	
TARESP								43
VOLIND	44	44	44	44	44	44	44	44

Figure 7: Overview of factors used for each indiviual country II

3. Regression Model and Variable Selection

As regression model, the multiple linear regression has been deemed fit for the tasks ahead. It is quite straight forward and can be used to calculate possible future yields with the determining factors and the regression equation. However, the main goal of this thesis is to find the real determinants of the government bond yields and not just to insert forty to fifty variables in an equation and then trying to explain the outcome. Therefore, before entering the factors in the regression model, the number of variables have to be reduced to a maximum number of 5. A target number had to be chosen in order to find a set of relevant determinants and five seems to be the most adequate balance between choosing too many variables, where adding another variable leads to negligible increases in R^2, and selecting too few determinants and the relinquishing of potential significant R^2 gains. To see which five variables are the most important in determining the yield, five different variable selection methods have been used: *Forward Selection*, *Backwards Elimination*, *Robust Regression*, *Lasso*, and the *subsets* method. Furthermore, there were a series of data adjustments and categorizations. Before the variable selection process started, a series of variables were removed beforehand. The criteria for the removal is explained in the following sections. Also, a categorization of the yield levels was implemented. This procedure created several new data sets and with those data sets, the different selection procedures were started anew. In total there were 160 different variable selection processes - 20 for every individual country.

3.1. Multiple Linear Regression

This model is widely accepted and basically common knowledge. Many scientific fields use this method to analyze data and it is taught in even the most prestigious universities.[28][29] It illustrates the relationship between a dependent variable, which in this thesis is always the government bond yield, and a series of independent variables. The relationship is represented by a linear equation:[30]

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip} + \epsilon_{ip}$$

y_i : Response for the ith observation
$x_{i1\ldots ip}$: Independent variables
$\beta_{0\ldots p}$: Regression coefficients
$\epsilon_{0\ldots p}$: Error term

The idea of implementing a time delay of a day or even more in the regression equation has been disregarded. In today's time and age, movements in some of the determinants have an immediate (in a matter of seconds) impact on the market and the corresponding

[28] see Aiken et al. (2003), p. 483-507
[29] see University of Yale (1998)
[30] see Schlittgen (2013), p. 19-22

yield levels.
After reducing the possible determinants to only five variables, R will calculate the values for the regression coefficients using this formula.
The coefficient of determination R^2 denotes the portion of dependent variables which can be explained by the linear regression. Therefore, its value ranges between 0 (lowest: 0 %) and 1 (highest 100 %).[31]

3.2. Forward Selection Method

The *Forward Selection* method is often mentioned as the first alternative in variable selection methods due to its straight on approach and relative simplicity.[32] It is the first of three classical selection methods.[33] It adds the most important variables one by one. The process is stopped when five variables are selected or the addition of another variable would not effect the result significantly. As selection criteria the F-value is used. The variable, which adds the most to the F-value will be added to the regression.
If there are already q variables and a further variable $(q+1)$ is supposed to be added, the test statistics are:[34]

$$\mathrm{F} = \frac{SS_{error}(q) - SS_{error}(q+1)}{SS_{error}(q+1)/(n-q-2)}$$

q : Number of variables already selected
$SS_{error}(q)$: Residual sum of squares q
$SS_{error}(q+1)$: Residual sum of squares $q+1$
n : Number of possible variables

The variable with the highest value for F in this equation is added to the regression model.

Example Forward Selection Method
The seven files in the folder "GermanyAddMethod" are used as data basis.[35] The file *GermanyAdd.xlsx* contains all the data used in the calculations. The five .csv files are needed by the implemented *R*-Code, and the document *GermanyAddOverview.xlsx* provides an overview of the variable selection process.[36]
For this example, ROUND 1 to 3 already took place and the first three selected variables

[31] see NASDAQ (2015)
[32] see Schlittgen (2013), p. 40-41
[33] see Xu and Zhang (2001)
[34] see Schlittgen (2013), p. 40-41
[35] Attached data files: Germany\AddMethod
[36] The *R*-Code can be seen at attached data files: Germany\R-Code\Germany

are: TARGER, LCOc1, and GDPESP. The output provided by the *R*-Code for ROUND 4 reveals the following results:[37]

```
[[1]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq    F value  Pr(>F)
TARGER       1 1816.97 1816.97 33555.7010 < 2e-16 ***
LCOc1        1   92.03   92.03  1699.6245 < 2e-16 ***
GDPESP       1   30.21   30.21   557.9199 < 2e-16 ***
ECOINDEU     1    0.31    0.31     5.6712 0.01734 *
Residuals 2023  109.54    0.05
---

[[2]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq    F value Pr(>F)
TARGER       1 1816.97 1816.97 33478.1593 <2e-16 ***
LCOc1        1   92.03   92.03  1695.6969 <2e-16 ***
GDPESP       1   30.21   30.21   556.6306 <2e-16 ***
ECOINDGER    1    0.05    0.05     0.9833 0.3215
Residuals 2023  109.79    0.05
---

[[3]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq  F value    Pr(>F)
TARGER       1 1816.97 1816.97 34519.51 < 2.2e-16 ***
LCOc1        1   92.03   92.03  1748.44 < 2.2e-16 ***
GDPESP       1   30.21   30.21   573.94 < 2.2e-16 ***
ECB          1    3.37    3.37    63.94 2.137e-15 ***
Residuals 2023  106.48    0.05
---

[[4]]
Analysis of Variance Table
```

[37] Tables 8 to 10 and 13 to 24 were removed to shorten the example output

```
Response: YTMGER
            Df  Sum Sq Mean Sq  F value    Pr(>F)
TARGER       1 1816.97 1816.97 36047.61 < 2.2e-16 ***
LCOc1        1   92.03   92.03  1825.84 < 2.2e-16 ***
GDPESP       1   30.21   30.21   599.35 < 2.2e-16 ***
FED          1    7.88    7.88   156.32 < 2.2e-16 ***
Residuals 2023  101.97    0.05
---

[[5]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq  F value    Pr(>F)
TARGER       1 1816.97 1816.97 35737.10 < 2.2e-16 ***
LCOc1        1   92.03   92.03  1810.11 < 2.2e-16 ***
GDPESP       1   30.21   30.21   594.19 < 2.2e-16 ***
DEBTGER      1    6.99    6.99   137.55 < 2.2e-16 ***
Residuals 2023  102.85    0.05
---

[[6]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq   F value    Pr(>F)
TARGER       1 1816.97 1816.97 34903.492 < 2.2e-16 ***
LCOc1        1   92.03   92.03  1767.891 < 2.2e-16 ***
GDPESP       1   30.21   30.21   580.329 < 2.2e-16 ***
UNEMPGER     1    4.54    4.54    87.154 < 2.2e-16 ***
Residuals 2023  105.31    0.05
---

[[7]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq F value    Pr(>F)
TARGER       1 1816.97 1816.97 36808.2 < 2.2e-16 ***
LCOc1        1   92.03   92.03  1864.4 < 2.2e-16 ***
GDPESP       1   30.21   30.21   612.0 < 2.2e-16 ***
DAX          1    9.99    9.99   202.3 < 2.2e-16 ***
Residuals 2023   99.86    0.05
---
```

```
[[11]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq  F value    Pr(>F)
TARGER       1 1816.97 1816.97 38252.64 < 2.2e-16 ***
LCOc1        1   92.03   92.03  1937.53 < 2.2e-16 ***
GDPESP       1   30.21   30.21   636.01 < 2.2e-16 ***
SPGRE        1   13.76   13.76   289.63 < 2.2e-16 ***
Residuals 2023   96.09    0.05
---

[[12]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq   F value    Pr(>F)
TARGER       1 1816.97 1816.97 34201.837 < 2.2e-16 ***
LCOc1        1   92.03   92.03  1732.352 < 2.2e-16 ***
GDPESP       1   30.21   30.21   568.663 < 2.2e-16 ***
SPESP        1    2.38    2.38    44.734 2.911e-11 ***
Residuals 2023  107.47    0.05
---

[[25]]
Analysis of Variance Table

Response: YTMGER
            Df  Sum Sq Mean Sq   F value    Pr(>F)
TARGER       1 1816.97 1816.97 33653.543 < 2.2e-16 ***
LCOc1        1   92.03   92.03  1704.580 < 2.2e-16 ***
GDPESP       1   30.21   30.21   559.547 < 2.2e-16 ***
GERINF       1    0.63    0.63    11.586 0.0006773 ***
Residuals 2023  109.22    0.05
---
```

On top of the four displayed variables are the already chosen and previously mentioned TARGER, LCOc1, and GDPESP. The fourth variable changes in every calculation set, providing a F-value for every possible additional variable. For ECOINDEU it would be 5.6712, for ECOINDGER 0.9833, and for ECB 63.94 and so on. Out of those three possibilities, only ECB would be viable regarding the significance level as marked by the 3 stars.[38] After ranking all viable F-values, SPGRE, with the highest value of 289.63, is

[38]Significance codes are always: "***": 0.001, "**": 0.01, "*": 0.05, ".": 0.1, " ": 1

selected as the fourth variable. This completes ROUND 4 and ROUND 5, which follows the same pattern, begins. After five variables are selected or no more viable variables are left to choose from, the regression model is run with the "winning" variables. In this example, the five selected variables are TARGER, LCOc1, GDPESP, SPGRE, and FED leading to the final R output of the regression as:

```
Call:
lm(formula = YTMGER ~ TARGER + LCOc1 + GDPESP + SPGRE + FED,
    data = GermanyAdd1)

Residuals:
    Min      1Q  Median      3Q     Max
-0.5954 -0.1223  0.0061  0.1351  0.5346

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -4.933e+00  3.444e-01  -14.32   <2e-16 ***
TARGER      -2.918e-06  6.105e-08  -47.80   <2e-16 ***
LCOc1        1.020e-02  3.023e-04   33.74   <2e-16 ***
GDPESP       7.786e-03  3.296e-04   23.62   <2e-16 ***
SPGRE       -4.400e-02  2.319e-03  -18.98   <2e-16 ***
FED          4.731e-02  3.169e-03   14.93   <2e-16 ***
---

Residual standard error: 0.2069 on 2022 degrees of freedom
Multiple R-squared:  0.9578,    Adjusted R-squared:  0.9577
F-statistic:  9169 on 5 and 2022 DF,  p-value: < 2.2e-16
```

The resulting summary provides the five variables, the regression equation and the corresponding R^2. The variables and the R^2 are entered in the overall result sheet *Results.xlsx* and will be shown in more detail in section 5.[39]
For every analyzed country, this procedure was implemented ten times with different data sets used.[40]

[39] Attached data files: Results.xlsx
[40] see section 3.8

3.3. Backwards Elimination Method

The second classic variable selection method is the *Backwards Elimination*.[41] In this method all parameters are originally part of the regression model and are eliminated step by step until only five variables remain.[42][43] The deciding factor is the t-value. The variable with the closest value to zero is removed from the regression. It does not matter if the deviation form zero is positive or negative. The absolute difference from zero is the determining factor.

Example Backwards Elimination Method
To illustrate this process, GermanyBackMethod is used.[44] The ".csv" file is again needed by the *R*-Code and *GermanyBackOverview.xlsx* provides the overview of the elimination process.[45] In this example, ROUNDs 1 through 20 already took place. So far, the remaining variables are DEBTGER, DEBTITA, GDPFRA, GDPITA, XAU, LCOc1, and TARGER with an output for ROUND 21 by the R-Code as:

```
Call:
lm(formula = YTMGER ~ DEBTGER + DEBTITA + GDPFRA + GDPITA + XAU +
    LCOc1 + TARGER)

Residuals:
     Min       1Q   Median       3Q      Max
-0.55496 -0.12960  0.00973  0.13108  0.45900

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.816e+01  9.882e-01   28.49   <2e-16 ***
DEBTGER      7.799e-02  3.316e-03   23.52   <2e-16 ***
DEBTITA     -1.971e-01  5.885e-03  -33.50   <2e-16 ***
GDPFRA       1.957e-02  6.867e-04   28.50   <2e-16 ***
GDPITA      -2.956e-02  9.777e-04  -30.24   <2e-16 ***
XAU         -1.016e-03  4.681e-05  -21.70   <2e-16 ***
LCOc1        1.294e-02  3.409e-04   37.97   <2e-16 ***
TARGER      -3.058e-06  7.396e-08  -41.34   <2e-16 ***
---

Residual standard error: 0.1922 on 2020 degrees of freedom
Multiple R-squared:  0.9636,    Adjusted R-squared:  0.9635
F-statistic:  7635 on 7 and 2020 DF,  p-value: < 2.2e-16
```

[41] see Xu and Zhang (2001)
[42] Or less if one or more of the remaining parameters are not significant
[43] see Draper and Smith (1998), p. 339-342
[44] Attached data files: Germany\BackMethod
[45] The *R*-Code can be seen at attached data files: Germany*R*-Code\GermanyBack

All of the variables are highly significant. However, XAU has the lowest deviation from zero and is removed from the regression in this round. Thus, at the beginning of ROUND 22 there are only six variables left and after the results of this round are analyzed, DEBTGER is removed, providing the final summary for GermanyBackMethod as:

```
Call:
lm(formula = YTMGER ~ DEBTITA + GDPFRA + GDPITA + LCOc1 + TARGER)

Residuals:
     Min       1Q   Median       3Q      Max
-0.67014 -0.13054  0.00451  0.14290  0.53172

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.721e+01  9.650e-01   17.83   <2e-16 ***
DEBTITA     -8.651e-02  3.461e-03  -25.00   <2e-16 ***
GDPFRA       8.537e-03  5.106e-04   16.72   <2e-16 ***
GDPITA      -1.348e-02  7.163e-04  -18.82   <2e-16 ***
LCOc1        9.843e-03  3.371e-04   29.20   <2e-16 ***
TARGER      -3.795e-06  7.052e-08  -53.82   <2e-16 ***
---

Residual standard error: 0.2183 on 2022 degrees of freedom
Multiple R-squared:  0.953,     Adjusted R-squared:  0.9529
F-statistic:  8198 on 5 and 2022 DF,  p-value: < 2.2e-16
```

The last five variables are DEBTITA, GDPFRA, GDPITA, LCOc1, and TARGER with a R^2 of 0.953.

3.4. Robust Regression

Robust regression is fitting a linear model by using an *M estimator*.[46] In this thesis, the *Huber* M estimator is applied:[47]

$$\rho(x) = \begin{cases} \frac{1}{2}x^2, & \text{if } |x| \leq k \\ k\,|x| - \frac{1}{2}k^2, & \text{if } |x| > k \end{cases}$$

[46] M stands for "maximum likelihood"
[47] see Fox and Weisberg (2013), p. 1-3

k : Constant. Default value was used: 1.345
x : The values for x are standardized

Basically, in a robust regression, the outliers are weighted less during the fitting process. While in the Least-Squares method all values are weighted equally with 1, the weighting in the *Huber* method is:[48]

$$\omega(x) = \begin{cases} 1, & \text{if } |x| \leq k \\ \frac{k}{|x|}, & \text{if } |x| > k \end{cases}$$

The robust regression was used as a variant of the *Forward Selection Method* and *Backwards Elimination Method*. The procedure is identical to the previously explained methods. However, this method was only applied on the complete data set, meaning only twice per country.[49]

3.5. Lasso Method

The *lasso* method was introduced by *Tibshirani* in 1996.[50] *Lasso* is an abbreviation and stands for "**L**east **A**bsolute **S**hrinkage and **S**election **O**perator". It is a form of penalized regression that can be used for parameter selection since some of the parameters are being set to zero. This zero-setting is done by "adding bias to the regression equation in order to reduce variance and therefore, reduce prediction error and avoid over-fitting."[51] The linear regression equation used by this method is identical to the equation described in section 3.1:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_p x_{ip}$$

y_i : Response for the ith observation
$x_{i1\ldots ip}$: Independent variables
$\beta_{0\ldots p}$: Regression coefficients

The *lasso* can be formulated as a minimization problem with an additional constraint:[52]

[48] see Fox and Weisberg (2013), p. 3-4
[49] see section 3.8 for more information on data sets
[50] see Tibshirani (1996)
[51] Mitsa (2015)
[52] Schlittgen (2013), p. 117-118

$$\sum_{i=1}^{n}\left(y_i - \sum_{j=1}^{p} x_{ij}\beta_j\right)^2 \stackrel{!}{=} \min$$

$$\text{subject to} \qquad \sum_{j=1}^{p} |\beta_j| \leq s$$

s is a tuning parameter and has to be higher than 0. If it is high enough, the additional constraint loses its effect, but for a smaller s, some coefficients will be set to zero, thus allowing a variable selection.[53]
For this procedure, the variables have to be standardized. Following *Tibshirani's* proposition, all regressors were standardized so that the mean equals 0 and variance is 1, using this standardization formula:[54]

$$x_{new} = \frac{x - \mu}{\sigma}$$

x_{new} : The new standardized value of the regression coefficient
x : The previous unstandardized value of the regression coefficient
μ : The mean of the unstandardized values
σ : The standard deviation of the unstandardized values

For further and more detailed information about the *lasso* method, see *Tibshirani's* original paper or the book *The Elements of Statistical Learning* by *Hastie, Tibshirani, and Friedman.*[55][56]

Example *Lasso* Method
GermanyLassoMethod is the corresponding data set.[57] The *R* package *glmnet* is programmed to use the formulas and standardization process previously described in this chapter. Only the penalty strength has to be adjusted by setting *nlambda* in the *R*-Code to different levels.[58] The value for *nlambda* is increased until not more than five vari-

[53] see Schlittgen (2013), p. 117-118
[54] see Tibshirani (1996), p. 268
[55] see Tibshirani (1996)
[56] see Hastie et al. (2013)
[57] Attached data files: Germany\LassoMethod; *R*-Code: Germany\R-Code\GermanyLasso
[58] see Cordell (2013)

ables are not being set to zero. The five regressors for this example are ECB, SPGRE, DEBTITA, GDPESP, and TARGER, as provided by the *R* output:

```
> lassoFIT<-glmnet(GermMAT,Germany$YTMGER,alpha=1,nlambda=65000)
> lasso<-predict(lassoFIT,s=lassoREG$lambda.min,type="coefficients")
> lasso
29 x 1 sparse Matrix of class "dgCMatrix"
1
(Intercept) -2.184891e-01
ECOINDEU     .
ECOINDGER    .
ECB          4.165736e-02
FED          .
DEBTGER      .
UNEMPGER     .
DAX          .
TVDAX        .
DAXChange    .
SPAUT        .
SPGRE       -7.007159e-03
SPESP        .
DEBTGRE      .
DEBTITA     -1.228237e-02
GDPAUT       .
GDPFRA       .
GDPIRE       .
GDPITA       .
GDPPOR       .
GDPESP       4.985776e-03
XAU          .
XAG          .
LCOc1        .
TARGER      -2.207584e-06
CHIMAN       .
VOLIND       .
EURINF       .
GERINF       .
```

Those five variables provide the following final regression output:

```
Call:
lm(formula = YTMGER ~ ECB + SPGRE + DEBTITA + GDPESP + TARGER)
```

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.93786 -0.15703  0.01236  0.16028  0.77603

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -5.707e+00  7.256e-01  -7.866 5.93e-15 ***
ECB          1.325e-01  1.266e-02  10.469  < 2e-16 ***
SPGRE       -1.932e-02  2.813e-03  -6.868 8.61e-12 ***
DEBTITA      5.310e-03  2.779e-03   1.911   0.0562 .
GDPESP       8.341e-03  5.536e-04  15.068  < 2e-16 ***
TARGER      -2.689e-06  9.840e-08 -27.327  < 2e-16 ***
---

Residual standard error: 0.26 on 2022 degrees of freedom
Multiple R-squared:  0.9333,    Adjusted R-squared:  0.9331
F-statistic:  5659 on 5 and 2022 DF,  p-value: < 2.2e-16
```

3.6. Subsets Method

The last method applied for the variable selection process is the *Subsets* method. It was first introduced by *Furnival* and *Wilson*.[59] The implemented *R* package *leaps* performs an exhaustive search for the best subsets of independent variables for predicting the dependent variable in a linear regression, using a branch-and-bound algorithm with the *Fortran* code provided by *Miller*, based on the work by *Furnival* and *Wilson*.[60]
Going into detail on how this methods works precisely, including mathematical formulas and the underlying *Fortran* code would be a pretty lengthy effort and exceeding the goal of this thesis. For more information about the *Subsets* method, see *Furnival* and *Wilson's* article and *Miller's* work describing this subject in detail.[61]

Example Subset Method
Here is an example of the *R* output for Germany using the *leaps* package.[62]

```
Subset selection object
Call: regsubsets.formula(YTMGER ~ ., data = Germ, nvmax = 4)
28 Variables  (and intercept)
          Forced in Forced out
ECOINDEU      FALSE      FALSE
ECOINDGER     FALSE      FALSE
```

[59] see Furnival and Wilson Jr. (1974)
[60] see Lumley (2015)
[61] see Miller (1990)
[62] Attached data files: Germany\SubsetsMethod

```
ECB           FALSE      FALSE
FED           FALSE      FALSE
DEBTGER       FALSE      FALSE
UNEMPGER      FALSE      FALSE
DAX           FALSE      FALSE
TVDAX         FALSE      FALSE
DAXChange     FALSE      FALSE
SPAUT         FALSE      FALSE
SPGRE         FALSE      FALSE
SPESP         FALSE      FALSE
DEBTGRE       FALSE      FALSE
DEBTITA       FALSE      FALSE
GDPAUT        FALSE      FALSE
GDPFRA        FALSE      FALSE
GDPIRE        FALSE      FALSE
GDPITA        FALSE      FALSE
XAU           FALSE      FALSE
XAG           FALSE      FALSE
LCOc1         FALSE      FALSE
TARGER        FALSE      FALSE
CHIMAN        FALSE      FALSE
VOLIND        FALSE      FALSE
EURINF        FALSE      FALSE
GERINF        FALSE      FALSE
GDPPOR        FALSE      FALSE
GDPESP        FALSE      FALSE
1 subsets of each size up to 5
Selection Algorithm: exhaustive
         ECOINDEU ECOINDGER   ECB   FED DEBTGER UNEMPGER   DAX
1  ( 1 )    FALSE     FALSE FALSE FALSE   FALSE    FALSE FALSE
2  ( 1 )    FALSE     FALSE FALSE FALSE   FALSE    FALSE FALSE
3  ( 1 )    FALSE     FALSE FALSE FALSE   FALSE    FALSE FALSE
4  ( 1 )    FALSE     FALSE FALSE FALSE   FALSE    FALSE FALSE
5  ( 1 )    FALSE     FALSE FALSE FALSE    TRUE    FALSE  TRUE
         TVDAX DAXChange SPAUT SPGRE SPESP DEBTGRE DEBTITA
1  ( 1 ) FALSE     FALSE FALSE FALSE FALSE   FALSE   FALSE
2  ( 1 ) FALSE     FALSE FALSE FALSE FALSE   FALSE   FALSE
3  ( 1 ) FALSE     FALSE FALSE FALSE FALSE   FALSE   FALSE
4  ( 1 ) FALSE     FALSE FALSE  TRUE FALSE   FALSE    TRUE
5  ( 1 ) FALSE     FALSE FALSE  TRUE  TRUE   FALSE   FALSE
         GDPAUT GDPFRA GDPIRE GDPITA GDPPOR GDPESP   XAU   XAG
1  ( 1 )  FALSE  FALSE  FALSE  FALSE  FALSE  FALSE FALSE FALSE
2  ( 1 )  FALSE  FALSE  FALSE  FALSE  FALSE  FALSE FALSE FALSE
3  ( 1 )  FALSE  FALSE  FALSE  FALSE  FALSE   TRUE FALSE FALSE
```

```
4  ( 1 )  FALSE  FALSE  FALSE  FALSE  FALSE  FALSE FALSE FALSE
5  ( 1 )  FALSE  FALSE  FALSE  FALSE  FALSE  FALSE FALSE FALSE
         LCOc1 TARGER CHIMAN VOLIND EURINF GERINF
1  ( 1 ) FALSE   TRUE  FALSE  FALSE  FALSE  FALSE
2  ( 1 )  TRUE   TRUE  FALSE  FALSE  FALSE  FALSE
3  ( 1 )  TRUE   TRUE  FALSE  FALSE  FALSE  FALSE
4  ( 1 )  TRUE   TRUE  FALSE  FALSE  FALSE  FALSE
5  ( 1 )  TRUE  FALSE  FALSE  FALSE  FALSE  FALSE
```

The parameter *nvmax* defines how many variables should be part of the final subset.[63] The TRUE and FALSE in the first section of the output indicate whether some variables are being forced in or forced out. Since, no parameter should be forced to be part of the subset, all variables are set to FALSE.
The second section consists of five subsets with increasing numbers of variables. The first subset contains only one variable, the second subset has two variables etc. TRUE and FALSE specify which parameters are part of the subset. Since the goal is to find the five dominating coefficients, the five variables DEBTGER, DAX, SPGRE, SPESP, and LCOc1 set to TRUE in the fifth subset are chosen as part of the regression.
The results of the regression for the *Subsets* method is then computed by *R*:

```
Call:
lm(formula = YTMGER ~ DEBTGER + DAX + SPGRE + SPESP + LCOc1)

Residuals:
     Min       1Q   Median       3Q      Max
-0.57296 -0.12965  0.01829  0.14142  0.49070

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.984e+00  9.233e-02   53.98   <2e-16 ***
DEBTGER     -3.164e-02  1.138e-03  -27.80   <2e-16 ***
DAX          1.593e-04  5.956e-06   26.74   <2e-16 ***
SPGRE       -7.737e-02  1.880e-03  -41.15   <2e-16 ***
SPESP       -1.830e-01  2.653e-03  -68.98   <2e-16 ***
LCOc1        6.306e-03  3.006e-04   20.98   <2e-16 ***
---

Residual standard error: 0.1985 on 2022 degrees of freedom
Multiple R-squared:  0.9611,    Adjusted R-squared:  0.961
F-statistic: 1e+04 on 5 and 2022 DF,  p-value: < 2.2e-16
```

[63] Note that the parameter is off by 1. Setting the parameter to 4 leads to a final subset with 5 independent variables.

3.7. Data and Sources

Several data sources were used for attaining the necessary data. Those sources include Thomson Reuters, Bloomberg, the IMF, and Eurostat. A detailed table with the variables and their sources is provided in appendix D.
The analyzed time period in the initial search for real determining factors is from 02.01.2006 to 16.12.2013. There is a second data set, covering the period from 17.12.2013 to 27.02.2015. Later on, this second set will serve as a benchmark in order to compare the predicted results with the real observable data. This time period was chosen because it fulfills a set of advantages:

- With a time span of 8 years, the data horizon is long enough to filter out temporary fluctuations, but not too long in order to yield recent results for determining factors
- It covers several different global financial situations: Two years of pre-financial crisis, the sub-prime crisis starting in 2008, pre-debt crisis, and the European debt crisis
- The time series ends with the 16.12.2013 in order for the daily and monthly analysis ending with the same date and values

The second data set starts where the first set ends. It spans over a time period of more than one year, resulting in sufficient data for its purpose of analysis the selected determinants. The main difference to the first set is that the second one does not end mid-month but on the 27.02.2015. February 2015 was a highly volatile month for the Euro-Zone and Greece and cutting off in mid-February might have lead to a loss in important market movements.[64] Furthermore, the predictions are made using daily data, therefore, a congruence of the monthly and daily data was not necessary.

Not all information is available on a daily basis. Some data is only provided in longer intervals like on a monthly or even annual basis.[65] In these cases, the data is forward filled until the provided information is updated. For example, the unemployment rate of Ireland in September 2013 was 12.7 %. This value was updated on 02.09.2013 and will be forward filled to 03.09.2013, 04.09.2013 etc. until new information is provided. Here, the update takes place on 01.10.2013 when the value is changed to 12.6 %. From now on, this new value is forward filled until the next update.
The same procedure is applied for non-regularly updated information. Non-regular updated information are information that are not updated on a pre-determined date as unemployment (beginning of month) or GDP (beginning of year), but may be changed any time due to the market situation. This category contains the ECB and FED interest rates, and the S&P ratings.

[64] see Tagesschau (2015)
[65] I.e. GDP data, unemployment data etc.

3.8. Data Adjustments

Before analyzing the data and starting to predict possible determinants, data preprocessing plays a crucial role. Figure 6 and 7 in section 2.10 provide an overview of all possible factors by country. However, before starting the variable selection process with all 44 variables, some previous data analysis and processing is reasonable in order to reduce and eliminate some of the regressors before the actual selection process begins. Aside from removing some variables beforehand, some data adjustments and categorizations were also made. Adjustments refer to actively changing the data at hand, i.e. shifting some data or assigning numerical values to rating classes. Categorization stands for dividing the data set in sub categories. Those sub categories range from only monthly changes are analyzed to sets where the values of the government bond yield is divided in quartiles to see if different yield level provide different results. All those adjustments and categorizations will be explained in detail in the following sections. In the end, every country will be analyzed on the basis of nine different data sets.

3.8.1. Ratings and Unchanged Factors

Standard&Poor's assigns rating categories based on a classification system using letters as differentiators, with AAA as the highest grade and SD as the lowest. Since those non-numerical values cannot be used in the regression equation, every letter grade was allocated to a corresponding numerical value as exhibited in Figure 8.

Classification	Notation	Value
Prime (Triple A)	AAA	0
High grade	AA+	1
	AA	2
	AA-	3
Upper Medium grade	A+	4
	A	5
	A-	6
Lower Medium grade	BBB+	7
	BBB	8
	BBB-	9
Non Investmentgrade speculative	BB+	10
	BB	11
	BB-	12
Highly Speculative	B+	13
	B	14
	B-	15
Substantial risks	CCC+	16
Extremely speculative	CCC	17
In default with little prospect for recovery	CCC-	18
	CC	19
	C	20
In default	SD	21

Figure 8: Values S&P rating

Related to ratings is the issue with unchanged and identical factors. The S&P rating of Germany never changed throughout the entire period, while the values for SPAUT and SPFRA were completely identical the entire time. Therefore, SPGER and SPFRA were removed as potential determinants beforehand. It is not possible to determine the influence of Germany's rating as long as Germany's rating stays on the AAA level. SPFRA was removed due to the indistinction with the SPAUT values. Therefore, whenever SPAUT is mentioned, it might be that SPFRA is the real cause behind the effect.

3.8.2. Correlation Adjustments

Coefficients, which are highly correlated should be sought out and removed. The removal process is quite simple: First, the correlation coefficients for all possible variable combinations are calculated. Second, the negative correlation coefficients are multiplied by -1 to get their absolute values. Finally, an elimination process similar to the *Backwards Elimination* method is applied. This process also relies on elimination rounds and on every round one variable is removed. The elimination criteria is the number of variables with which the regressor has a correlation coefficient higher than a certain parameter. This parameter is adjusted each round depending if there are still variables with a correlation coefficient higher than the parameter left. If there are still some left, the parameter stays at its current level until all regressors have a count of 0. If one variable is removed, all its correlation coefficients are also removed from the correlation table and therefore, the correlation coefficient of the corresponding variable is also removed. This procedure actively decreases the number of correlation coefficients higher than the elimination parameter. The lowest parameter applied is 0.95.[66]

The following small example illustrates the described method:

	A	B	C
A	1	0.98	0.98
B	0.98	1	0.87
C	0.98	0.87	1
count	2	1	1

Table 1: Example Correlation Elimination

Table 1 shows the initial situation. The value *count* is always reduced by 1 to adjust for the correlation coefficient of 1 when one variable is correlated with itself. The elimination parameter in this example is 0.98. In this scenario variable A has to be removed - it is highly correlated with B and C. After the removal, the table is adjusted accordingly and results in Table 2:

[66]This value is low enough that around ten variables are removed for each country

	B	C
B	1	0.87
C	0.87	1
count	0	0

Table 2: Example Correlation Elimination II

Since A was removed, B and C no longer have a correlation higher than the elimination parameter of 0.98. Now, the parameter would be reduced until the *count* value is higher than 0 again or the threshold parameter is reached and the remaining variables will not be removed due to high correlation.
It might happen that *count* for various variables is identical. In this case, the highest correlation coefficient lower than the current elimination parameter is the deciding criteria.
The data sets of all countries went through this procedure and according to the results, different variables have been removed.[67] Figure 9 provides an overview of the removed variables (and in which round) for Germany. The red cells indicate the removed ones, while the variables with a green status are included in the selection process.
Noticeable in Figure 9 is the absence of most of the possible interest rate determinants. Only ECB and FED have been part of the correlation checks. Figure 10 provides the explanation for the missing remaining rates: ECB is highly correlated with EONIA, EULIBOR, and EURIBOR, while FED and LIBOR have a highly significant correlation as well. Therefore, EONIA, EULIBOR, EURIBOR, and LIBOR have been removed beforehand and only ECB and FED represent interest rates in the selection process.

[67] Attached data files: Every country folder has a file in it called COUNTRY_Correlations.xlsx - here the process can be examined.

Variable	Status
ECOINDEU	
ECOINDGER	
ECB	
FED	
DEBTGER	
GDPGER	ROUND 6
UNEMPGER	
DAX	
TVDAX	
DAXChange	
SPAUT	
SPPOR	ROUND 4
SPIRL	ROUND 9
SPITA	ROUND 10
SPGRE	
SPESP	
DEBTAUT	ROUND 5
DEBTFRA	ROUND 1
DEBTGRE	
DEBTIRE	ROUND 3
DEBTITA	
DEBTPOR	ROUND 7
DEBTESP	ROUND 2
GDPAUT	
GDPFRA	
GDPGRE	ROUND 8
GDPIRE	
GDPITA	
GDPPOR	
GDPESP	
XAU	
XAG	
LCOc1	
TARGER	
CHIMAN	
VOLIND	
EURINF	
GERINF	

Figure 9: Removed variables due to correlation

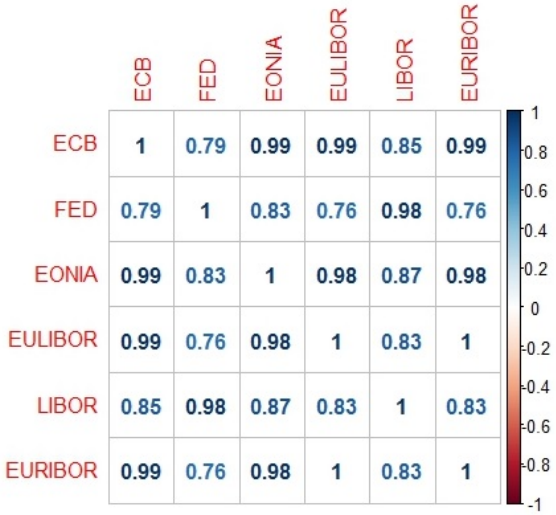


Figure 10: Correlation interest rates

3.8.3. Logarithmic Data Sample

As previously mentioned, the *lasso* method described in section 3.5 uses a certain standardization method for the variables. For *lasso*, all variables were standardized that their mean equals 0 and their variance is 1. Another possibility to address various data problems, like enormous value differences or extreme outliers, is the natural logarithm and forming a log-log model. All values in this data set are being logarithmized. The logarithmization solves the issue of different scaling, the effect of outliers is reduced, and for not normally distributed residuals, the logarithm of a skewed variable might improve the fitting to create a normally distributed variable. Furthermore, the logarithmic model is a common method to transform variables to achieve linearity for a regression analy-

sis.[68]
Since some of the variables have negative values, a shift of those values is necessary.[69] This shift is called a *linear transformation* and it preserves the linear relationship between variables, meaning that the outcome of the variable selection methods is not affected by this shift.[70]

3.8.4. Monthly Data Sample

In order to analyze the data not only on a daily basis, but on a monthly basis as well, the 15th of every month was taken to create a strongly reduced data set.[71] Even though, the data set was reduced from around 2000 entries to 96, the possible gain is to eliminate short term market fluctuations and analyze the determinants on a month to month scale.

3.8.5. Quartile Analysis

The quartile analysis is a different form of data adjustment. The data is not adjusted similarly to the previous adjustments, but categorized. The bond yield values are divided into three different categories: 1. quartile, 2. and 3. quartile, and 4. quartile. As the names implicate, in the first category are all yields that fall into the 1. quartile. The second category consists of the 2. and 3. quartile, and the 4. category contains the values of the 4. quartile.
With this data separation, it is possible to investigate if the same coefficients are determining the government bond yields independently of the yield level, or whether the determinants change with higher or lower levels.

3.8.6. Tier Analysis

Similar to the quartile analysis is the tier analysis. The data is separated into different categories depending on the value of the government bond yields. However, in the tier analysis the data is not distinguished according to a relative parameter like quartiles, but through an absolute parameter.
There are three tiers: Tier 1 contains all yields that are below 2 %, tier 2 is between 2 % and 5 %, and tier 3 has all yields above 5 %. With this division, every country is divided into only two tiers. Germany, France, and Austria have tier 1 and tier 2, while Portugal, Italy, Ireland, Greece, and Spain are separated in tier 2 and 3.
The reasoning behind using an absolute categorization factor in addition to the relative quartile method is to investigate if the yield is affected by an absolute value. Maybe, the determinants change if the yield surpasses or undercuts a certain threshold. This cannot be precluded by the quartile analysis method alone.

[68] see Stocker (2015)
[69] The amount of the several shifts can be seen in the attached data files in the overall data information file. For Germany it would be: Germany\Germany.xlsx
[70] see StatTrek.com (2015)
[71] If the 15th was on a weekend or a holiday, the next following trading day was taken instead

3.8.7. Summary

To summarize all data adjustments: Adjustments were made to reduce the number of variables before the variable selection process started. This was accomplished by removing coefficients which are to highly correlated to each other. These data adjustments affect all data sets.
Another type of adjustments are the shifts in the logarithmic data sets. Here, only individual variables are targeted and a linear shift is performed to countermand the negative values in some of the variables. The logarithmic data set itself is a result of an adjustment. To counter some of the drawbacks of non-standardized or adjusted data, the entire data set (dependent and independent variables alike) have been logarithmized.
More data sets have been created by categorization and not by adjusting the data in the existing main data set. First, the data sets were reduced from a daily change and circa 2000 values to a monthly change with 96 values. Second, there are three data sets for each country, generated by splitting the main data set depending on the quartiles of the bond yield level. Third, there are two data sets per country, separated according to a fixed value of the yields.
Therefore, in total there are nine different data sets for every country:[72]

1. The main, unchanged daily set
2. The main set logarithmized
3. The monthly set
4. The monthly set logarithmized
5. Quartile 1 set
6. Quartile M set (containing the 2. and 3. Quartile)
7. Quartile 4 set
8. Tier 1 set
9. Tier 2 set
10. Tier 3 set

4. Hypothesis

In the analyzed time period, the increase and decrease of the yield to maturity of the ten-year government bonds issued by Germany, France, Austria, Portugal, Italy, Ireland, Greece, and Spain are primarily influenced by a certain set of underlying variables. Those certain variables consist of five variables, which are the main determinants for

[72]Please keep in mind that every country only has two different tier sets: 1 and 2, or 2 and 3

changes in value of the yield for all relative yield levels and all participating countries. In order to ensure the correctness of the selected variables, calculating future yield levels with the selected determinants and comparing the results is the most reliable method. This statement leads to the following hypothesis:

- H1: The individual yield values of Germany, France, Austria, Portugal, Italy, Ireland, Greece, and Spain for the analyzed time period can be explained by a set of five determinants out of the suggested variables
- H2: For every relative and absolute yield level, those five variables are the main force determining the performance of the bond yield
- H3: For all eight countries, the five main determinants are identical.

The corresponding null hypothesis are:

- $H0_1$: The individual yield levels of the eight countries cannot be explained satisfactory by a subset of five variables out of the spectrum of suggested variables
- $H0_2$: Depending on the relative and absolute yield level, different determinants are responsible for the yield value
- $H0_2$: Every country has different main determinants influencing the corresponding government bond yield performances

As it is scientifically customary, this thesis does not try to prove the main hypothesis correct, but to disprove the null hypothesis. If the null hypothesis is proven incorrect, the hypothesis can be seen as true.

5. Empirical Results

In the previous chapters, the variables, the variable selection process, and the data adjustments were explained in detail. After applying all the mentioned methods for all eight countries there are 272 coefficients of determination in total. An overview of all the methods and their resulting R^2 is provided in Figure 11. Every different data set is marked in a different color and the "X" in the figure represent the tier subset not applicable for this specific country.
However, this compilation only displays the R^2 levels for every selection method and not the determinants used in the regressions. Figures 12 to 19 provide the determinant information for every country and method.
As previously mentioned, in some cases there were less than five significant determinants for certain methods. Here, the "missing" determinants are also marked with an "X".
Those summaries, represented by Figures 12 to 19, are the main basis for analysis in the following sections.

R^2	Germany	France	Austria	Portugal	Italy	Ireland	Greece	Spain
Add	0.9578	0.9079	0.9158	0.9352	0.6862	0.9046	0.8663	0.8152
Back	0.9530	0.9111	0.9077	0.9244	0.5763	0.8813	0.8571	0.7166
AddLN	0.9366	0.8816	0.8928	0.9311	0.6852	0.8989	0.9700	0.8425
BackLN	0.9278	0.8654	0.8764	0.9179	0.6747	0.8542	0.9667	0.6402
Lasso	0.9333	0.8860	0.8887	0.8878	0.6287	0.9038	0.8207	0.7459
Subsets	0.9611	0.9229	0.9226	0.9393	0.7267	0.9109	0.8670	0.8178
AddRobust	0.9578	0.9162	0.9149	0.9324	0.6777	0.9046	0.8585	0.7197
BackRobust	0.9530	0.9111	0.9107	0.9240	0.5763	0.9038	0.8316	0.7166
AddMonthly	0.9531	0.8959	0.9154	0.9345	0.6686	0.8814	0.7927	0.8365
BackMonthly	0.9546	0.8896	0.9032	0.9089	0.6732	0.8992	0.8375	0.7349
AddLNMonthly	0.9150	0.8631	0.8761	0.9187	0.6600	0.8861	0.9584	0.8434
BackLNMonthly	0.9442	0.8416	0.8652	0.9042	0.5832	0.8397	0.9675	0.7409
LassoMonthly	0.9364	0.8898	0.8964	0.8845	0.6193	0.8845	0.8145	0.7611
SubsetsMonthly	0.9627	0.9272	0.9247	0.9409	0.7119	0.8992	0.8572	0.8448
1.Quartile Add	0.6805	0.7686	0.7962	0.4027	0.5081	0.4727	0.7018	0.6008
1.Quartile Back	0.7439	0.7750	0.7760	0.4977	0.5846	0.5098	0.7622	0.5556
1.Quartile Lasso	0.6616	0.7021	0.6601	0.3196	0.3175	0.2745	0.5840	0.4217
1.Quartile Subsets	0.7439	0.7750	0.8009	0.5990	0.6185	0.5098	0.7846	0.6204
2.+3.Quartile Add	0.8819	0.6930	0.6831	0.8683	0.3543	0.6885	0.9307	0.5167
2.+3.Quartile Back	0.8493	0.7290	0.7315	0.8635	0.4018	0.6980	0.9397	0.4265
2.+3.Quartile Lasso	0.7360	0.6251	0.6208	0.8326	0.3412	0.5408	0.9210	0.4804
2.+3.Quartile Subsets	0.8913	0.7397	0.7770	0.8724	0.4177	0.7212	0.9424	0.5691
4.Quartile Add	0.6397	0.6573	0.5074	0.7705	0.5283	0.7420	0.7640	0.7142
4.Quartile Back	0.6552	0.6473	0.5877	0.7866	0.5400	0.7873	0.7721	0.6699
4.Quartile Lasso	0.4623	0.4559	0.4568	0.6832	0.3695	0.7170	0.6944	0.4573
4.Quartile Subsets	0.6743	0.6857	0.5895	0.7910	0.5400	0.7884	0.7721	0.7142
1.Tier Add	0.6915	0.4833	0.7659	X	X	X	X	X
1.Tier Back	0.7642	0.6125	0.8102	X	X	X	X	X
1.Tier Lasso	0.6806	0.6292	0.6086	X	X	X	X	X
1.Tier Subsets	0.7642	0.7483	0.8102	X	X	X	X	X
2.Tier Add	0.8837	0.9117	0.8646	0.6143	0.5326	0.7800	0.7164	0.5701
2.Tier Back	0.9149	0.9057	0.8626	0.6892	0.5292	0.7326	0.7428	0.5973
2.Tier Lasso	0.8149	0.8841	0.8434	0.5561	0.3247	0.6402	0.6778	0.4708
2.Tier Subsets	0.9242	0.8943	0.8974	0.7020	0.6171	0.8098	0.7487	0.6751
3.Tier Add	X	X	X	0.9040	0.5524	0.8314	0.8085	0.6728
3.Tier Back	X	X	X	0.9057	0.6271	0.8159	0.7935	0.6717
3.Tier Lasso	X	X	X	0.8807	0.3651	0.8099	0.8026	0.3678
3.Tier Subsets	X	X	X	0.9066	0.6271	0.8586	0.8278	0.6754

Figure 11: Overview coefficient of determination for all variable selection methods and countries

Determinants	Germany	1	2	3	4	5
Add	0.9578	TARGER	LCOc1	GDPESP	SPGRE	FED
Back	0.9530	DEBTITA	GDPFRA	GDPITA	LCOc1	TARGER
AddLN	0.9366	SPESP	CHIMAN	ECB	DAX	FED
BackLN	0.9278	SPGRE	DEBTGRE	DEBTITA	GDPITA	LCOc1
Lasso	0.9333	ECB	SPGRE	DEBTITA	GDPESP	TARGER
Subsets	0.9611	DEBTGER	DAX	SPGRE	SPESP	LCOc1
AddRobust	0.9578	TARGER	LCOc1	GDPESP	SPGRE	FED
BackRobust	0.9530	DEBTITA	GDPFRA	GDPITA	LCOc1	TARGER
AddMonthly	0.9531	TARGER	LCOc1	GDPESP	SPGRE	X
BackMonthly	0.9546	SPGRE	DEBTITA	LCOc1	TARGER	X
AddLNMonthly	0.9150	SPESP	CHIMAN	X	X	X
BackLNMonthly	0.9442	FED	DAX	SPESP	XAU	X
LassoMonthly	0.9364	ECB	SPGRE	DEBTITA	GDPESP	TARGER
SubsetsMonthly	0.9627	DEBTGER	DAX	SPGRE	SPESP	LCOc1
1.Quartile Add	0.6805	ECOINDEU	LCOc1	TARGER	DEBTGER	ECOINDGER
1.Quartile Back	0.7439	ECOINDEU	UNEMPGER	LCOc1	TARGER	EURINF
1.Quartile Lasso	0.6616	ECOINDEU	LCOc1	TARGER	CHIMAN	GERINF
1.Quartile Subsets	0.7439	ECOINDEU	UNEMPGER	LCOc1	TARGER	EURINF
2.+3.Quartile Add	0.8819	TARGER	LCOc1	SPGRE	ECOINDEU	DAX
2.+3.Quartile Back	0.8493	GDPAUT	GDPFRA	XAU	XAG	CHIMAN
2.+3.Quartile Lasso	0.7360	DEBTGER	SPGRE	TARGER	X	X
2.+3.Quartile Subsets	0.8913	UNEMPGER	SPGRE	GDPPOR	LCOc1	TARGER
4.Quartile Add	0.6397	DAX	LCOc1	XAU	VOLIND	TARGER
4.Quartile Back	0.6552	ECOINDEU	ECOINDGER	DAX	TARGER	CHIMAN
4.Quartile Lasso	0.4623	ECOINDGER	ECB	DAX	LCOc1	X
4.Quartile Subsets	0.6743	UNEMPGER	DAX	LCOc1	TARGER	CHIMAN
1.Tier Add	0.6915	TARGER	LCOc1	ECOINDEU	DEBTGER	ECOINDGER
1.Tier Back	0.7642	ECOINDEU	UNEMPGER	LCOc1	TARGER	EURINF
1.Tier Lasso	0.6806	ECOINDEU	LCOc1	TARGER	CHIMAN	GERINF
1.Tier Subsets	0.7642	ECOINDEU	UNEMPGER	LCOc1	TARGER	EURINF
2.Tier Add	0.8837	DEBTGER	CHIMAN	GDPESP	SPGRE	LCOc1
2.Tier Back	0.9149	DEBTGRE	DEBTITA	GDPIRE	LCOc1	TARGER
2.Tier Lasso	0.8149	ECB	DEBTGER	SPESP	GDPIRE	TARGER
2.Tier Subsets	0.9242	SPGRE	DEBTITA	GDPIRE	LCOc1	TARGER
3.Tier Add	X	X	X	X	X	X
3.Tier Back	X	X	X	X	X	X
3.Tier Lasso	X	X	X	X	X	X
3.Tier Subsets	X	X	X	X	X	X

Figure 12: Determinants Germany

Determinants	France	1	2	3	4	5
Add	0.9079	DEBTITA	SPESP	GDPIRE	SPGRE	LCOc1
Back	0.9111	GDPFRA	SPESP	GDPAUT	GDPIRE	LCOc1
AddLN	0.8816	SPESP	LCOc1	FRAINF	VOLIND	XAG
BackLN	0.8654	GDPFRA	SPESP	DEBTGRE	GDPAUT	GDPIRE
Lasso	0.8860	UNEMPFRA	CAC40	SPESP	DEBTGER	GDPESP
Subsets	0.9229	SPESP	GDPIRE	GDPITA	XAU	LCOc1
AddRobust	0.9162	DEBTITA	SPESP	GDPIRE	GDPITA	LCOc1
BackRobust	0.9111	GDPFRA	SPESP	GDPAUT	GDPIRE	LCOc1
AddMonthly	0.8959	DEBTITA	SPESP	GDPIRE	X	X
BackMonthly	0.8896	SPESP	GDPIRE	X	X	X
AddLNMonthly	0.8631	SPESP	XAG	X	X	X
BackLNMonthly	0.8416	SPESP	X	X	X	X
LassoMonthly	0.8898	ECB	UNEMPFRA	SPESP	DEBTGER	GDPESP
SubsetsMonthly	0.9272	SPITA	SPESP	DEBTGER	LCOc1	FRAINF
1.Quartile Add	0.7686	ECOINDEU	FRAINF	UNEMPFRA	GDPGRE	ECB
1.Quartile Back	0.7750	ECOINDEU	ECB	GDPFRA	UNEMPFRA	FRAINF
1.Quartile Lasso	0.7021	ECOINDEU	VOLIND	FRAINF	X	X
1.Quartile Subsets	0.7750	ECOINDEU	ECB	GDPFRA	UNEMPFRA	FRAINF
2.+3.Quartile Add	0.6930	SPESP	GDPPOR	GDPESP	CHIMAN	GDPGRE
2.+3.Quartile Back	0.7290	ECOINDEU	FED	SPGRE	DEBTGRE	LCOc1
2.+3.Quartile Lasso	0.6251	UNEMPFRA	SPGRE	SPESP	DEBTGER	FRAINF
2.+3.Quartile Subsets	0.7397	ECOINDEU	FED	SPGRE	DEBTGRE	XAG
4.Quartile Add	0.6573	LCOc1	GDPIRE	FRAINF	XAG	X
4.Quartile Back	0.6473	ECB	SPGRE	XAU	LCOc1	X
4.Quartile Lasso	0.4559	GDPIRE	LCOc1	X	X	X
4.Quartile Subsets	0.6857	ECB	XAU	LCOc1	VOLIND	FRAINF
1.Tier Add	0.4833	CHIMAN	X	X	X	X
1.Tier Back	0.6125	ECB	GDPFRA	X	X	X
1.Tier Lasso	0.6292	ECB	GDPFRA	UNEMPFRA	CAC40Change	LCOc1
1.Tier Subsets	0.7483	ECB	XAU	XAG	LCOc1	TARFRA
2.Tier Add	0.9117	DEBTITA	SPESP	GDPIRE	GDPITA	LCOc1
2.Tier Back	0.9057	GDPFRA	SPESP	GDPAUT	GDPIRE	LCOc1
2.Tier Lasso	0.8841	UNEMPFRA	SPESP	DEBTGER	GDPESP	CHIMAN
2.Tier Subsets	0.8943	SPESP	GDPIRE	GDPITA	XAU	XAG
3.Tier Add	X	X	X	X	X	X
3.Tier Back	X	X	X	X	X	X
3.Tier Lasso	X	X	X	X	X	X
3.Tier Subsets	X	X	X	X	X	X

Figure 13: Determinants France

Determinants	Austria	1	2	3	4	5
Add	0.9158	SPESP	GDPESP	GDPPOR	SPGRE	LCOc1
Back	0.9077	SPESP	DEBTITA	GDPESP	XAU	LCOc1
AddLN	0.8928	SPESP	FED	GDPIRE	LCOc1	EURINF
BackLN	0.8764	SPESP	DEBTGRE	GDPGRE	GDPIRE	GDPPOR
Lasso	0.8887	SPGRE	SPESP	DEBTGER	GDPESP	X
Subsets	0.9226	SPGRE	SPESP	GDPIRE	GDPITA	LCOc1
AddRobust	0.9149	GDPGRE	SPESP	GDPAUT	GDPPOR	SPGRE
BackRobust	0.9107	SPESP	DEBTGRE	GDPFRA	GDPITA	XAU
AddMonthly	0.9154	SPESP	SPITA	DEBTGER	FED	X
BackMonthly	0.9032	SPITA	SPGRE	SPESP	X	X
AddLNMonthly	0.8761	SPESP	FED	X	X	X
BackLNMonthly	0.8652	GDPAUT	SPESP	GDPFRA	X	X
LassoMonthly	0.8964	SPGRE	SPESP	DEBTGER	GDPESP	X
SubsetsMonthly	0.9247	SPGRE	SPESP	GDPIRE	GDPITA	LCOc1
1.Quartile Add	0.7962	SPESP	SPITA	XAU	XAG	ECB
1.Quartile Back	0.7760	ECB	SPITA	GDPIRE	XAU	LCOc1
1.Quartile Lasso	0.6601	ECOINDAUT	SPESP	X	X	X
1.Quartile Subsets	0.8009	ECB	SPESP	DEBTGER	XAU	LCOc1
2.+3.Quartile Add	0.6831	SPESP	SPITA	XAG	SPGRE	GDPPOR
2.+3.Quartile Back	0.7315	ECOINDAUT	FED	GDPAUT	SPGRE	DEBTGRE
2.+3.Quartile Lasso	0.6208	ECOINDAUT	SPGRE	SPESP	DEBTGER	GDPESP
2.+3.Quartile Subsets	0.7770	SPGRE	GDPIRE	GDPPOR	EURINF	AUTINF
4.Quartile Add	0.5074	LCOc1	TARAUT	UNEMPAUT	SPITA	XAU
4.Quartile Back	0.5877	SPITA	SPGRE	XAU	LCOc1	TARAUT
4.Quartile Lasso	0.4568	SPITA	XAU	LCOc1	TARAUT	X
4.Quartile Subsets	0.5895	GDPIRE	GDPITA	XAU	LCOc1	TARAUT
1.Tier Add	0.7659	TARAUT	EURINF	ECB	GDPGRE	ATX
1.Tier Back	0.8102	ECOINDAUT	ECB	GDPAUT	EURINF	AUTINF
1.Tier Lasso	0.6086	LCOc1	TARAUT	EURINF	X	X
1.Tier Subsets	0.8102	ECOINDAUT	ECB	DEBTGER	EURINF	AUTINF
2.Tier Add	0.8646	GDPGRE	LCOc1	SPESP	SPITA	SPGRE
2.Tier Back	0.8626	SPESP	DEBTITA	GDPESP	XAU	LCOc1
2.Tier Lasso	0.8434	SPGRE	SPESP	DEBTGER	GDPESP	X
2.Tier Subsets	0.8974	SPGRE	SPESP	GDPIRE	GDPITA	LCOc1
3.Tier Add	X	X	X	X	X	X
3.Tier Back	X	X	X	X	X	X
3.Tier Lasso	X	X	X	X	X	X
3.Tier Subsets	X	X	X	X	X	X

Figure 14: Determinants Austria

Determinants	Portugal	1	2	3	4	5
Add	0.9352	SPGRE	SPESP	SPITA	PORINF	ECOINDEU
Back	0.9244	GDPPOR	SPGRE	SPESP	DEBTGER	GDPFRA
AddLN	0.9311	SPGRE	SPESP	GDPESP	ECOINDPOR	TARPOR
BackLN	0.9179	GDPPOR	SPGRE	SPESP	GDPFRA	GDPGRE
Lasso	0.8878	SPGRE	XAG	VOLIND	PORINF	X
Subsets	0.9393	ECOINDPOR	SPITA	SPGRE	SPESP	PORINF
AddRobust	0.9324	SPGRE	SPESP	GDPAUT	GDPPOR	PORINF
BackRobust	0.9240	GDPPOR	SPGRE	SPESP	GDPFRA	GDPGRE
AddMonthly	0.9345	SPGRE	SPESP	SPITA	PORINF	X
BackMonthly	0.9089	SPGRE	SPESP	X	X	X
AddLNMonthly	0.9187	SPGRE	SPESP	GDPESP	X	X
BackLNMonthly	0.9042	SPGRE	SPESP	X	X	X
LassoMonthly	0.8845	SPGRE	XAG	VOLIND	PORINF	X
SubsetsMonthly	0.9409	ECOINDPOR	SPITA	SPGRE	SPESP	PORINF
1.Quartile Add	0.4027	GDPPOR	XAG	ECB	GDPFRA	SPITA
1.Quartile Back	0.4977	ECOINDEU	FED	GDPPOR	PSI20	XAG
1.Quartile Lasso	0.3196	ECB	GDPAUT	XAG	X	X
1.Quartile Subsets	0.5990	ECOINDEU	FED	GDPAUT	GDPIRE	XAU
2.+3.Quartile Add	0.8683	TARPOR	XAG	XAU	ECOINDPOR	SPITA
2.+3.Quartile Back	0.8635	ECOINDEU	ECOINDPOR	PSI20	SPESP	GDPFRA
2.+3.Quartile Lasso	0.8326	ECOINDPOR	SPITA	GDPFRA	XAG	TARPOR
2.+3.Quartile Subsets	0.8724	PSI20	SPGRE	XAU	XAG	TARPOR
4.Quartile Add	0.7705	SPGRE	PORINF	XAU	ECOINDEU	PSI20
4.Quartile Back	0.7866	ECOINDEU	ECOINDPOR	PSI20	SPESP	VOLIND
4.Quartile Lasso	0.6832	SPGRE	SPESP	PORINF	X	X
4.Quartile Subsets	0.7910	PSI20	SPITA	SPGRE	SPESP	VOLIND
1.Tier Add	X	X	X	X	X	X
1.Tier Back	X	X	X	X	X	X
1.Tier Lasso	X	X	X	X	X	X
1.Tier Subsets	X	X	X	X	X	X
2.Tier Add	0.6143	GDPAUT	ECOINDPOR	CHIMAN	SPGRE	ECB
2.Tier Back	0.6892	ECOINDPOR	ECB	SPESP	DEBTGRE	DEBTITA
2.Tier Lasso	0.5561	ECOINDPOR	GDPPOR	SPITA	GDPAUT	LCOc1
2.Tier Subsets	0.7020	ECOINDPOR	ECB	SPESP	DEBTGER	GDPIRE
3.Tier Add	0.9040	SPGRE	PORINF	ECOINDEU	PSI20	TARPOR
3.Tier Back	0.9057	ECOINDEU	PSI20	SPGRE	SPESP	LCOc1
3.Tier Lasso	0.8807	ECOINDEU	SPGRE	SPESP	VOLIND	PORINF
3.Tier Subsets	0.9066	ECOINDEU	PSI20	SPGRE	SPESP	EURINF

Figure 15: Determinants Portugal

Determinants	Italy	1	2	3	4	5
Add	0.6862	ITAINF	SPGRE	GDPGRE	ECOINDITA	UNEMPITA
Back	0.5763	DEBTITA	GDPITA	DEBTGER	DEBTGRE	TARITA
AddLN	0.6852	GDPAUT	ITAINF	EURINF	SPGRE	ECB
BackLN	0.6747	DEBTITA	GDPITA	GDPGRE	GDPPOR	ITAINF
Lasso	0.6287	ECOINDITA	SPGRE	VOLIND	ITAINF	X
Subsets	0.7267	ECOINDEU	UNEMPITA	SPGRE	LCOc1	TARITA
AddRobust	0.6777	ITAINF	SPGRE	GDPGRE	EURINF	GDPESP
BackRobust	0.5763	DEBTITA	GDPITA	DEBTGER	DEBTGRE	TARITA
AddMonthly	0.6686	ITAINF	SPGRE	EURINF	GDPESP	X
BackMonthly	0.6732	GDPITA	UNEMPITA	LCOc1	TARITA	VOLIND
AddLNMonthly	0.6600	ITAINF	SPGRE	EURINF	ECB	X
BackLNMonthly	0.5832	DEBTITA	GDPITA	SPITA	DEBTGRE	ITAINF
LassoMonthly	0.6193	ECOINDITA	SPGRE	XAG	VOLIND	ITAINF
SubsetsMonthly	0.7119	ECOINDEU	UNEMPITA	SPGRE	LCOc1	TARITA
1.Quartile Add	0.5081	EURINF	ECOINDEU	GDPFRA	UNEMPITA	GDPGRE
1.Quartile Back	0.5846	ECOINDEU	FED	DEBTITA	GDPITA	DEBTGRE
1.Quartile Lasso	0.3175	TVFTMIB	SPITA	EURINF	X	X
1.Quartile Subsets	0.6185	FED	DEBTITA	DEBTGRE	GDPGRE	EURINF
2.+3.Quartile Add	0.3543	XAG	GDPESP	VOLIND	LCOc1	TVFTMIB
2.+3.Quartile Back	0.4018	ECOINDEU	ECB	DEBTITA	DEBTGRE	LCOc1
2.+3.Quartile Lasso	0.3412	GDPESP	XAG	LCOc1	VOLIND	ITAINF
2.+3.Quartile Subsets	0.4177	ECOINDITA	DEBTITA	DEBTGER	DEBTGRE	LCOc1
4.Quartile Add	0.5283	SPGRE	XAG	SPITA	XAU	ECOINDEU
4.Quartile Back	0.5400	UNEMPITA	SPITA	XAU	XAG	TARITA
4.Quartile Lasso	0.3695	SPGRE	CHIMAN	VOLIND	ITAINF	X
4.Quartile Subsets	0.5400	UNEMPITA	SPITA	XAU	XAG	TARITA
1.Tier Add	X	X	X	X	X	X
1.Tier Back	X	X	X	X	X	X
1.Tier Lasso	X	X	X	X	X	X
1.Tier Subsets	X	X	X	X	X	X
2.Tier Add	0.5326	GDPFRA	VOLIND	ITAINF	XAG	DEBTGER
2.Tier Back	0.5292	GDPITA	UNEMPITA	GDPIRE	LCOc1	VOLIND
2.Tier Lasso	0.3247	GDPAUT	ITAINF	X	X	X
2.Tier Subsets	0.6171	ECOINDEU	UNEMPITA	SPITA	GDPGRE	LCOc1
3.Tier Add	0.5524	DEBTGRE	XAG	CHIMAN	EURINF	X
3.Tier Back	0.6271	ECB	UNEMPITA	SPITA	XAG	ITAINF
3.Tier Lasso	0.3651	DEBTGRE	LCOc1	CHIMAN	ITAINF	X
3.Tier Subsets	0.6271	ECB	UNEMPITA	SPITA	XAG	ITAINF

Figure 16: Determinants Italy

Determinants	Ireland	1	2	3	4	5
Add	0.9046	TARIRE	GDPITA	XAG	SPESP	GDPFRA
Back	0.8813	SPITA	SPGRE	DEBTITA	GDPFRA	TARIRE
AddLN	0.8989	TARIRE	GDPESP	SPGRE	GDPAUT	XAG
BackLN	0.8542	GDPIRE	SPGRE	DEBTITA	GDPITA	TARIRE
Lasso	0.9038	ECOINDEU	SPESP	XAG	TARIRE	EURINF
Subsets	0.9109	GDPIRE	SPESP	GDPGRE	XAG	TARIRE
AddRobust	0.9046	TARIRE	GDPITA	XAG	SPESP	GDPFRA
BackRobust	0.9038	ECOINDEU	SPGRE	SPESP	GDPFRA	TARIRE
AddMonthly	0.8814	TARIRE	GDPITA	XAG	SPESP	X
BackMonthly	0.8992	SPGRE	SPESP	XAU	XAG	TARIRE
AddLNMonthly	0.8861	TARIRE	GDPESP	SPGRE	GDPAUT	X
BackLNMonthly	0.8397	GDPIRE	SPGRE	DEBTITA	GDPITA	TARIRE
LassoMonthly	0.8845	ECOINDEU	SPESP	XAG	TARIRE	EURINF
SubsetsMonthly	0.8992	SPGRE	SPESP	XAU	XAG	TARIRE
1.Quartile Add	0.4727	GDPIRE	VOLIND	LCOc1	ISEQ	TARIRE
1.Quartile Back	0.5098	ISEQ	LCOc1	TARIRE	VOLIND	EURINF
1.Quartile Lasso	0.2745	ECOINDEU	GDPIRE	VOLIND	X	X
1.Quartile Subsets	0.5098	ISEQ	LCOc1	TARIRE	VOLIND	EURINF
2.+3.Quartile Add	0.6885	TARIRE	SPITA	LCOc1	ECOINDIRE	GDPGRE
2.+3.Quartile Back	0.6980	SPGRE	GDPAUT	GDPGRE	LCOc1	TARIRE
2.+3.Quartile Lasso	0.5408	GDPFRA	TARIRE	X	X	X
2.+3.Quartile Subsets	0.7212	GDPAUT	GDPPOR	LCOc1	TARIRE	IREINF
4.Quartile Add	0.7420	TARIRE	XAG	SPITA	GDPIRE	ISEQ
4.Quartile Back	0.7873	SPITA	SPGRE	XAU	XAG	TARIRE
4.Quartile Lasso	0.7170	ECOINDEU	SPITA	DEBTGRE	XAG	TARIRE
4.Quartile Subsets	0.7884	ECB	ISEQ	SPITA	GDPGRE	TARIRE
1.Tier Add	X	X	X	X	X	X
1.Tier Back	X	X	X	X	X	X
1.Tier Lasso	X	X	X	X	X	X
1.Tier Subsets	X	X	X	X	X	X
2.Tier Add	0.7800	ECOINDIRE	GDPPOR	UNEMPIRE	XAG	DEBTGRE
2.Tier Back	0.7326	DEBTITA	GDPFRA	GDPGRE	LCOc1	TARIRE
2.Tier Lasso	0.6402	ECOINDIRE	GDPPOR	IREINF	X	X
2.Tier Subsets	0.8098	UNEMPIRE	ISEQ	GDPGRE	LCOc1	TARIRE
3.Tier Add	0.8314	TARIRE	GDPITA	XAG	SPITA	GDPAUT
3.Tier Back	0.8159	ECOINDEU	GDPIRE	DEBTGRE	GDPAUT	TARIRE
3.Tier Lasso	0.8099	SPITA	DEBTGRE	GDPITA	XAG	TARIRE
3.Tier Subsets	0.8586	SPITA	SPGRE	XAU	XAG	TARIRE

Figure 17: Determinants Ireland

Determinants	Greece	1	2	3	4	5
Add	0.8663	SPGRE	UNEMPGRE	TARGRE	DEBTGRE	SPIRL
Back	0.8571	SPGRE	DEBTITA	GDPITA	GDPFRA	TARGRE
AddLN	0.9700	TARGRE	SPGRE	ECB	ATG	ECOINDEU
BackLN	0.9667	ECOINDEU	ATG	DEBTITA	GDPFRA	TARGRE
Lasso	0.8207	SPGRE	TARGRE	VOLIND	EURINF	X
Subsets	0.8670	SPGRE	DEBTGER	DEBTITA	GDPPOR	GDPESP
AddRobust	0.8585	XAU	SPGRE	UNEMPGRE	DEBTGRE	TARGRE
BackRobust	0.8316	SPGRE	DEBTITA	GDPITA	GDPIRE	GDPFRA
AddMonthly	0.7927	SPGRE	UNEMPGRE	X	X	X
BackMonthly	0.8375	SPGRE	DEBTITA	TARGRE	X	X
AddLNMonthly	0.9584	TARGRE	SPGRE	GDPESP	X	X
BackLNMonthly	0.9675	ECOINDEU	ATG	GDPIRE	TARGRE	X
LassoMonthly	0.8145	SPGRE	TARGRE	VOLIND	EURINF	X
SubsetsMonthly	0.8572	ATGChange	SPGRE	DEBTITA	GDPPOR	TARGRE
1.Quartile Add	0.7018	XAU	FED	TARGRE	UNEMPGRE	CHIMAN
1.Quartile Back	0.7622	FED	SPIRL	DEBTGER	LCOc1	CHIMAN
1.Quartile Lasso	0.5840	UNEMPGRE	GDPPOR	XAU	XAG	CHIMAN
1.Quartile Subsets	0.7846	FED	GDPITA	GDPIRE	LCOc1	CHIMAN
2.+3.Quartile Add	0.9307	XAU	TARGRE	GDPFRA	SPGRE	XAG
2.+3.Quartile Back	0.9397	SPGRE	XAU	XAG	TARGRE	GREINF
2.+3.Quartile Lasso	0.9210	ECOINDEU	SPGRE	GDPFRA	XAG	TARGRE
2.+3.Quartile Subsets	0.9424	ECB	SPAUT	SPIRL	SPGRE	TARGRE
4.Quartile Add	0.7640	ATG	GREINF	CHIMAN	GDPAUT	UNEMPGRE
4.Quartile Back	0.7721	ECB	UNEMPGRE	ATG	SPIRL	CHIMAN
4.Quartile Lasso	0.6944	ECOINDGRE	ATG	XAG	CHIMAN	EURINF
4.Quartile Subsets	0.7721	ECB	UNEMPGRE	ATG	SPIRL	CHIMAN
1.Tier Add	X	X	X	X	X	X
1.Tier Back	X	X	X	X	X	X
1.Tier Lasso	X	X	X	X	X	X
1.Tier Subsets	X	X	X	X	X	X
2.Tier Add	0.7164	XAU	GDPAUT	TARGRE	UNEMPGRE	FED
2.Tier Back	0.7428	ECOINDGRE	UNEMPGRE	ATG	SPIRL	DEBTGER
2.Tier Lasso	0.6778	UNEMPGRE	GDPAUT	XAU	TARGRE	VOLIND
2.Tier Subsets	0.7487	UNEMPGRE	ATG	SPGRE	DEBTITA	LCOc1
3.Tier Add	0.8085	SPGRE	DEBTITA	TARGRE	GDPPOR	DEBTGER
3.Tier Back	0.7935	ATG	DEBTGER	DEBTITA	GDPITA	LCOc1
3.Tier Lasso	0.8026	ECOINDGRE	ATG	SPGRE	TARGRE	EURINF
3.Tier Subsets	0.8278	ECOINDGRE	ATG	DEBTITA	XAG	LCOc1

Figure 18: Determinants Greece

Determinants	Spain	1	2	3	4	5
Add	0.8152	XAG	TARESP	SPESP	GDPFRA	XAU
Back	0.7166	GDPESP	DEBTIRE	DEBTGER	GDPFRA	GDPGRE
AddLN	0.8425	XAG	TARESP	ECB	IBEX	GDPESP
BackLN	0.6402	DEBTGER	GDPAUT	GDPGRE	GDPITA	GDPPOR
Lasso	0.7459	GDPFRA	XAG	TARESP	VOLIND	EURINF
Subsets	0.8178	IBEX	SPESP	GDPIRE	XAG	TARESP
AddRobust	0.7197	XAG	GDPFRA	ECOINDESP	FED	DEBTGER
BackRobust	0.7166	GDPESP	DEBTIRE	DEBTGER	GDPFRA	GDPGRE
AddMonthly	0.8365	XAG	TARESP	SPESP	GDPFRA	X
BackMonthly	0.7349	GDPESP	DEBTIRE	DEBTGER	GDPFRA	GDPGRE
AddLNMonthly	0.8434	XAG	TARESP	ECB	IBEX	X
BackLNMonthly	0.7409	GDPESP	DEBTIRE	DEBTGER	GDPFRA	GDPGRE
LassoMonthly	0.7611	GDPFRA	XAG	TARESP	VOLIND	EURINF
SubsetsMonthly	0.8448	IBEX	SPESP	GDPIRE	XAG	TARESP
1.Quartile Add	0.6008	XAG	VOLIND	FED	ECOINDESP	DEBTIRE
1.Quartile Back	0.5556	ECOINDESP	FED	SPESP	DEBTIRE	XAG
1.Quartile Lasso	0.4217	ECB	GDPFRA	XAG	VOLIND	ESPINF
1.Quartile Subsets	0.6204	ECOINDESP	FED	GDPFRA	XAU	CHIMAN
2.+3.Quartile Add	0.5167	XAG	EURINF	CHIMAN	GDPIRE	IBEX
2.+3.Quartile Back	0.4265	IBEX	DEBTIRE	DEBTGER	GDPAUT	LCOc1
2.+3.Quartile Lasso	0.4804	GDPFRA	XAG	LCOc1	CHIMAN	EURINF
2.+3.Quartile Subsets	0.5691	ECOINDESP	FED	SPGRE	GDPPOR	LCOc1
4.Quartile Add	0.7142	IBEX	ECOINDEU	TARESP	SPITA	GDPITA
4.Quartile Back	0.6699	IBEX	SPESP	XAU	TARESP	ESPINF
4.Quartile Lasso	0.4573	IBEX	LCOc1	X	X	X
4.Quartile Subsets	0.7142	ECOINDEU	IBEX	SPITA	GDPITA	TARESP
1.Tier Add	X	X	X	X	X	X
1.Tier Back	X	X	X	X	X	X
1.Tier Lasso	X	X	X	X	X	X
1.Tier Subsets	X	X	X	X	X	X
2.Tier Add	0.5701	GDPAUT	LCOc1	VOLIND	ECB	XAU
2.Tier Back	0.5973	ECOINDESP	FED	DEBTGER	GDPAUT	LCOc1
2.Tier Lasso	0.4708	GDPAUT	LCOc1	X	X	X
2.Tier Subsets	0.6751	ECOINDESP	FED	SPGRE	GDPPOR	LCOc1
3.Tier Add	0.6728	IBEX	XAU	GDPITA	TARESP	ECOINDEU
3.Tier Back	0.6717	IBEX	SPITA	XAU	TARESP	EURINF
3.Tier Lasso	0.3678	IBEX	DEBTGRE	X	X	X
3.Tier Subsets	0.6754	ECOINDEU	IBEX	SPITA	GDPITA	TARESP

Figure 19: Determinants Spain

5.1. Analysis

The previous figures provided a summary of the R^2 values and the related determinants for each country and selection method. In order to find the most important determinants, a ranking system has to be implemented. One possibility would be simply counting how often a certain variable has been selected for each country. However, this system is not feasible. First, there is a real chance of some of the variables are chosen the same amount of time and a tie-breaker is required. Furthermore, distinguishing between variables relevant for the complete data set and variables only selected in certain subsets,is beneficial. Therefore, a scoreboard based system is used to pick the coefficients.
In this system, there are seven scoreboards for every country:

- *Overall*: All methods of all data sets are added up.
- *Complete data set*: The complete data set and the methods used on the complete set are used as underlying data[73]
- Three *Quartile* boards: Scores form the methods applied on the three quartile data sets[74]
- Two *Tier* sets: Similar to the quartile boards, only with the tier data sets [75]

The scoreboards reflect how often a determinant was selected in their corresponding subsets - and how many points were allocated to them. Those points are a result of adding up the R^2 values of the methods this determinant was selected in. Using R^2 as the point basis has the advantage that methods and variables, which were able to explain the yield values to a higher degree, receive more points. To illustrate with the help of Figure 19: XAG is one of the determinants in the *Add* method (on top of the figure), leading to XAG receiving 0.8152 points. GDPFRA is also selected and is awarded the 0.8152 points as well.[76] However, in the second method (*Back*), XAG is not being chosen and stays at 0.8152 points, while GDPFRA is a part again and receives an additional 0.7166 points resulting in the new score of 1.5318.
After calculating all the sums of points, the final five determinants for each data set (and also five determinants compromised of the results of each data set) are found.[77]
In the following sections, the scoreboards for each country are presented and their results analyzed in detail.

5.1.1. Germany

In the *Overall* scoreboard, shown in Figure 20, ECOINDEU, SPGRE, DEBTITA, LCOc1, and TARGER scored the most points. Out of those five, LCOc1 and TARGER out-

[73] Green colored areas in Figures 11 to 19
[74] Blue colored
[75] The orange colored areas
[76] The position of the five determinants is irrelevant and not any kind of ranking. All selected variables receive the same amount of points for the corresponding method (the value of R^2)
[77] Some scoreboards have less than five determinants. Here the score was a draw for some variables and since the maximum number is five, the tied variables were both excluded

classed the other three by far in terms of number of times selected and points. This outclassing does not appear in the *Complete data set*. There, they are on a similar level as the other selected variables. Another difference in the *Overall* and *Complete data set* result is that ECOINDEU is no longer one of the five highlighted variables, but GDPESP is selected instead. In fact, ECOINDEU has not been selected once in any of the methods based on a complete data set, meaning all ten selections in *Overall* are from categorized sets.

Overall		
Determinants	# selected	Points
ECOINDEU	10	7.2675
ECOINDGER	4	2.4895
ECB	5	4.0835
FED	4	3.7964
DEBTGER	7	5.7304
UNEMPGER	6	4.5818
DAX	9	7.1180
TVDAX	0	0.0000
DAXChange	0	0.0000
SPAUT	0	0.0000
SPGRE	14	12.8617
SPESP	6	5.5345
DEBTGRE	2	1.8427
DEBTITA	8	7.4972
GDPAUT	1	0.8493
GDPFRA	3	2.7553
GDPIRE	3	2.6540
GDPITA	3	2.8338
GDPPOR	1	0.8913
GDPESP	6	5.6221
XAU	3	2.4332
XAG	1	0.8493
LCOc1	25	20.5836
TARGER	25	20.4618
CHIMAN	8	6.2563
VOLIND	1	0.6397
EURINF	4	3.0162
GERINF	2	1.3422

Complete data set		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDGER	0	0.0000
ECB	3	2.8063
FED	4	3.7964
DEBTGER	2	1.9238
UNEMPGER	0	0.0000
DAX	4	3.8046
TVDAX	0	0.0000
DAXChange	0	0.0000
SPAUT	0	0.0000
SPGRE	9	8.5446
SPESP	5	4.7196
DEBTGRE	1	0.9278
DEBTITA	6	5.6581
GDPAUT	0	0.0000
GDPFRA	2	1.9060
GDPIRE	0	0.0000
GDPITA	3	2.8338
GDPPOR	0	0.0000
GDPESP	5	4.7384
XAU	1	0.9442
XAG	0	0.0000
LCOc1	9	8.5809
TARGER	8	7.5990
CHIMAN	2	1.8516
VOLIND	0	0.0000
EURINF	0	0.0000
GERINF	0	0.0000

Figure 20: Scoreboards Germany *Overall* and *Complete data set*

The first batch of the categorized subsets, the quartile sets, is represented in Figure 21, while the second set (tier sets) is shown by Figure 22. The selected determinants for each set are highlighted in green. All scoreboards select LCOc1 and TARGER as determinants as well. This is in accordance with the previous two tables. LCOc1 and TARGER seem to be determining factors of the government bond yield for Germany, not depending on whether the yield is currently on a high or low level. UNEMPGER, is only selected in the first two quartile and the first tier table, indicating in the lower yield levels the unemployment rate is important for the yield, but not in relatively higher yield regions. The same seems to be the case for ECOINDEU. It has the highest score in *1.Quartile* and *1.Tier*, but is negligible in the other sets. This high score in the low

yield sets is the reason for ECOINDEU being part of the *Overall* scoreboard.

1. Quartile		
Determinants	# selected	Points
ECOINDEU	4	2.8299
ECOINDGER	1	0.6805
ECB	0	0.0000
FED	0	0.0000
DEBTGER	1	0.6805
UNEMPGER	2	1.4878
DAX	0	0.0000
TVDAX	0	0.0000
DAXChange	0	0.0000
SPAUT	0	0.0000
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	0	0.0000
LCOc1	4	2.8299
TARGER	4	2.8299
CHIMAN	1	0.6616
VOLIND	0	0.0000
EURINF	2	1.4878
GERINF	1	0.6616

2.+3. Quartile		
Determinants	# selected	Points
ECOINDEU	1	0.8819
ECOINDGER	0	0.0000
ECB	0	0.0000
FED	0	0.0000
DEBTGER	1	0.7360
UNEMPGER	1	0.8913
DAX	1	0.8819
TVDAX	0	0.0000
DAXChange	0	0.0000
SPAUT	0	0.0000
SPGRE	3	2.5092
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	1	0.8493
GDPFRA	1	0.8493
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	1	0.8913
GDPESP	0	0.0000
XAU	1	0.8493
XAG	1	0.8493
LCOc1	2	1.7732
TARGER	3	2.5092
CHIMAN	1	0.8493
VOLIND	0	0.0000
EURINF	0	0.0000
GERINF	0	0.0000

4. Quartile		
Determinants	# selected	Points
ECOINDEU	1	0.6552
ECOINDGER	2	1.1175
ECB	1	0.4623
FED	0	0.0000
DEBTGER	0	0.0000
UNEMPGER	1	0.6743
DAX	4	2.4315
TVDAX	0	0.0000
DAXChange	0	0.0000
SPAUT	0	0.0000
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	1	0.6397
XAG	0	0.0000
LCOc1	3	1.7763
TARGER	3	1.9692
CHIMAN	2	1.3295
VOLIND	1	0.6397
EURINF	0	0.0000
GERINF	0	0.0000

Figure 21: Scoreboards Germany *Quartile* data sets

Also quite interesting is the selection of SPGRE. It is chosen in the *2.+3.Quartile* and *2.Tier*. However, neither in the *1.Quartile* nor in the *4.Quartile* it received a single point. With the previous observations in mind, there seem to be different determinants responsible for the yield depending whether the yield is in a low, medium, or high section of its performance during the analyzed period.

Other determinants like GDPPOR, DAX, ECOINDGER, or DEBTITA only appeared in one of the subsets. This might be because of the implemented point system where even being selected once might suffice to earn enough point to be selected as one of the five determinants in the related set. Out of those four, DEBTITA seems to have the most significance for the yield. In the categorized sets, it was only highlighted in *2.Tier*, however, it is also part of the *Complete* set. Apparently, it does not play a key role in the low, medium, or high yield regions, but is significant in a set covering the entire yield spectrum.

1. Tier		
Determinants	# selected	Points
ECOINDEU	4	2.9005
ECOINDGER	1	0.6915
ECB	0	0.0000
FED	0	0.0000
DEBTGER	1	0.6915
UNEMPGER	2	1.5284
DAX	0	0.0000
TVDAX	0	0.0000
DAXChange	0	0.0000
SPAUT	0	0.0000
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	0	0.0000
LCOc1	4	2.9005
TARGER	4	2.9005
CHIMAN	1	0.6806
VOLIND	0	0.0000
EURINF	2	1.5284
GERINF	1	0.6806

2. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDGER	0	0.0000
ECB	1	0.8149
FED	0	0.0000
DEBTGER	2	1.6986
UNEMPGER	0	0.0000
DAX	0	0.0000
TVDAX	0	0.0000
DAXChange	0	0.0000
SPAUT	0	0.0000
SPGRE	2	1.8079
SPESP	1	0.8149
DEBTGRE	1	0.9149
DEBTITA	2	1.8391
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPIRE	3	2.6540
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	1	0.8837
XAU	0	0.0000
XAG	0	0.0000
LCOc1	3	2.7228
TARGER	3	2.6540
CHIMAN	1	0.8837
VOLIND	0	0.0000
EURINF	0	0.0000
GERINF	0	0.0000

Figure 22: Scoreboards Germany *Tier* data sets

5.1.2. France

For France, the analysis is quite difficult. Except for TVCAC40, all the variables have been chosen at least once in one of the scoreboards. When looking at the *Overall* table in figure 23, it becomes evident that the three most chosen determinants are SPESP, GDPIRE, and LCOc1. They are also selected in the *Complete data set* board. However, none of those three are highlighted in the low yield sets *1.Quartile* and *1.Tier.* Apparently, they are only determining factors when the French yield level is in mid or high regions.
In the low yield sections, ECB, GDPFRA, and FRAINF seem to be the driving factors. The influence of GDPFRA in the higher regions is quite low, therefore, it is not selected in the *Overall* set unlike ECB and FRAINF, which together with SPESP, GDPIRE, and LCOc1 account for the five most often selected determinants in all of France's sets combined.

Overall		
Determinants	# selected	Points
ECOINDEU	6	4.4894
ECB	9	6.5314
FED	2	1.4687
GDPFRA	8	6.3850
UNEMPFRA	8	6.2328
CAC40	1	0.8860
TVCAC40	0	0.0000
CAC40Change	1	0.6292
SPITA	1	0.9272
SPGRE	5	3.6490
SPESP	20	17.4233
DEBTGER	5	4.2122
DEBTGRE	3	2.3341
DEBTITA	4	3.6317
GDPAUT	4	3.5933
GDPGRE	2	1.4616
GDPIRE	13	11.0450
GDPITA	4	3.6451
GDPPOR	1	0.6930
GDPESP	4	3.3529
XAU	5	3.8985
XAG	6	4.7843
LCOc1	16	12.7481
TARFRA	1	0.7483
CHIMAN	3	2.0604
VOLIND	3	2.2694
FRAINF	9	6.7976

Complete data set		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECB	1	0.8898
FED	0	0.0000
GDPFRA	3	2.6876
UNEMPFRA	2	1.7758
CAC40	1	0.8860
TVCAC40	0	0.0000
CAC40Change	0	0.0000
SPITA	1	0.9272
SPGRE	1	0.9079
SPESP	14	12.5094
DEBTGER	3	2.7030
DEBTGRE	1	0.8654
DEBTITA	3	2.7200
GDPAUT	3	2.6876
GDPGRE	0	0.0000
GDPIRE	8	7.2201
GDPITA	2	1.8391
GDPPOR	0	0.0000
GDPESP	2	1.7758
XAU	1	0.9229
XAG	2	1.7447
LCOc1	7	6.3780
TARFRA	0	0.0000
CHIMAN	0	0.0000
VOLIND	1	0.8816
FRAINF	2	1.8088

Figure 23: Scoreboard France *Overall* and *Complete data set*

1. Quartile		
Determinants	# selected	Points
ECOINDEU	4	3.0207
ECB	3	2.3186
FED	0	0.0000
GDPFRA	2	1.5500
UNEMPFRA	3	2.3186
CAC40	0	0.0000
TVCAC40	0	0.0000
CAC40Change	0	0.0000
SPITA	0	0.0000
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGER	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPGRE	1	0.7686
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	0	0.0000
LCOc1	0	0.0000
TARFRA	0	0.0000
CHIMAN	0	0.0000
VOLIND	1	0.7021
FRAINF	4	3.0207

2.+3. Quartile		
Determinants	# selected	Points
ECOINDEU	2	1.4687
ECB	0	0.0000
FED	2	1.4687
GDPFRA	0	0.0000
UNEMPFRA	1	0.6251
CAC40	0	0.0000
TVCAC40	0	0.0000
CAC40Change	0	0.0000
SPITA	0	0.0000
SPGRE	3	2.0938
SPESP	2	1.3181
DEBTGER	1	0.6251
DEBTGRE	2	1.4687
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPGRE	1	0.6930
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	1	0.6930
GDPESP	1	0.6930
XAU	0	0.0000
XAG	1	0.7397
LCOc1	1	0.7290
TARFRA	0	0.0000
CHIMAN	1	0.6930
VOLIND	0	0.0000
FRAINF	1	0.6251

4. Quartile		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECB	2	1.3330
FED	0	0.0000
GDPFRA	0	0.0000
UNEMPFRA	0	0.0000
CAC40	0	0.0000
TVCAC40	0	0.0000
CAC40Change	0	0.0000
SPITA	0	0.0000
SPGRE	1	0.6473
SPESP	0	0.0000
DEBTGER	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPGRE	0	0.0000
GDPIRE	2	1.1132
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	2	1.3330
XAG	1	0.6573
LCOc1	4	2.4462
TARFRA	0	0.0000
CHIMAN	0	0.0000
VOLIND	1	0.6857
FRAINF	2	1.3430

Figure 24: Scoreboard France *Quartile* data sets

1. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECB	3	1.9900
FED	0	0.0000
GDPFRA	2	1.2417
UNEMPFRA	1	0.6292
CAC40	0	0.0000
TVCAC40	0	0.0000
CAC40Change	1	0.6292
SPITA	0	0.0000
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGER	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	1	0.7483
XAG	1	0.7483
LCOc1	2	1.3775
TARFRA	1	0.7483
CHIMAN	1	0.4833
VOLIND	0	0.0000
FRAINF	0	0.0000

2. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECB	0	0.0000
FED	0	0.0000
GDPFRA	1	0.9057
UNEMPFRA	1	0.8841
CAC40	0	0.0000
TVCAC40	0	0.0000
CAC40Change	0	0.0000
SPITA	0	0.0000
SPGRE	0	0.0000
SPESP	4	3.5958
DEBTGER	1	0.8841
DEBTGRE	0	0.0000
DEBTITA	1	0.9117
GDPAUT	1	0.9057
GDPGRE	0	0.0000
GDPIRE	3	2.7117
GDPITA	2	1.8060
GDPPOR	0	0.0000
GDPESP	1	0.8841
XAU	1	0.8943
XAG	1	0.8943
LCOc1	2	1.8174
TARFRA	0	0.0000
CHIMAN	1	0.8841
VOLIND	0	0.0000
FRAINF	0	0.0000

Figure 25: Scoreboard France *Tier* data sets

5.1.3. Austria

Overall		
Determinants	# selected	Points
ECOINDAUT	5	3.6328
ECB	6	4.7594
FED	4	3.4158
GDPAUT	4	3.3218
UNEMPAUT	1	0.5074
ATX	1	0.7659
TVATX	0	0.0000
ATXChange	0	0.0000
SPITA	9	6.4904
SPGRE	15	12.3718
SPESP	23	19.6397
DEBTGER	7	5.7758
DEBTGRE	3	2.5186
DEBTITA	2	1.7703
GDPFRA	2	1.7759
GDPGRE	4	3.4218
GDPIRE	8	6.6564
GDPITA	5	4.2449
GDPPOR	5	4.1672
GDPESP	7	5.9354
XAU	6	3.8483
XAG	2	1.4793
LCOc1	15	11.5151
TARAUT	6	3.5159
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	6	4.6647
AUTINF	3	2.3974

Complete data set		
Determinants	# selected	Points
ECOINDAUT	0	0.0000
ECB	0	0.0000
FED	3	2.6843
GDPAUT	2	1.7801
UNEMPAUT	0	0.0000
ATX	0	0.0000
TVATX	0	0.0000
ATXChange	0	0.0000
SPITA	2	1.8186
SPGRE	7	6.3663
SPESP	14	12.6106
DEBTGER	3	2.7005
DEBTGRE	2	1.7871
DEBTITA	1	0.9077
GDPFRA	2	1.7759
GDPGRE	2	1.7913
GDPIRE	4	3.6165
GDPITA	3	2.7580
GDPPOR	3	2.7071
GDPESP	4	3.6086
XAU	1	0.9107
XAG	0	0.0000
LCOc1	5	4.5636
TARAUT	0	0.0000
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	1	0.8928
AUTINF	0	0.0000

Figure 26: Scoreboard Austria *Overall* and *Complete data set*

The three most dominating determinants for Austria in the *Overall* scoreboard are SPGRE, SPESP, and LCOc1 again. They are part of the *Complete data set* and at least two out of the three are part of every scoreboard expect *1.Tier*.
SPITA and GDPIRE are completing the *Overall* set. Both show some interesting behavior. While SPITA is not selected in the *Complete data set*, the *2.+3.Quartile*, or in any of the tier sets, it is marked in the *1.Quartile* and *4.Quartile* tables. Thus, implicating that SPITA is relevant only in the relatively low and high yield regions, but not in the mid section. GDPIRE is only selected in the *Complete data set* but in none of the other sets. Apparently, it has an influence on the yield throughout all yield levels, but not a particular increased significance in a specific yield region.
Finally, ECB as a possible determinant has to be mentioned. It is a strong factor in both low yield scoreboards, but it is never selected in the other data sets at all, thus the non-consideration for *Overall* selection.

1. Quartile		
Determinants	# selected	Points
ECOINDAUT	1	0.6601
ECB	3	2.3731
FED	0	0.0000
GDPAUT	0	0.0000
UNEMPAUT	0	0.0000
ATX	0	0.0000
TVATX	0	0.0000
ATXChange	0	0.0000
SPITA	2	1.5722
SPGRE	0	0.0000
SPESP	3	2.2572
DEBTGER	1	0.8009
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	1	0.7760
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	1	0.7962
XAG	1	0.7962
LCOc1	2	1.5769
TARAUT	0	0.0000
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
AUTINF	0	0.0000

2.+3. Quartile		
Determinants	# selected	Points
ECOINDAUT	2	1.3523
ECB	0	0.0000
FED	1	0.7315
GDPAUT	1	0.7315
UNEMPAUT	0	0.0000
ATX	0	0.0000
TVATX	0	0.0000
ATXChange	0	0.0000
SPITA	1	0.6831
SPGRE	4	2.8124
SPESP	2	1.3039
DEBTGER	1	0.6208
DEBTGRE	1	0.7315
DEBTITA	0	0.0000
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	1	0.7770
GDPITA	0	0.0000
GDPPOR	2	1.4601
GDPESP	1	0.6208
XAU	0	0.0000
XAG	1	0.6831
LCOc1	0	0.0000
TARAUT	0	0.0000
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	1	0.7770
AUTINF	1	0.7770

4. Quartile		
Determinants	# selected	Points
ECOINDAUT	0	0.0000
ECB	0	0.0000
FED	0	0.0000
GDPAUT	0	0.0000
UNEMPAUT	1	0.5074
ATX	0	0.0000
TVATX	0	0.0000
ATXChange	0	0.0000
SPITA	3	1.5519
SPGRE	1	0.5877
SPESP	0	0.0000
DEBTGER	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	1	0.5895
GDPITA	1	0.5895
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	4	2.1414
XAG	0	0.0000
LCOc1	4	2.1414
TARAUT	4	2.1414
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
AUTINF	0	0.0000

Figure 27: Scoreboard Austria *Quartile* data sets

1. Tier		
Determinants	# selected	Points
ECOINDAUT	2	1.6204
ECB	3	2.3863
FED	0	0.0000
GDPAUT	1	0.8102
UNEMPAUT	0	0.0000
ATX	1	0.7659
TVATX	0	0.0000
ATXChange	0	0.0000
SPITA	0	0.0000
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGER	1	0.8102
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPFRA	0	0.0000
GDPGRE	1	0.7659
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	0	0.0000
LCOc1	1	0.6086
TARAUT	2	1.3745
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	4	2.9949
AUTINF	2	1.6204

2. Tier		
Determinants	# selected	Points
ECOINDAUT	0	0.0000
ECB	0	0.0000
FED	0	0.0000
GDPAUT	0	0.0000
UNEMPAUT	0	0.0000
ATX	0	0.0000
TVATX	0	0.0000
ATXChange	0	0.0000
SPITA	1	0.8646
SPGRE	3	2.6054
SPESP	4	3.4680
DEBTGER	1	0.8434
DEBTGRE	0	0.0000
DEBTITA	1	0.8626
GDPFRA	0	0.0000
GDPGRE	1	0.8646
GDPIRE	1	0.8974
GDPITA	1	0.8974
GDPPOR	0	0.0000
GDPESP	2	1.7060
XAU	0	0.0000
XAG	0	0.0000
LCOc1	3	2.6246
TARAUT	0	0.0000
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
AUTINF	0	0.0000

Figure 28: Scoreboard Austria *Tier* data sets

5.1.4. Portugal

Overall		
Determinants	# selected	Points
ECOINDEU	10	8.0495
ECOINDPOR	11	8.7239
ECB	5	2.7278
FED	2	1.0967
GDPPOR	7	5.1552
PSI20	9	7.2980
TVPSI20	0	0.0000
PSI20Change	0	0.0000
SPITA	9	7.2006
SPGRE	23	20.2122
SPESP	21	18.3200
DEBTGRE	1	0.6892
DEBTITA	1	0.6892
DEBTGER	2	1.6264
GDPAUT	5	3.0214
GDPFRA	6	4.8651
GDPGRE	2	1.8419
GDPIRE	2	1.3010
GDPITA	0	0.0000
GDPESP	2	1.8498
XAU	4	3.1102
XAG	8	5.5656
LCOc1	2	1.4618
TARPOR	5	4.4084
CHIMAN	1	0.6143
VOLIND	5	4.2306
EURINF	1	0.9066
PORINF	11	9.6930

Complete data set		
Determinants	# selected	Points
ECOINDEU	1	0.9352
ECOINDPOR	3	2.8113
ECB	0	0.0000
FED	0	0.0000
GDPPOR	4	3.6987
PSI20	0	0.0000
TVPSI20	0	0.0000
PSI20Change	0	0.0000
SPITA	4	3.7499
SPGRE	14	12.8838
SPESP	12	11.1115
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
DEBTGER	1	0.9244
GDPAUT	1	0.9324
GDPFRA	3	2.7663
GDPGRE	2	1.8419
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPESP	2	1.8498
XAU	0	0.0000
XAG	2	1.7723
LCOc1	0	0.0000
TARPOR	1	0.9311
CHIMAN	0	0.0000
VOLIND	2	1.7723
EURINF	0	0.0000
PORINF	7	6.4546

Figure 29: Scoreboard Portugal *Overall* and *Complete data set*

The determinants of Portugal with the most points are highlighted in figures 29, 30, and 31. The two dominating factors in *Overall* are SPGRE and SPESP. They have the most points in the *Complete data set* as well. Although, both are not selected in the lower and mid yield section, except SPESP in *2.Tier*. Their key role in the *4.Quartile* and *3.Tier* sets explains the high score in the *Overall* table.

PORINF is also selected in *Overall*. It owes its score to the *Complete data set* and *3.Tier*. The remaining two variables highlighted are ECOINDEU and ECOINDPOR. Both have their importance in specific yield regions. ECOINDEU is relevant in relatively low and high yield regions, but not in the mid region. This spot is taken by ECOINDPOR, which was selected in *2.+3.Quartile* and *2.Tier*.

Worth mentioning are XAG, which seems to be a determining factor during low yield periods, with being selecting in *1.Quartile* and *2.+3.Quartile*, and LCOc1, which unlike in the previous three countries received a really low point score and was not even selected once.

1. Quartile		
Determinants	# selected	Points
ECOINDEU	2	1.0967
ECOINDPOR	0	0.0000
ECB	2	0.7223
FED	2	1.0967
GDPPOR	2	0.9004
PSI20	1	0.4977
TVPSI20	0	0.0000
PSI20Change	0	0.0000
SPITA	1	0.4027
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
DEBTGER	0	0.0000
GDPAUT	2	0.9186
GDPFRA	1	0.4027
GDPGRE	0	0.0000
GDPIRE	1	0.5990
GDPITA	0	0.0000
GDPESP	0	0.0000
XAU	1	0.5990
XAG	3	1.2200
LCOc1	0	0.0000
TARPOR	0	0.0000
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
PORINF	0	0.0000

2.+3. Quartile		
Determinants	# selected	Points
ECOINDEU	1	0.8635
ECOINDPOR	3	2.5644
ECB	0	0.0000
FED	0	0.0000
GDPPOR	0	0.0000
PSI20	2	1.7359
TVPSI20	0	0.0000
PSI20Change	0	0.0000
SPITA	2	1.7009
SPGRE	1	0.8724
SPESP	1	0.8635
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
DEBTGER	0	0.0000
GDPAUT	0	0.0000
GDPFRA	2	1.6961
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPESP	0	0.0000
XAU	2	1.7407
XAG	3	2.5733
LCOc1	0	0.0000
TARPOR	3	2.5733
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
PORINF	0	0.0000

4. Quartile		
Determinants	# selected	Points
ECOINDEU	2	1.5571
ECOINDPOR	1	0.7866
ECB	0	0.0000
FED	0	0.0000
GDPPOR	0	0.0000
PSI20	3	2.3481
TVPSI20	0	0.0000
PSI20Change	0	0.0000
SPITA	1	0.7910
SPGRE	3	2.2447
SPESP	3	2.2608
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
DEBTGER	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPESP	0	0.0000
XAU	1	0.7705
XAG	0	0.0000
LCOc1	0	0.0000
TARPOR	0	0.0000
CHIMAN	0	0.0000
VOLIND	2	1.5776
EURINF	0	0.0000
PORINF	2	1.4537

Figure 30: Scoreboard Portugal *Quartile* data sets

2. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDPOR	4	2.5616
ECB	3	2.0055
FED	0	0.0000
GDPPOR	1	0.5561
PSI20	0	0.0000
TVPSI20	0	0.0000
PSI20Change	0	0.0000
SPITA	1	0.5561
SPGRE	1	0.6143
SPESP	2	1.3912
DEBTGRE	1	0.6892
DEBTITA	1	0.6892
DEBTGER	1	0.7020
GDPAUT	2	1.1704
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	1	0.7020
GDPITA	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	0	0.0000
LCOc1	1	0.5561
TARPOR	0	0.0000
CHIMAN	1	0.6143
VOLIND	0	0.0000
EURINF	0	0.0000
PORINF	0	0.0000

3. Tier		
Determinants	# selected	Points
ECOINDEU	4	3.5970
ECOINDPOR	0	0.0000
ECB	0	0.0000
FED	0	0.0000
GDPPOR	0	0.0000
PSI20	3	2.7163
TVPSI20	0	0.0000
PSI20Change	0	0.0000
SPITA	0	0.0000
SPGRE	4	3.5970
SPESP	3	2.6930
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
DEBTGER	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	0	0.0000
LCOc1	1	0.9057
TARPOR	1	0.9040
CHIMAN	0	0.0000
VOLIND	1	0.8807
EURINF	1	0.9066
PORINF	2	1.7847

Figure 31: Scoreboard Portugal *Tier* data sets

5.1.5. Italy

Overall		
Determinants	# selected	Points
ECOINDEU	7	4.079
ECOINDITA	4	2.352
ECB	5	3.001
FED	2	1.203
DEBTITA	8	4.433
GDPITA	7	4.198
UNEMPITA	11	6.787
TVFTMIB	2	0.672
FTMIBChange	0	0.000
SPITA	8	4.380
SPGRE	11	6.962
DEBTGER	4	2.103
DEBTGRE	9	4.676
GDPAUT	2	1.010
GDPGRE	6	3.782
GDPIRE	1	0.529
GDPFRA	2	1.041
GDPPOR	1	0.675
GDPESP	4	2.042
XAU	3	1.608
XAG	10	5.262
LCOc1	10	5.138
TARITA	7	4.344
CHIMAN	3	1.287
VOLIND	8	4.048
EURINF	8	4.688
ITAINF	16	9.071

Complete data set		
Determinants	# selected	Points
ECOINDEU	2	1.4386
ECOINDITA	3	1.9342
ECB	2	1.3452
FED	0	0.0000
DEBTITA	4	2.4105
GDPITA	5	3.0837
UNEMPITA	4	2.7980
TVFTMIB	0	0.0000
FTMIBChange	0	0.0000
SPITA	1	0.5832
SPGRE	9	6.0643
DEBTGER	2	1.1526
DEBTGRE	3	1.7358
GDPAUT	1	0.6852
GDPGRE	3	2.0386
GDPIRE	0	0.0000
GDPFRA	0	0.0000
GDPPOR	1	0.6747
GDPESP	2	1.3463
XAU	0	0.0000
XAG	1	0.6193
LCOc1	3	2.1118
TARITA	5	3.2644
CHIMAN	0	0.0000
VOLIND	3	1.9212
EURINF	4	2.6915
ITAINF	9	5.8836

Figure 32: Scoreboard Italy *Overall* and *Complete data set*

The inflation rate in Italy (ITAINF) is the most select determinant overall, even though, it is not part in any of the quartile scoreboards. However, it has significant influence on the *Complete data set*, as well as on the two tier data sets.

Similar is the behavior of SPGRE and UNEMPITA. While SPGRE is only an important variable in the *Complete data set*, UNEMPITA is selected in both tier sets, the *4.Quartile* set and in the *Complete data set*. Though, both are missing in any of the quartile scoreboards.

A quite interesting performance is shown by XAG and LCOc1. Both are only represented in two scoreboards, but manage to be part of the *Overall* result. On the one hand, LCOc1 is selected in the *2.+3.Quartile* and *2.Tier* table, indicating a responsibility for government bond yields during mid yield period. On the other hand, XAG is part of the *3.Tier* and *4.Quartile* and therefore, a determining factor during Italy's relatively higher yield periods.

1. Quartile		
Determinants	# selected	Points
ECOINDEU	2	1.093
ECOINDITA	0	0.000
ECB	0	0.000
FED	2	1.203
DEBTITA	2	1.203
GDPITA	1	0.585
UNEMPITA	1	0.508
TVFTMIB	1	0.318
FTMIBChange	0	0.000
SPITA	1	0.318
SPGRE	0	0.000
DEBTGER	0	0.000
DEBTGRE	2	1.203
GDPAUT	0	0.000
GDPGRE	2	1.127
GDPIRE	0	0.000
GDPFRA	1	0.508
GDPPOR	0	0.000
GDPESP	0	0.000
XAU	0	0.000
XAG	0	0.000
LCOc1	0	0.000
TARITA	0	0.000
CHIMAN	0	0.000
VOLIND	0	0.000
EURINF	3	1.444
ITAINF	0	0.000

2.+3. Quartile		
Determinants	# selected	Points
ECOINDEU	1	0.4018
ECOINDITA	1	0.4177
ECB	1	0.4018
FED	0	0.0000
DEBTITA	2	0.8195
GDPITA	0	0.0000
UNEMPITA	0	0.0000
TVFTMIB	1	0.3543
FTMIBChange	0	0.0000
SPITA	0	0.0000
SPGRE	0	0.0000
DEBTGER	1	0.4177
DEBTGRE	2	0.8195
GDPAUT	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPFRA	0	0.0000
GDPPOR	0	0.0000
GDPESP	2	0.6955
XAU	0	0.0000
XAG	2	0.6955
LCOc1	4	1.5150
TARITA	0	0.0000
CHIMAN	0	0.0000
VOLIND	2	0.6955
EURINF	0	0.0000
ITAINF	1	0.3412

4. Quartile		
Determinants	# selected	Points
ECOINDEU	1	0.5283
ECOINDITA	0	0.0000
ECB	0	0.0000
FED	0	0.0000
DEBTITA	0	0.0000
GDPITA	0	0.0000
UNEMPITA	2	1.0800
TVFTMIB	0	0.0000
FTMIBChange	0	0.0000
SPITA	3	1.6083
SPGRE	2	0.8978
DEBTGER	0	0.0000
DEBTGRE	0	0.0000
GDPAUT	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPFRA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	3	1.6083
XAG	3	1.6083
LCOc1	0	0.0000
TARITA	2	1.0800
CHIMAN	1	0.3695
VOLIND	1	0.3695
EURINF	0	0.0000
ITAINF	1	0.3695

Figure 33: Scoreboard Italy *Quartile* data sets

2. Tier		
Determinants	# selected	Points
ECOINDEU	1	0.6171
ECOINDITA	0	0.0000
ECB	0	0.0000
FED	0	0.0000
DEBTITA	0	0.0000
GDPITA	1	0.5292
UNEMPITA	2	1.1463
TVFTMIB	0	0.0000
FTMIBChange	0	0.0000
SPITA	1	0.6171
SPGRE	0	0.0000
DEBTGER	1	0.5326
DEBTGRE	0	0.0000
GDPAUT	1	0.3247
GDPGRE	1	0.6171
GDPIRE	1	0.5292
GDPFRA	1	0.5326
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	1	0.5326
LCOc1	2	1.1463
TARITA	0	0.0000
CHIMAN	0	0.0000
VOLIND	2	1.0618
EURINF	0	0.0000
ITAINF	2	0.8573

3. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDITA	0	0.0000
ECB	2	1.2542
FED	0	0.0000
DEBTITA	0	0.0000
GDPITA	0	0.0000
UNEMPITA	2	1.2542
TVFTMIB	0	0.0000
FTMIBChange	0	0.0000
SPITA	2	1.2542
SPGRE	0	0.0000
DEBTGER	0	0.0000
DEBTGRE	2	0.9175
GDPAUT	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPFRA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	3	1.8066
LCOc1	1	0.3651
TARITA	0	0.0000
CHIMAN	2	0.9175
VOLIND	0	0.0000
EURINF	1	0.5524
ITAINF	3	1.6193

Figure 34: Scoreboard Italy *Tier* data sets

5.1.6. Ireland

Overall		
Determinants	# selected	Points
ECOINDEU	6	4.4995
ECOINDIRE	3	2.1087
ECB	1	0.7884
GDPIRE	7	4.9099
UNEMPIRE	2	1.5898
ISEQ	6	3.8325
TVISEQ	0	0.0000
ISEQChange	0	0.0000
SPITA	9	7.1044
SPGRE	11	9.4063
SPESP	9	8.0920
DEBTGRE	4	3.1228
DEBTITA	4	3.3078
GDPAUT	6	4.8515
GDPFRA	6	4.8677
GDPGRE	6	4.6282
GDPITA	7	6.0258
GDPPOR	3	2.1414
GDPESP	2	1.7850
XAU	4	3.4443
XAG	16	13.6133
LCOc1	8	5.1424
TARIRE	31	24.4859
CHIMAN	0	0.0000
VOLIND	4	1.7668
EURINF	4	2.8079
IREINF	2	1.3614

Complete data set		
Determinants	# selected	Points
ECOINDEU	3	2.6921
ECOINDIRE	0	0.0000
ECB	0	0.0000
GDPIRE	3	2.6048
UNEMPIRE	0	0.0000
ISEQ	0	0.0000
TVISEQ	0	0.0000
ISEQChange	0	0.0000
SPITA	1	0.8813
SPGRE	8	7.0624
SPESP	9	8.0920
DEBTGRE	0	0.0000
DEBTITA	3	2.5752
GDPAUT	2	1.7850
GDPFRA	4	3.5943
GDPGRE	1	0.9109
GDPITA	5	4.3845
GDPPOR	0	0.0000
GDPESP	2	1.7850
XAU	2	1.7984
XAG	9	8.0871
LCOc1	0	0.0000
TARIRE	14	12.4522
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	2	1.7883
IREINF	0	0.0000

Figure 35: Scoreboard Ireland *Overall* and *Complete data set*

The most outstanding factor for Ireland is its *TARGET2* balance represented by TARIRE. In all of the scenarios, TARIRE is one of the determining variables.

XAG and SPGRE are the second and third most often selected coefficients, with XAG being chosen in the *Complete data set*, *4.Quartile*, and *3.Tier*, signaling an increased importance in the higher yield regions, but still a meaningfulness in the complete spectrum of yields as well. Also significant in the *Complete data set* is SPGRE. However, unlike XAG, it is not represented in any of the categorized sets. SPGRE seems to have an influence on Ireland's yield throughout the entire set, but not an increased influence in a special yield region.

Ireland's five overall determinants are concluded with SPITA and SPESP. With three rating variables in the *Overall* scoreboard, Ireland, together with Austria, seems to be the most depended on rating classifications out of the eight countries. While SPESP is marked in the *Complete data set*, SPITA is apparently more relevant in Ireland's higher yield periods.

1. Quartile		
Determinants	# selected	Points
ECOINDEU	1	0.2745
ECOINDIRE	0	0.0000
ECB	0	0.0000
GDPIRE	2	0.7472
UNEMPIRE	0	0.0000
ISEQ	3	1.4923
TVISEQ	0	0.0000
ISEQChange	0	0.0000
SPITA	0	0.0000
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	0	0.0000
LCOc1	3	1.4923
TARIRE	3	1.4923
CHIMAN	0	0.0000
VOLIND	4	1.7668
EURINF	2	1.0196
IREINF	0	0.0000

2.+3. Quartile		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDIRE	1	0.6885
ECB	0	0.0000
GDPIRE	0	0.0000
UNEMPIRE	0	0.0000
ISEQ	0	0.0000
TVISEQ	0	0.0000
ISEQChange	0	0.0000
SPITA	1	0.6885
SPGRE	1	0.6980
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTITA	0	0.0000
GDPAUT	2	1.4192
GDPFRA	1	0.5408
GDPGRE	2	1.3865
GDPITA	0	0.0000
GDPPOR	1	0.7212
GDPESP	0	0.0000
XAU	0	0.0000
XAG	0	0.0000
LCOc1	3	2.1077
TARIRE	4	2.6485
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
IREINF	1	0.7212

4. Quartile		
Determinants	# selected	Points
ECOINDEU	1	0.7170
ECOINDIRE	0	0.0000
ECB	1	0.7884
GDPIRE	1	0.7420
UNEMPIRE	0	0.0000
ISEQ	2	1.5304
TVISEQ	0	0.0000
ISEQChange	0	0.0000
SPITA	4	3.0347
SPGRE	1	0.7873
SPESP	0	0.0000
DEBTGRE	1	0.7170
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPGRE	1	0.7884
GDPITA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	1	0.7873
XAG	3	2.2463
LCOc1	0	0.0000
TARIRE	4	3.0347
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
IREINF	0	0.0000

Figure 36: Scoreboard Ireland *Quartile* data sets

2. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDIRE	2	1.4202
ECB	0	0.0000
GDPIRE	0	0.0000
UNEMPIRE	2	1.5898
ISEQ	1	0.8098
TVISEQ	0	0.0000
ISEQChange	0	0.0000
SPITA	0	0.0000
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGRE	1	0.7800
DEBTITA	1	0.7326
GDPAUT	0	0.0000
GDPFRA	1	0.7326
GDPGRE	2	1.5424
GDPITA	0	0.0000
GDPPOR	2	1.4202
GDPESP	0	0.0000
XAU	0	0.0000
XAG	1	0.7800
LCOc1	2	1.5424
TARIRE	2	1.5424
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
IREINF	1	0.6402

3. Tier		
Determinants	# selected	Points
ECOINDEU	1	0.8159
ECOINDIRE	0	0.0000
ECB	0	0.0000
GDPIRE	1	0.8159
UNEMPIRE	0	0.0000
ISEQ	0	0.0000
TVISEQ	0	0.0000
ISEQChange	0	0.0000
SPITA	3	2.4999
SPGRE	1	0.8586
SPESP	0	0.0000
DEBTGRE	2	1.6258
DEBTITA	0	0.0000
GDPAUT	2	1.6473
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPITA	2	1.6413
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	1	0.8586
XAG	3	2.4999
LCOc1	0	0.0000
TARIRE	4	3.3158
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
IREINF	0	0.0000

Figure 37: Scoreboard Ireland *Tier* data sets

5.1.7. Greece

Overall		
Determinants	# selected	Points
ECOINDEU	4	3.8252
ECOINDGRE	4	3.0676
ECB	4	3.4566
FED	4	2.9650
DEBTGRE	2	1.7248
UNEMPGRE	12	8.9972
ATG	12	9.8222
TVATG	0	0.0000
ATGChange	1	0.8572
SPAUT	1	0.9424
SPIRL	6	4.8579
SPGRE	19	16.4251
DEBTGER	5	3.9740
DEBTITA	10	8.3956
GDPAUT	3	2.1582
GDPITA	4	3.2668
GDPIRE	3	2.5837
GDPFRA	5	4.5071
GDPPOR	4	3.1167
GDPESP	2	1.8254
XAU	7	5.4089
XAG	6	4.8976
LCOc1	5	3.9168
TARGRE	20	17.2153
CHIMAN	8	5.8352
VOLIND	3	2.3130
EURINF	4	3.1322
GREINF	2	1.7037

Complete data set		
Determinants	# selected	Points
ECOINDEU	3	2.9042
ECOINDGRE	0	0.0000
ECB	1	0.9700
FED	0	0.0000
DEBTGRE	2	1.7248
UNEMPGRE	3	2.5175
ATG	3	2.9042
TVATG	0	0.0000
ATGChange	1	0.8572
SPAUT	0	0.0000
SPIRL	1	0.8663
SPGRE	12	10.3315
DEBTGER	1	0.8670
DEBTITA	6	5.2171
GDPAUT	0	0.0000
GDPITA	2	1.6887
GDPIRE	2	1.7991
GDPFRA	3	2.6554
GDPPOR	2	1.7242
GDPESP	2	1.8254
XAU	1	0.8585
XAG	0	0.0000
LCOc1	0	0.0000
TARGRE	11	9.7744
CHIMAN	0	0.0000
VOLIND	2	1.6352
EURINF	2	1.6352
GREINF	0	0.0000

Figure 38: Scoreboard Greece *Overall* and *Complete data set*

Greece's determinants are represented in Figures 38 to 40. The five elected overall coefficients are UNEMPGRE, ATG, SPGRE, DEBTITA, and TARGRE, with SPGRE and TARGRE standing out. SPGRE is playing an overall important role, without being limited to a certain yield region and TARGRE performs similarly. Both are selected in the *Complete data set* and the *2.+3.Quartile* board with TARGRE also being part of the *2.Tier*.

The Greek index ATG is seemingly a driving factor in the time period during high Greek yield levels. However, it is also influential when analyzing the entire spectrum, demonstrated by its selection in the *Complete data set*.

UNEMPGRE is exhibiting a feature also observed in other determinants of the previous countries: It is significant during low and high yield phases, but has not been selected in the *2.Quartile* or the *Complete data set*. Contrary, DEBTITA is relevant during the entire term, but not during certain yield periods.

1. Quartile		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDGRE	0	0.0000
ECB	0	0.0000
FED	3	2.2486
DEBTGRE	0	0.0000
UNEMPGRE	2	1.2858
ATG	0	0.0000
TVATG	0	0.0000
ATGChange	0	0.0000
SPAUT	0	0.0000
SPIRL	1	0.7622
SPGRE	0	0.0000
DEBTGER	1	0.7622
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPITA	1	0.7846
GDPIRE	1	0.7846
GDPFRA	0	0.0000
GDPPOR	1	0.5840
GDPESP	0	0.0000
XAU	2	1.2858
XAG	1	0.5840
LCOc1	2	1.5468
TARGRE	1	0.7018
CHIMAN	4	2.8326
VOLIND	0	0.0000
EURINF	0	0.0000
GREINF	0	0.0000

2.+3. Quartile		
Determinants	# selected	Points
ECOINDEU	1	0.9210
ECOINDGRE	0	0.0000
ECB	1	0.9424
FED	0	0.0000
DEBTGRE	0	0.0000
UNEMPGRE	0	0.0000
ATG	0	0.0000
TVATG	0	0.0000
ATGChange	0	0.0000
SPAUT	1	0.9424
SPIRL	1	0.9424
SPGRE	4	3.7338
DEBTGER	0	0.0000
DEBTITA	0	0.0000
GDPAUT	0	0.0000
GDPITA	0	0.0000
GDPIRE	0	0.0000
GDPFRA	2	1.8517
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	2	1.8704
XAG	3	2.7914
LCOc1	0	0.0000
TARGRE	4	3.7338
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
GREINF	1	0.9397

4. Quartile		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDGRE	1	0.6944
ECB	2	1.5442
FED	0	0.0000
DEBTGRE	0	0.0000
UNEMPGRE	3	2.3082
ATG	4	3.0026
TVATG	0	0.0000
ATGChange	0	0.0000
SPAUT	0	0.0000
SPIRL	2	1.5442
SPGRE	0	0.0000
DEBTGER	0	0.0000
DEBTITA	0	0.0000
GDPAUT	1	0.7640
GDPITA	0	0.0000
GDPIRE	0	0.0000
GDPFRA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	0	0.0000
XAG	1	0.6944
LCOc1	0	0.0000
TARGRE	0	0.0000
CHIMAN	4	3.0026
VOLIND	0	0.0000
EURINF	1	0.6944
GREINF	1	0.7640

Figure 39: Scoreboard Greece *Quartile* data sets

2. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDGRE	1	0.7428
ECB	0	0.0000
FED	1	0.7164
DEBTGRE	0	0.0000
UNEMPGRE	4	2.8857
ATG	2	1.4915
TVATG	0	0.0000
ATGChange	0	0.0000
SPAUT	0	0.0000
SPIRL	1	0.7428
SPGRE	1	0.7487
DEBTGER	1	0.7428
DEBTITA	1	0.7487
GDPAUT	2	1.3942
GDPITA	0	0.0000
GDPIRE	0	0.0000
GDPFRA	0	0.0000
GDPPOR	0	0.0000
GDPESP	0	0.0000
XAU	2	1.3942
XAG	0	0.0000
LCOc1	1	0.7487
TARGRE	2	1.3942
CHIMAN	0	0.0000
VOLIND	1	0.6778
EURINF	0	0.0000
GREINF	0	0.0000

3. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDGRE	2	1.6304
ECB	0	0.0000
FED	0	0.0000
DEBTGRE	0	0.0000
UNEMPGRE	0	0.0000
ATG	3	2.4239
TVATG	0	0.0000
ATGChange	0	0.0000
SPAUT	0	0.0000
SPIRL	0	0.0000
SPGRE	2	1.6111
DEBTGER	2	1.6020
DEBTITA	3	2.4298
GDPAUT	0	0.0000
GDPITA	1	0.7935
GDPIRE	0	0.0000
GDPFRA	0	0.0000
GDPPOR	1	0.8085
GDPESP	0	0.0000
XAU	0	0.0000
XAG	1	0.8278
LCOc1	2	1.6213
TARGRE	2	1.6111
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	1	0.8026
GREINF	0	0.0000

Figure 40: Scoreboard Greece *Tier* data sets

Even more expressing the feature of being significant during low and high yield periods is CHIMAN. It scored most points in the *1.Quartile* and *4.Quartile* but no points in the *2.+3.Quartile* or the *Complete data* set at all, thus the reason for not being part of the *Overall* five coefficients.

5.1.8. Spain

Overall		
Determinants	# selected	Points
ECOINDEU	4	2.7766
ECOINDESP	7	4.3380
ECB	4	2.6777
FED	7	4.3380
GDPESP	5	3.7515
IBEX	14	9.2350
TVIBEX	0	0.0000
IBEXChange	0	0.0000
SPITA	4	2.7755
SPGRE	2	1.2442
SPESP	6	4.5398
DEBTGRE	1	0.3678
DEBTIRE	7	4.4919
DEBTGER	8	5.2927
GDPAUT	5	2.7049
GDPFRA	12	8.3099
GDPGRE	5	3.5492
GDPIRE	3	2.1793
GDPITA	5	3.4168
GDPPOR	3	1.8844
XAU	6	4.0201
XAG	14	9.8021
LCOc1	8	4.2466
TARESP	14	10.6254
CHIMAN	3	1.6175
VOLIND	5	3.0996
EURINF	5	3.1758
ESPINF	2	1.0916

Complete data set		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDESP	1	0.7197
ECB	2	1.6859
FED	1	0.7197
GDPESP	5	3.7515
IBEX	4	3.3485
TVIBEX	0	0.0000
IBEXChange	0	0.0000
SPITA	0	0.0000
SPGRE	0	0.0000
SPESP	4	3.3143
DEBTGRE	0	0.0000
DEBTIRE	4	2.9090
DEBTGER	6	4.2689
GDPAUT	1	0.6402
GDPFRA	9	6.7874
GDPGRE	5	3.5492
GDPIRE	2	1.6626
GDPITA	1	0.6402
GDPPOR	1	0.6402
XAU	1	0.8152
XAG	9	7.2269
LCOc1	0	0.0000
TARESP	8	6.5072
CHIMAN	0	0.0000
VOLIND	2	1.5070
EURINF	2	1.5070
ESPINF	0	0.0000

Figure 41: Scoreboard Spain *Overall* and *Complete data set*

For Spain, it is hard to determine which of the five selected overall determinants truly distinguished itself from the rest. IBEX, GDPFRA, XAG, and TARESP are almost on an identical level with only DEBTGER falling behind.
Out of those four, IBEX and TARESP are highly relevant during higher yield times, explained by being selected in *4.Quartile* and *3.Tier* and IBEX also being part of *2.+3. Quartile*.
XAG and GDPFRA, however, are more responsible for the yield during low yield levels, but both have still a significant influence on the *Complete data set* as well.
Also selected in the complete set is DEBTGER, which is the only scoreboard where it was able to rank in the top five variables.
Only in special yield areas responsible determinants are ECOINDESP, which is marked in *1.Quartile* and *2.Tier*, and LCOc1, also highlighted in 2.Tier but with an entry in *2.+3. Quartile* as well.

1. Quartile		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDESP	3	1.7768
ECB	1	0.4217
FED	3	1.7768
GDPESP	0	0.0000
IBEX	0	0.0000
TVIBEX	0	0.0000
IBEXChange	0	0.0000
SPITA	0	0.0000
SPGRE	0	0.0000
SPESP	1	0.5556
DEBTGRE	0	0.0000
DEBTIRE	2	1.1564
DEBTGER	0	0.0000
GDPAUT	0	0.0000
GDPFRA	2	1.0421
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	0	0.0000
XAU	1	0.6204
XAG	3	1.5781
LCOc1	0	0.0000
TARESP	0	0.0000
CHIMAN	1	0.6204
VOLIND	2	1.0225
EURINF	0	0.0000
ESPINF	1	0.4217

2.+3. Quartile		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDESP	1	0.5691
ECB	0	0.0000
FED	1	0.5691
GDPESP	0	0.0000
IBEX	2	0.9432
TVIBEX	0	0.0000
IBEXChange	0	0.0000
SPITA	0	0.0000
SPGRE	1	0.5691
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTIRE	1	0.4265
DEBTGER	1	0.4265
GDPAUT	1	0.4265
GDPFRA	1	0.4804
GDPGRE	0	0.0000
GDPIRE	1	0.5167
GDPITA	0	0.0000
GDPPOR	1	0.5691
XAU	0	0.0000
XAG	2	0.9971
LCOc1	3	1.4760
TARESP	0	0.0000
CHIMAN	2	0.9971
VOLIND	0	0.0000
EURINF	2	0.9971
ESPINF	0	0.0000

4. Quartile		
Determinants	# selected	Points
ECOINDEU	2	1.4284
ECOINDESP	0	0.0000
ECB	0	0.0000
FED	0	0.0000
GDPESP	0	0.0000
IBEX	4	2.5556
TVIBEX	0	0.0000
IBEXChange	0	0.0000
SPITA	2	1.4284
SPGRE	0	0.0000
SPESP	1	0.6699
DEBTGRE	0	0.0000
DEBTIRE	0	0.0000
DEBTGER	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPITA	2	1.4284
GDPPOR	0	0.0000
XAU	1	0.6699
XAG	0	0.0000
LCOc1	1	0.4573
TARESP	3	2.0983
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	0	0.0000
ESPINF	1	0.6699

Figure 42: Scoreboard Spain *Quartile* data sets

2. Tier		
Determinants	# selected	Points
ECOINDEU	0	0.0000
ECOINDESP	2	1.2724
ECB	1	0.5701
FED	2	1.2724
GDPESP	0	0.0000
IBEX	0	0.0000
TVIBEX	0	0.0000
IBEXChange	0	0.0000
SPITA	0	0.0000
SPGRE	1	0.6751
SPESP	0	0.0000
DEBTGRE	0	0.0000
DEBTIRE	0	0.0000
DEBTGER	1	0.5973
GDPAUT	3	1.6382
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPITA	0	0.0000
GDPPOR	1	0.6751
XAU	1	0.5701
XAG	0	0.0000
LCOc1	4	2.3133
TARESP	0	0.0000
CHIMAN	0	0.0000
VOLIND	1	0.5701
EURINF	0	0.0000
ESPINF	0	0.0000

3. Tier		
Determinants	# selected	Points
ECOINDEU	2	1.3482
ECOINDESP	0	0.0000
ECB	0	0.0000
FED	0	0.0000
GDPESP	0	0.0000
IBEX	4	2.3877
TVIBEX	0	0.0000
IBEXChange	0	0.0000
SPITA	2	1.3471
SPGRE	0	0.0000
SPESP	0	0.0000
DEBTGRE	1	0.3678
DEBTIRE	0	0.0000
DEBTGER	0	0.0000
GDPAUT	0	0.0000
GDPFRA	0	0.0000
GDPGRE	0	0.0000
GDPIRE	0	0.0000
GDPITA	2	1.3482
GDPPOR	0	0.0000
XAU	2	1.3445
XAG	0	0.0000
LCOc1	0	0.0000
TARESP	3	2.0199
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	1	0.6717
ESPINF	0	0.0000

Figure 43: Scoreboard Spain *Tier* data sets

5.1.9. Cross-Country Examination

After examining the empirical results for every individual country, a cross-country analysis is in order as well. Therefore, all *Overall* scoreboards are listed next to each other in Figure 44. This lineup eases the comparison of the results of all eight participating countries.
On the first glance, it becomes obvious that not a single variable managed to be significant throughout all eight countries. The closest one to achieving this feat is SPGRE, which was select a total number of 6 times. Only for France and Spain this coefficient has not been selected. The other determinants which managed to be selected in at least half of the scoreboards are SPESP, LCOc1, and individual *TARGET2* balances, with each being present exactly 4 times. For this comparison, all the individual *TARGET2* balances were regarded as one variable. The same applies for all other country specific determinants. For example, all different stock index are regarded as one variable as well.

A comparison of the relevant determinants for each country, as shown in Figure 45, makes it evident that at most three variables are in common for two countries. This is the case for comparing Austria with France and Austria with Ireland. Most of the time, the different country scoreboards have two determinants in common, while sometimes being reduced to one or even zero common variables.

Germany		
Determinants	# selected	Points
ECOINDEU	10	7.2675
ECOINDGER	4	2.4895
ECB	5	4.0835
FED	4	3.7964
DEBTGER	7	5.7304
UNEMPGER	6	4.5818
DAX	9	7.1180
TVDAX	0	0.0000
DAXChange	0	0.0000
SPAUT	0	0.0000
SPGRE	14	12.8617
SPESP	6	5.5345
DEBTGRE	2	1.8427
DEBTITA	8	7.4972
GDPAUT	1	0.8493
GDPFRA	3	2.7553
GDPIRE	3	2.6540
GDPITA	3	2.8338
GDPPOR	1	0.8913
GDPESP	6	5.6221
XAU	3	2.4332
XAG	1	0.8493
LCOc1	25	20.5836
TARGER	25	20.4618
CHIMAN	8	6.2563
VOLIND	1	0.6397
EURINF	4	3.0162
GERINF	2	1.3422

France		
Determinants	# selected	Points
ECOINDEU	6	4.4894
ECB	9	6.5314
FED	2	1.4687
GDPFRA	8	6.3850
UNEMPFRA	8	6.2328
CAC40	1	0.8860
TVCAC40	0	0.0000
CAC40Change	1	0.6292
SPITA	1	0.9272
SPGRE	5	3.6490
SPESP	20	17.4233
DEBTGER	5	4.2122
DEBTGRE	3	2.3341
DEBTITA	4	3.6317
GDPAUT	4	3.5933
GDPGRE	2	1.4616
GDPIRE	13	11.0450
GDPITA	4	3.6451
GDPPOR	1	0.6930
GDPESP	4	3.3529
XAU	5	3.8985
XAG	6	4.7843
LCOc1	16	12.7481
TARFRA	1	0.7483
CHIMAN	3	2.0604
VOLIND	3	2.2694
FRAINF	9	6.7976

Austria		
Determinants	# selected	Points
ECOINDAUT	5	3.6328
ECB	6	4.7594
FED	4	3.4158
GDPAUT	4	3.3218
UNEMPAUT	1	0.5074
ATX	1	0.7659
TVATX	0	0.0000
ATXChange	0	0.0000
SPITA	9	6.4904
SPGRE	15	12.3718
SPESP	23	19.6397
DEBTGER	7	5.7758
DEBTGRE	3	2.5186
DEBTITA	2	1.7703
GDPFRA	2	1.7759
GDPGRE	4	3.4218
GDPIRE	8	6.6564
GDPITA	5	4.2449
GDPPOR	5	4.1672
GDPESP	7	5.9354
XAU	6	3.8483
XAG	2	1.4793
LCOc1	15	11.5151
TARAUT	6	3.5159
CHIMAN	0	0.0000
VOLIND	0	0.0000
EURINF	6	4.6647
AUTINF	3	2.3974

Portugal		
Determinants	# selected	Points
ECOINDEU	10	8.0495
ECOINDPOR	11	8.7239
ECB	5	2.7278
FED	2	1.0967
GDPPOR	7	5.1552
PSI20	9	7.2980
TVPSI20	0	0.0000
PSI20Change	0	0.0000
SPITA	9	7.2006
SPGRE	23	20.2122
SPESP	21	18.3200
DEBTGRE	1	0.6892
DEBTITA	1	0.6892
DEBTGER	2	1.6264
GDPAUT	5	3.0214
GDPFRA	6	4.8651
GDPGRE	2	1.8419
GDPIRE	2	1.3010
GDPITA	0	0.0000
GDPESP	2	1.8498
XAU	4	3.1102
XAG	8	5.5656
LCOc1	2	1.4618
TARPOR	5	4.4084
CHIMAN	1	0.6143
VOLIND	5	4.2306
EURINF	1	0.9066
PORINF	11	9.6930

Italy		
Determinants	# selected	Points
ECOINDEU	7	4.079
ECOINDITA	4	2.352
ECB	5	3.001
FED	2	1.203
DEBTITA	8	4.433
GDPITA	7	4.198
UNEMPITA	11	6.787
TVFTMIB	2	0.672
FTMIBChange	0	0.000
SPITA	8	4.380
SPGRE	11	6.962
DEBTGER	4	2.103
DEBTGRE	9	4.676
GDPAUT	2	1.010
GDPGRE	6	3.782
GDPIRE	1	0.529
GDPFRA	2	1.041
GDPPOR	1	0.675
GDPESP	4	2.042
XAU	3	1.608
XAG	10	5.262
LCOc1	10	5.138
TARITA	7	4.344
CHIMAN	3	1.287
VOLIND	8	4.048
EURINF	8	4.688
ITAINF	16	9.071

Ireland		
Determinants	# selected	Points
ECOINDEU	6	4.4995
ECOINDIRE	3	2.1087
ECB	1	0.7884
GDPIRE	7	4.9099
UNEMPIRE	2	1.5898
ISEQ	6	3.8325
TVISEQ	0	0.0000
ISEQChange	0	0.0000
SPITA	9	7.1044
SPGRE	11	9.4063
SPESP	9	8.0920
DEBTGRE	4	3.1228
DEBTITA	4	3.3078
GDPAUT	6	4.8515
GDPFRA	6	4.8677
GDPGRE	6	4.6282
GDPITA	7	6.0258
GDPPOR	3	2.1414
GDPESP	2	1.7850
XAU	4	3.4443
XAG	16	13.6133
LCOc1	8	5.1424
TARIRE	31	24.4859
CHIMAN	0	0.0000
VOLIND	4	1.7668
EURINF	4	2.8079
IREINF	2	1.3614

Greece		
Determinants	# selected	Points
ECOINDEU	4	3.8252
ECOINDGRE	4	3.0676
ECB	4	3.4566
FED	4	2.9650
DEBTGRE	2	1.7248
UNEMPGRE	12	8.9972
ATG	12	9.8222
TVATG	0	0.0000
ATGChange	1	0.8572
SPAUT	1	0.9424
SPIRL	6	4.8579
SPGRE	19	16.4251
DEBTGER	5	3.9740
DEBTITA	10	8.3956
GDPAUT	3	2.1582
GDPITA	4	3.2668
GDPIRE	3	2.5837
GDPFRA	5	4.5071
GDPPOR	4	3.1167
GDPESP	2	1.8254
XAU	7	5.4089
XAG	6	4.8976
LCOc1	5	3.9168
TARGRE	20	17.2153
CHIMAN	8	5.8352
VOLIND	3	2.3130
EURINF	4	3.1322
GREINF	2	1.7037

Spain		
Determinants	# selected	Points
ECOINDEU	4	2.7766
ECOINDESP	7	4.3380
ECB	4	2.6777
FED	7	4.3380
GDPESP	5	3.7515
IBEX	14	9.2350
TVIBEX	0	0.0000
IBEXChange	0	0.0000
SPITA	4	2.7755
SPGRE	2	1.2442
SPESP	6	4.5398
DEBTGRE	1	0.3678
DEBTIRE	7	4.4919
DEBTGER	8	5.2927
GDPAUT	5	2.7049
GDPFRA	12	8.3099
GDPGRE	5	3.5492
GDPIRE	3	2.1793
GDPITA	5	3.4168
GDPPOR	3	1.8844
XAU	6	4.0201
XAG	14	9.8021
LCOc1	8	4.2466
TARESP	14	10.6254
CHIMAN	3	1.6175
VOLIND	5	3.0996
EURINF	5	3.1758
ESPINF	2	1.0916

Figure 44: Comparison *Overall* results for all countries

	Germany	France	Austria	Portugal	Italy	Ireland	Greece	Spain
Germany	X	1	2	2	2	2	2	1
France	1	X	3	2	2	1	0	0
Austria	2	3	X	2	2	3	1	0
Portugal	2	2	2	X	2	2	1	0
Italy	2	2	2	2	X	2	2	1
Ireland	2	1	3	2	2	X	2	2
Greece	2	0	1	1	2	2	X	2
Spain	1	0	0	0	1	2	2	X

Figure 45: Number of identical variables selected

Germany	France	Austria	Portugal	Italy	Ireland	Greece	Spain
ECOINDEU	ECB	SPITA	ECOINDEU	UNEMPCOU	SPITA	UNEMPCOU	INDEX
SPGRE	SPESP	SPGRE	ECOINDCOU	SPGRE	SPGRE	INDEX	DEBTGER
DEBTITA	GDPIRE	SPESP	SPGRE	XAG	SPESP	SPGRE	GDPFRA
LCOc1	LCOc1	GDPIRE	SPESP	LCOc1	XAG	DEBTITA	XAG
TARGET2	COUINF	LCOc1	COUINF	COUINF	TARGET2	TARGET2	TARGET2

Summary	
ECOINDEU	2
ECOINDCOU	1
ECB	1
UNEMPCOU	2
INDEX	2
SPGRE	6
SPITA	2
SPESP	4
DEBTITA	2
DEBTGER	1
GDPIRE	2
GDPFRA	1
XAG	3
LCOc1	4
TARGET2	4
COUINF	3

Figure 46: Overview *Overall* determinants per country

5.2. Interpretation

The interpretation of the empirical data analysis is divided into three parts: First, the results of the individual country analysis, specifically the differences in complete or yield dependent data sets. Second, the cross-country comparison is interpreted and finally, in the third part, the real determinants of government bond yields are assessed.

5.2.1. Differences in Complete and Yield-Based Sets

With the exception of TARGER and LCOc1 for Germany, and TARIRE for Ireland, none of the variables managed to be significant for complete data sets as well as for all yield-based subsets, thus strongly implying that different relative yield levels are being influenced by different coefficients.
Therefore, the current yield level is important when trying to generate future yield levels depending on certain determinants. However, this leads to quite a dilemma in form of a vicious cycle. In order to choose the right variables for the calculation of future yields, the level of those future yields have to be known, thus rendering the calculation pointless. A forecast relying on the future values of the value it is supposed to predict is not very useful.
Since it has been established that there is a significant difference of selected determinants of a complete and a yield depending set, the future yield level is relevant. By creating the *Overall* scoreboards, it is possible to select the five determinants which are the most influential in all possible scenarios. Those determinants can be used to generate future yield levels. The calculation might not be as precise as using the corresponding subset determinants, but it does not rely on an already existing prognosis of yield levels. To be on the safe side, four different calculation models could be used: The first with the results of the *Overall* as basis, the second using the *Complete data set*, and third and fourth as the quartile and tier yield-based data sets depending on the current yield level. The difference between the *Complete data set* and *Overall* is the later amplifies variables which are highly significant in certain yield regions, while both are covering the entire yield spectrum during the analyzed period.

To summarize the results: It is not possible to select five variables which always produce the best possible result in determining the government bond yield. The determinants depend on the yield level and with an alteration in this yield level, the determining variables alter as well. Therefore, $H0_2$ cannot be rejected. In order to test if $H0_1$ has to be rejected, an attempt is made to calculate future government bond yields and then comparing the results with the artificially created yields.

5.2.2. Cross-Country Differences

The determinants for each individual country differ greatly from each other. Only rating categories seem to be a constant throughout most countries. With the exception of Spain, all have at least one S&P rating as a significant determinant and SPGRE is distinguishing itself from the rest by being selected six times. It is the only rating that was downgraded

to "in default" during the test period. Apparently, a country defaulting is a major event affecting government yields and the effect is not limited to the defaulted country itself but is also influencing other countries as well.
Apart from this one extraordinary variable, there is no consensus in variable selection throughout the eight countries. Only two country pairs managed to have three identical determinants, while the rest is mostly unaligned to each other.
Concluding, except for maybe SPGRE, it is not possible to find considerable similarities between the individual country determinants. Therefore, for each country, different determinants have to be used to determine the corresponding government yields and $H0_3$ cannot be rejected.

5.2.3. Real Determinants of Government Bond Yields

In union with the interpretations in sections 5.2.1 and 5.2.2, it has to be deduced there are no real determinants of government bond yields which generate satisfactory results for all countries in all scenarios. For attempts in calculating the yield values, the individual characteristics of the yield, like country and current relative yield level, have to be put in consideration as well.
The following section exhibits how to select variables for the calculation process and presents the results for the generated yields.

6. Calculation and Comparison of Future Yield Levels

After determining there are no universal valid determinants for all government bond yields, but the determinants are dependent on the country and yield level as well, the effectiveness of the resulting variables for each country have to be verified. Therefore, for each country, the yield to maturity will be calculated by utilizing the selected determinants. The results can then be compared with the actual yields provided by the second data period spanning from 17.12.2013 to 27.02.2015. In this data period, all variables were updated using the original sources. With this information, it is possible to get a reliable comparison of the calculated results and the actual yield performance.

6.1. Calculation Process

Before beginning the calculations, two parameters have to be checked. First, for which country is the yield supposed to be computed and second, what is the current yield level of this specific country. The current yield has to be classified according to the previously set quartile and tier categories.
The next step is using the main determinants to create the regression equations with the variables of the results for the *Overall*, *Complete data set*, the according quartile, and the matching tier scoreboard. With the equation formulas and the values for the variables provided by the second period data set, several possible yields can be estimated and compared to the actual yield that occurred.

Example Calculated Yields Germany
The yield for Germany at the last day of the first analyzed period was 1.833 %, which belongs in the *1.Quartile* as well as the *1.Tier* category. Therefore, the variables used are highlighted in section 5.1.1 in the *Overall*, *Complete data set*, *1.Quartile*, and *1.Tier* scoreboards. With those determinants, the regression equation is produced via *R*:[78]

```
Call:
lm(formula = YTMGER ~ ECOINDEU + SPGRE + DEBTITA + LCOc1 + TARGER)

Residuals:
     Min       1Q   Median       3Q      Max
-0.68275 -0.11980 -0.00187  0.14444  0.60092

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  6.685e+00  1.659e-01  40.289   <2e-16 ***
ECOINDEU     1.417e-05  5.912e-04   0.024    0.981
SPGRE       -5.044e-02  2.492e-03 -20.242   <2e-16 ***
DEBTITA     -3.065e-02  1.322e-03 -23.190   <2e-16 ***
LCOc1        1.192e-02  3.063e-04  38.916   <2e-16 ***
TARGER      -2.553e-06  7.761e-08 -32.894   <2e-16 ***
---

Residual standard error: 0.2144 on 2022 degrees of freedom
Multiple R-squared:  0.9546,    Adjusted R-squared:  0.9545
F-statistic:  8508 on 5 and 2022 DF,  p-value: < 2.2e-16
```

This is the output for the *Overall* variables. The relevant part is the information provided by the column *Estimate*. Using those values the regression equation for the *Overall* Germany future yield calculation is:

$$y_i = 6.685 + 1.417e^{-05}\text{ECOINDEU}_i - 5.044e^{-02}\text{SPGRE}_i - 3.065e^{-02}\text{DEBTITA}_i + 1.192e^{-02}\text{LCOc1}_i - 2.553e^{-06}\text{TARGER}_i$$

The procedure for the remaining three calculations is identical.[79] After plugging in the values, the computed yields can be compared to the actual yield.

[78] All *R* outputs for the calculated yields for Germany are in the attached data files: Calculated_Yields\GermanyCalculatedYields.xlsx

[79] Note: For *Overall* and *Complete data set*, the complete data set was used to generate the equation. For the categorized sets, the corresponding subsets have been the data basis.

6.2. Calculation Results

Figures 47, 48, and 49 represent the calculated yields and the actual yield (red) for Germany, Austria and France.

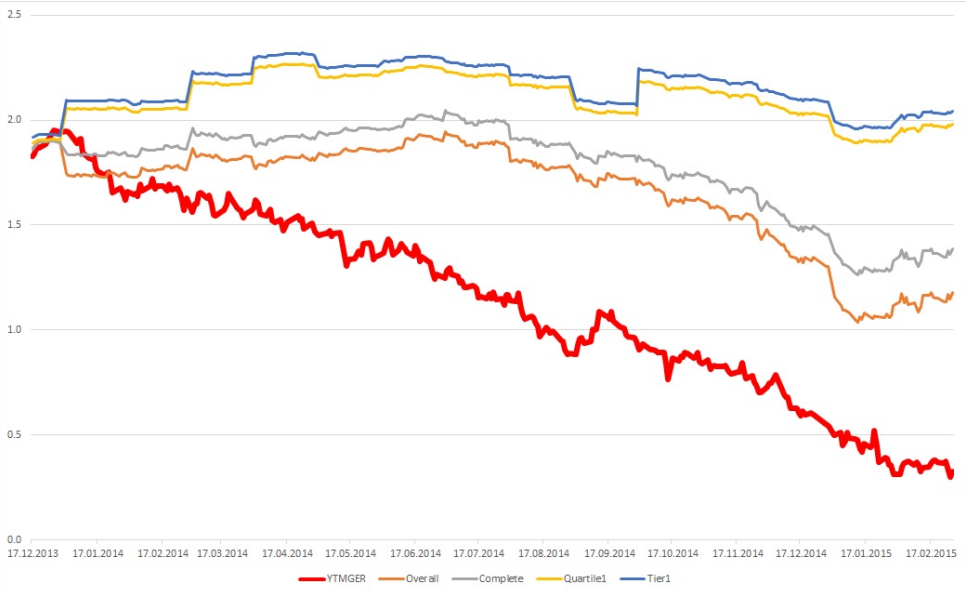


Figure 47: Calculation results Germany

It is evident that the computed results are not close to the actual values. For France, the results are completely implausible with negative rates of more than -12 %. However, there is a logical explanation for France's results for *Quartile1* and *Tier1*. Recalling the selected variables presented in section 5.1.2 for those two data sets:

- *1.Quartile*: ECOINDEU, ECB, GDPFRA, UNEMPITA, and FRAINF
- *1.Tier*: ECB, GDPFRA, and LCOc1

Except for LCOc1, all selected variables are not updated at a daily, but on a monthly (or even longer) basis. Thus, a change in, for example, GDPFRA might have a huge impact on the result of the regression equation.

Apparently, the results for all three countries suffer from the same condition. At the beginning, the results are quite close to the actual yield, but as time progresses, the predicted and real yields diverge rather quickly. It seems knowing the real determinants is not enough to successfully estimate yield levels. The changing values for the β parameter of the regression equation makes a prediction based on the past equation nearly impossible.
Therefore, in order to verify if the selected determinants can actually be used to explain the government bond yield, the regression equation has to be updated as well. For the

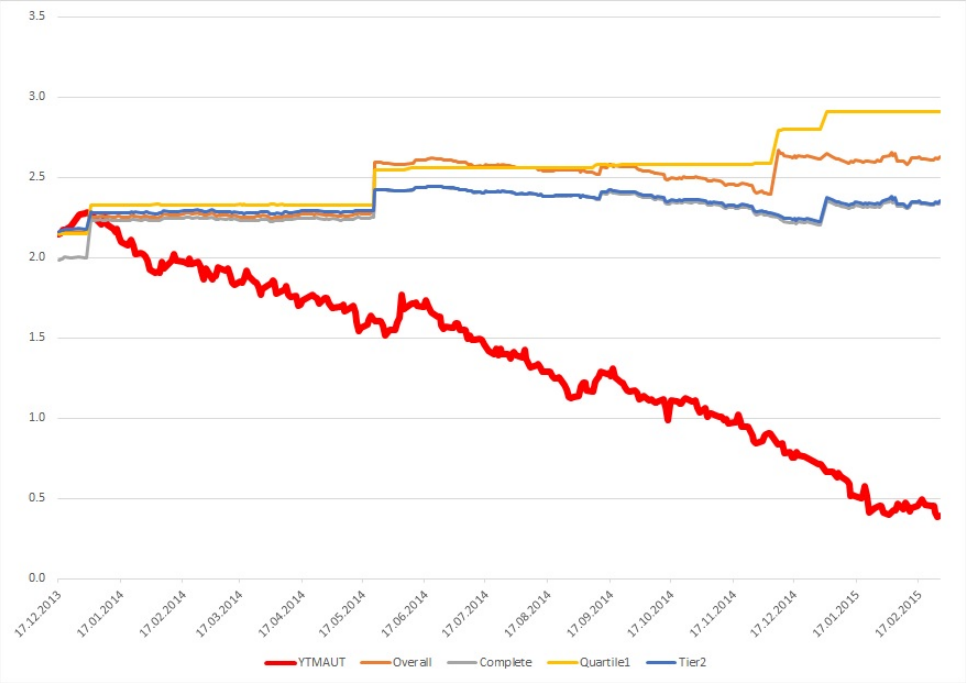


Figure 48: Calculation results Austria

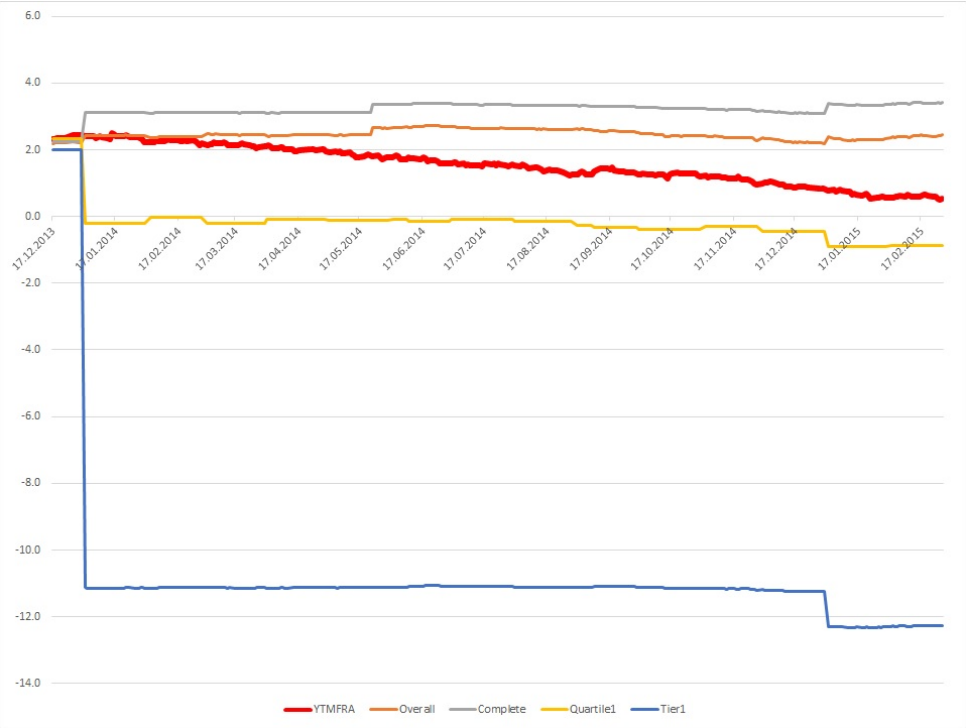


Figure 49: Calculation results France

updating process the linear regression is run in R again while using only the second period data set with the different selected variables. The output for the *Overall* scoreboard for Germany is:

```
Call:
lm(formula = YTMGER ~ ECOINDEU + SPGRE + DEBTITA + LCOc1 + TARGER)

Residuals:
     Min       1Q   Median       3Q      Max
-0.51884 -0.11817  0.01047  0.11631  0.33160

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.685e+00  2.325e+00   1.155 0.249170
ECOINDEU    -6.884e-02  1.749e-02  -3.937 0.000103 ***
SPGRE        3.790e-02  4.235e-02   0.895 0.371572
DEBTITA      2.393e-03  1.800e-02   0.133 0.894332
LCOc1        2.201e-02  8.845e-04  24.885  < 2e-16 ***
TARGER       5.164e-06  6.996e-07   7.382  1.6e-12 ***
---

Residual standard error: 0.1709 on 295 degrees of freedom
Multiple R-squared:  0.8587,    Adjusted R-squared:  0.8563
F-statistic: 358.5 on 5 and 295 DF,  p-value: < 2.2e-16
```

Accordingly, the updated regression equation would be:

$$y_i = 2.685 - 6.884e^{-02}\text{ECOINDEU}_i + 3.790e^{-02}\text{SPGRE}_i - 2.393e^{-03}\text{DEBTITA}_i + 2.201e^{-02}\text{LCOc1}_i + 5.164e^{-06}\text{TARGER}_i$$

After updating all equations for Germany, the newly calculated yields are presented in Figure 50. With the new equations, the computed values are much closer to the actual yields, which leads to the conclusion that the selected determinants are indeed responsible for the yield, however, the changes in the yield cannot be predicted by the determinants themselves without updating the regression equation as well. In agreement with the visual confirmation are the R^2 values of the updated generated yields:

	Overall	Complete data set	1.Quartile	1.Tier
R^2	0.8587	0.8828	0.8929	0.8929

Table 3: R^2 updated calculation results Germany

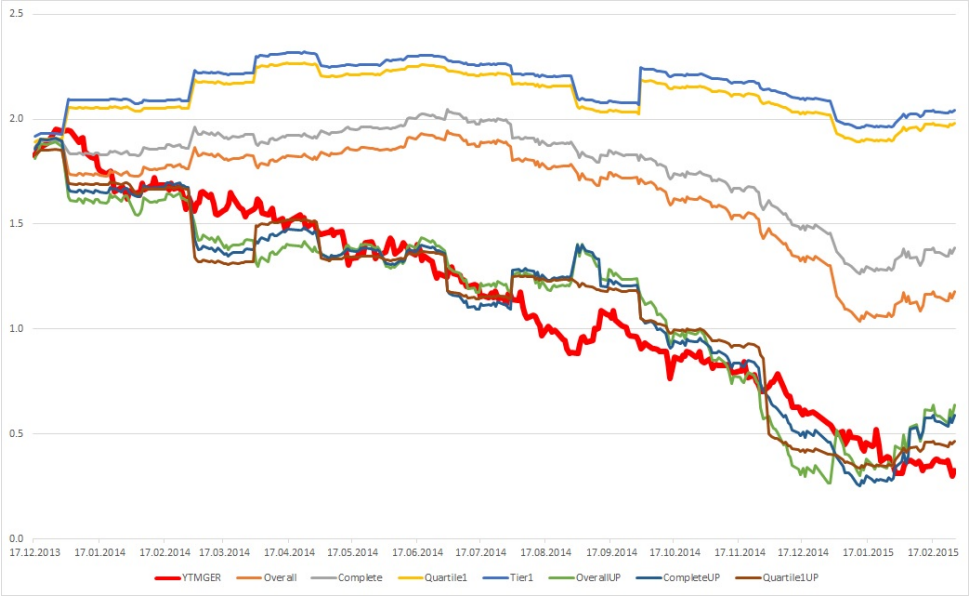


Figure 50: Updated calculation results Germany

6.2.1. Updated calculation Results

The possibility of Germany's result being just a lucky coincidence has to be eliminated. There is a chance that the results for the other countries are not as favorable. Therefore, for all countries, the selected determinants have to be used for the according yield estimation.
The following Figures 51 to 57 and Table 4 provide a complete picture over the calculation results for the remaining seven countries with updated equations.

R^2	Overall	Complete	Quartile	Tier
Germany	0.8587	0.8828	**0.8929**	**0.8929**
France	**0.9524**	0.9437	0.9503	0.8933
Austria	0.9370	0.9356	**0.9398**	0.9331
Portugal	0.8235	0.7930	**0.8493**	0.7887
Italy	**0.9001**	0.8003	0.7244	0.8748
Ireland	0.9628	0.9449	0.9643	**0.9745**
Greece	**0.8927**	0.8686	0.8527	0.8801
Spain	0.8823	0.8483	0.8862	**0.9123**

Table 4: R^2 updated calculation results

Figure 51: Updated calculation results France

Figure 52: Updated calculation results Austria

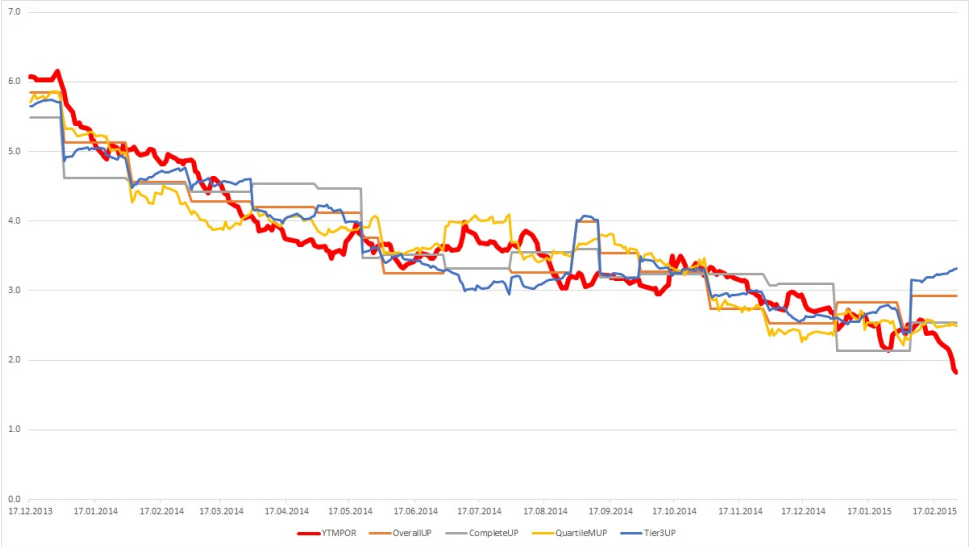


Figure 53: Updated calculation results Portugal

Figure 54: Updated calculation results Italy

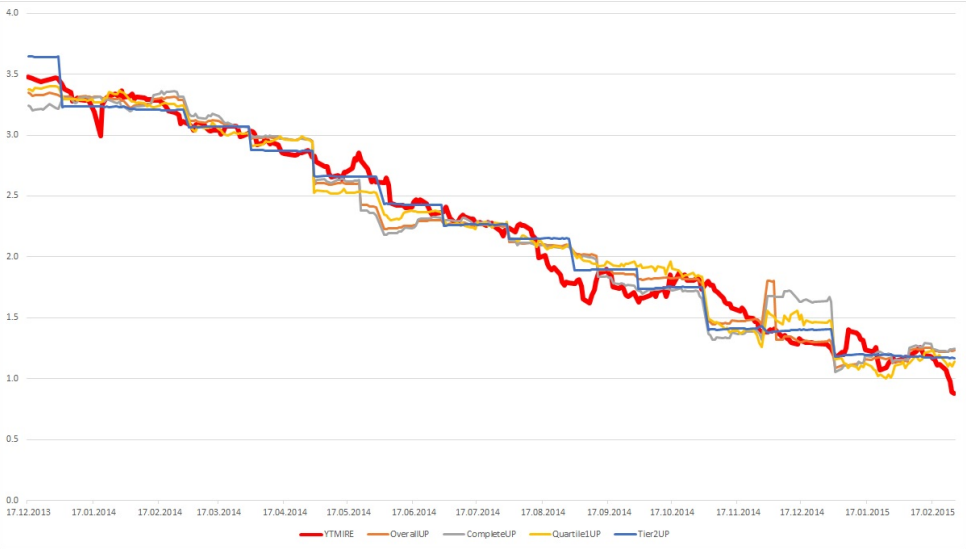


Figure 55: Updated calculation results Ireland

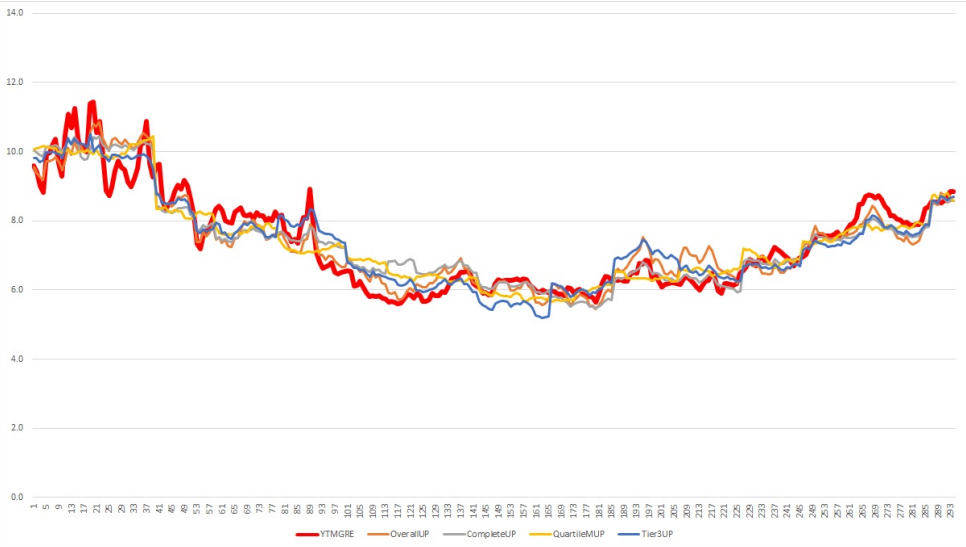


Figure 56: Updated calculation results Greece

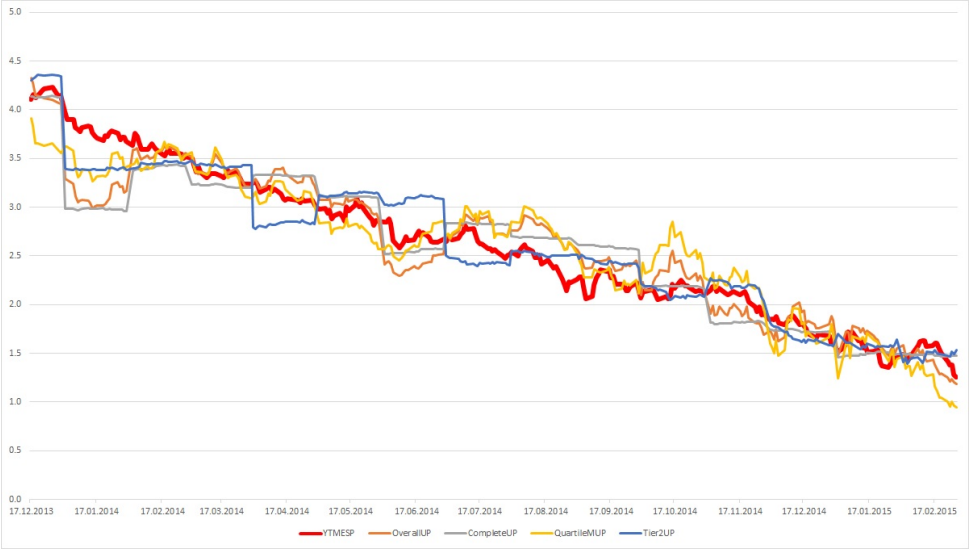


Figure 57: Updated calculation results Spain

After updating the regression equations, it is possible to compare the tendencies of the selected determinants. Figures 58 to 60 provide this comparison for Germany, France, and Austria and it is evident that not even the direction of the yield movement linked to the determinants seems to be predictable.

	Intercept	SPGRE	DEBTITA	GDPESP	LCOc1	TARGER	ECOINDEU	UNEMPGER	EURINF
Overall	6.6850	- 0.0504	- 0.0307		0.0119	- 0.0000	0.0000		
Overall up.	2.6850	0.0379	0.0024		0.0220	0.0000	- 0.0688		
Complete	1.4560	- 0.0459	- 0.0206	0.0040	0.0108	- 0.0000			
Complete up.	15.4000	0.1121	0.0801	- 0.0318	0.0143	0.0000			
Quartile 1	6.3660				0.0044	- 0.0000	0.0265	- 1.3420	0.2981
Quartile 1 up.	- 9.6470				0.0066	0.0000	0.0322	0.8350	0.5114
Tier 1	6.82500				0.00404	- 0.00000	0.02800	- 1.43800	0.32030
Tier 1 up.	- 9.6470				0.0066	0.0000	0.0322	0.8350	0.5114

Figure 58: Parameter sign comparison Germany

	Intercept	ECB	SPESP	GDPIRE	LCOc1	FRAINF	DEBTGER	DEBTITA	ECOINDEU	GDPFRA	UNEMPFRA
Overall	0.1755309	0.2114537	-0.1911842	0.0164512	0.0106151	-0.2077746					
Overall up.	-0.555948	1.143193	0.400981	-0.012728	0.007529	0.341539					
Complete	-2.0636806		-0.2401234	0.0299988	0.0053355		-0.050626	0.038072			
Complete up.	-10.61		0.6037	0	0.01416		0.05028	0.01469			
Quartile 1	2.851305	0.429274				0.46516			0.053091	-0.008079	0.770692
Quartile 1 up.	14.2606038	3.5006687				0.6420873			-0.0957822	-0.0007126	-0.2337807
Tier 1	97.469498	-0.371848			0.003661					-0.052858	
Tier 1 up.	2.7229504	3.6875766			0.0104175					-0.0013156	

Figure 59: Parameter sign comparison France

	Intercept	SPITA	SPGRE	SPESP	GDPIRE	LCOc1	GDPESP	ECB	DEBTGER
Overall	1.5275487	0.2854985	-0.0545071	-0.3161675	0.0081032	0.0061082			
Overall up.	-0.784417	0.137987	-0.082484	0.444686	-0.018261	0.019182			
Complete	-3.72596		-0.041694	-0.172757	0.0116994	0.0049537	0.0053607		
Complete up.	-0.0092889		-0.0324886	0.4504079	-0.0180294	0.0160322	-0.0001683		
Quartile 1	5.477796	0.2097267		-0.2164453		-0.0002725		-0.1398125	-0.0372675
Quartile 1 up.	-7.25701	-0.010556		0.322222		0.011845		1.164315	0.062952
Tier 2	-5.4396554		-0.0490305	-0.1290956		0.004701	0.0088635		
Tier 2 up.	7.6414573		0.0057055	0.4610615		0.0142282	-0.0112052		

Figure 60: Parameter sign comparison Austria

6.2.2. Interpretation Calculation Results

The analysis of the calculation results yields a series of findings. First of all, the selected variables for each country do provide more than satisfactory results in explaining government bond yield levels. Unfortunately, the regression equations used at first for the predictions were not suitable for the task. However, after updating the equations, the results in terms of R^2 were acceptable. The worst value for R^2 for a country, with the updated equations, was 0.8493 for Portugal. Therefore, it can be concluded that it is possible to determine variables which have a significant influence on future yield levels, however, this knowledge of significant determinants cannot be used to predict or forecast future yield levels. It is not even possible to use these determinants as indicators in which direction the yield might adjust after movements in the underlying variable.
The second finding is relying on only one of the data sets as calculation basis can be very risky. For Italy, for example, the R^2 values vary a great deal with the lowest value being 0.7244 and the highest 0.9000. Therefore, using different sets for multiple scenario calculations is beneficiary. If only one scenario is computed, the safest method seems to be using the *Overall* set for the specific country. In three of the eight cases it has the highest results and in the remaining five it is always relatively close to the corresponding high score. Those high R^2 values only lead to one conclusion: $H0_1$ has to be rejected.

7. Conclusion and Prospect

The intensive analysis and interpretation of the variable selection processes for different yield levels and cross-country country comparison, combined with the verification of the results with calculating the yield levels and comparing the results with the actual values,

leads to the following conclusions.
For different relative and absolute yield levels, different determinants are responsible for yield value changes. For example, when only the yield values categorized into the first quartile are being analyzed, the selected variables differ as when the complete spectrum of yields is used as data basis. This results in several series of different variables for different yield values. Using a scoreboard system, it is possible to determine five overall variables, which seem to have the most influence throughout all relative and absolute yield levels.
However, the overall determinants also vary from country to country. No country pair had more than three out of five variables in common and only the rating of Greece has been selected in more than half of the countries. Therefore, only this rating classification of Greece might be called an universal real determinant for government bond yields. The most likely explanation for this selection is that Greece is the only one of the selected countries which went into default during the analyzed time period and this extreme economic event influenced the yields of the other countries as well.
To sum up, it is possible to explain the government bond yield values with five main determinants, but for each country and for each yield level, different determinants have to be used.

Calculating the yields provided some interesting feedback. The regression equation obtained during the initial selection process cannot be used to forecast exact yield levels. The selected determinants merely provide an idea, which variables drive the yields, but cannot be used in calculating precise future yield values or not even as an indication of the direction of future yield movements. When a yield scenario computation is attempted, the current yield should be checked first in order to pick the right determinants out of the possible sets. The most recommended approach would be using more than one variable set. However, if only one set should be used, the determinants of the *Overall* scoreboard provide the most satisfactory and reliable results.

This thesis provided a method of selecting determinants. For the future, it would be beneficial to find or create a reliable method of predicting the regression coefficients in the regression equation. Both parts combined (determinant selection and values for the regression coefficients) might be able to predict future yield performances a little more precisely or at least produce an indication of future yield momentum.

The impact of not quantifiable natural or political occurrences was also not part of the determinant analysis. War or unexpected changes in the interest rate policy of the ECB probably have an impact on yield levels, even though, the effect might have not reached the other underlying variables yet. Those not quantifiable events should be explored in further research into the topic of determinants for government bond yields.

References

Aiken, L., West, S., and Pitts, S. (2003). *Comprehensive handbook of psychology*. John Wiley & Sons, New York, 2nd edition.

ARD Boerse (2015). LIBOR. Available at `http://boerse.ard.de/boersenwissen/boersenlexikon/libor-100.html`. [Online; accessed 04-August-2015].

Aßmann, C. and Boysen-Hogrefe, J. (2011). Determinants of government bond spreads in the euro area: in good times as in bad. *Empirica*, 39:341–356.

Codogno, L., Favero, C., and Missale, A. (2003). Yield spreads on EMU government bonds. *Economic Policy*, 18:503–532.

Cordell, H. (2013). Computer Practical Exercise on Penalized Regression Methods for Association Studies. Available at `https://www.staff.ncl.ac.uk/heather.cordell/PenalizedRegressionTutorial2013.html`. [Online; accessed 19-March-2015].

Draper, N. R. and Smith, H. (1998). *Applied Regression Analysis*. John Wiley & Sons, New York, 3rd edition.

ECB (2015). All glossary entries. Available at `http://www.ecb.europa.eu/home/glossary/html/glosse.en.html#189`. [Online; accessed 29-March-2015].

Euribor-Rates (2015). Euribor. Available at `http://www.euribor-rates.eu/`. [Online; accessed 1-March-2015].

Federal Reserve Bank of New York (2015). Federal Funds Data. Available at `http://www.newyorkfed.org/markets/omo/dmm/fedfundsdata.cfm`. [Online; accessed 04-August-2015].

Forbes (2014). Volatility Update: Divergence Between Index, Fear Gauge. Available at `VolatilityUpdate:DivergenceBetweenIndex,FearGauge`. [Online; accessed 04-August-2015].

Fox, J. and Weisberg, S. (2013). Robust Regression. *University of Minnesota*. Available at `http://www.bauer.uh.edu/rsusmel/phd/fw-robustreg.pdf` [Online; accessed 04-April-2015].

Furnival, G. M. and Wilson Jr., R. W. (1974). Regressions by Leaps and Bounds. *Technometrics*, 16(4):499–511.

Hastie, T., Tibshirani, R., and Friedman, J. (2013). *The Elements of Statistical Learning*. Springer, 2nd edition.

Jiménez-Rodríguez, R. and Sánchez, M. (2004). Oil price shocks and real GDP growth: empirical evidence for some OECD countries. *ECB Working Paper Series*, (No. 362).

Jobst, C., Handig, M., and Holzfeind, R. (2012). Understanding TARGET2: The Eurosystem's Euro Payment System from an Economic and Balance Sheet Perspective. *Monetary Policy & the Economy*, (Q1/12):81–91.

Lumley, T. (2015). Package leaps. Available at `http://cran.r-project.org/web/packages/leaps/leaps.pdf`. [Online; accessed 21-March-2015].

Miller, A. (1990). *Subset Selection in Regression*. Chapman and Hall, 1st edition.

Mitsa, T. (2015). 3-way Variable Selection in R Regression (lasso, stepwise, and best subset). Available at `http://www.theophanomitsa.com/blog/3-way-variable-selection-in-r-regression-lassostepwiseand-best-subset/`. [Online; accessed 19-March-2015].

Money Morning (2014a). Of All Safe Haven Investments, Gold Reigns Supreme. Available at `http://moneymorning.com/2014/10/17/of-all-safe-haven-investments-gold-reigns-supreme/`. [Online; accessed 04-August-2015].

Money Morning (2014b). What Yesterday's Volatility Index (VIX) Spike Says About the Market Today. Available at `http://moneymorning.com/2014/07/18/what-yesterdays-volatility-index-vix-spike-says-about-the-market-today/`. [Online; accessed 04-August-2015].

NASDAQ (2015). Coefficient of determination. Available at `http://www.nasdaq.com/investing/glossary/c/coefficient-of-determination`. [Online; accessed 04-August-2015].

Rankin, E. and Idil, M. S. (2014). A Century of Stock-Bond Correlations. *Bulletin Reserve Bank of Australia*, (Q3/14):67–74.

Schlittgen, R. (2013). *Regressionsanalysen mit R*. Oldenbourg Wissenschaftsverlag, München, 1st edition.

StatTrek.com (2015). Transformations to Achieve Linearity. Available at `http://stattrek.com/regression/linear-transformation.aspx`. [Online; accessed 20-March-2015].

Stocker, H. (2015). Einführung in die angewandte Ökonometrie. *University of Innsbruck*. Available at `http://www.uibk.ac.at/econometrics/einf/kap03.pdf` [Online; accessed 20-March-2015].

Tagesschau (2015). Februar 2015 - Griechenland bekommt mehr Zeit. Available at `http://www.tagesschau.de/wirtschaft/chronologiefinanzmarktkrise-113.html`. [Online; accessed 05-August-2015].

The Economist (2012). The rotten heart of finance. Available at `http://www.economist.com/node/21558281`. [Online; accessed 29-March-2015].

The New York Times (2008). Mortgages - How Rates Are Set. Available at http://www.nytimes.com/2008/11/16/realestate/16mort.html?_r=0. [Online; accessed 04-August-2015].

The New York Times (2012). Q. and A.: Understanding Libor. Available at http://dealbook.nytimes.com/2012/07/10/q-and-a-understanding-libor/. [Online; accessed 04-August-2015].

Thomson Reuters (2015). Reuters RIC: aXZECOSE. Available at Thomson Reuters EIKON.

Tibshirani, R. (1996). Regression Shrinkage and Selection via the Lasso. *Journal of the Royal Statistical Society*, 58(1):267–288.

Tversky, A. and Kahneman, D. (1986). Rational choice and the framing of decisions. *Journal of Business*, 59:67–94.

University of Yale (1998). Multiple Linear Regression. Available at http://www.stat.yale.edu/Courses/1997-98/101/linmult.htm. [Online; accessed 08-August-2015].

Worldbank (2015). GDP ranking. Available at http://data.worldbank.org/data-catalog/GDP-ranking-table. [Online; accessed 05-August-2015].

Xu, L. and Zhang, W.-J. (2001). Comparison of different methods for variable selection. *Analytica Chimica Acta*, 446:475–481.

Appendix A Abstract

The main goal of this thesis was finding the real determinants behind government bond yield performances during the tested time period and all relative and absolute yield levels. Therefore, the yield values of eight member states of the European Union have been analyzed and out of a set of 44 possible candidates, the most important determinants were chosen. The test-subjects were Germany, France, Austria, Portugal, Italy, Ireland, Greece, and Spain. This country selection covers economically sound economies, as well as the known PIIGS states, which have suffered heavily in the recent debt crises. Several variable selection procedures have been implemented: *Forward Selection*, *Backwards Elimination*, *Robust Regression*, *Lasso* and the *Subsets* method. With the help of a point based scoreboard system, the main determinants were selected. The quality of the chosen variables was tested by generating yield levels based on the selected variables and comparing the real yields with its calculated counterparts. The results implied that government bond yields can be explained by a small set of certain determinants. However, every country and yield level renders different significant variables. These findings indicate that the yield curves are depending on some factors quite heavily, but in order to confidently predict yield developments, more research, especially into the regression equation used for calculating future yields, is necessary.

Appendix B Abstract (German/Deutsch)

Ziel dieser Arbeit war das Finden von relevanten Bestimmungsfaktoren für Staatsanleihen-Renditen über den gesamten Testzeitraum und für alle relativen und absoluten Rendite Werte. Hierfür wurde die Rendite von acht Mitgliedstaaten der Europischen Union analysiert und die wichtigsten Faktoren wurden aus einem Set von 44 möglichen Variablen ausgewählt. Die Länder waren Deutschland, Frankreich, Österreich, Portugal, Italien, Irland, Griechenland und Spanien. Diese Länderauswahl beinhalted sowohl wirtschaftlich gesunde Volkswirtschaften, als auch die bekannten PIIGS Staaten, die unter der Schuldenkrise sehr stark gelitten haben. Mehrere Auswahlverfahren für die Variablen wurden angewendet: *Forward Selection*, *Backwards Elimination*, *Robust Regression*, *Lasso* and *Subsets* Methode. Mit Hilfe eines Punktesystems wurden die wichtigsten Bestimmungsfaktoren ausgewählt. Die Qualität der gewählten Variablen wurde durch eine Vorausberechnung der Rendite und den darauf folgenden Vergleich mit der wahren Rendite, überprüft. Die Ergebnisse deuten darauf hin, dass Staatsanleihen-Renditen von einer geringen Anzahl von bestimmen Variablen erklärt werden können. Allerdings liefert jedes Land und unterschiedliche Renditehöhen, verschiedene signifikante Bestimmungsfaktoren. Diese Resultate bedeuten Renditekurven sind von manchen Faktoren stark abhängig. Um aber zuversichtliche Vorhersagen über die Entwicklung von Renditen treffen zu können, muss weitere Forschungsarbeit, besonders in dem Bereich der vorhergesagten Regressionsgleichung, betrieben werden.

Appendix C Variable Short-Name Descriptions

Shortname	Description
DAX	German main stockindex
TVDAX	Tradevolume DAX
DAXChange	Relative change DAX
CAC40	French main stockindex
TVCAC40	Tradevolume CAC40
CAC40Change	Relative change CAC40
ATX	Austrian main stockindex
TVATX	Tradevolume ATX
ATXChange	Relative change ATX
PSI20	Portuguese main stockindex
TVPSI20	Tradevolume PSI20
PSI20Change	Relative change PSI20
FTMIB	Italian main stockindex
TVFTMIB	Tradevolume FTMIB
FTMIBChange	Relative change FTMIB
ISEQ	Irish main stockindex
TVISEQ	Tradevolume ISEQ
ISEQChange	Relative change ISEQ
ATG	Greek main stockindex
TVATG	Tradevolume ATG
ATGChange	Relative change ATG
IBEX	Spanish main stockindex
TVIBEX	Tradevolume IBEX
IBEXChange	Relative change IBEX
SPGER	Standard & Poor's long term rating for Germany
SPFRA	Standard & Poor's long term rating for France
SPAUT	Standard & Poor's long term rating for Austria
SPPOR	Standard & Poor's long term rating for Portugal
SPITA	Standard & Poor's long term rating for Italy
SPIRL	Standard & Poor's long term rating for Ireland
SPGRE	Standard & Poor's long term rating for Greece
SPESP	Standard & Poor's long term rating for Spain
GDPGER	Gross domestic product of Germany
GDPFRA	Gross domestic product of France
GDPAUT	Gross domestic product of Austria
GDPPOR	Gross domestic product of Portugal
GDPITA	Gross domestic product of Italy
GDPIRE	Gross domestic product of Ireland
GDPGRE	Gross domestic product of Greece
GDPESP	Gross domestic product of Spain
DEBTGER	Germany's debt to GDP ratio
DEBTFRA	France's debt to GDP ratio
DEBTAUT	Austria's debt to GDP ratio

DEBTPOR	Potugal's debt to GDP ratio
DEBTITA	Italy's debt to GDP ratio
DEBTIRE	Ireland's debt to GDP ratio
DEBTGRE	Greece's debt to GDP ratio
DEBTESP	Spain's debt to GDP ratio
UNEMPGER	Unemployment rate of Germany
UNEMPFRA	Unemployment rate of France
UNEMPAUT	Unemployment rate of Austria
UNEMPPOR	Unemployment rate of Portugal
UNEMPITA	Unemployment rate of Italy
UNEMPIRE	Unemployment rate of Ireland
UNEMPGRE	Unemployment rate of Greece
UNEMPESP	Unemployment rate of Spain
EURINF	Euro 17 annual inflation rate
GERINF	Germany's annual inflation rate
FRAINF	France's annual inflation rate
AUTINF	Austria's annual inflation rate
PORINF	Portugal's annual inflation rate
ITAINF	Italy's annual inflation rate
IREINF	Ireland's annual inflation rate
GREINF	Greece's annual inflation rate
ESPINF	Spain's annual inflation rate
LCOc1	Oil price; one barrel Brent Crude
XAU	Gold price
XAG	Silver price
ECOINDEU	Economic sentiment indicator European Union
ECOINDGER	Economic sentiment indicator Germany
ECOINDFRA	Economic sentiment indicator France
ECOINDAUT	Economic sentiment indicator Austria
ECOINDPOR	Economic sentiment indicator Portugal
ECOINDITA	Economic sentiment indicator Italy
ECOINDIRE	Economic sentiment indicator Ireland
ECOINDGRE	Economic sentiment indicator Greece
ECOINDESP	Economic sentiment indicator Spain
CHIMAN	HSBC Chinese factory production indicator
ECB	ECB interest rate
FED	Fed funds rate
EONIA	Eonia rate
EULIBOR	Eulibor rate (3 month)
LIBOR	Libor rate (3 month)
EURIBOR	Euribor rate (3 month)
TARGER	Target2 balance for Germany
TARFRA	Target2 balance for France
TARAUT	Target2 balance for Austria
TARPOR	Target2 balance for Portugal
TARITA	Target2 balance for Italy
TARIRE	Target2 balance for Ireland
TARGRE	Target2 balance for Greece
TARESP	Target2 balance for Spain
VOLIND	Euro Stoxx 50 volatility price index

Appendix D Sources: Market Data

	Source	RIC/Additional Information
YTMGER	Thomson Reuters IDN Selectfeed	RIC: DE10YT=RR
YTMFRA	Thomson Reuters IDN Selectfeed	RIC: FR10YT=RR
YTMAUT	Thomson Reuters IDN Selectfeed	RIC: AT10YT=RR
YTMPOR	Thomson Reuters IDN Selectfeed	RIC: PT10YT=RR
YTMITA	Thomson Reuters IDN Selectfeed	RIC: IT10YT=RR
YTMIRE	Thomson Reuters IDN Selectfeed Bloomberg	RIC: IE10YT=RR In the timeframe from 26.10.2007 to 16.08.2011 Bloomberg data (GTIEP10Y Govt) was used since Reuters did not provide a quote for this period
YTMGRE	Thomson Reuters IDN Selectfeed	RIC: GR10YT=RR
YTMESP	Thomson Reuters IDN Selectfeed	RIC: ES10YT=RR
DAX	Thomson Reuters IDN Selectfeed	RIC: .GDAXI
TVDAX	Thomson Reuters IDN Selectfeed	RIC: .GDAXI
DAXChange	Thomson Reuters IDN Selectfeed	RIC: .GDAXI
CAC40	Thomson Reuters IDN Selectfeed	RIC: .FCHI
TVCAC40	Thomson Reuters IDN Selectfeed	RIC: .FCHI
CAC40Change	Thomson Reuters IDN Selectfeed	RIC: .FCHI
ATX	Thomson Reuters IDN Selectfeed	RIC: .ATX
TVATX	Thomson Reuters IDN Selectfeed	RIC: .ATX
ATXChange	Thomson Reuters IDN Selectfeed	RIC: .ATX
PSI20	Thomson Reuters IDN Selectfeed	RIC: .PSI20
TVPSI20	Thomson Reuters IDN Selectfeed	RIC: .PSI21
PSI20Change	Thomson Reuters IDN Selectfeed	RIC: .PSI22
FTMIB	Thomson Reuters IDN Selectfeed	RIC: .FTMIB
TVFTMIB	Thomson Reuters IDN Selectfeed	RIC: .FTMIB
FTMIBChange	Thomson Reuters IDN Selectfeed	RIC: .FTMIB
ISEQ	Thomson Reuters IDN Selectfeed	RIC: .ISEQ
TVISEQ	Thomson Reuters IDN Selectfeed	RIC: .ISEQ
ISEQChange	Thomson Reuters IDN Selectfeed	RIC: .ISEQ
ATG	Thomson Reuters IDN Selectfeed	RIC: .ATG
TVATG	Thomson Reuters IDN Selectfeed	RIC: .ATG
ATGChange	Thomson Reuters IDN Selectfeed	RIC: .ATG
IBEX	Thomson Reuters IDN Selectfeed	RIC: .IBEX
TVIBEX	Thomson Reuters IDN Selectfeed	RIC: .IBEX
IBEXChange	Thomson Reuters IDN Selectfeed	RIC: .IBEX

SPGER	Thomson Reuters EIKON	Country Information Germany
SPFRA	Thomson Reuters EIKON	Country Information France
SPAUT	Thomson Reuters EIKON	Country Information Austria
SPPOR	Thomson Reuters EIKON	Country Information Portugal
SPITA	Thomson Reuters EIKON	Country Information Italy
SPIRL	Thomson Reuters EIKON	Country Information Ireland
SPGRE	Thomson Reuters EIKON	Country Information Greece
SPESP	Thomson Reuters EIKON	Country Information Spain
GDPGER	International Monetary Fund (IMF) World Economic Outlook Database, October 2013	World Economic Outlook Database, October 2013 Gross domestic product, constant prices (National currency) Expressed in billions of national currency units; the base year is country-specific. Expenditure-based GDP is total final expenditures at purchasers' prices (including the f.o.b. value of exports of goods and services), less the f.o.b. value of imports of goods and services. [SNA 1993]
GDPFRA	International Monetary Fund (IMF) World Economic Outlook Database, October 2013	See GDPGER
GDPAUT	International Monetary Fund (IMF) World Economic Outlook Database, October 2013	See GDPGER
GDPPOR	International Monetary Fund (IMF) World Economic Outlook Database, October 2013	See GDPGER
GDPITA	International Monetary Fund (IMF) World Economic Outlook Database, October 2013	See GDPGER
GDPIRE	International Monetary Fund (IMF) World Economic Outlook Database, October 2013	See GDPGER
GDPGRE	International Monetary Fund (IMF) World Economic Outlook Database, October 2013	See GDPGER
GDPESP	International Monetary Fund (IMF) World Economic Outlook Database, October 2013	See GDPGER

DEBTGER	International Monetary Fund, World Economic Outlook Database, October 2013	General government gross debt (National currency) Gross debt consists of all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future. This includes debt liabilities in the form of SDRs, currency and deposits, debt securities, loans, insurance, pensions and standardized guarantee schemes, and other accounts payable. Thus, all liabilities in the GFSM 2001 system are debt, except for equity and investment fund shares and financial derivatives and employee stock options.
DEBTFRA	International Monetary Fund, World Economic Outlook Database, October 2014	See DEBTGER
DEBTAUT	International Monetary Fund, World Economic Outlook Database, October 2015	See DEBTGER
DEBTPOR	International Monetary Fund, World Economic Outlook Database, October 2016	See DEBTGER
DEBTITA	International Monetary Fund, World Economic Outlook Database, October 2017	See DEBTGER
DEBTIRE	International Monetary Fund, World Economic Outlook Database, October 2018	See DEBTGER
DEBTGRE	International Monetary Fund, World Economic Outlook Database, October 2019	See DEBTGER
DEBTESP	International Monetary Fund, World Economic Outlook Database, October 2020	See DEBTGER
UNEMPGER	Eurostat	Seasonally adjusted; all ages and sexes
UNEMPFRA	Eurostat	Seasonally adjusted; all ages and sexes
UNEMPAUT	Eurostat	Seasonally adjusted; all ages and sexes
UNEMPPOR	Eurostat	Seasonally adjusted; all ages and sexes
UNEMPITA	Eurostat	Seasonally adjusted; all ages and sexes
UNEMPIRE	Eurostat	Seasonally adjusted; all ages and sexes
UNEMPGRE	Eurostat	Seasonally adjusted; all ages and sexes
UNEMPESP	Eurostat	Seasonally adjusted; all ages and sexes

EURINF	Eurostat	Annual rate of change; All-items HICP
GERINF	Eurostat	Annual rate of change; All-items HICP
FRAINF	Eurostat	Annual rate of change; All-items HICP
AUTINF	Eurostat	Annual rate of change; All-items HICP
PORINF	Eurostat	Annual rate of change; All-items HICP
ITAINF	Eurostat	Annual rate of change; All-items HICP
IREINF	Eurostat	Annual rate of change; All-items HICP
GREINF	Eurostat	Annual rate of change; All-items HICP
ESPINF	Eurostat	Annual rate of change; All-items HICP
LCOc1	Thomson Reuters IDN Selectfeed	RIC: LCOc1
XAU	Thomson Reuters IDN Selectfeed	RIC: XAU=
XAG	Thomson Reuters IDN Selectfeed	RIC: XAG=
ECOINDEU	Thomson Reuters EIKON	EIKON Identifier: aXZECOSE/A The economic sentiment indicator is composed of the industrial confidence indicator (40%), the service confidence indicator (30%), the consumer confidence indicator (20%), the construction confidence indicator (5%), and the retail trade confidence indicator (5%). Its long term average (1990-2003) equals 100.The reported ESI average is based on this standardisation sample. he series until April 2010 is based on source data classified according to NACE rev1.1.The series after May 2010 is based on source data classified according to NACE rev2. In order to reflect and represent total economic activity, a composite indicator, the EU Economic Sentiment Indicator (ESI) has been calculated on a monthly basis since 1985.
ECOINDGER	Thomson Reuters EIKON	EIKON Identifier: aDEECFIN/A Additional information: see ECOINDEU
ECOINDFRA	Thomson Reuters EIKON	EIKON Identifier: aFRECFIN/A Additional information: see ECOINDEU
ECOINDAUT	Thomson Reuters EIKON	EIKON Identifier: aATECFIN/A Additional information: see ECOINDEU
ECOINDPOR	Thomson Reuters EIKON	EIKON Identifier: aDEECFIN/A Additional information: see ECOINDEU
ECOINDITA	Thomson Reuters EIKON	EIKON Identifier: aITECFIN/A Additional information: see ECOINDEU
ECOINDIRE	Thomson Reuters EIKON	EIKON Identifier: IECONC=ECI Consumer Sentiment Index (KBC Bank Ireland/ESRI)
ECOINDGRE	Thomson Reuters EIKON	EIKON Identifier :aGRECFIN/A Additional information: see ECOINDEU
ECOINDESP	Thomson Reuters EIKON	EIKON Identifier: aESECFIN/A Additional information: see ECOINDEU
CHIMAN	Thomson Reuters EIKON	EIKON Identifier: aCNPMIT HSBC PMI, China, Manufacturing Sector, Total

ECB	Thomson Reuters IDN Selectfeed	RIC: ECBMRO=ECBF
FED	Thomson Reuters IDN Selectfeed	RIC: USFFTARGET=
EONIA	Thomson Reuters IDN Selectfeed	RIC: EONIA=
EULIBOR	Thomson Reuters IDN Selectfeed	RIC: EUR3MFSR=
LIBOR	Thomson Reuters IDN Selectfeed	RIC: USD3MFSR=
EURIBOR	Thomson Reuters IDN Selectfeed	RIC: EURIBOR3MD=
TARGER	University of Osnabrück	Sources: Individual Central Banks, IFS. See CESifo Working Paper #3944 for details. http://ideas.repec.org/p/ces/ceswps/_3944.html
TARFRA	University of Osnabrück	See TARGER
TARAUT	University of Osnabrück	See TARGER
TARPOR	University of Osnabrück	See TARGER
TARITA	University of Osnabrück	See TARGER
TARIRE	University of Osnabrück	See TARGER
TARGRE	University of Osnabrück	See TARGER
TARESP	University of Osnabrück	See TARGER
VOLIND	Thomson Reuters IDN Selectfeed	RIC: .V2TX

Appendix E Rolling of Benchmark Bonds

Germany		
Government Benchmark Bond ISIN	Benchmark Effective Date	Benchmark End Date
DE0001135283	20.05.2005	22.11.2005
DE0001135291	23.11.2005	16.05.2006
DE0001135309	17.05.2006	15.11.2006
DE0001135317	16.11.2006	22.05.2007
DE0001135333	23.05.2007	15.11.2007
DE0001135341	16.11.2007	28.05.2008
DE0001135358	29.05.2008	11.11.2008
DE0001135374	12.11.2008	19.05.2009
DE0001135382	20.05.2009	10.11.2009
DE0001135390	11.11.2009	29.04.2010
DE0001135408	30.04.2010	18.08.2010
DE0001135416	19.08.2010	24.11.2010
DE0001135424	25.11.2010	27.04.2011
DE0001135440	28.04.2011	24.08.2011
DE0001135457	25.08.2011	24.11.2011
DE0001135465	25.11.2011	12.04.2012
DE0001135473	13.04.2012	06.09.2012
DE0001135499	07.09.2012	17.01.2013
DE0001102309	18.01.2013	23.05.2013
DE0001102317	24.05.2013	12.09.2013
DE0001102325	13.09.2013	30.01.2014
DE0001102333	31.01.2014	22.05.2014
DE0001102358	23.05.2014	11.09.2014
DE0001102366	12.09.2014	15.01.2015
DE0001102374	16.01.2015	

Date/ISIN	YTM	Abs. Change	Rel. Change
17.05.2006			
DE0001135291	4.033323		
DE0001135309	4.053691	0.020368	0.505%
16.11.2006			
DE0001135309	3.746139		
DE0001135317	3.752329	0.00619	0.165%
23.05.2007			
DE0001135317	4.359094		
DE0001135333	4.370659	0.011565	0.265%
16.11.2007			
DE0001135333	4.087464		
DE0001135341	4.099035	0.011571	0.283%
29.05.2008			
DE0001135341	4.416039		
DE0001135358	4.450321	0.034282	0.776%

France		
Government Benchmark Bond ISIN	Benchmark Effective Date	Benchmark End Date
FR0010163543	07.02.2005	10.07.2005
FR0010216481	11.07.2005	05.02.2006
FR0010288357	06.02.2006	04.01.2007
FR0010415331	05.01.2007	09.09.2007
FR0010517417	10.09.2007	03.04.2008
FR0010604983	04.04.2008	06.11.2008
FR0010670737	07.11.2008	03.03.2009
FR0000189151	04.03.2009	08.07.2009
FR0010776161	09.07.2009	03.02.2010
FR0010854182	04.02.2010	27.10.2010
FR0010949651	28.10.2010	25.04.2011
FR0010192997	26.04.2011	08.06.2011
FR0011059088	09.06.2011	10.02.2012
FR0011196856	11.02.2012	17.10.2012
FR0011337880	18.10.2012	13.05.2013
FR0011486067	14.05.2013	01.10.2013
FR0010466938	02.10.2013	14.01.2014
FR0011619436	15.01.2014	16.07.2014
FR0011962398	17.07.2014	

Austria		
Government Benchmark Bond ISIN	Benchmark Effective Date	Benchmark End Date
AT0000386198	28.04.2005	20.04.2006
AT0000A011T9	21.04.2006	30.05.2007
AT0000A06P24	24.09.2007	08.01.2008
AT0000A08968	09.01.2008	22.12.2009
AT0000386115	23.12.2009	16.12.2010
AT0000A001X2	17.12.2010	30.12.2011
AT0000A0N9A0	31.12.2011	04.10.2012
AT0000A0U3T4	05.10.2012	18.04.2013
AT0000A105W3	19.04.2013	04.06.2014
AT0000A185T1	05.06.2014	

Portugal		
Government Benchmark Bond ISIN	Benchmark Effective Date	Benchmark End Date
PTOTE3OE0017	07.07.2005	20.07.2006
PTOTE6OE0006	21.07.2006	17.05.2007
PTOTELOE0010	18.05.2007	27.02.2008
PTOTENOE0018	28.02.2008	25.02.2009
PTOTEMOE0027	26.02.2009	21.02.2010
PTOTECOE0029	22.02.2010	07.05.2010
PTOTECOE0029	08.05.2010	31.03.2011
PTOTEYOE0007	01.04.2011	16.08.2011
PTOTEYOE0007	17.08.2011	26.07.2012
PTOTEAOE0021	27.07.2012	29.01.2014
PTOTEQOE0015	30.01.2014	03.02.2015
PTOTEKOE0011	04.02.2015	

Italy		
Government Benchmark Bond ISIN	Benchmark Effective Date	Benchmark End Date
IT0003844534	23.05.2005	02.03.2006
IT0004019581	03.03.2006	05.03.2006
IT0003844534	06.03.2006	29.03.2006
IT0004019581	30.03.2006	13.02.2007
IT0004164775	14.02.2007	15.11.2007
IT0004273493	16.11.2007	05.06.2008
IT0004361041	06.06.2008	20.01.2009
IT0004423957	21.01.2009	19.05.2009
IT0004489610	20.05.2009	11.11.2009
IT0004536949	12.11.2009	29.04.2010
IT0004594930	30.04.2010	07.05.2010
IT0004594930	08.05.2010	25.11.2010
IT0004634132	26.11.2010	06.05.2011
IT0004695075	07.05.2011	16.08.2011
IT0004695075	17.08.2011	05.12.2011
IT0004759673	06.12.2011	08.05.2012
IT0004801541	09.05.2012	14.09.2012
IT0004848831	15.09.2012	07.05.2013
IT0004898034	08.05.2013	16.09.2013
IT0004953417	17.09.2013	01.07.2014
IT0005001547	02.07.2014	20.11.2014
IT0005045270	21.11.2014	15.01.2015
IT0004513641	16.01.2015	

Ireland		
Government Benchmark Bond ISIN	Benchmark Effective Date	Benchmark End Date
IE0006857530	07.12.2005	25.10.2007
IE00B28HXX02	26.10.2007	08.04.2008
IE00B2QTFG59	09.04.2008	23.06.2009
IE00B6089D15	24.06.2009	12.03.2010
IE0034074488	13.03.2010	07.05.2010
IE0034074488	08.05.2010	24.09.2010
IE00B60Z6194	25.09.2010	16.08.2011
IE00B60Z6194	17.08.2011	14.03.2013
IE00B4S3JD47	15.03.2013	16.01.2014
IE00B6X95T99	20.01.2014	07.01.2015
IE00B4TV0D44	08.01.2015	

Greece		
Government Benchmark Bond ISIN	Benchmark Effective Date	Benchmark End Date
GR0124026601	23.02.2005	17.01.2006
GR0124028623	18.01.2006	21.01.2007
GR0124029639	22.01.2007	10.05.2008
GR0124030645	11.05.2008	15.03.2009
GR0124031650	16.03.2009	09.03.2010
GR0124032666	10.03.2010	07.05.2010
GR0124032666	08.05.2010	16.08.2011
GR0124032666	17.08.2011	17.11.2011
GR0133002155	18.11.2011	11.03.2012
GR0128010676	12.03.2012	17.09.2013
GR0128011682	18.09.2013	12.02.2015
GR0128012698	13.02.2015	

Spain		
Government Benchmark Bond ISIN	Benchmark Effective Date	Benchmark End Date
ES00000120G4	15.11.2005	18.10.2006
ES00000120J8	19.10.2006	18.02.2008
ES00000121A5	19.02.2008	03.02.2009
ES00000121L2	04.02.2009	26.05.2009
ES00000121O6	27.05.2009	19.01.2010
ES00000122D7	20.01.2010	07.05.2010
ES00000122D7	08.05.2010	13.07.2010
ES00000122T3	14.07.2010	24.01.2011
ES00000123B9	25.01.2011	16.08.2011
ES00000123B9	17.08.2011	19.01.2012
ES00000123K0	20.01.2012	24.01.2013
ES00000123U9	25.01.2013	23.06.2013
ES00000123X3	24.06.2013	03.02.2014
ES00000124W3	04.02.2014	13.08.2014
ES00000126B2	14.08.2014	03.03.2015
ES00000126Z1	04.03.2015	

Appendix F Attached Data Files

Together with this thesis come a series of attached data files. Those files consist of all data information, *R*-outputs, and used *R*-Codes. The attached files are separated in one folder for each country with various sub-folders for each selection method. The file containing all results is not stored in a separate folder but shown directly.

Figure 61: Overview attached data files

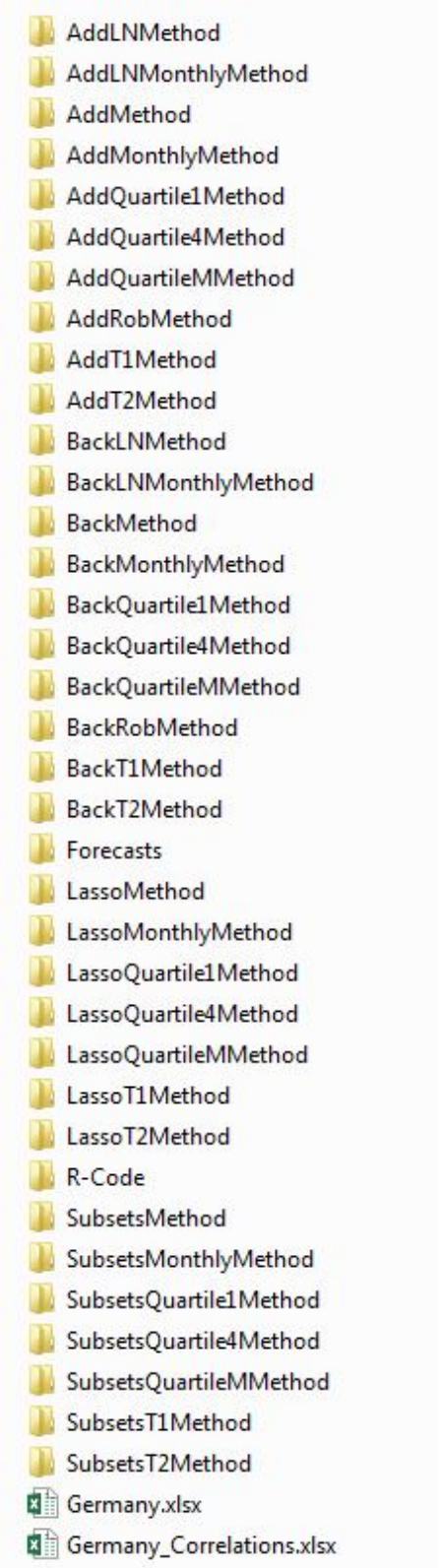


Figure 62: Sample overview attached data files Germany

Appendix G Curriculum Vitae

STEFFEN CHRISTOPH MEGNER

EDUCATION

2011-current University of Vienna

Masters of Business Administration

Faculty of Business, Economics and Statistics
Core-subject I: Financial Markets
Core-subject II: Corporate Finance
Thesis: *Real Determinants of Government Bond Yields*
Description: The thesis is an attempt to discover the real influences on the performance of government bond yield levels. As a result, several determining factors have been identified. However, those factors vary widely depending on the analyzed country and market situation.
Advisor: a.o. Univ.-Prof.Mag.Dr. Christian Keber

2006-2011 Vienna University of Economics and Business

Bachelor of Business Administration

Core-subject I: Finance
Core-subject II: International Marketing Management
Thesis: *Optimizing of a portfolio considering a varying number of assets and different risk preferences*
Advisor: Univ. Prof. Mag. Dr. Stefan Pichler

2009 University of Tulsa, Oklahoma

Semester Abroad United States

Core-subjects: Financial Mathematics and Corporate Finance
Part of the Bachelor of Business Administration degree of the Vienna University of Economics and Business

WORK EXPERIENCE

2012–Present Erste Group Bank AG

Erste Group Bank AG

Risk Controller - Market Risk and Data
Location: Vienna, Austria

2011–2012 Donauchem GmbH

Donauchem GmbH

Technical purchase / purchase commodities - part time
Location: Vienna, Austria

2006–2010 Siemens AG

Siemens AG

Technical purchase - Summer Intern
Location: Erlangen, Germany