Appendices

Appendix 1: Stoxx Europe 600 factsheet

BROAD INDICES 1

STOXX® EUROPE 600 INDEX

Stated objective

The STOXX Global 1800 derived benchmark indices are designed to provide a broad yet investable representation of the world's developed markets of Europe, North America and Asia/Pacific, represented by the STOXX Europe 600, the STOXX North America 600 and the STOXX Asia/Pacific 600 indices.The STOXX Global 1800 Index is a combination of all three indices. The EURO STOXX Index, a Eurozone subset, is derived from the STOXX Europe 600, as is the STOXX Nordic, a subset covering the Nordic region (Denmark, Finland, Iceland, Norway and Sweden).

Key facts

» Broad and liquid index benchmarks with well-balanced diversification of all regions: Europe, North America and Asia/Pacific are each represented by 600 components

» Broad number of components

» Index composition/design strictly rules based, objective and transparent

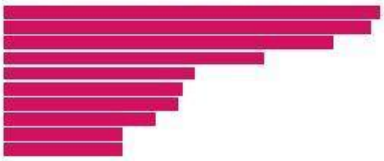
» Serve as benchmarks for the relevant regions/actively managed funds

» Serve as an underlying for a variety of financial products, are used for academic research and receive wide media coverage

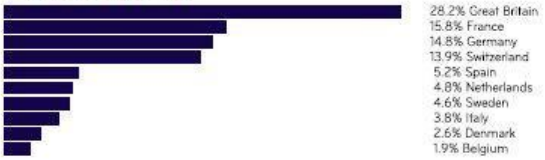
Descriptive statistics

Index	Market cap (EUR bn.)		Components (EUR bn.)				Component weight (%)		Turnover (%)
	Full	Free-float	Mean	Median	Largest	Smallest	Largest	Smallest	Last 12 months
STOXX Europe 600 Index	10,055.4	8,155.5	13.6	5.6	223.4	1.2	2.7	0.0	2.6
STOXX Europe Total Market Index	11,183.9	8,818.8	8.1	2.4	223.4	0.1	2.5	0.0	2.8

Supersector weighting (top 10)



Country weighting



Risk and return figures[1]

Index returns	Return (%)					Annualized return (%)				
	Last month	YTD	1Y	3Y	5Y	Last month	YTD	1Y	3Y	5Y
STOXX Europe 600 Index	3.4	6.3	17.1	26.0	72.1	44.5	26.5	16.3	7.8	11.2
STOXX Europe Total Market Index	3.3	6.1	17.2	26.1	73.1	43.0	25.7	16.5	7.8	11.3
Index volatility and risk	**Annualized volatility (%)**					**Annualized Sharpe ratio[2]**				
STOXX Europe 600 Index	7.7	8.0	15.4	17.5	16.0	4.9	3.1	0.9	0.4	0.7
STOXX Europe Total Market Index	7.8	7.9	15.3	17.4	15.8	4.7	3.0	1.0	0.4	0.7
Index to benchmark	**Correlation**					**Tracking error (%)**				
STOXX Europe 600 Index	1.0	1.0	1.0	1.0	1.0	0.3	0.3	0.4	0.4	0.4
Index to benchmark	**Beta**					**Annualized information ratio**				
STOXX Europe 600 Index	1.0	1.0	1.0	1.0	1.0	3.5	2.4	-0.2	0.0	-0.2

[1] For information on data calculation, please refer to STOXX calculation reference guide.
[2] Based on Euribor1m

(EUR, gross return), all data as of Mar. 31, 2017

STOXX

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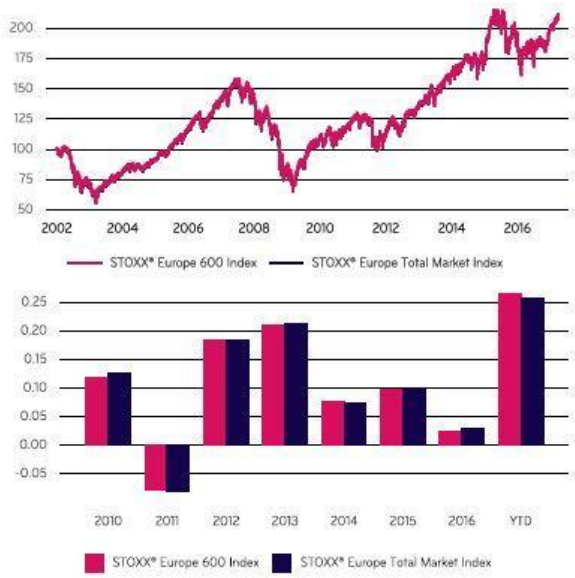
BROAD INDICES

STOXX® EUROPE 600 INDEX

Fundamentals (for last 12 months)

Index	Price/earnings incl. negative		Price/earnings excl. negative		Price/ book	Dividend yield (%) [4]	Price/ sales	Price/ cash flow
	Trailing	Projected	Trailing	Projected	Trailing	Trailing	Trailing	Trailing
STOXX Europe 600 Index	25.0	15.3	19.6	15.2	1.8	4.1	1.2	16.7
STOXX Europe Total Market Index	24.7	15.3	19.3	15.2	1.8	4.1	1.1	13.3

Performance and annual returns[3]



Methodology

The Global 1800 Index is a combination of the 600 largest stocks measured by free-float market cap of the following regions: Europe, the Americas, Asia/Pacific. The STOXX North America 600 comprises the 600 largest stocks from the STOXX North America TMI. The STOXX Asia/Pacific 600 comprises the 600 largest stocks from the STOXX Asia/Pacific TMI. The EURO STOXX and STOXX Nordic indices are derived from the STOXX Europe 600 Index. The detailed methodology including the calculation formula can be found in our rulebook : http://www.stoxx.com/indices/rulebooks.html

Versions and symbols

Index		ISIN	Symbol	Bloomberg	Reuters
Gross Return	AUD	CH0271081603	SXXAGU		.SXXAGU
Net Return	AUD	CH0271081629	SXXAU		.SXXCGD
Price	AUD	CH0271081645	SXXAA		.SXXAU
Gross Return	CAD	CH0148120766	SXXGDA	SXXGDA INDEX	.SXXGDA
Net Return	CAD	CH0148120758	SXXDA	SXXDA INDEX	.SXXDA
Price	CAD	CH0148120741	SXXCA	SXXCA INDEX	.SXXCA
Gross Return	CHF	CH0271081611	SXXCGD		.SXXCHD
Net Return	CHF	CH0271081637	SXXCHD		.SXXAA
Price	CHF	CH0271081652	SXXCHC		.SXXCHC
Gross Return	EUR	CH0102635015	SXXGR	SXXGR INDEX	.SXXGR

Complete list available here: www.stoxx.com/data/vendor_codes.html

Quick facts	
Weighting	Free-float market cap
Cap factor	20% for Global, Europe, North America, Asia/Pacific and Eurozone; no cap for Nordic Index
No. of components	600 for the three regional indices; 1,800 for the combined index; variable for Eurozone and Nordic subset
Review frequency	Quarterly (Mar., Jun., Sep., Dec.)

To learn more about the inception date, currency versions, calculation hours and historical values, please see our data vendor code sheet.

[3] STOXX data from Jan. 03, 2002 to Mar. 31, 2017
[4] gr. div. yield is calculated as gr. return index return minus price index return (EUR, gross return), all data as of Mar. 31, 2017

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STOXX is part of Deutsche Boerse Group

CUSTOMIZATION
The index can be used as a basis for the definition of STOXX® Customized Indices, which can be tailored to specific client or mandate needs. STOXX offers a wide range of customization, in terms of component selection, weighting schemes and personalized calculation methodologies.

BACKTESTED PERFORMANCE
This document contains index performance data based on backtesting, i.e. calculations of how the index might have performed prior to launch if it had existed using the same index methodology and based on historical constituents. Backtested performance information is purely hypothetical and is provided in this document solely for information purposes. Backtested performance does not represent actual performance and should not be interpreted as an indication of actual performance.

BROAD INDICES

STOXX® EUROPE 600 INDEX

Top 10 Components[5]

Company	Supersector	Country	Weight (%)
NESTLE	Food & Beverage	CH	2.74
NOVARTIS	Health Care	CH	2.24
ROCHE HLDG P	Health Care	CH	2.06
HSBC	Banks	GB	1.88
TOTAL	Oil & Gas	FR	1.43
BRITISH AMERICAN TOBACCO	Personal & Household Goods	GB	1.42
SIEMENS	Industrial Goods & Services	DE	1.34
ROYAL DUTCH SHELL A	Oil & Gas	GB	1.34
BP	Oil & Gas	GB	1.28
SANOFI	Health Care	FR	1.22

[5] Based on the composition as of Mar. 31, 2017

Appendix 2: Bloomberg Barclay's Euro Aggregate Bond Index factsheet

IEAG iSHARES BARCLAYS EURO AGGREGATE BOND

FOR UK AND IRELAND INVESTORS ONLY

All data as at 30 September 2009

Fund description

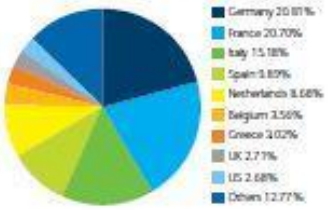
iShares Barclays Euro Aggregate Bond provides exposure to a basket of Euro-denominated investment grade bonds, including treasury bonds, securitised bonds and corporate bonds. Inclusion in the fund is based on the currency of the issue (i.e. Euros) and not the domicile of the issuer. The iShares Barclays Euro Aggregate Bond offers a high level of diversification among global investment grade debt investments.

iShares Barclays Euro Aggregate Bond is an exchange traded fund (ETF) managed by BlackRock and is listed on the London Stock Exchange. That means you can buy shares in iShares Barclays Euro Aggregate Bond through a broker as you would buy any ordinary share.

iShares ETFs are a simple and cost-effective way to gain exposure to different markets. The aim of iShares ETFs is to offer investors returns based on the performance of the relevant underlying index. Using ETFs as building blocks, you can spread the risk of individual companies, entire sectors or even whole countries suffering losses. However, they will not mitigate all market risk, and you can still lose some, or all of your investment should the value of the underlying bonds decrease. Note that investment in iShares Barclays Euro Aggregate Bond may be affected by interest rates movements.

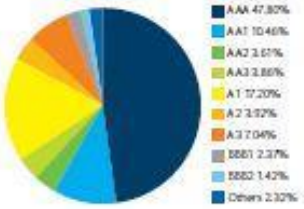
For more details please refer to the prospectus.

Country allocation



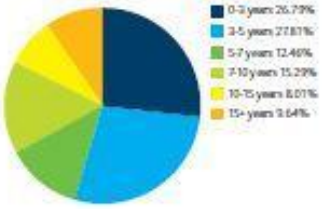
Others include: Austria 2.57%, Supranational 2.43%, Ireland 1.71%, Sweden 0.82%, Australia 0.79%, Finland 0.7%, Norway 0.63%, Switzerland 0.61%, Luxembourg 0.52%, Cash 0.52%, Canada 0.34%, Denmark 0.27%, Poland 0.24%, Portugal 0.22%, Cayman Islands 0.13%, Czech Republic 0.11%, Hungary 0.11% and Guernsey 0.05%.

Credit rating



Others include: BBB3 0.72%, N/A 1.07% and Cash 0.53%.

Maturity



Source: BlackRock Advisors (UK) Limited

Fund facts

UCITS III compliant	Yes	
Umbrella company	iShares III plc	
UK distributor status	Yes	
Benchmark index	Barclays Capital Euro Aggregate Bond Index	
Fund value	€47.5m	
Total expense ratio	0.25%	
Number of holdings	390	
ETF methodology	Sampled	
Inception date	6 March 2009	
Base currency	EUR	
Flat yield	4.21% pa	
Yield to maturity (%)	2.96% pa	
Modified duration (%)	5.22	
Maturity (years)	6.96 years	
London Stock Exchange (Non Sterling)	Exch code	IEAC
	Reuters	IEAC.L
	Bloomberg	IEAC LN
	SEDOL™	B3DKXQ4
	Trading currency	EUR
London Stock Exchange	Exch code	SEAC
	Reuters	SEAC.L
	Bloomberg	SEAC LN
	Bloomberg INAV	INAVEABC
	SEDOL™	B3DKXZ3
	Trading currency	GBP
This fund is also listed on:	Borsa Italiana	
	NYSE Euronext Amsterdam	
	XETRA Deutsche Börse	
Bloomberg INAV	INAVEABE <index>	
Reuters INAV page	iShares	
ISIN	IE00B3DKXQ41	
Total return index ticker	LBEATREU <index> <go>	
Use of income	Distributing	
Dividend frequency	January and July	

The next dividend payment for this fund will be 27 January 2010

1st distribution for the accounting year ending 30 June 2010

Ex date	24 June 2009
Record date	26 June 2009
Pay date	22 July 2009
Dividend rate per share	€0.9827
Underlying index rebalance frequency	Monthly
ISA/SIPP available?	Yes*

Source: BlackRock Advisors (UK) Limited and Bank of Ireland

*Please contact your broker or financial adviser for further information.

Yield Information

The level of the yield may be subject to fluctuation. The difference between the redemption and the running (or income) yield is because the redemption yield takes into account expected capital payments as well as income payments should the bonds be held until maturity. The running (or income) yield gives an indication of the income to be paid based on the fund's current holdings. The Gross redemption yield figures quoted are predications and not guaranteed.

iShares Barclays Euro Aggregate Bond

Top 10 holdings

Issuer	Rating	% of Fund	% of Index
BTPS 4.250% 01/08/2013	A1	1.69	0.38
BTPS 3.750% 01/08/2021	A1	1.53	0.31
BTPS 5.500% 01/11/2010	A1	1.35	0.32
OBL 2.250% 11/04/2014	AAA	1.28	0.27
BTPS 6.000% 01/05/2031	A1	1.25	0.50
BTPS 3.750% 01/08/2016	A1	1.20	0.39
FRTR 4.750% 25/10/2012	AAA	1.19	0.31
DBR 5.000% 04/01/2012	AAA	1.17	0.40
DBR 4.500% 04/01/2013	AAA	1.17	0.38
FRTR 4.000% 25/04/2014	AAA	1.14	0.30

Source: BlackRock Advisors (UK) Limited
The ratings above are an average taken from S&P, Moody's and Fitch rating agencies.

Appendix 3: OLS regression

The OLS regression consists in drawing a straight line in the middle of a dataset, such as it minimizes the sum of squared residuals. The residuals are the difference between the straight line and the actual observed value, as represented in the illustration below.

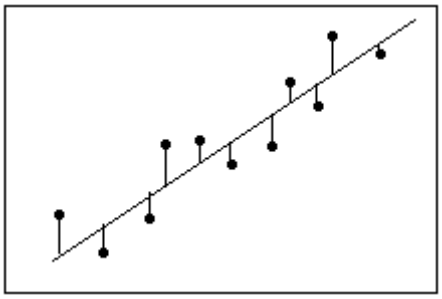


Illustration of residuals

By minimizing this difference, we obtained the best suitable linear model for our given dataset.

More precisely, the model of a multiple regression can be noted as followed:

$$y_t = \beta_1 + \beta_2 x_{2t} + \beta_3 x_{3t} + \ldots + \beta_k x_{kt} + u_t \;\; ; \; t = 1; 2; \ldots; T$$

With:

$y_t = The dependent\ variable$
$x_{kt} = \ The\ independant\ variables$
$\beta_{kt} = The\ coefficients\ of\ the\ independant\ variables$
$u_t = The\ disturbance\ or\ error\ \ term$

Here it is important to note the special characteristic of x_1, which is a constant term that could be represented as followed:

$$x_1 = \begin{bmatrix} 1 \\ 1 \\ . \\ . \\ . \\ 1 \end{bmatrix}$$

The length of the column x_1 is T. As a consequence of this β_1 is the coefficient of the constant term x_1.

In fact, we could write one separate equation for every value of t up until T:

$$y_t = \beta_1 + \beta_2 x_{21} + \beta_3 x_{31} + \ldots + \beta_k x_{k1} + u_1$$
$$y_t = \beta_1 + \beta_2 x_{22} + \beta_3 x_{32} + \ldots + \beta_k x_{k2} + u_2$$
$$\ldots = \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots$$
$$y_t = \beta_1 + \beta_2 x_{2T} + \beta_3 x_{3T} + \ldots + \beta_k x_{kT} + u_T$$

Under a matrix form you could write this as:

$$y = X\,\beta + u$$

With:

$y = T\,x\,1$
$X = T\,x\,k$
$\beta = k\,x\,1$
$u = T\,x\,1$

This is the true relationship model of our population. This equation represents the true relationship between our dependent and independent variables. However, as we don't observe the entire population but only a part of the population, we do not know the true relationship of the variables. We can only estimate the true relationship with the help of the OLS method and based on our sample, which represents only a part of the entire population.

Now, in order to demonstrate the methodology of the OLS method, we will assume that k is 2, meaning that we have 2 regressors and one of them is the constant term. The matrix will look as follows:

$$\begin{bmatrix} y_1 \\ y_2 \\ . \\ . \\ . \\ y_T \end{bmatrix} = \begin{bmatrix} 1 & x_{21} \\ 1 & x_{22} \\ . & . \\ . & . \\ . & . \\ 1 & x_{2T} \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ . \\ . \\ . \\ u_T \end{bmatrix}$$

$$T\ x\ 1 \qquad T\ x\ 2 \qquad 2\ x\ 1 \quad T\ x\ 1$$

The disturbance term under the matrix form can be defined as following:

$$\hat{u} = \begin{bmatrix} \hat{u}_1 \\ \hat{u}_2 \\ . \\ . \\ . \\ \hat{u}_T \end{bmatrix}$$

The Residual Sum of Square or simply the RSS is given by:

$$\hat{u}'\hat{u} = [\hat{u}_1 \quad \hat{u}_2 \quad . \quad . \quad . \quad \hat{u}_T] \begin{bmatrix} \hat{u}_1 \\ \hat{u}_2 \\ . \\ . \\ . \\ \hat{u}_T \end{bmatrix} = \hat{u}_1^2 + \hat{u}_2^2 + \ ... \ + \hat{u}_T^2 = \sum \hat{u}_t^2$$

Now, as already mentioned beforehand, in order to obtain the different estimators β1, β2, …, βk we have to minimize the RSS, so in this case, $\sum \hat{u}_t^2$ with respect to all the β's. So, by minimizing $\hat{u}'\hat{u}$ we get:

$$Min_{\beta}\ \hat{u}'\hat{u} = (y - X\beta)'(y - X\beta)$$

$$\Leftrightarrow Min_{\beta}\ \hat{u}'\hat{u} = y'y - 2\beta'X'y + \beta'X'X\beta$$

$$\frac{\delta(\hat{u}'\hat{u})}{\delta\beta} = -2X'y + 2X'X\beta = 0$$

$$X'X\beta = X'y$$

And finally, we have:

$$\hat{\beta} = \begin{bmatrix} \hat{\beta}_1 \\ \hat{\beta}_2 \\ \cdot \\ \cdot \\ \cdot \\ \hat{\beta}_k \end{bmatrix} = (X'X)^{-1}X'y$$

This procedure represents the derivation of the OLS estimators' β in a multiple regression analysis. This is the method that we are going to use in this research paper to estimate the coefficients of our explanatory variables.

The equation of the line, which represents the predictive model, is given by:

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \cdots + \hat{\beta}_n x_n$$

We will use this regression method during the second part of our analysis in order to form a forecast model and to understand which factors have an impact on correlation.

Appendix 4: Descriptive statistics

We will analyze the descriptive statistics of our correlation in more detail. In fact, we can observe that over the course of our observation period the correlation is negative as well as positive. This is coherent with our literature review that suggests that the correlation is dynamic over time (Scruggs & Glabadanidis, 2003). However, the average, as well as the median of our computed correlation, is negative during our observation period. This is consistent with the findings of Ohmi and Okimoto (2016) who observed a statistically significant decrease in the stock-bond correlation, in more advanced and safe countries, in comparison to previous studies. If the correlation had been negative over the entire period, this would of course have had a positive impact on diversification and asset allocation. If these two asset types de-correlate, they can be used as an effective hedging technique and the asset allocation in portfolio management can be considered as effective. However, (Ohmi & Okimoto, 2016) also observed periods where the stock-bond correlation increases and as a result of that, the diversification effect gets deteriorated. This is coherent with our observations as well as other scientific researches: we clearly observed periods with positive correlation, often during crises or in times of high uncertainty or volatility. This phenomenon is confirmed by a multitude of scientific researches like Mighri and Mansouri (2013), Hartmann, Straetmans and De Vries (2004) or Campbell (2002). This confirms our observations during the literature review.

Appendix 5: Basic regression

Regression Statistics	
Multiple R	0,373393984
R Square	0,139423068
Adjusted R Square	0,08726689
Standard Error	0,086012432
Observations	71

ANOVA

	df	SS	MS	F	Significance F
Regression	4	0,079106346	0,019776587	2,6731841	0,03947505
Residual	66	0,488277142	0,007398139		
Total	70	0,567383488			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	-0,19260306	0,056453574	-3,411707124	0,0011065	-0,3053163	-0,0798899	-0,3053163	-0,0798899
EU_GDP	-0,152753213	0,055791039	-2,737952472	0,0079386	-0,2641436	-0,0413628	-0,2641436	-0,0413628
EURO_GDP	0,125705608	0,04981257	2,523572023	0,0140323	0,0262516	0,22515961	0,0262516	0,22515961
US_GDP	0,03193513	0,010893812	2,931492519	0,0046312	0,01018493	0,05368533	0,01018493	0,05368533
EuroInauguration	0,089881824	0,053830852	1,669708349	0,0997139	-0,0175949	0,19735859	-0,0175949	0,19735859

Appendix 6: Regression on macroeconomic factors

Regression Statistics	
Multiple R	0,529068854
R Square	0,279913853
Adjusted R Square	0,22452261
Standard Error	0,079281872
Observations	71

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	0,158818498	0,0317637	5,053395481	0,00056655
Residual	65	0,40856499	0,006285615		
Total	70	0,567383488			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,117258734	0,024757949	-4,736205573	1,22331E-05	-0,166703772	-0,067813697	-0,166703772	-0,067813697
EU_CPI	0,047452495	0,059333236	0,799762467	0,426761587	-0,07104416	0,16594915	-0,07104416	0,16594915
EURO_CPI	-0,068275609	0,059250848	-1,152314461	0,253412331	-0,186607724	0,050056506	-0,186607724	0,050056506
US_CPI	0,009048203	0,012390742	0,730238985	0,467867923	-0,015697818	0,033794224	-0,015697818	0,033794224
SubprimeCrisis	-0,025716475	0,03476173	-0,739792737	0,462089397	-0,095140443	0,043707493	-0,095140443	0,043707493
DebtCrisis	0,081854371	0,022681225	3,608904262	0,000598228	0,036556836	0,127151906	0,036556836	0,127151906

Appendix 7: Regression on financial factors

Regression Statistics	
Multiple R	0,638856419
R Square	0,408137524
Adjusted R Square	0,368011255
Standard Error	0,072409533
Observations	64

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0,213318845	0,053329711	10,17132988	2,48767E-06
Residual	59	0,309345288	0,00524314		
Total	63	0,522664133			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,108507396	0,042555845	-2,549764806	0,013397627	-0,193661446	-0,023353347	-0,193661446	-0,023353347
VIX	0,001127341	0,001512884	0,745160081	0,459133173	-0,001899933	0,004154615	-0,001899933	0,004154615
Liquidity_Risk	0,060209823	0,019653202	3,063613924	0,003293334	0,020883857	0,099535789	0,020883857	0,099535789
GG10Y	-0,082419857	0,018392053	-4,481275655	3,46955E-05	-0,119222269	-0,045617445	-0,119222269	-0,045617445
USG10Y	0,062758391	0,021112888	2,97251565	0,004270692	0,020511599	0,105005183	0,020511599	0,105005183

Appendix 8: Regression on policy factors

Regression Statistics	
Multiple R	0,416853598
R Square	0,173766922
Adjusted R Square	0,148729556
Standard Error	0,084025867
Observations	69

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0,098001894	0,049000947	6,940303637	0,001838167
Residual	66	0,465982854	0,007060346		
Total	68	0,563984748			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0,055287679	0,020419501	-2,707592101	0,00862082	-0,096056527	-0,01451883	-0,096056527	-0,01451883
ECBRate	-2,507622704	0,781757615	-3,207672884	0,002065339	-4,068452142	-0,946793265	-4,068452142	-0,946793265
QE	0,026961125	0,046566813	0,578977235	0,564575351	-0,066012518	0,119934767	-0,066012518	0,119934767