

A Work Project presented as part of the requirements for the Award of a Master's Degree in Economics from the NOVA – School of Business and Economics.

Enhancing and Implementing a Pairs Trading Strategy

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"The contrary investor is every human when he resigns momentarily from the herd and
thinks for himself."

Archibald MacLeish

Abstract

This paper designs a pairs trading model with the intent to identify existing profitable market opportunities to invest, i.e. traditionally strong correlated stocks that have diverged from its historical norm. It comprises a broad literature review on this strategy whose relevant findings (*strategy improvements*) are contemplated in the model. The authors combine the statistical results of the model with a backtesting analysis in order to provide guidance on the best investment opportunities.

Keywords: Pairs Trading; Investment Modeling; Statistical Arbitrage

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I. Purpose of the Work Project

The purpose of this Work Project, which consists in a direct research internship (DRI), is to enhance and implement a Pairs Trading strategy for the Trading and Treasury Department, Equities Desk, of the Portuguese bank Caixa Económica Montepio Geral (henceforth Montepio). The project is of practical nature and aims to search, analyse and recommend pair trading ideas on the market that are feasible and profitable. The work process is divided in three phases. The first one related with researching the academic literature on pairs trading. This contributes to the second phase of designing a Financial Internal Model (henceforth Model) that tries to identify existing pairs trading investment opportunities on the market. The last step is to analyze these investment opportunities (through a statistical analysis and backtesting) and support the decision of whether or not to invest in a given pair.

This DRI also intends to be a first contact experience with a Trading floor and Investment practices, with a rotation across desks and solid on-the-job training. Although the main focus is in the Equities desk, the trainee is expected to collaborate with other desks and activities.

Montepio is a Portuguese savings bank, the 6th largest by net assets, that offers a wide range of banking and financial products, mainly owned by the mutual association Montepio Geral – Associação Mutualista (MGAM). The Treasury and Trading department has three main responsibilities: treasury management of the bank; provide risk-hedging solutions to corporate clients; proprietary trading in equities, fixed income and forex. The organogram of the department can be seen in the appendix (Figure 1).

This document is organized as follows: Section II provides a literature review on pairs trading, namely its origin, definition, evidence of profitability and factor analysis. Section III outlines the data, methodology and model used, pointing out improvements of this strategy found in the literature. Section IV discusses the results, highlighting the positive and negative aspects for each pair. A description of the work conducted and relevant results is provided throughout the paper.

II. Literature Review

This section starts with the definition, important concepts and methodology of the Pairs trading strategy, followed by scientific evidence on its profitability throughout time and impact of transactions costs. The section ends with an overview of the factors explaining its returns. The goal is to provide a comprehensive understanding of this strategy based on relevant academic findings. Although it has been growing, the literature on this topic is not abundant due to its proprietary nature.

a) Introduction to Pairs Trading

Pairs trading strategies were pioneered in the mid-80s by a quantitative group at Morgan Stanley's Advanced Proprietary Trading². This group included traders such as Nunzio Tartaglia, Ph.D in physics, Gerry Bamberger and David Shaw, both computer scientists. Although the group was disbanded in 1989, pairs trading has become an increasingly popular investment strategy among individual and institutional traders, as

² Some authors argue that the principles of Pairs Trading had been around for many years prior to 1980. Ehrman (2006, p. 21) states that Jesse Livermore used this notion on his "Top Down Trading" approach, despite referring to it as "sister stocks" rather than "pairs". For more about Livermore's "sister stocks" concept, please see Livermore, 1940, *How to Trade Stocks*, chapter 8 (*Tandem trading – sister stocks*).

well as hedge funds. Of the \$137 billion Assets under management in 2000, hedge funds employed \$119 billion in “Market Neutral”, “Relative Value” or “Arbitrage” strategies, all of which might impact pairs trading (Gatev, Goetzmann & Rouwnhorst, 2006. Henceforth, GGR).

Pairs trading is defined as “a non-directional, relative-value investment strategy that seeks to identify two companies with similar characteristics (*a pair*) whose equity securities are currently trading at a price relationship that is outside their historical trading range. This investment strategy entails buying the undervalued security while short-selling the overvalued security, thereby maintaining market neutrality³.” (Ehrman, 2006, p. 2). This definition points out four important concepts: the investment procedure; market neutrality; relative-value strategy and prices’ relationship.

The investment procedure starts with identifying securities that move closely (“with similar characteristics”), a phase also called *pairs formation*. The second stage consists in spotting relative mispricings in the pairs (i.e. when the “price relationship is outside their historical trading range”), a phase also named *divergence in the pair*. The last step is betting the pair will mean-revert to its long-run equilibrium, also named *convergence in the pair*. This convergence is exploited by investing long in the overvalued and short in the undervalued stock – a contrarian strategy. Hence returns are a combination of forming the best pairs and identifying the right mispricings, so that the investor can profit when pairs return to its long-run relationship value. Figure 2 has an illustrative example of a pairs trading situation (i.e. spotting mispricings and mean-reversion in a pair).

³ For a distinction between pairs trading, market neutral and long/short investment strategies, please see [1] in Appendix B.

Market neutrality means that pairs trading is non-directional (i.e. independent of the market direction) and can profit in several market conditions⁴. This implies that both the long and short position have similar market risk and equal dollar amounts invested (in practical terms, this means that the funds received from the short-sale are used to finance the long side – self-funded strategy). Another practical implication is that pairs trading's returns come from stock-picking.

Finally, pairs trading is commonly referred as a risk arbitrage strategy, particularly, a relative value (GGR 2006) or statistical arbitrage strategy (Low 2009). The strategy analyzes securities in relative and not absolute terms and exploits temporary distortions in prices of securities that have been statistically and historically related. The difference between relative value and statistical arbitrage is that the latter is almost purely model and computer driven, with little human analysis affecting any single trade (Ehrman 2006).

The association of pairs trading with arbitrage raises the question whether the strategy consists in short-term investments and high frequency trades. For GGR (2006), the average duration of an open pair is 3.75 months, indicating that pairs trading is a medium-term investment strategy in which the mean-reversion process might take some time to materialize on the market (e.g. in this work we found pairs that have been divergent for 8 months. Please see [4] on Appendix B for Societe Generale vs. Credit Agricole). Moreover, Engelberg *et al.* (2009) show that a large portion of the profits come in the first 10-days, suggesting the mean-reversion behavior is not linear⁵.

⁴ Bowen & Hutchinson (2013) show that pairs trading profits are held in several market conditions (expansions, contractions and neutral economic cycles).

⁵ Almeida (2011) found that limiting the number of days a pair is open increases returns.

b) Profitability of Pairs Trading

According to Huck (2010), the most cited papers on pairs trading in the academic literature are Gatev, Goetzmann & Rouwnhorst (1999 & 2006). GGR (1999) test the performance of pairs trading strategy for US stocks from 1962 to 1998. This analysis is extended to 2002 in GGR (2006), allowing them to test the results out-of-sample and thus avoid data snooping problems. GGR (2006) show that pairs trading yields a mean monthly excess return of 0.715% for all pairs (vs the 0.41% equity premium for the S&P500) whilst the sharpe ratios are 0.45 and 0.09, respectively⁶. Do & Faff (2009) extended GGR (2006) to 2008 (six more years) and also found significant positive returns despite being lower (0.58% per month). These abnormal positive returns can be observed in other stock markets around the world. Bowen & Hutchinson (2013) applied GGR approach to UK equity market from 1980 to 2012, Broussard & Vaihekoski (2012) to Finland from 1987-2008, Hong & Susmel (2003) for dual-listed Asian shares in 1991 to 2000, Perlin (2007) and Caldeira & Moura (2013) to Brazil, the former in 2000-06 and the latter in 2005-12, Andrade *et al.* (2005) to Taiwan from 1994 to 2002. Although statistically significant, the magnitude of the returns varies substantially (lowest is 7.2%/y in Do & Faff (2009) and highest is 54.58%/y in Perlin (2007)). Please see Table 1 for a comparison of the returns of these studies.

To what concerns transaction costs in pairs trading, one has to take into account not only the common visible transactions costs as commissions, fees, taxes and spreads but also short-selling costs and constrains. These costs are loan fees related with securities lending (short-sale rebate fee) and dividend payments that Montepio has to transfer to the securities' titleholder. Following Do & Faff (2012), short-sale constrains

⁶ Please see GGR (2006) output table in Figure 3.

can take three forms: 1) the inability to short securities at the desired timing (*shortability*); 2) loan fees can increase in the case of *specials* (e.g. company enters in a takeover process); 3) possibility of the borrowed stock being recalled prematurely (*recall risk*). Evidence from Do & Faff (2011) find non-significant positive returns for pairs trading in the US equity market from 1963-2009. Bowen & Hutchinson (2013) corroborate the findings for the UK stock market from 1980-2012.

i. Recent profitability

In more recent periods the profitability of pairs trading has been declining. GGR (2006) present a mean monthly return for all pairs of 0.2% after 1989 compared to 1% prior to 1989 (Figure 4). Sharpe ratios also fall considerably, from 0.6 to 0.16 respectively. The authors mention increasing trading competition (and therefore fewer pairs trading opportunities in the market) as an explanatory factor, due to the emergence of hedge funds' activity and lower transactions costs after 1989⁷. Do & Faff (2009) argue this is not the case and state that the decline is because more pairs do not mean-revert after the initial divergence. The proportion of non-convergent (unprofitable) pairs⁸ increased from 26% (pre 1988) to 39% (1989-2002), and to 42% (2003-2008) whereas the proportion of convergent (profitable) pairs has reduced from 42% to 24% and 21%, respectively. They report a decline of 60% in mean monthly returns after 1988 compared with 1962-1988⁹.

⁷ In line with this, Do & Faff (2012) estimate that the average one-way commission in NYSE decreased from 70 bps in 1963 to 9 bps in 2009.

⁸ Non-convergent pairs are pairs that diverge initially (triggering the opening of the position) but do not converge afterwards to its long-run equilibrium (thus representing a loss). Remember that the returns of this strategy come from the fact that the pair mean-reverts after divergence.

⁹ This phenomenon is not exclusive to the US stock market. Bowen & Hutchinson (2013) also finds this decline in profitability for the UK stock market after 1989.

c) Factors explaining Pairs Trading returns

Studies that tried to explain pair trading profitability are unanimous in finding that common factors as Market factors, the three Fama-French factors and Carhart's Momentum factor are not statistically significant¹⁰. GGR (2006) and Bowen & Hutchinson (2013) also show that a Reversal factor is not statistically significant. In addition, GGR (2006) and Engelberg *et al.* (2009) prove that short-selling risks/constraints are not relevant for large stocks¹¹. This evidence supports the hypothesis that pairs trading is market-neutral.

The first important factor in the literature is the type of news and subsequent reaction time of each of the stocks in a pair. Engelberg *et al.* (2009) find that firm-specific/*idiosyncratic* news are more likely to cause a permanent divergence whilst *industry*-specific news (i.e. common to both stocks) can trigger profitable pairs. The reason is that there is a time-lag reaction between both stocks in the same pair in incorporating the common information into the price (sort of a lead-lag relationship similar to Lo & MacKinlay, 1990). These authors report that half of contrarian returns are generated by lead-lag effects, in which a price change in one stock (the leader) at time t anticipates a price change in another stock (the follower) at time $t + lag$. This might occur due to market frictions such as slow information diffusion or costly information acquisition. Engelberg *et al.* (2009) consider three aspects of market frictions¹² (institutional ownership, analyst's coverage and liquidity of the shares – all negatively correlated with market frictions) and show that returns are larger the bigger

¹⁰ Low (2009) explains that Equity Market Neutral (EMN) portfolios, in which pairs trading is included, are well-diversified in terms of factor loadings (hence the market neutrality).

¹¹ This is similar to D'Avolio (2002) that argues that specials have minimal effect of large stocks.

¹² Market friction is defined as any costs or restraints to a transaction. Engelberg *et al.* (2009) have placed attention into information costs: institutional ownership, analyst's coverage and liquidity of the shares.

the market frictions and the differences in pairwise information diffusion rates. In sum, companies with lower institutional ownership, analyst's coverage and liquidity of shares (thus with higher market frictions) tend to have a more prevalent lead-lag relationship such that when there is a common (industry) information shock they react with a lag. Investors can take advantage of this phenomenon by combining in a pair two stocks with different time-reactions and by filtering company-specific from industry-specific news.

Another important factor in the literature seems to be the liquidity provision of pairs trading. Andrade *et al.* (2005) affirm that profits come from uninformed market orders. The uninformed buying (or selling) orders causes prices to diverge away from fundamentals. Optimizing investors¹³ accommodate this and make a profit when prices mean-revert/converge to fundamentals. Hence the returns are a compensation for the provision of liquidity by the pairs trading (or optimizing) investors. In addition, Engelberg *et al.* (2009), Do (2011), Beckman & Riboe (2013) and Bowen & Hutchinson (2013) argue that liquidity provision plays an important part in explaining pairs trading profits. Do (2011) combine Pastor and Stambaugh's liquidity factor with pairs trading returns and conclude that liquidity is negatively correlated with returns. This is consistent with Avramov and Chordia (2006) that identify the strongest reversal for illiquid stocks. Engelberg *et al.* (2009) also demonstrate that the *level* of liquidity has a persistent negative effect on profits¹⁴ and that a *positive change* in liquidity has a temporary negative effect (only impacts pairs that are closed 10 days after the opening). In other words, if a stock becomes less liquid in the short-run profits increase and the

¹³ Jegadeesh & Titman (1995) name them "disciplined investors" rather than "optimizing investors".

¹⁴ "Pairs from the most illiquid tercile outperform those from the most liquid tercile by 70 - 80 basis points per month (...)The effect is stronger among pairs with smaller average market capitalization." (Engelberg *et al.* 2009).

less liquid stocks return higher profits in the long-run. From this evidence, one might see pairs trading as a reward for providing immediate liquidity on the market¹⁵.

In summary, pairs trading profits do not depend on common factors. The literature identifies three significant factors: type of market news (idiosyncratic or systemic); lead-lag relationships and liquidity provision. When company-specific news is released profits decrease, on average, as it is more likely the divergence is permanent and fundamental. However, for industry-news (news that tend to impact both stocks in the same way) profits increase if there is a lead-lag relationship on their price reaction¹⁶. For more illiquid stocks and in the case of a negative liquidity shock, returns seem to be higher – one possible interpretation is that investors are compensated for providing liquidity in a situation when the market is retracting.

III. Data and Methodology of the Model

This chapter introduces the methodology and main data used in this work project. The first subchapter presents the sample selection, data sources and statistical software. The second subchapter describes the methodology and model used, namely the methods to form the pairs (*pairs formation*) and the set of statistical criteria to filter the best pairs trading investment opportunities (*pairs trading*).

¹⁵ Or as Beckman & Riboe (2013) have put it: “pairs trading may (...) be thought of as a way of quantifying the costs of maintaining relative prices in markets with funding frictions.”

¹⁶ This lead-lag effect is larger for illiquid stocks thus both factors (liquidity and market news) are related.

a) Data Sample and Software considerations

The sample of this work project comprises all stocks of the Euro STOXX Index (Bloomberg Ticker “SXXE”). This index is a subset of the STOXX Europe 600 Index (“SXXP”) and contains 293 stocks in total, ranging from small, mid and large companies (approximately 100 of each) of twelve Euro Zone countries¹⁷. The stocks were grouped according to the Industry Classification Benchmark (ICB)¹⁸, similarly to other Internal Models of the Equities Desk at Montepio.

The model uses daily *closing* stock prices (excluding weekends and holidays, when markets were closed in Europe) for the last one-year period. A dynamic time period, that updates automatically the data inputs until the most recent working day, has the advantage of not being obsolete, including the impact of market news, and allows the Equities desk to use it on a later stage. For the purpose of this work project, the time period considered is a static one ranging from 15 April of 2013 until 15 April of 2014 (the equivalent to 256 working days¹⁹). This totals a sample size of 75008 observations. To avoid a selection bias on the time period, the author decided to stick with the one when the empirical work started. The choice of a 12-month time period for the pairs formation seems a reasonable time span for short to medium-term investments, avoids seasonality issues and follows the methodology used in the literature that consider a 12-month time period for pairs formation and a 6-month for pairs trading (GGR 1999 &

¹⁷ The full description of the Euro STOXX Index can be seen in [3] in Appendix B, including the 293 stocks.

¹⁸ The ICB has a four-tier, hierarchical industry-classification structure, using a system of 10 industries, partitioned into 19 super-sectors, which are further divided into 41 sectors, which in turn contain 114 subsectors. The principal aim of the ICB is to categorize individual companies into subsectors based primarily on each company’s major source of revenue. The ICB is adopted by stock exchanges representing over 65% of the world’s market capitalization. The ICB competes with the Global Industry Classification Standard (GICS) for equities and is developed by Dow Jones and FTSE.

¹⁹ For the missing values (i.e. days where European markets were open but for some reason a particular stock was not traded) they were assumed as such by Excel.

2006, Andrade *et al.* 2005, Papadakis & Wysocki 2007, Perlin 2007 & 2009, Do & Faff 2010, Broussard & Vaihekoski 2012, Bowen & Hutchinson 2013)²⁰.

The data comes from Bloomberg database, including stock prices, tickers, financial and statistical indicators. The statistical software used for modeling and analysis was Microsoft Excel 2010. The reasons for this are that Excel is one of the most frequently used softwares in the Equities desk and enables Bloomberg add-ins and commands to be directly integrated into the model. The drawbacks of this choice are mainly the limitations in the workable sample size. A total of 75008 observations is already quite considerable and heavy for data analysis on Excel. This constraint was the major reason for using the Euro STOXX rather than the broader STOXX Europe 600 and not combining US and European stocks all together.

In order to increase its flexibility, the model was built in a way that easily enables its application to other stock market indexes and time periods.

b) Methodology and Model

As mentioned previously, a pairs trading strategy can be divided into two parts. The first is related with the identification of the pairs (*pairs formation*) and the second with the trading of those same pairs (*pairs trading*).

i. Pairs Formation methods

This first stage attempts to find the “best matches” of stocks. The matching process can be done using three possible statistical methods (Do *et al.* 2006):

²⁰ Despite no evidence of the optimal formation period, Huck (2013) demonstrate that pairs trading returns are highly sensitive to changes in the length of the formation period. We come back to this in the Conclusions section.

- The *distance* method – pairs are formed taking into account the co-movement of price series, measured by the sum of squared differences (SSD) between the two stocks' returns²¹. Pairs are selected by choosing, for each stock, a matching partner that minimizes this sum of squared differences. This method is used in GGR (2006)²².
- The *cointegration* method – explores the possibility of pairs having a cointegration relationship (Engle and Granger 1987). Cointegration is verified when a linear combination between both stock prices can produce a time series that is stationary. This indicates that the pair has a long-run equilibrium (so that divergences will be compensated with mean-reversion). The main literary reference for this method is Vidyamurthy (2004).
- The *stochastic spread* method – tests whether the mean-reversion behavior of the spread follows an Ornstein–Uhlenbeck process, a continuous time setting in which the spread is driven by a latent state variable. The spread is the difference between the logarithms of prices. This method was introduced by Elliott *et al.* (2005) and further discussed by Do *et al.* (2006).

Each method has its own pros and cons. The *distance* method is model-free and thus not subject to model mis-specifications. On the other hand, being non-parametric means the strategy lacks forecasting capacity on the convergence time or expected holding period, it does not take into account non-linearity and it assumes that the price level

²¹ $SSD_{i,j} = \sum_{t=1}^T (p_{i,t}^* - p_{j,t}^*)^2$, where $i \neq j$, T is the number of days of the formation period and $p_{i,t}^*$ and $p_{j,t}^*$ are normalized prices at time t for stock i and j , respectively, defined as:
 $p_{x,t}^* = \frac{P_{x,t} - P_{x,baseyear}}{P_{x,baseyear}}$, where $x = i, j$

²² Please see Table 3 for a discrimination of the statistical methods used in relevant studies.

distance is static throughout time. This last feature only holds for pairs whose risk-return profile is very similar (Do *et al.* 2006). The *cointegration* method is able to produce forecasts as it is parametric and returns stationary time series. However, if variables are not cointegrated this leads to spurious estimators making mean-reversion analysis on the spread unreliable. Finally, the stochastic spread method, due to its continuous time setting, has strong forecasting reliability and its parameters are tractable. The drawback is that the model restricts the long-run relationship between the two stocks to one of return parity (similar to the distance method where the two stocks must provide the same risk-return profile). Therefore any deviation from this state in the short-term has to be corrected in the long-term.

In this project the preferred statistical approach was the distance method. The reason for this was the short to medium-term time horizon of the Equities Desk for pairs trading investments. In a cointegration relationship it might take a considerable time span before reaching its long-run equilibrium, therefore potentially creating a mismatch between the desired holding period and the actual time period needed for the convergence²³. As John Maynard Keynes stated, “the market can stay irrational longer than you can stay solvent”. Moreover, the model is not a forecasting one which diminishes the benefits of a stochastic spread. The simplicity and ease of interpretation for the distance method further contributed to this decision.

The authors used as distance measure the (Pearson) Correlation coefficient. Maximizing a correlation is equivalent to minimizing a SSD, when variables are suitably normalized (Duda & Hart 1973). In order to avoid spurious results, the daily

²³ The investment professionals at Montepio had also shown preference for a simple distance measure due to its simplicity and practicable computation.

price returns²⁴ were calculated for each of the stocks. By first-differencing prices we were able to get stationary time series.

A Correlation Table was then computed, displaying the correlation coefficient²⁵ for every possible pair. Due to high number of combinations (${}^{293}C_2 = 42778$) the authors abstained from attaching the correlation table. Almost all pairs (99,21%) have positive correlation in returns ranging from -0,59 to 0,93 with mean 0,26. The top 200 pairs were ranked (i.e. the top 200 pairs that exhibited a larger correlation coefficient) as all of them were statistically significant for a 1% significance level²⁶. The top pairs identified seem reasonable with Heineken Holding vs Heineken at the top, followed by Banco Santander vs Banco Bilbao Vizcaya Argentaria (BBVA), Volkswagen vs Porsche, LVMH vs Christian Dior and Société Générale vs BNP Paribas. Pairs seem to share the same industry and geography, although the closeness for the top pair might come from institutional ownership as Heineken Holding holds 50% of Heineken's shares outstanding. The list of total top 200 pairs can be seen in [4] of Appendix B.

The pairs were grouped by supersector (Figure 5) with Banks having a significant weight of almost 30% (no. of pairs: 59), Insurance 7% (14) and Automobiles and Parts 8.5% (17). Mixed pairs – pairs with companies from different super sectors – account for 44% of all pairs (87). For the most correlated pairs (top 100 and top 20)

²⁴ Returns at time t for stock i are defined as: $returns_{i,t} = \frac{p_{i,t} - p_{i,t-1}}{p_{i,t-1}}$

²⁵ The correlation coefficient (r) for stock i and l is defined as $r = \frac{cov(p_i, p_l)}{\sigma_i \sigma_l}$, where σ are the standard deviations for both stock i and l , respectively. Notice that coefficient of determination (R-squared) is the square of the correlation coefficient. This implies that a maximization of the correlation coefficient corresponds to a maximization of the R-squared.

²⁶ The t-statistic for the correlation coefficient is given as $t = r \sqrt{\frac{n-2}{1-r^2}}$ where the null hypothesis states the correlation coefficient equals zero and the alternative states a difference from zero (two-tailed test).

Banks gain even more relevance with 44% and 45% weight, respectively, whereas Mixed pairs account for 37% and 35%.

ii. Pairs Trading Criteria

When implementing this strategy, most of the papers do it in a mechanical manner, just taking into consideration statistical and econometric indicators. If a pair diverges two SD a trading position is triggered automatically²⁷, without considering its reliability (e.g. are both stocks in anyway related? For example, are they in the same industry?) or company-fundamentals.

To distinguish the profitable from the non-profitable (permanent divergent) pairs, the authors improved the model with relevant statistical criteria mentioned in the literature. The goal is to filter the best pairs identified by the model. In order to strengthen the investment recommendations, a further step would be to conduct fundamental analysis on the pairs and understand if the divergence is justified and if mean-reversion is likely. This analysis is not considered in this report though it is being performed as part of the internship.

1. Statistical Criteria and Model Improvements

The first pairs trading criteria²⁸ aims to detect any mispricings on the market. A mispricing corresponds to a divergence in a pair. To spot this, the model calculated the Bollinger Bands for the spread – this is the *average of the spread* for each pair plus and minus a given number of *standard deviations of the spread* on the last year. This follows the literature papers on distance method (GGR 2006, Hong & Susmel 2003,

²⁷ Not all papers proceed in this mechanical way. For instances, Yu (2012) trade pairs based on analysts' recommendations rather than divergences.

²⁸ We refer to criteria or improvements. For model purposes they have the same meaning.

Andrade *et al.* 2005, Papadakis & Wysocki 2007, Engelberg *et al.* 2009, Do & Faff 2010; 2012).

Bollinger Band: $avg_spread_{1y} \pm N * SD_spread_{1y}$, where N equals 1, 2 and 3 in order to rank the pairs according to whether they are two or three standard-deviations away from historical mean spread. Usually the Bollinger Band has two SD.

The spread is calculated as the difference between the logarithms of prices to ensure consistency in the spreads regardless of the price level²⁹. The *current* spread, i.e. using prices of the last close, was then compared with the Bollinger Bands. If it was within the range the pair is considered *IN_LINE*. Otherwise it is classified as *DIVERGENT*. The latter pairs are the interesting ones. The task of the authors is to grasp whether this divergence is justified by fundamentals or not. The sample contained 46 pairs (out of the top 200) which were at least two SD divergent. From these, 13 were three SD away. Although the model is dynamic in nature (i.e. updates data every day from the last trading day), for the purpose of this work project the last closing prices used were the ones of the 26th of May 2014 (last day prior to the writing of this report).

After divergence, the concern was *homogeneity* in the pair. GGR (2006) prove that pairs in the same industry show larger returns (mainly financials and industrials). Do (2009) show that the tinier the sectorial proximity between both stocks the more profitable that pair is to trade. Hence the first filter to apply was sub-sector similarity (the tiniest one on ICB). At first glance, for the most divergent pairs (3SD away) and slight divergent ones (2SD away) only 4 out of 13 and 13 out of 46 showed this feature,

²⁹ To see this, imagine stocks A and B both return r in a given time period so that $p_{t+1}^A = p_t^A e^r$ and $p_{t+1}^B = p_t^B e^r$. The log difference at time $t+1$ is: $\log(p_{t+1}^A) - \log(p_{t+1}^B) = (\log(p_t^A) + r) - (\log(p_t^B) + r) = \log(p_t^A) - \log(p_t^B)$

respectively. The possibility of stocks, despite not being in the same sector, having strategic interest on each other (v.g. supplier-customer relationship) was also contemplated but without any findings. A criterion of *geographical proximity* was also applied to get pairs exposed to the same macroeconomic factors. We present the identified pairs which are divergent and belong to the same industry and geography (*tradable pairs*) on Table 4 (see next section for discussion). The graphs of the divergence for each pair can be seen on [4] of Appendix B.

The third statistical indicator considered was the *zero cross of the spread*. It is defined as the number of times a given pair has diverged and subsequently came close or crossed zero in the last year (mean-reversion behavior). This feature signals the strength of the mean-reversion behavior for that particular pair. It was firstly introduced by Do (2009) as they noticed that the probability of convergence was higher for pairs that had shown more zero crosses in the past³⁰. This component is seen as a crucial one because it represents the time-series closeness of a pair, whereas the correlation coefficient is the cross-section closeness (Do 2009).

The fourth statistical metric was the *average crossing period*. This indicates the number of time periods a pair stays out of equilibrium. The lower it is the stronger is the attraction to the mean, thus the more reliable a pair is. Both the zero cross and the average crossing period have come from a Pairs Trading Backtesting spreadsheet available on Bloomberg Excel Template library (BB command “XLTP”, XPTD.xls).

³⁰ The zero cross can also be seen as a complementary indicator to the correlation coefficient. As Do & Faff (2011) noted, just by looking at the closeness of two stocks we incur in a paradox. We are looking for the closest pairs in the past and expecting that they are the ones with the highest probability of drifting and then converging in the future.

Finally, tradable pairs undertook a Backtesting analysis for different time spans (12 and 24 month periods³¹) to have a picture of its past behavior and profit potential, using the same Bloomberg spreadsheet mentioned previously.

We also analyzed volume shocks as a criterion to filter the best pairs, similar to Engelberg (2009) and Almeida (2011), although no significant conclusions were found.

IV. Findings and Discussion of the Results

The industry homogeneity criteria screened the number of pairs to 13. They can be divided into four groups: Spanish (1), French³² (4) and Italian banks (3) and Other sectors (5). This discrimination ensures proper comparisons. The list of these pairs (*tradable pairs*) can be seen in Table 4.

The pairs in the banking sector have strong correlation (top 38, with a coefficient of correlation above 70.5%) whereas other sectors have a weaker relationship (highest pair is 95th in correlation terms). The exception is Volkswagen and Porsche Holding as the latter owns 50.7% of Volkswagen's common stock (top 3 pair). In terms of divergence, banks present greater divergence with 3 out of 8 pairs being three SD away. For other sectors, only 1 pair out of 5 has a deviation of 3 SD (Telefonica vs Orange). These two factors (low correlation for other sectors and small divergence), together with the limit of pages, have pushed this work to focus on pairs for the banking sector. These results corroborate Engelberg *et al.* (2009) whose traded pairs tend to concentrate in a

³¹ A time period of 6 months was also analyzed although the backtesting results have not changed compared to the 12 month period.

³² To be rigorous, this group should be name French and Belgian banks as it includes KBC which is a Belgian bank. For simplicity we decided to call it French banks.

few industries (for example 44% of traded pairs are Financials). From Table 4, we detected one contradictory indication: sell KBC vs BNP and buy KBC vs Credit Agricole. Indeed it seems that KBC is cheap in relation to Credit Agricole but expensive in relation to BNP. For investment purposes, however, we decided to exclude KBC from trading.

A ranking of the pairs was constructed, in which a score is assigned to each pair. The higher the score the better it is to invest in that pair. The score was computed by rescaling³³ each statistical criterion between 0 and 1 and setting them in relative terms to the other tradable pairs. Each criterion was equally weighted³⁴. To support this ranking table, a Backtesting analysis was conducted for two time periods (12 and 24 months). The variables of interest are total P&L and maximum loss and gain of any trade, to assess the volatility of the pair. Results are shown in Table 6 (score for the statistical criteria) and Table 7 (results of the backtests). Table 8 presents a combination of both tables including a *final score*, which is a simple equally weighted average of the score for statistical indicators and backtesting results.

The model suggests the best pair to trade on the market is BNP (long) vs Credit Agricole (short). This pair was the top performer in statistical terms and had shown the lowest average maximum loss in the last 24 month period. It is strongly correlated and is 27,1% away from its historical average (the largest potential upside). On backtesting, it had the maximum gain, which was partially compensated by having the lowest maximum loss, indicating a relatively controlled risk. The pair Societe Generale (long)

³³ The rescaling formula for pair i and statistic s is given by: $score_{i,s} = \frac{[value_{i,s} - \min(value_s)] * (1-0)}{[\max(value_s) - \min(value_s)] + 0}$, where $value_s$ is the minimum (or maximum) value of statistic s .

³⁴ Albeit the literature mentions strategy improvements (that result in higher returns) there are no references to which criteria is more favorable. That's why we assumed an equal weight to each of them.

vs Credit Agricole (short), despite having a relative strong performance on statistical scoring (0,745 above average of 0,604), had the worst backtesting result (with the second lowest profit, including a negative performance on the last 12 month, and the biggest downside, which contrarily to BNP vs Credit Agricole did not compensate with a large maximum gain).

Santander (short) vs BBVA (long) was penalized by the small number of zero crosses, high average crossing periods and low potential upside (the pair is only 7,2% divergent). A positive aspect of this pair is its high correlation (top 2) in the past year.

Regarding the Italian banks, Mediobanca (long) vs Intesa Sanpaolo (short) is the top pick due to its consistency on both the statistical scoring as well as in the backtesting, achieving the highest number of zero crosses last year and the highest profits. It also suggests trading Unicredit (long) vs Intesa Sanpaolo (short) meaning that the latter seems to be overvalued in relation to its Italian peers. Less consistent is Banca Popolare di Milano (short) vs Banca Popolare dell'Emilia Romagna with the highest score on backtesting (largest maximum gain and strong profits) although it performs poorly in statistical terms (lowest correlation and number of zero crosses. These two statistics correspond to a weak mean-reversion behavior). A summary of the positives and negatives for each pair is shown in [5] of Appendix B.

V. Conclusions and Future Work

As part of a direct internship at Montepio, in the Treasury and Trading Department, Equities Desk, this work is a practical application of a pairs trading strategy. This investment strategy consists on identifying a pair of stocks that have

historically moved together and that are currently mispriced (divergent from its historical mean). Assuming a mean-reversion behavior in the pair, investors open a long position on the undervalued stock and a short position on the overvalued one. Thus, this study has the objective of identifying potentially profitable pairs of stocks trading on the European equity markets. In other words, mispriced pairs and that have the potential to mean-revert. To achieve this, the paper starts with a comprehensive literature review on pairs trading using its main strategy improvements to define a set of statistical criteria that filter the best pairs. Out of the 200 most correlated pairs, from which 46 were divergent/mispriced at least 2 standard-deviations, only 6 were selected given its industry homogeneity. Deliberately, as roughly 70% of tradable pairs are banks, the authors decided to focus on the banking sector. Finally, a ranking of the statistical criteria is presented where we assign a score to each pair. The same was done to the backtesting results. We conclude with a discussion of the results from the model, pointing out the positive and negative aspects of each pair.

In terms of future work, a fundamental analysis is required to strengthen the model conclusions. This is essential to understand what caused the divergence in the first place. Secondly, some stocks are present in more than one recommended pair (v.g Credit Agricole). This suggests that a trio or even quadruple approach can be undertaken, weighting the stocks by their correlation coefficients in a similar way as the multivariate approach of Perlin (2007). Finally, Huck (2013) found that pairs trading performance is highly sensitive to the pair formation period length. One should calculate the optimal time period of pairs formation to enrich the model.

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Appendix I

Figure 1: Organogram of Montepio's Trading and Treasury Department

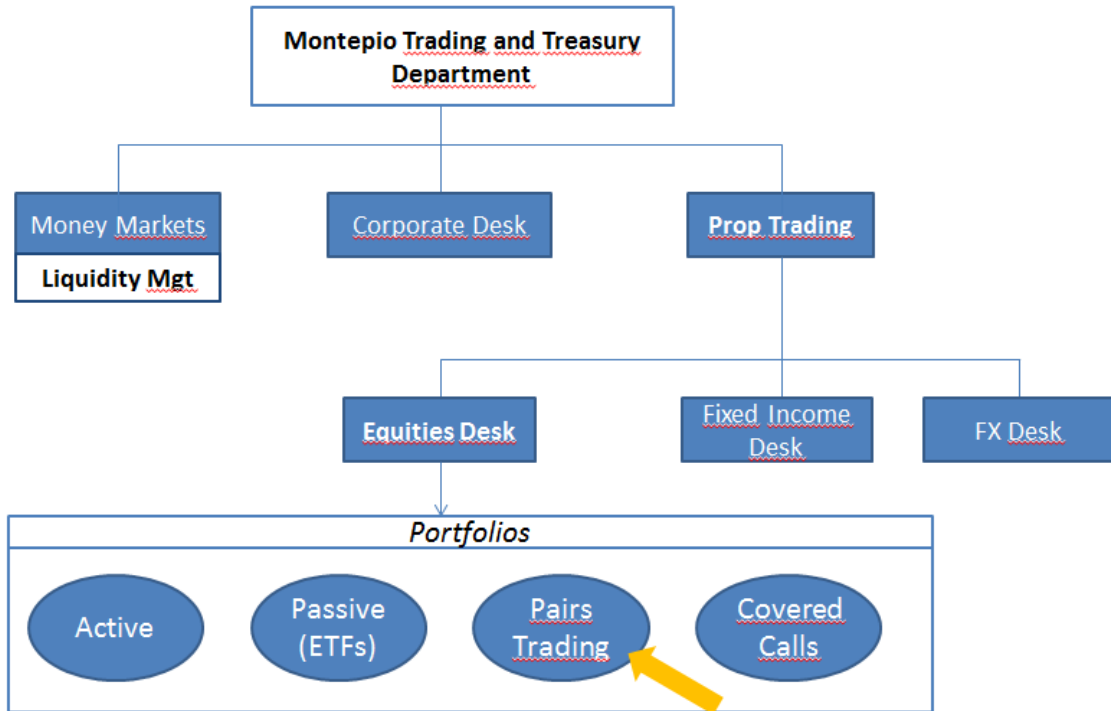


Figure 2: Pair Trading of Kennecott vs Uniroyal. *Source: GGR (2006)*

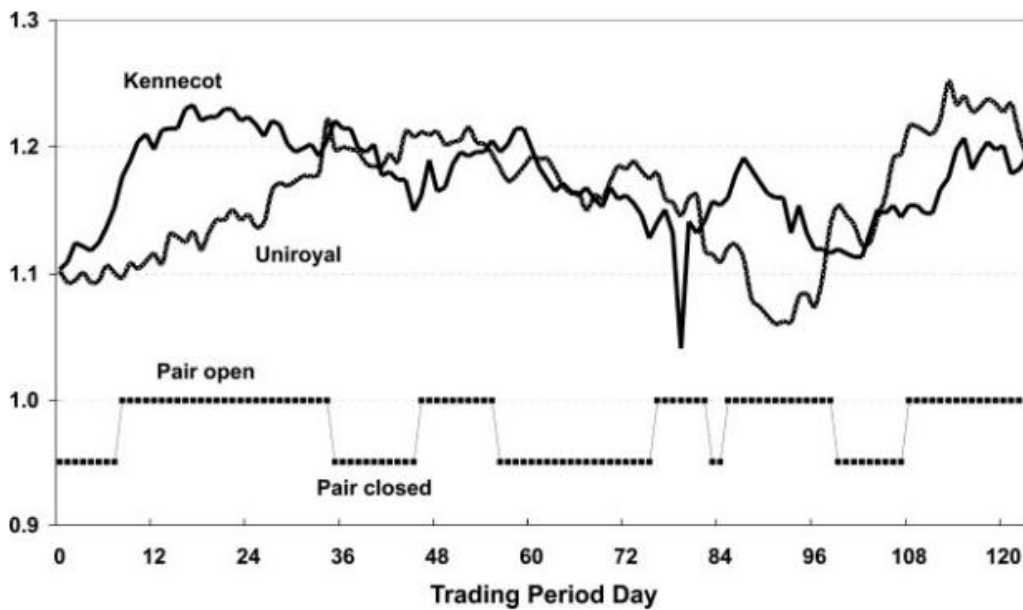


Figure 1
Daily normalized prices: Kennecott and Uniroyal (pair 5)
Trading period August 1963–January 1964.

Figure 3: GGR (2006)'s mean excess returns and sharpe ratios for Pairs Trading and S&P500. *Source: GGR (2006)*

Table 4
Systematic risk of pairs trading strategies

	Top 5	Top 20	20 after top 100	All	Equity premium
"Wait one day" portfolio performance					
Mean excess return	0.00745	0.00895	0.00795	0.00715	0.00410
Standard deviation	0.02101	0.01527	0.01438	0.01577	0.04509
Sharpe Ratio	0.35	0.59	0.55	0.45	0.09
Monthly serial correlation	0.14	0.24	0.19	0.12	0.05
Factor model: Fama-French, Momentum, Reversal					
Intercept	0.00545 (3.81)	0.00764 (7.08)	0.00714 (8.66)	0.00512 (5.30)	
Market	-0.06661 (-1.03)	-0.03155 (-0.64)	-0.07697 (-1.77)	-0.14520 (-3.10)	
SMB	-0.04233 (-0.71)	0.00111 (0.02)	-0.02333 (-0.50)	-0.07079 (-1.66)	
HML	0.05740 (1.37)	0.04514 (1.45)	-0.01724 (-0.59)	-0.05403 (-1.82)	
Momentum	-0.02804 (-0.94)	-0.04817 (-2.45)	-0.10312 (-5.83)	-0.18077 (-8.50)	
Reversal	0.10192 (1.50)	0.07237 (1.27)	0.09459 (2.24)	0.20077 (4.34)	
R ²	0.05	0.09	0.18	0.54	
Factor model: Ibbotson factors					
Intercept	0.00716 (6.32)	0.00857 (9.25)	0.00766 (9.39)	0.00651 (7.77)	
Market	-0.00182 (-0.07)	0.01377 (0.74)	0.01642 (0.90)	0.06466 (1.98)	
Small stock premium	0.04120 (1.32)	0.05227 (2.22)	0.03646 (1.66)	0.07608 (1.93)	
Bond default premium	0.14593 (1.11)	0.15989 (1.38)	0.16811 (1.81)	0.30571 (2.82)	
Bond horizon premium	0.07997 (1.55)	0.06818 (1.64)	0.04034 (1.04)	0.03422 (0.77)	
R ²	0.02	0.05	0.04	0.15	

Monthly risk exposures for portfolios of pairs formed and traded according to the "wait one day" rule discussed in the text, over the period between June 1963 and December 2002. The five factors are the three Fama-French factors, Carhart's Momentum factor, and the Reversal factor discussed in the text. Returns for the portfolios are in excess of the riskless rate. S&P 500 returns are calculated in excess of Treasury bill returns. The Ibbotson factors are from the Ibbotson EnCorr analyzer: The U.S. Small stock premium is the monthly geometric difference between small-company stock total returns and large-company stock total returns. U.S. bond default premium is the monthly geometric difference between total return to long-term corporate bonds and long-term government bonds. The U.S. bond horizon premium is the monthly geometric difference between investing in long-term government bonds and U.S. Treasury bills. The *t*-statistics are in parentheses next to the coefficients and are computed using Newey-West standard errors with six lags.

Figure 4: Pairs Trading Returns for pre-1989 and post-1988 periods. *Source: GGR(2006)*

Table 8
Subperiod analysis

Portfolio	Top 5	Top 20	20 after top 100	All	Factor SD
A. Pre-1989					
"Wait one day" portfolio performance					
Mean excess return	0.01034	0.01181	0.01052	0.00992	
Standard deviation	0.02259	0.01689	0.01527	0.01651	
Regression on Fama-French factors					
Intercept	0.00353	0.00670	0.00710	0.00446	
<i>t</i> -Statistic	1.72	4.41	6.54	4.19	
U.S. equity risk-premium	-0.43395	-0.31200	-0.28946	-0.43429	0.04580
<i>t</i> -Statistic	-4.29	-3.57	-3.80	-7.26	
SMB: small minus big	-0.44181	-0.33193	-0.27508	-0.40184	0.02923
<i>t</i> -Statistic	-3.75	-2.86	-2.86	-5.76	
HML: high minus low book to market	0.03568	0.03162	-0.06840	-0.06983	0.02597
<i>t</i> -Statistic	0.64	0.73	-1.84	-1.97	
Momentum	0.01291	-0.01630	-0.07689	-0.15848	0.03506
<i>t</i> -Statistic	0.29	-0.50	-2.92	-5.01	
Reversal	0.43575	0.33274	0.28765	0.45222	0.07228
<i>t</i> -Statistic	4.44	3.62	4.05	7.98	
R ²	0.19	0.23	0.26	0.70	
B. Post-1988					
"Wait one day" portfolio performance					
Mean excess return	0.00217	0.00375	0.00327	0.00212	
Standard deviation	0.01660	0.00987	0.01121	0.01295	
Regression on Fama-French factors					
Intercept	0.00337	0.00417	0.00363	-0.00065	
<i>t</i> -Statistic	2.12	3.77	3.01	-0.56	
U.S. equity risk-premium	0.07339	0.04804	0.00241	-0.06958	0.04390
<i>t</i> -Statistic	1.68	1.81	0.06	-2.43	
SMB: small minus big	-0.00400	0.02888	0.02332	-0.06063	0.03856
<i>t</i> -Statistic	-0.10	1.32	0.69	-2.83	
HML: high minus low book to market	0.03441	0.01412	0.01830	-0.08202	0.03641
<i>t</i> -Statistic	0.61	0.45	0.50	-2.65	
Momentum	-0.00424	-0.02266	-0.08840	-0.12670	0.04926
<i>t</i> -Statistic	-0.13	-1.29	-4.17	-7.59	
Reversal	-0.06259	-0.01727	0.02404	0.18808	0.04448
<i>t</i> -Statistic	-1.76	-0.67	0.54	5.56	
R ²	0.02	0.04	0.19	0.64	

Monthly risk profile for portfolios of pairs formed and traded according to the "wait one day" rule discussed in the text, over the two subperiods between July 1963 and December 1988 (Panel A) and between January 1989 and December 2002 (Panel B). The "top *n*" portfolios include the *n* pairs with least distance measures, and the portfolio "20 after top 100" includes the 20 pairs after the top 100 pairs. The average number of pairs in the all-pair portfolio is 2057. The *t*-statistics are computed using Newey-West correction with six lags for the standard errors.

Table 1: Comparison Table of the estimated Returns of Pairs Trading across several studies

Study	Region and Time Period	Mean Returns³⁵
Hong & Susmel (2003)	Dual-listed Asian shares 1991-2000	8.5%/y (3m); 33.8%/y (6m holding period)
Andrade <i>et al.</i> (2005)	Taiwan 1994 – 2002	10.18%/y
GGR (2006)	US 1962 - 2002	0.715%/m (all pairs) or 8.9%/y
Perlin (2007)	Brazil 2000-06	54.58%/y (trading in monthly frequency and <i>d</i> equals 3.0)
Do & Faff (2009)	US 1962-2008	0.58%/m (all pairs) or 7.2%/y
Broussard (2012)	Finland 1987-2008	0.834%/m or 10.5%/y (top 5 pairs)
Bowen (2013)	UK 1980-2012	8.1%/y (top 5 pairs with transaction costs)
Caldeira (2013)	Brazil 2005-2012	16.38%/y

Table 2: Comparison of the transaction costs between relevant studies

Note: N/A (do not include transaction costs); * (average between 1963-2002); ** (average between 1963-2009); *** (transaction costs were used but not presented in the study)

Studies	Transaction cost (per trade)
Hong & Susmel (2003)	N/A
Vidyamurthy (2004)	N/A
Elliott <i>et al.</i> (2005)	N/A
Andrade <i>et al.</i> (2005)	N/A
GGR (2006)	0.405%*
Papadakis & Wysocki (2007)	N/A
Engelberg <i>et al.</i> (2009)	N/A
Perlin (2007; 2009)	0.1%; 0.1%
Bolgün <i>et al.</i> (2009)	0.21%
Chan (2009)	0.05%
Huck (2010)	***
Do & Faff (2010; 2012)	N/A; 0.34%**
Caldeira & Moura (2012; 2013)	0.25%; 0.25%

³⁵ The profitability concerns all pairs in a portfolio (unless otherwise stated) of a value-weighted and fully invested portfolio. To avoid the bid-ask bounce we use the returns for the portfolios that wait one day before trading, as in GGR 2006.

Table 3: Comparison of the methodologies used across Pairs Trading studies

Method	Studies
Distance method	GGR (1999; 2006) Hong & Susmel (2003) Andrade <i>et al.</i> (2005) Papadakis & Wysocki (2007) Engelberg <i>et al.</i> (2009) Perlin (2007; 2009) Bolgün <i>et al.</i> (2009) Huck (2010) Do & Faff (2010; 2012)
Cointegration method	Vidyamurthy (2004) Chan (2009) Caldeira & Moura (2012; 2013) Hanson & Hall (2012)
Stochastic spread method	Elliott <i>et al.</i> (2005) Do <i>et al.</i> (2006)

Figure 5: Top 200 Pairs grouped by Super sector (ICB Classification)

% Pairs by Supersector (ICB)

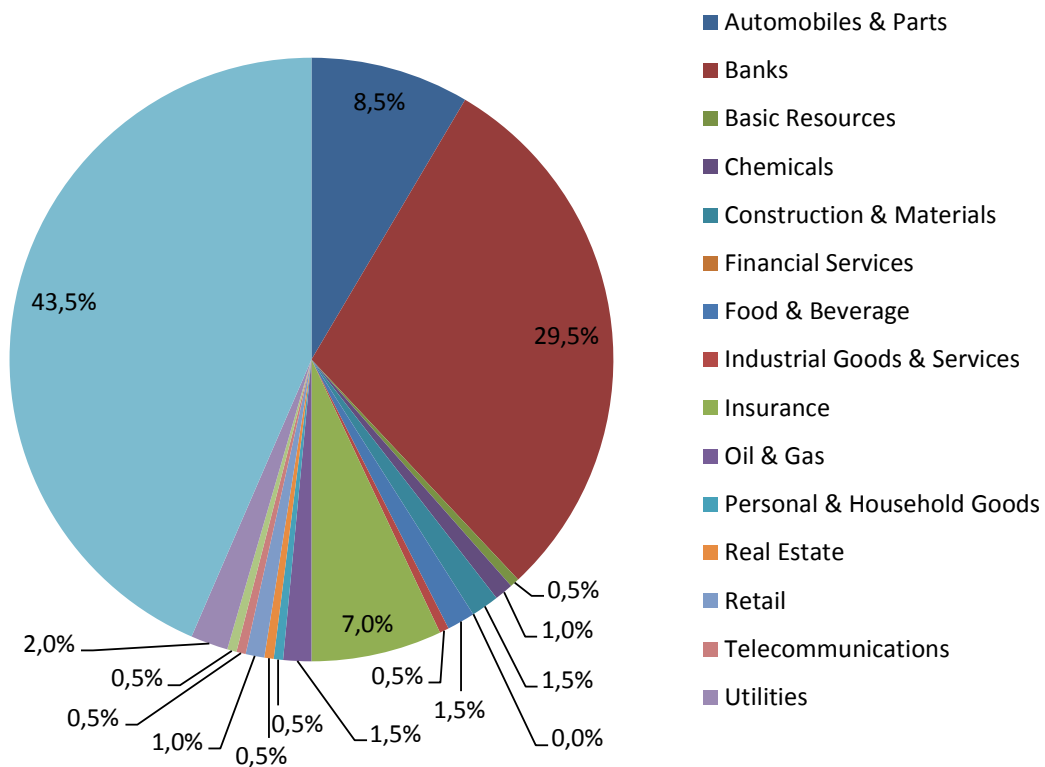


Table 4: List of Divergent Pairs within the same subsector (*tradable pairs*)

Top	STOCK 1 BB TICKET	STOCK 1 NAME	STOCK 2 BB TICKET	STOCK 2 NAME	Actual Spread	Avg Spread	Div	Positions	Zero Cross	Avg Crossing period	Potential Upside	CLASSIFIC ATION
2	SAN SQ Equity	BANCO SANTANDER SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA	-0,22	-0,291	2SD	SHORT/LONG	17	15	7,2%	SPANISH BANKS
3	VOW3 GY Equity	VOLKSWAGEN AG- PREF	PAH3 GY Equity	PORSCHE AUTOMOBIL HLDG- PRF	0,89	0,967	2SD	LONG/SHORT	28	6	7,4%	OTHER SECTOR
6	GLE FP Equity	SOCIETE GENERALE SA	ACA FP Equity	CREDIT AGRICOLE SA	1,29	1,456	2SD	LONG/SHORT	20	10	15,7%	FRENCH BANKS
7	UCG IM Equity	UNICREDIT SPA	ISP IM Equity	INTESA SANPAOLO	0,94	1,068	2SD	LONG/SHORT	22	11	11,9%	ITALIAN BANKS
14	BNP FP Equity	BNP PARIBAS	ACA FP Equity	CREDIT AGRICOLE SA	1,5	1,778	3SD	LONG/SHORT	22	10	27,1%	FRENCH BANKS
20	KBC BB Equity	KBC GROEP NV	BNP FP Equity	BNP PARIBAS	-0,22	-0,320	2SD	SHORT/LONG	45	6	9,5%	FRENCH BANKS
33	KBC BB Equity	KBC GROEP NV	ACA FP Equity	CREDIT AGRICOLE SA	1,28	1,458	3SD	LONG/SHORT	38	6	17,7%	FRENCH BANKS
38	MB IM Equity	MEDIOBANCA SPA	ISP IM Equity	INTESA SANPAOLO	1,074	1,233	3SD	LONG/SHORT	24	10	15,9%	ITALIAN BANKS
81	PMI IM Equity	BANCA POPOLARE DI MILANO	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA	-2,518	-2,75	2SD	SHORT/LONG	15	16	23,2%	ITALIAN BANKS
95	FP FP Equity	TOTAL SA	ENI IM Equity	ENI SPA	1,016	0,887	2SD	SHORT/LONG	22	10	12,8%	OTHER SECTOR
99	TEF SQ Equity	TELEFONICA SA	ORA FP Equity	ORANGE	0,005	0,249	3SD	LONG/SHORT	22	10	24,4%	OTHER SECTOR
101	LG FP Equity	LAFARGE SA	HEI GY Equity	HEIDELBERGCEMENT AG	0,032	-0,08	2SD	SHORT/LONG	31	8	12,1%	OTHER SECTOR
104	REP SQ Equity	REPSOL SA	ENI IM Equity	ENI SPA	0,076	0,038	2SD	SHORT/LONG	22	10	3,9%	OTHER SECTOR

Table 5: Market friction factors for tradable pairs

<i>TOP</i>	<i>STOCK 1</i>	<i>STOCK 2</i>	<i>MARKET CAP 1</i>	<i>SIZE</i>	<i>INST OWNER 1 (%)</i>	<i>MARKET CAP 2</i>	<i>SIZE</i>	<i>INST OWNER 2 (%)</i>	<i>RATIO MKT CAPs (1/2)</i>
2	BANCO SANTANDER SA	BANCO BILBAO VIZCAYA ARGENTA	88.312.048.518,75	LARGE	17,81	55.362.934.548,84	LARGE	25,08	1,6
3	VOLKSWAGEN AG-PREF	PORSCHE AUTOMOBIL HLDG-PRF	90.302.035.027,45	LARGE	#N/A N/A	23.881.375.000,00	LARGE	#N/A N/A	3,78
6	SOCIETE GENERALE SA	CREDIT AGRICOLE SA	34.348.834.398,79	LARGE	46,57	29.768.920.964,30	LARGE	65,39	1,15
7	UNICREDIT SPA	INTESA SANPAOLO	37.011.000.000,00	LARGE	56,45	39.765.859.375,00	LARGE	54,42	0,93
14	BNP PARIBAS	CREDIT AGRICOLE SA	65.968.725.620,82	LARGE	40,72	29.768.920.964,30	LARGE	65,39	2,22
20	KBC GROEP NV	BNP PARIBAS	18.180.391.434,48	LARGE	59,04	65.968.725.620,82	LARGE	40,72	0,28
33	KBC GROEP NV	CREDIT AGRICOLE SA	18.180.391.434,48	LARGE	59,04	29.768.920.964,30	LARGE	65,39	0,61
38	MEDIOBANCA SPA	INTESA SANPAOLO	6.249.505.695,56	MID	32,37	39.765.859.375,00	LARGE	54,42	0,16
81	BANCA POPOLARE DI MILANO	BANCA POPOL EMILIA ROMAGNA	2.894.600.640,16	SMALL	21,13	2.710.680.664,06	SMALL	10,91	1,07
95	TOTAL SA	ENI SPA	123.281.969.173,71	LARGE	41,42	68.577.077.177,10	LARGE	52,59	1,8
99	TELEFONICA SA	ORANGE	55.545.255.072,13	LARGE	36,17	32.223.690.684,20	LARGE	56,98	1,72
101	LAFARGE SA	HEIDELBERGCEMENT AG	18.495.405.386,06	LARGE	60,71	11.953.367.101,97	LARGE	65,96	1,55
104	REPSOL SA	ENI SPA	27.066.484.868,70	LARGE	47,83	68.577.077.177,10	LARGE	52,59	0,39

<i>STATS</i>	<i>MARKET CAP</i>	<i>INST OWNER (%)</i>	<i>EURO STOXX LARGE</i>		<i>MID</i>		<i>SMALL</i>	
			<i>MARKET CAP</i>	<i>INST OWN</i>	<i>MARKET CAP</i>	<i>INST OWN</i>	<i>MARKET CAP</i>	<i>INST OWN</i>
AVERAGE	41.689.617.572,62	47,05	32,9 b €	47,93	8,38 b €	49,91	4,63 b €	48,56
MEDIAN	33.286.262.541,49	52,59	23,49 b €	48,33	7,03 b €	50,23	3,31 b €	47,01
MAXIMUM	123.281.969.173,71	65,96	129,17 b €	81,29	51,15 b €	96,51	29,8 b €	113,04
MINIMUM	2.710.680.664,06	10,91	7,18 b €	9,9	2,47 b €	3,11	1,41 b €	1,44

Table 6: Ranking of the tradable pairs (score is equally weighted by correlation, divergence, no. of zero crosses and average crossing period. Table is built in descending order of the total score. The higher the score, the higher the potential for a given pair)

<i>STOCK 1</i>	<i>STOCK 2</i>	<i>CORR COEF</i>	<i>SCORE</i>	<i>DIV</i>	<i>QUANTIFYING DIV (%)</i>	<i>SCORE</i>	<i>ZERO CROSS</i>	<i>SCORE</i>	<i>AVG CROSS PERIOD</i>	<i>SCORE</i>	<i>TOTAL SCORE</i>
BNP PARIBAS	CREDIT AGRICOLE SA	0,7631	0,85	3SD	27,1	1	22	0,78	10	1	0,906
MEDIOBANCA SPA	INTESA SANPAOLO	0,7056	0,54	3SD	15,9	0,44	24	1	10	1	0,745
SOCIETE GENERALE SA	CREDIT AGRICOLE SA	0,7967	0,95	2SD	15,7	0,43	20	0,55	10	1	0,733
UNICREDIT SPA	INTESA SANPAOLO	0,7962	0,94	2SD	11,9	0,24	22	0,78	11	0,83	0,696
BANCO SANTANDER SA	BANCO BILBAO VIZCAYA ARGENTA	0,8848	1	2SD	7,2	0	17	0,22	15	0,16	0,347
BANCA POPOLARE DI MILANO	BANCA POPOL EMILIA ROMAGNA	0,6646	0	2SD	23,2	0,80	15	0	16	0	0,201

Table 7: Results of the Backtests for tradable pairs (includes total P&L for the period, Maximum loss and gain in any trade. “Avg” is the mean value of each variable for the two time periods. Scores are based on this average).

<i>STOCK 1</i>	<i>STOCK 2</i>	<i>PERIOD (months)</i>	<i>P&L</i>	<i>Max LOSS</i>	<i>Max GAIN</i>	<i>SCORE P&L</i>	<i>SCORE Max LOSS</i>	<i>SCORE Max GAIN</i>	<i>TOTAL SCORE</i>
BANCA POPOLARE DI MILANO	BANCA POPOL EMILIA ROMAGNA	24	17217,1	-7566,7	14167,6				0,607
		12	14657,1	0,0	12812,1	0,667	0,155	1	
		Avg	15937,1	-3783,4	13489,8				
MEDIOBANCA SPA	INTESA SANPAOLO	24	26301,7	-8833,7	6200,1				0,398
		12	14228,2	-148,9	6200,1	1	0,022	0,174	
		Avg	20265,0	-4491,3	6200,1				
UNICREDIT SPA	INTESA SANPAOLO	24	17980,8	-3960,3	6643,8				0,382
		12	9535,3	-1173,6	5729,3	0,499	0,48	0,173	
		Avg	13758,1	-2567,0	6186,6				
BNP PARIBAS	CREDIT AGRICOLE SA	24	15790,3	-2730,8	8516,7	0	1	0	0,333

		12	-1226,9	-1226,9	808,1				
		Avg	7281,7	-1978,8	4662,4				
BANCO SANTANDER SA	BBVA	24	14447,5	-3578,1	10853,5				
		12	2827,3	-552,8	2360,4	0,104	0,662	0,220	0,328
		Avg	8637,4	-2065,4	6607,0				
SOCIETE GENERALE SA	CREDIT AGRICOLE SA	24	17959,1	-10505,0	10107,3				
		12	-417,6	-1038,7	988,8	0,115	0	0,100	0,071
		Avg	8770,7	-5771,8	5548,0				

Table 8: Final score (simple average of score for statistical criteria and score for backtesting).

STOCK 1	STOCK 2	SCORE STATS	SCORE BACKTEST	FINAL SCORE
BNP PARIBAS	CREDIT AGRICOLE SA	0,906	0,33	0,620
MEDIOBANCA SPA	INTESA SANPAOLO	0,745	0,398	0,572
UNICREDIT SPA	INTESA SANPAOLO	0,696	0,382	0,539
BANCA POPOLARE DI MILANO	BANCA POPOL EMILIA ROMAGNA	0,201	0,607	0,404
SOCIETE GENERALE SA	CREDIT AGRICOLE SA	0,733	0,07	0,402
BANCO SANTANDER SA	BANCO BILBAO VIZCAYA ARGENTA	0,347	0,328	0,338

Appendix II

[1] According to Jacobs *et al.* (1999), long/short equity strategies can be divided in:

1. **Market Neutral:** Long and short positions have equal market risk, offsetting each other.
 - a. Pairs trading: particular market neutral strategy associated with exploiting mispricings in a pair of securities (also referred as *statistical* or *relative value arbitrage*). According to Low (2009), pairs trading is statistical arbitrage whereas other Equity Market Neutral (EMN) approaches look for diversification in factor loadings.
2. **Equitized:** holds stocks long and short in equal dollar amount although it adds a permanent stock index futures overlay in an amount that equals the invested capital.
3. **Hedge:** holds stocks long and short although it adds a variable of equity market exposure based on a market outlook. For instances, it might have different dollar amounts or beta exposure.

[2] Descriptive stats, sector weights, facts and list of stocks of the Euro STOXX Index as of April 2014. *Source: STOXX Factsheet (April 2014)*

Index	Market Capitalization (EUR Bi)		Coverage of EURO STOXX TMI (%)	Components (EUR Bi)			
	Full	Free Float		Mean	Median	Largest	Smallest
Euro STOXX	4405,79	3246,05	93,49	11,08	4,7	122,35	1,17

Super_sectors	# of stocks	%	Mrk_Cap	Weight (%)	Industry	# of stocks	%	Mrk_Cap	Weight (%)
Automobiles & Parts	13	4,4%	330892,3	7,53%	Basic Materials	22	7,5%	374495,2	8,5%
Banks	29	9,9%	501292,4	11,41%	Consumer Goods	42	14,3%	1025532	23,3%
Basic Resources	7	2,4%	78654,38	1,79%	Consumer Services	36	12,3%	333490,1	7,6%
Chemicals	15	5,1%	295840,8	6,73%	Financials	63	21,5%	882457,8	20,1%
Construction & Materials	12	4,1%	127961,4	2,91%	Health Care	12	4,1%	223953,8	5,1%
Financial Services	7	2,4%	39339,53	0,90%	Industrials	58	19,8%	603708,5	13,7%
Food & Beverage	15	5,1%	384254,8	8,75%	Oil & Gas	11	3,8%	238074,1	5,4%
Health Care	12	4,1%	223953,8	5,10%	Technology	17	5,8%	204908,6	4,7%
Industrial Goods & Services	46	15,7%	475747,1	10,83%	Telecommunications	14	4,8%	194757,8	4,4%
Insurance	15	5,1%	286878,1	6,53%	Utilities	18	6,1%	312559,2	7,1%
Media	17	5,8%	120153,8	2,73%	Total	293		4393937	
Oil & Gas	11	3,8%	238074,1	5,42%					
Personal & Household Goods	14	4,8%	310385,3	7,06%					
Real Estate	12	4,1%	54947,72	1,25%					
Retail	11	3,8%	166595,8	3,79%					
Technology	17	5,8%	204908,6	4,66%					
Telecommunications	14	4,8%	194757,8	4,43%					
Travel & Leisure	8	2,7%	46740,49	1,06%					
Utilities	18	6,1%	312559,2	7,11%					
Total	293		4393937						

Categories	Facts
Weighting	Free float market capitalisation subject to 20% weighting cap
Component Number	Variable
Review Frequency	Quarterly, in March, June, September and December
Calculation/Distribution	Price and Gross Return (EUR/USD): Every 15 seconds during local trading hours Price, Gross Return (USD) and Net Return (EUR/USD): End-of-day
Base Value / Base Date	100 as of 31 December 1991 for Price and Net Return 100 as of 31 December 2000 for Gross Return
History	Available daily back to 31 December 1986 for Price and Net Return and back to 31 December 2000 for Gross Return
Date Introduced	EURO STOXX: 15 June 1998 EURO STOXX Large, Mid and Small indices: 11 October 1999

TICKER BB	NAME	ICB_INDUSTRY_NAME	ICB_SUPERSECTOR_NAME	ICB_SECTOR_NAME	ICB_SUBSECTOR_NAME
AALB NA Equity	AALBERTS INDUSTRIES NV	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery
ABE SQ Equity	ABERTIS INFRAESTRUCTURAS SA	Industrials	Industrial Goods & Services	Industrial Transportation	Transportation Services
ABI BB Equity	ANHEUSER-BUSCH INBEV NV	Consumer Goods	Food & Beverage	Beverages	Brewers
AC FP Equity	ACCOR SA	Consumer Services	Travel & Leisure	Travel & Leisure	Hotels
ACA FP Equity	CREDIT AGRICOLE SA	Financials	Banks	Banks	Banks
ACKB BB Equity	ACKERMANS & VAN HAAREN	Financials	Financial Services	Financial Services	Specialty Finance
ACS SQ Equity	ACS ACTIVIDADES CONS Y SERV	Industrials	Construction & Materials	Construction & Materials	Heavy Construction
ADP FP Equity	ADP	Industrials	Industrial Goods & Services	Industrial Transportation	Transportation Services
ADS GY Equity	ADIDAS AG	Consumer Goods	Personal & Household Goods	Personal Goods	Footwear
AF FP Equity	AIR FRANCE-KLM	Consumer Services	Travel & Leisure	Travel & Leisure	Airlines
AGN NA Equity	AEGON NV	Financials	Insurance	Life Insurance	Life Insurance
AGS BB Equity	AGEAS	Financials	Insurance	Life Insurance	Life Insurance

AH NA Equity	KONINKLIJKE AHOLD NV	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
AI FP Equity	AIR LIQUIDE SA	Basic Materials	Chemicals	Chemicals	Commodity Chemicals
AIR FP Equity	AIRBUS GROUP NV	Industrials	Industrial Goods & Services	Aerospace & Defense	Aerospace
AKE FP Equity	ARKEMA	Basic Materials	Chemicals	Chemicals	Commodity Chemicals
AKZA NA Equity	AKZO NOBEL	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
ALO FP Equity	ALSTOM	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery
ALU FP Equity	ALCATEL-LUCENT	Technology	Technology	Technology Hardware & Equipment	Telecommunications Equipment
ALV GY Equity	ALLIANZ SE-REG	Financials	Insurance	Nonlife Insurance	Full Line Insurance
AMEAS FH Equity	AMER SPORTS OYJ	Consumer Goods	Personal & Household Goods	Leisure Goods	Recreational Products
AMS SQ Equity	AMADEUS IT HOLDING SA-A SHS	Industrials	Industrial Goods & Services	Support Services	Financial Administration
ANDR AV Equity	ANDRITZ AG	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery
ASM NA Equity	ASM INTERNATIONAL NV	Technology	Technology	Technology Hardware & Equipment	Semiconductors
ASML NA Equity	ASML HOLDING NV	Technology	Technology	Technology Hardware & Equipment	Semiconductors
ATL IM Equity	ATLANTIA SPA	Industrials	Industrial Goods & Services	Industrial Transportation	Transportation Services
ATO FP Equity	ATOS	Technology	Technology	Software & Computer Services	Computer Services
AZM IM Equity	AZIMUT HOLDING SPA	Financials	Financial Services	Financial Services	Asset Managers
BAS GY Equity	BASF SE	Basic Materials	Chemicals	Chemicals	Commodity Chemicals
BAYN GY Equity	BAYER AG-REG	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
BB FP Equity	SOCIETE BIC SA	Consumer Goods	Personal & Household Goods	Household Goods & Home Construction	Nondurable Household Products
BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA	Financials	Banks	Banks	Banks
BCP PL Equity	BANCO COMERCIAL PORTUGUES-R	Financials	Banks	Banks	Banks
BEI GY Equity	BEIERSDORF AG	Consumer Goods	Personal & Household Goods	Personal Goods	Personal Products
BELG BB Equity	BELGACOM SA	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
BES PL Equity	BANCO ESPIRITO SANTO-REG	Financials	Banks	Banks	Banks
BKIA SQ Equity	BANKIA SA	Financials	Banks	Banks	Banks
BKIR ID Equity	BANK OF IRELAND	Financials	Banks	Banks	Banks

BKT SQ Equity	BANKINTER SA	Financials	Banks	Banks	Banks
BME SQ Equity	BOLSAS Y MERCADOS ESPANOL	Financials	Financial Services	Financial Services	Investment Services
BMPS IM Equity	BANCA MONTE DEI PASCHI SIENA	Financials	Banks	Banks	Banks
BMW GY Equity	BAYERISCHE MOTOREN WERKE AG	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Automobiles
BN FP Equity	DANONE	Consumer Goods	Food & Beverage	Food Producers	Food Products
BNP FP Equity	BNP PARIBAS	Financials	Banks	Banks	Banks
BNR GY Equity	BRENTAG AG	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
BOKA NA Equity	BOSKALIS WESTMINSTER	Industrials	Construction & Materials	Construction & Materials	Heavy Construction
BOL FP Equity	BOLLORE	Industrials	Industrial Goods & Services	Industrial Transportation	Transportation Services
BOSS GY Equity	HUGO BOSS AG -ORD	Consumer Goods	Personal & Household Goods	Personal Goods	Clothing & Accessories
BP IM Equity	BANCO POPOLARE SC	Financials	Banks	Banks	Banks
BPE IM Equity	BANCA POPOL EMILIA ROMAGNA	Financials	Banks	Banks	Banks
BPSO IM Equity	BANCA POPOLARE DI SONDRIO	Financials	Banks	Banks	Banks
BVI FP Equity	BUREAU VERITAS SA	Industrials	Industrial Goods & Services	Support Services	Business Support Services
CA FP Equity	CARREFOUR SA	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
CABK SQ Equity	CAIXABANK S.A	Financials	Banks	Banks	Banks
CAP FP Equity	CAP GEMINI	Technology	Technology	Software & Computer Services	Computer Services
CBK GY Equity	COMMERZBANK AG	Financials	Banks	Banks	Banks
CDI FP Equity	CHRISTIAN DIOR	Consumer Goods	Personal & Household Goods	Personal Goods	Clothing & Accessories
CGG FP Equity	CGG	Oil & Gas	Oil & Gas	Oil Equipment, Services & Distribution	Oil Equipment & Services
CNHI IM Equity	CNH INDUSTRIAL NV	Industrials	Industrial Goods & Services	Industrial Engineering	Commercial Vehicles & Trucks
CNP FP Equity	CNP ASSURANCES	Financials	Insurance	Life Insurance	Life Insurance
CO FP Equity	CASINO GUICHARD PERRACHON	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
COFB BB Equity	COFINIMMO	Financials	Real Estate	Real Estate Investment Trusts	Industrial & Office REITs
COLR BB Equity	COLRUYT SA	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
CON GY Equity	CONTINENTAL AG	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Tires

CORA NA Equity	CORIO NV	Financials	Real Estate	Real Estate Investment Trusts	Retail REITs
CPR IM Equity	DAVIDE CAMPARI-MILANO SPA	Consumer Goods	Food & Beverage	Beverages	Distillers & Vintners
CRH ID Equity	CRH PLC	Industrials	Construction & Materials	Construction & Materials	Building Materials & Fixtures
CS FP Equity	AXA SA	Financials	Insurance	Nonlife Insurance	Full Line Insurance
DAI GY Equity	DAIMLER AG-REGISTERED SHARES	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Automobiles
DB1 GY Equity	DEUTSCHE BOERSE AG	Financials	Financial Services	Financial Services	Investment Services
DBK GY Equity	DEUTSCHE BANK AG-REGISTERED	Financials	Banks	Banks	Banks
DEC FP Equity	JC DECAUX SA	Consumer Services	Media	Media	Media Agencies
DELB BB Equity	DELHAIZE GROUP	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
DEQ GY Equity	DEUTSCHE EUROSHOP AG	Financials	Real Estate	Real Estate Investment & Services	Real Estate Holding & Development
DG FP Equity	VINCI SA	Industrials	Construction & Materials	Construction & Materials	Heavy Construction
DIA SQ Equity	DISTRIBUIDORA INTERNACIONAL	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
DL NA Equity	DELTA LLOYD NV	Financials	Insurance	Life Insurance	Life Insurance
DPW GY Equity	DEUTSCHE POST AG-REG	Industrials	Industrial Goods & Services	Industrial Transportation	Delivery Services
DSM NA Equity	KONINKLIJKE DSM NV	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
DSY FP Equity	DASSAULT SYSTEMES SA	Technology	Technology	Software & Computer Services	Software
DTE GY Equity	DEUTSCHE TELEKOM AG-REG	Telecommunications	Telecommunications	Mobile Telecommunications	Mobile Telecommunications
DWNI GY Equity	DEUTSCHE WOHNEN AG-BR	Financials	Real Estate	Real Estate Investment & Services	Real Estate Holding & Development
EBRO SQ Equity	EBRO FOODS SA	Consumer Goods	Food & Beverage	Food Producers	Food Products
EBS AV Equity	ERSTE GROUP BANK AG	Financials	Banks	Banks	Banks
EDEN FP Equity	EDENRED	Industrials	Industrial Goods & Services	Support Services	Financial Administration
EDF FP Equity	EDF	Utilities	Utilities	Electricity	Conventional Electricity
EDP PL Equity	EDP-ENERGIAS DE PORTUGAL SA	Utilities	Utilities	Electricity	Alternative Electricity
EGPW IM Equity	ENEL GREEN POWER SPA	Utilities	Utilities	Electricity	Alternative Electricity
EI FP Equity	ESSILOR INTERNATIONAL	Health Care	Health Care	Health Care Equipment & Services	Medical Supplies

ELE SQ Equity	ENDESA SA	Utilities	Utilities	Electricity	Conventional Electricity
ELI1V FH Equity	ELISA OYJ	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
EN FP Equity	BOUYGUES SA	Industrials	Construction & Materials	Construction & Materials	Heavy Construction
ENEL IM Equity	ENEL SPA	Utilities	Utilities	Electricity	Conventional Electricity
ENG SQ Equity	ENAGAS SA	Utilities	Utilities	Gas, Water & Multiutilities	Gas Distribution
ENI IM Equity	ENI SPA	Oil & Gas	Oil & Gas	Oil & Gas Producers	Integrated Oil & Gas
EOAN GY Equity	E.ON SE	Utilities	Utilities	Gas, Water & Multiutilities	Multiutilities
ETL FP Equity	EUTELSAT COMMUNICATIONS	Consumer Services	Media	Media	Broadcasting & Entertainment
EVK GY Equity	EVONIK INDUSTRIES AG	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
EXO IM Equity	EXOR SPA	Financials	Financial Services	Financial Services	Specialty Finance
F IM Equity	FIAT SPA	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Automobiles
FDR FP Equity	FONCIERE DES REGIONS	Financials	Real Estate	Real Estate Investment Trusts	Industrial & Office REITs
FER SQ Equity	FERROVIAL SA	Industrials	Construction & Materials	Construction & Materials	Heavy Construction
FGR FP Equity	EIFFAGE	Industrials	Construction & Materials	Construction & Materials	Heavy Construction
FME GY Equity	FRESENIUS MEDICAL CARE AG &	Health Care	Health Care	Health Care Equipment & Services	Health Care Providers
FNC IM Equity	FINMECCANICA SPA	Industrials	Industrial Goods & Services	Aerospace & Defense	Defense
FNTN GY Equity	FREENET AG	Telecommunications	Telecommunications	Mobile Telecommunications	Mobile Telecommunications
FP FP Equity	TOTAL SA	Oil & Gas	Oil & Gas	Oil & Gas Producers	Integrated Oil & Gas
FPE3 GY Equity	FUCHS PETROLUB SE -PREF	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
FR FP Equity	VALEO SA	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Auto Parts
FRA GY Equity	FRAPORT AG FRANKFURT AIRPORT	Industrials	Industrial Goods & Services	Industrial Transportation	Transportation Services
FRE GY Equity	FRESENIUS SE & CO KGAA	Health Care	Health Care	Health Care Equipment & Services	Health Care Providers
FUM1V FH Equity	FORTUM OYJ	Utilities	Utilities	Electricity	Conventional Electricity
FUR NA Equity	FUGRO NV-CVA	Oil & Gas	Oil & Gas	Oil Equipment, Services & Distribution	Oil Equipment & Services
G IM Equity	ASSICURAZIONI GENERALI	Financials	Insurance	Nonlife Insurance	Full Line Insurance
G1A GY Equity	GEA GROUP AG	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery

GALP PL Equity	GALP ENERGIA SGPS SA	Oil & Gas	Oil & Gas	Oil & Gas Producers	Integrated Oil & Gas
GAS SQ Equity	GAS NATURAL SDG SA	Utilities	Utilities	Gas, Water & Multiutilities	Gas Distribution
GBF GY Equity	BILFINGER SE	Industrials	Industrial Goods & Services	Support Services	Business Support Services
GBLB BB Equity	GROUPE BRUXELLES LAMBERT SA	Financials	Financial Services	Financial Services	Specialty Finance
GCC ID Equity	C&C GROUP PLC	Consumer Goods	Food & Beverage	Beverages	Distillers & Vintners
GET FP Equity	GROUPE EUROTUNNEL SA - REGR	Industrials	Industrial Goods & Services	Industrial Transportation	Railroads
GFC FP Equity	GECINA SA	Financials	Real Estate	Real Estate Investment Trusts	Industrial & Office REITs
GLB ID Equity	GLANBIA PLC	Consumer Goods	Food & Beverage	Food Producers	Food Products
GLE FP Equity	SOCIETE GENERALE SA	Financials	Banks	Banks	Banks
GRF SQ Equity	GRIFOLS SA	Health Care	Health Care	Pharmaceuticals & Biotechnology	Biotechnology
GSZ FP Equity	GDF SUEZ	Utilities	Utilities	Gas, Water & Multiutilities	Multiutilities
GTO NA Equity	GEMALTO	Technology	Technology	Software & Computer Services	Software
GXI GY Equity	GERRESHEIMER AG	Health Care	Health Care	Health Care Equipment & Services	Medical Supplies
HAV FP Equity	HAVAS SA	Consumer Services	Media	Media	Media Agencies
HEI GY Equity	HEIDELBERGCEMENT AG	Industrials	Construction & Materials	Construction & Materials	Building Materials & Fixtures
HEIA NA Equity	HEINEKEN NV	Consumer Goods	Food & Beverage	Beverages	Brewers
HEIO NA Equity	HEINEKEN HOLDING NV	Consumer Goods	Food & Beverage	Beverages	Brewers
HEN3 GY Equity	HENKEL AG & CO KGAA VORZUG	Consumer Goods	Personal & Household Goods	Household Goods & Home Construction	Nondurable Household Products
HNR1 GY Equity	HANNOVER RUECK SE	Financials	Insurance	Nonlife Insurance	Reinsurance
HO FP Equity	THALES SA	Industrials	Industrial Goods & Services	Aerospace & Defense	Defense
HTO GA Equity	HELLENIC TELECOMMUN ORGANIZA	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
HUH1V FH Equity	HUHTAMAKI OYJ	Industrials	Industrial Goods & Services	General Industrials	Containers & Packaging
IBE SQ Equity	IBERDROLA SA	Utilities	Utilities	Electricity	Conventional Electricity
ICAD FP Equity	ICADE	Financials	Real Estate	Real Estate Investment Trusts	Industrial & Office REITs
IFX GY Equity	INFINEON TECHNOLOGIES AG	Technology	Technology	Technology Hardware & Equipment	Semiconductors
IIA AV Equity	IMMOFINANZ AG	Financials	Real Estate	Real Estate Investment & Services	Real Estate Holding & Development

ILD FP Equity	ILIAD SA	Technology	Technology	Software & Computer Services	Internet
ING FP Equity	INGENICO	Technology	Technology	Technology Hardware & Equipment	Computer Hardware
INGA NA Equity	ING GROEP NV-CVA	Financials	Insurance	Life Insurance	Life Insurance
ISP IM Equity	INTESA SANPAOLO	Financials	Banks	Banks	Banks
ITX SQ Equity	INDITEX	Consumer Services	Retail	General Retailers	Apparel Retailers
JAZ SQ Equity	JAZZTEL PLC	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
JMT PL Equity	JERONIMO MARTINS	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
KBC BB Equity	KBC GROEP NV	Financials	Banks	Banks	Banks
KCR1V FH Equity	KONECRANES OYJ	Industrials	Industrial Goods & Services	Industrial Engineering	Commercial Vehicles & Trucks
KD8 GY Equity	KABEL DEUTSCHLAND HOLDING AG	Consumer Services	Media	Media	Broadcasting & Entertainment
KER FP Equity	KERING	Consumer Services	Retail	General Retailers	Broadline Retailers
KESBV FH Equity	KESKO OYJ-B SHS	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
KN FP Equity	NATIXIS	Financials	Banks	Banks	Banks
KNEBV FH Equity	KONE OYJ-B	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery
KPN NA Equity	KONINKLIJKE KPN NV	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
KSP ID Equity	KINGSPAN GROUP PLC	Industrials	Construction & Materials	Construction & Materials	Building Materials & Fixtures
KYG ID Equity	KERRY GROUP PLC-A	Consumer Goods	Food & Beverage	Food Producers	Food Products
LEG GY Equity	LEG IMMOBILIEN AG	Financials	Real Estate	Real Estate Investment & Services	Real Estate Holding & Development
LEO GY Equity	LEONI AG	Industrials	Industrial Goods & Services	Electronic & Electrical Equipment	Electrical Components & Equipment
LG FP Equity	LAFARGE SA	Industrials	Construction & Materials	Construction & Materials	Building Materials & Fixtures
LHA GY Equity	DEUTSCHE LUFTHANSA-REG	Consumer Services	Travel & Leisure	Travel & Leisure	Airlines
LI FP Equity	KLEPIERRE	Financials	Real Estate	Real Estate Investment Trusts	Retail REITs
LIN GY Equity	LINDE AG	Basic Materials	Chemicals	Chemicals	Commodity Chemicals
LR FP Equity	LEGRAND SA	Industrials	Industrial Goods & Services	Electronic & Electrical Equipment	Electrical Components & Equipment
LUX IM Equity	LUXOTTICA GROUP SPA	Consumer Goods	Personal & Household Goods	Personal Goods	Clothing & Accessories

LXS GY Equity	LANXESS AG	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
MAN GY Equity	MAN SE	Industrials	Industrial Goods & Services	Industrial Engineering	Commercial Vehicles & Trucks
MAP SQ Equity	MAPFRE SA	Financials	Insurance	Nonlife Insurance	Full Line Insurance
MB IM Equity	MEDIOBANCA SPA	Financials	Banks	Banks	Banks
MC FP Equity	LVMH MOET HENNESSY LOUIS VUI	Consumer Goods	Personal & Household Goods	Personal Goods	Clothing & Accessories
MEO GY Equity	METRO AG	Consumer Services	Retail	Food & Drug Retailers	Food Retailers & Wholesalers
MEO1V FH Equity	METSO OYJ	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery
MF FP Equity	WENDEL	Financials	Financial Services	Financial Services	Specialty Finance
ML FP Equity	MICHELIN (CGDE)	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Tires
MMB FP Equity	LAGARDERE SCA	Consumer Services	Media	Media	Publishing
MRK GY Equity	MERCK KGAA	Health Care	Health Care	Pharmaceuticals & Biotechnology	Pharmaceuticals
MS IM Equity	MEDIASET SPA	Consumer Services	Media	Media	Broadcasting & Entertainment
MT NA Equity	ARCELORMITTAL	Basic Materials	Basic Resources	Industrial Metals & Mining	Iron & Steel
MTX GY Equity	MTU AERO ENGINES AG	Industrials	Industrial Goods & Services	Aerospace & Defense	Aerospace
MUV2 GY Equity	MUENCHENER RUECKVER AG-REG	Financials	Insurance	Nonlife Insurance	Reinsurance
NDA GY Equity	AURUBIS AG	Basic Materials	Basic Resources	Industrial Metals & Mining	Nonferrous Metals
NEO FP Equity	NEOPOST SA	Technology	Technology	Technology Hardware & Equipment	Electronic Office Equipment
NES1V FH Equity	NESTE OIL OYJ	Oil & Gas	Oil & Gas	Oil & Gas Producers	Integrated Oil & Gas
NK FP Equity	IMERYS SA	Basic Materials	Basic Resources	Mining	General Mining
NOK1V FH Equity	NOKIA OYJ	Technology	Technology	Technology Hardware & Equipment	Telecommunications Equipment
NRE1V FH Equity	NOKIAN RENKAAT OYJ	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Tires
NUO NA Equity	NUTRECO NV	Consumer Goods	Food & Beverage	Food Producers	Farming, Fishing & Plantations
O2D GY Equity	TELEFONICA DEUTSCHLAND HOLDI	Telecommunications	Telecommunications	Mobile Telecommunications	Mobile Telecommunications
OCI NA Equity	OCI NV	Industrials	Construction & Materials	Construction & Materials	Heavy Construction
OMV AV Equity	OMV AG	Oil & Gas	Oil & Gas	Oil & Gas Producers	Integrated Oil & Gas
OPAP GA Equity	OPAP SA	Consumer Services	Travel & Leisure	Travel & Leisure	Gambling

OR FP Equity	L'OREAL	Consumer Goods	Personal & Household Goods	Personal Goods	Personal Products
ORA FP Equity	ORANGE	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
ORNBV FH Equity	ORION OYJ-CLASS B	Health Care	Health Care	Pharmaceuticals & Biotechnology	Pharmaceuticals
OSR GY Equity	OSRAM LICHT AG	Consumer Goods	Personal & Household Goods	Household Goods & Home Construction	Durable Household Products
OTE1V FH Equity	OUTOTEC OYJ	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery
PAH3 GY Equity	PORSCHE AUTOMOBIL HLDG-PRF	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Automobiles
PC IM Equity	PIRELLI & C.	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Tires
PHIA NA Equity	KONINKLIJKE PHILIPS NV	Industrials	Industrial Goods & Services	General Industrials	Diversified Industrials
PMI IM Equity	BANCA POPOLARE DI MILANO	Financials	Banks	Banks	Banks
PNL NA Equity	POSTNL NV	Industrials	Industrial Goods & Services	Industrial Transportation	Delivery Services
POP SQ Equity	BANCO POPULAR ESPANOL	Financials	Banks	Banks	Banks
PRY IM Equity	PRYSMIAN SPA	Industrials	Industrial Goods & Services	Electronic & Electrical Equipment	Electrical Components & Equipment
PSM GY Equity	PROSIEBEN SAT.1 MEDIA AG-REG	Consumer Services	Media	Media	Broadcasting & Entertainment
PTC PL Equity	PORTUGAL TELECOM SGPS SA-REG	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
PUB FP Equity	PUBLICIS GROUPE	Consumer Services	Media	Media	Media Agencies
PWL ID Equity	PADDY POWER PLC	Consumer Services	Travel & Leisure	Travel & Leisure	Gambling
QIA GY Equity	QIAGEN N.V.	Health Care	Health Care	Pharmaceuticals & Biotechnology	Biotechnology
RAND NA Equity	RANDSTAD HOLDING NV	Industrials	Industrial Goods & Services	Support Services	Business Training Employment Agency
RBI AV Equity	RAIFFEISEN BANK INTERNATIONA	Financials	Banks	Banks	Banks
RCF FP Equity	TELEPERFORMANCE	Industrials	Industrial Goods & Services	Support Services	Business Support Services
RCO FP Equity	REMY COINTREAU	Consumer Goods	Food & Beverage	Beverages	Distillers & Vintners
REE SQ Equity	RED ELECTRICA CORPORACION SA	Utilities	Utilities	Electricity	Conventional Electricity
REN NA Equity	REED ELSEVIER NV	Consumer Services	Media	Media	Publishing
REP SQ Equity	REPSOL SA	Oil & Gas	Oil & Gas	Oil & Gas Producers	Integrated Oil & Gas
RF FP Equity	EURAZEO	Industrials	Industrial Goods & Services	General Industrials	Diversified Industrials

RHK GY Equity	RHOEN-KLINIKUM AG	Health Care	Health Care	Health Care Equipment & Services	Health Care Providers
RHM GY Equity	RHEINMETALL AG	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Auto Parts
RI FP Equity	PERNOD RICARD SA	Consumer Goods	Food & Beverage	Beverages	Distillers & Vintners
RMS FP Equity	HERMES INTERNATIONAL	Consumer Goods	Personal & Household Goods	Personal Goods	Clothing & Accessories
RNO FP Equity	RENAULT SA	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Automobiles
RRTL GY Equity	RTL GROUP	Consumer Services	Media	Media	Broadcasting & Entertainment
RUI FP Equity	RUBIS	Utilities	Utilities	Gas, Water & Multiutilities	Gas Distribution
RWE GY Equity	RWE AG	Utilities	Utilities	Gas, Water & Multiutilities	Multiutilities
RXL FP Equity	REXEL SA	Industrials	Industrial Goods & Services	Electronic & Electrical Equipment	Electrical Components & Equipment
RYA ID Equity	RYANAIR HOLDINGS PLC	Consumer Services	Travel & Leisure	Travel & Leisure	Airlines
SAB SQ Equity	BANCO DE SABADELL SA	Financials	Banks	Banks	Banks
SAF FP Equity	SAFRAN SA	Industrials	Industrial Goods & Services	Aerospace & Defense	Aerospace
SAMAS FH Equity	SAMPO OYJ-A SHS	Financials	Insurance	Nonlife Insurance	Property & Casualty Insurance
SAN FP Equity	SANOFI	Health Care	Health Care	Pharmaceuticals & Biotechnology	Pharmaceuticals
SAN SQ Equity	BANCO SANTANDER SA	Financials	Banks	Banks	Banks
SAP GY Equity	SAP AG	Technology	Technology	Software & Computer Services	Software
SAZ GY Equity	STADA ARZNEIMITTEL AG	Health Care	Health Care	Pharmaceuticals & Biotechnology	Pharmaceuticals
SBMO NA Equity	SBM OFFSHORE NV	Oil & Gas	Oil & Gas	Oil Equipment, Services & Distribution	Oil Equipment & Services
SCR FP Equity	SCOR SE	Financials	Insurance	Nonlife Insurance	Reinsurance
SDF GY Equity	K+S AG-REG	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
SESG FP Equity	SES	Consumer Services	Media	Media	Broadcasting & Entertainment
SEV FP Equity	SUEZ ENVIRONNEMENT CO	Utilities	Utilities	Gas, Water & Multiutilities	Water
SGO FP Equity	COMPAGNIE DE SAINT-GOBAIN	Industrials	Construction & Materials	Construction & Materials	Building Materials & Fixtures
SIE GY Equity	SIEMENS AG-REG	Industrials	Industrial Goods & Services	General Industrials	Diversified Industrials
SK FP Equity	SEB SA	Consumer Goods	Personal & Household Goods	Household Goods & Home Construction	Durable Household Products
SKG ID Equity	SMURFIT KAPPA GROUP PLC	Industrials	Industrial Goods & Services	General Industrials	Containers & Packaging

SKYD GY Equity	SKY DEUTSCHLAND AG	Consumer Services	Media	Media	Broadcasting & Entertainment
SOLB BB Equity	SOLVAY SA	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
SOW GY Equity	SOFTWARE AG	Technology	Technology	Software & Computer Services	Software
SPM IM Equity	SAIPEM SPA	Oil & Gas	Oil & Gas	Oil Equipment, Services & Distribution	Oil Equipment & Services
SPR GY Equity	AXEL SPRINGER SE	Consumer Services	Media	Media	Publishing
SRG IM Equity	SNAM SPA	Utilities	Utilities	Gas, Water & Multiutilities	Gas Distribution
STERV FH Equity	STORA ENSO OYJ-R SHS	Basic Materials	Basic Resources	Forestry & Paper	Paper
STM IM Equity	STMICROELECTRONICS NV	Technology	Technology	Technology Hardware & Equipment	Semiconductors
SU FP Equity	SCHNEIDER ELECTRIC SA	Industrials	Industrial Goods & Services	Electronic & Electrical Equipment	Electrical Components & Equipment
SW FP Equity	SODEXO	Consumer Services	Travel & Leisure	Travel & Leisure	Restaurants & Bars
SY1 GY Equity	SYMRISE AG	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
SZU GY Equity	SUEDZUCKER AG	Consumer Goods	Food & Beverage	Food Producers	Food Products
TEC FP Equity	TECHNIP SA	Oil & Gas	Oil & Gas	Oil Equipment, Services & Distribution	Oil Equipment & Services
TEF SQ Equity	TELEFONICA SA	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
TEN IM Equity	TENARIS SA	Basic Materials	Basic Resources	Industrial Metals & Mining	Iron & Steel
TFI FP Equity	TELEVISION FRANCAISE (T.F.1)	Consumer Services	Media	Media	Broadcasting & Entertainment
TIT IM Equity	TELECOM ITALIA SPA	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
TKA AV Equity	TELEKOM AUSTRIA AG	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications
TKA GY Equity	THYSSENKRUPP AG	Industrials	Industrial Goods & Services	General Industrials	Diversified Industrials
TNET BB Equity	TELENET GROUP HOLDING NV	Consumer Services	Media	Media	Broadcasting & Entertainment
TNTE NA Equity	TNT EXPRESS NV	Industrials	Industrial Goods & Services	Industrial Transportation	Delivery Services
TOD IM Equity	TOD'S SPA	Consumer Goods	Personal & Household Goods	Personal Goods	Footwear
TPEIR GA Equity	PIRAEUS BANK S.A	Financials	Banks	Banks	Banks
TRN IM Equity	TERNA SPA	Utilities	Utilities	Electricity	Conventional Electricity
TUI1 GY Equity	TUI AG	Consumer Services	Travel & Leisure	Travel & Leisure	Travel & Tourism
UBI IM Equity	UBI BANCA SCPA	Financials	Banks	Banks	Banks

UCB BB Equity	UCB SA	Health Care	Health Care	Pharmaceuticals & Biotechnology	Pharmaceuticals
UCG IM Equity	UNICREDIT SPA	Financials	Banks	Banks	Banks
UG FP Equity	PEUGEOT SA	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Automobiles
UL NA Equity	UNIBAIL-RODAMCO SE	Financials	Real Estate	Real Estate Investment Trusts	Retail REITs
UMI BB Equity	UMICORE	Basic Materials	Chemicals	Chemicals	Specialty Chemicals
UNA NA Equity	UNILEVER NV-CVA	Consumer Goods	Food & Beverage	Food Producers	Food Products
UPM1V FH Equity	UPM-KYMMENE OYJ	Basic Materials	Basic Resources	Forestry & Paper	Paper
US IM Equity	UNIPOLSAI SPA	Financials	Insurance	Nonlife Insurance	Property & Casualty Insurance
UTDI GY Equity	UNITED INTERNET AG-REG SHARE	Technology	Technology	Software & Computer Services	Internet
VIE FP Equity	VEOLIA ENVIRONNEMENT	Utilities	Utilities	Gas, Water & Multiutilities	Water
VIG AV Equity	VIENNA INSURANCE GROUP AG	Financials	Insurance	Nonlife Insurance	Full Line Insurance
VIS SQ Equity	VISCOFAN SA	Consumer Goods	Food & Beverage	Food Producers	Food Products
VIV FP Equity	VIVENDI	Consumer Services	Media	Media	Broadcasting & Entertainment
VK FP Equity	VALLOUREC	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery
VOE AV Equity	VOESTALPINE AG	Basic Materials	Basic Resources	Industrial Metals & Mining	Iron & Steel
VOW3 GY Equity	VOLKSWAGEN AG-PREF	Consumer Goods	Automobiles & Parts	Automobiles & Parts	Automobiles
VPK NA Equity	VOPAK	Industrials	Industrial Goods & Services	Industrial Transportation	Marine Transportation
WDI GY Equity	WIRECARD AG	Industrials	Industrial Goods & Services	Support Services	Financial Administration
WHA NA Equity	WERELDHAVE NV	Financials	Real Estate	Real Estate Investment Trusts	Retail REITs
WIN GY Equity	WINCOR NIXDORF AG	Technology	Technology	Software & Computer Services	Computer Services
WKL NA Equity	WOLTERS KLUWER	Consumer Services	Media	Media	Publishing
WRT1V FH Equity	WARTSILA OYJ ABP	Industrials	Industrial Goods & Services	Industrial Engineering	Industrial Machinery
ZC FP Equity	ZODIAC AEROSPACE	Industrials	Industrial Goods & Services	Aerospace & Defense	Aerospace
ZIGGO NA Equity	ZIGGO NV	Telecommunications	Telecommunications	Fixed Line Telecommunications	Fixed Line Telecommunications

[3] List of the Top 200 Pairs

Top Pair no.	Corr Value	R-squared	Stock no. 1	Name Stock no. 1	Stock no. 2	Name Stock no. 2
1	0,9296	0,8642	HEIO NA Equity	HEINEKEN HOLDING NV	HEIA NA Equity	HEINEKEN NV
2	0,8848	0,7828	SAN SQ Equity	BANCO SANTANDER SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
3	0,8503	0,7229	VOW3 GY Equity	VOLKSWAGEN AG-PREF	PAH3 GY Equity	PORSCHE AUTOMOBIL HLDG-PRF
4	0,8167	0,6670	MC FP Equity	LVMH MOET HENNESSY LOUIS VUI	CDI FP Equity	CHRISTIAN DIOR
5	0,8017	0,6427	GLE FP Equity	SOCIETE GENERALE SA	BNP FP Equity	BNP PARIBAS
6	0,7967	0,6348	GLE FP Equity	SOCIETE GENERALE SA	ACA FP Equity	CREDIT AGRICOLE SA
7	0,7962	0,6340	UCG IM Equity	UNICREDIT SPA	ISP IM Equity	INTESA SANPAOLO
8	0,7759	0,6020	TEF SQ Equity	TELEFONICA SA	SAN SQ Equity	BANCO SANTANDER SA
9	0,7685	0,5906	SAN SQ Equity	BANCO SANTANDER SA	BNP FP Equity	BNP PARIBAS
10	0,7675	0,5891	TEF SQ Equity	TELEFONICA SA	IBE SQ Equity	IBERDROLA SA
11	0,7648	0,5850	CS FP Equity	AXA SA	BNP FP Equity	BNP PARIBAS
12	0,7640	0,5837	TEF SQ Equity	TELEFONICA SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
13	0,7634	0,5828	BNP FP Equity	BNP PARIBAS	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
14	0,7631	0,5823	BNP FP Equity	BNP PARIBAS	ACA FP Equity	CREDIT AGRICOLE SA
15	0,7564	0,5722	INGA NA Equity	ING GROEP NV-CVA	GLE FP Equity	SOCIETE GENERALE SA
16	0,7505	0,5633	UBI IM Equity	UBI BANCA SCPA	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA
17	0,7477	0,5591	UPM1V FH Equity	UPM-KYMMENE OYJ	STERV FH Equity	STORA ENSO OYJ-R SHS
18	0,7443	0,5540	UCG IM Equity	UNICREDIT SPA	G IM Equity	ASSICURAZIONI GENERALI
19	0,7403	0,5481	BNP FP Equity	BNP PARIBAS	ALV GY Equity	ALLIANZ SE-REG
20	0,7364	0,5422	KBC BB Equity	KBC GROEP NV	BNP FP Equity	BNP PARIBAS
21	0,7318	0,5355	UCG IM Equity	UNICREDIT SPA	UBI IM Equity	UBI BANCA SCPA
22	0,7262	0,5274	CS FP Equity	AXA SA	ALV GY Equity	ALLIANZ SE-REG

23	0,7243	0,5245	TEF SQ Equity	TELEFONICA SA	REP SQ Equity	REPSOL SA
24	0,7232	0,5230	RWE GY Equity	RWE AG	EOAN GY Equity	E.ON SE
25	0,7227	0,5223	ISP IM Equity	INTESA SANPAOLO	G IM Equity	ASSICURAZIONI GENERALI
26	0,7205	0,5192	INGA NA Equity	ING GROEP NV-CVA	BNP FP Equity	BNP PARIBAS
27	0,7184	0,5161	GLE FP Equity	SOCIETE GENERALE SA	DBK GY Equity	DEUTSCHE BANK AG-REGISTERED
28	0,7178	0,5152	INGA NA Equity	ING GROEP NV-CVA	ACA FP Equity	CREDIT AGRICOLE SA
29	0,7141	0,5100	GLE FP Equity	SOCIETE GENERALE SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
30	0,7118	0,5066	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA	BP IM Equity	BANCO POPOLARE SC
31	0,7113	0,5060	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA	ACA FP Equity	CREDIT AGRICOLE SA
32	0,7111	0,5056	KBC BB Equity	KBC GROEP NV	GLE FP Equity	SOCIETE GENERALE SA
33	0,7091	0,5028	KBC BB Equity	KBC GROEP NV	ACA FP Equity	CREDIT AGRICOLE SA
34	0,7090	0,5026	UCG IM Equity	UNICREDIT SPA	MB IM Equity	MEDIOBANCA SPA
35	0,7079	0,5012	SAN SQ Equity	BANCO SANTANDER SA	GLE FP Equity	SOCIETE GENERALE SA
36	0,7079	0,5011	SAN SQ Equity	BANCO SANTANDER SA	IBE SQ Equity	IBERDROLA SA
37	0,7079	0,5011	G IM Equity	ASSICURAZIONI GENERALI	ENEL IM Equity	ENEL SPA
38	0,7056	0,4979	MB IM Equity	MEDIOBANCA SPA	ISP IM Equity	INTESA SANPAOLO
39	0,7041	0,4957	ISP IM Equity	INTESA SANPAOLO	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
40	0,7013	0,4919	DBK GY Equity	DEUTSCHE BANK AG-REGISTERED	BNP FP Equity	BNP PARIBAS
41	0,6996	0,4894	INGA NA Equity	ING GROEP NV-CVA	CS FP Equity	AXA SA
42	0,6992	0,4889	IBE SQ Equity	IBERDROLA SA	ENEL IM Equity	ENEL SPA
43	0,6991	0,4888	UBI IM Equity	UBI BANCA SCPA	ISP IM Equity	INTESA SANPAOLO
44	0,6986	0,4881	UBI IM Equity	UBI BANCA SCPA	BP IM Equity	BANCO POPOLARE SC
45	0,6970	0,4859	SAN SQ Equity	BANCO SANTANDER SA	BKT SQ Equity	BANKINTER SA
46	0,6969	0,4857	UCG IM Equity	UNICREDIT SPA	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA
47	0,6967	0,4854	SAN SQ Equity	BANCO SANTANDER SA	ACA FP Equity	CREDIT AGRICOLE SA
48	0,6967	0,4854	ISP IM Equity	INTESA SANPAOLO	BNP FP Equity	BNP PARIBAS

49	0,6961	0,4845	DAI GY Equity	DAIMLER AG-REGISTERED SHARES	BMW GY Equity	BAYERISCHE MOTOREN WERKE AG
50	0,6943	0,4820	ML FP Equity	MICHELIN (CGDE)	CON GY Equity	CONTINENTAL AG
51	0,6930	0,4802	SAN SQ Equity	BANCO SANTANDER SA	REP SQ Equity	REPSOL SA
52	0,6924	0,4794	TEF SQ Equity	TELEFONICA SA	ENEL IM Equity	ENEL SPA
53	0,6918	0,4785	SAN SQ Equity	BANCO SANTANDER SA	ENEL IM Equity	ENEL SPA
54	0,6889	0,4745	GLE FP Equity	SOCIETE GENERALE SA	CS FP Equity	AXA SA
55	0,6883	0,4737	G IM Equity	ASSICURAZIONI GENERALI	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
56	0,6881	0,4735	SAN SQ Equity	BANCO SANTANDER SA	ISP IM Equity	INTESA SANPAOLO
57	0,6853	0,4697	REP SQ Equity	REPSOL SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
58	0,6823	0,4655	G IM Equity	ASSICURAZIONI GENERALI	CS FP Equity	AXA SA
59	0,6803	0,4628	SAN SQ Equity	BANCO SANTANDER SA	CS FP Equity	AXA SA
60	0,6793	0,4614	SAN SQ Equity	BANCO SANTANDER SA	G IM Equity	ASSICURAZIONI GENERALI
61	0,6790	0,4611	REP SQ Equity	REPSOL SA	FP FP Equity	TOTAL SA
62	0,6789	0,4609	G IM Equity	ASSICURAZIONI GENERALI	BNP FP Equity	BNP PARIBAS
63	0,6784	0,4602	UCG IM Equity	UNICREDIT SPA	SAN SQ Equity	BANCO SANTANDER SA
64	0,6783	0,4600	RNO FP Equity	RENAULT SA	DAI GY Equity	DAIMLER AG-REGISTERED SHARES
65	0,6777	0,4593	REP SQ Equity	REPSOL SA	IBE SQ Equity	IBERDROLA SA
66	0,6769	0,4582	BKT SQ Equity	BANKINTER SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
67	0,6755	0,4563	SAN SQ Equity	BANCO SANTANDER SA	CABK SQ Equity	CAIXABANK S.A
68	0,6731	0,4530	ISP IM Equity	INTESA SANPAOLO	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA
69	0,6727	0,4526	UCG IM Equity	UNICREDIT SPA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
70	0,6704	0,4494	DG FP Equity	VINCI SA	BNP FP Equity	BNP PARIBAS
71	0,6702	0,4491	ENEL IM Equity	ENEL SPA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
72	0,6680	0,4462	CS FP Equity	AXA SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
73	0,6666	0,4444	ISP IM Equity	INTESA SANPAOLO	ENEL IM Equity	ENEL SPA
74	0,6664	0,4441	KBC BB Equity	KBC GROEP NV	INGA NA Equity	ING GROEP NV-CVA

75	0,6662	0,4439	ISP IM Equity	INTESA SANPAOLO	ACA FP Equity	CREDIT AGRICOLE SA
76	0,6659	0,4434	UCG IM Equity	UNICREDIT SPA	ENEL IM Equity	ENEL SPA
77	0,6658	0,4433	GLE FP Equity	SOCIETE GENERALE SA	ALV GY Equity	ALLIANZ SE-REG
78	0,6657	0,4432	BAYN GY Equity	BAYER AG-REG	BAS GY Equity	BASF SE
79	0,6651	0,4423	KBC BB Equity	KBC GROEP NV	CS FP Equity	AXA SA
80	0,6647	0,4418	SAN SQ Equity	BANCO SANTANDER SA	POP SQ Equity	BANCO POPULAR ESPANOL
81	0,6646	0,4417	PMI IM Equity	BANCA POPOLARE DI MILANO	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA
82	0,6644	0,4414	INGA NA Equity	ING GROEP NV-CVA	ALV GY Equity	ALLIANZ SE-REG
83	0,6643	0,4412	CS FP Equity	AXA SA	AGS BB Equity	AGEAS
84	0,6631	0,4397	UCG IM Equity	UNICREDIT SPA	BNP FP Equity	BNP PARIBAS
85	0,6630	0,4396	SAB SQ Equity	BANCO DE SABADELL SA	POP SQ Equity	BANCO POPULAR ESPANOL
86	0,6622	0,4385	IBE SQ Equity	IBERDROLA SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
87	0,6616	0,4377	SAB SQ Equity	BANCO DE SABADELL SA	CABK SQ Equity	CAIXABANK S.A
88	0,6615	0,4375	TEF SQ Equity	TELEFONICA SA	BNP FP Equity	BNP PARIBAS
89	0,6610	0,4370	UBI IM Equity	UBI BANCA SCPA	MB IM Equity	MEDIOBANCA SPA
90	0,6602	0,4359	IBE SQ Equity	IBERDROLA SA	G IM Equity	ASSICURAZIONI GENERALI
91	0,6602	0,4358	BES PL Equity	BANCO ESPIRITO SANTO-REG	BCP PL Equity	BANCO COMERCIAL PORTUGUES-R
92	0,6578	0,4327	DG FP Equity	VINCI SA	CS FP Equity	AXA SA
93	0,6568	0,4314	ISP IM Equity	INTESA SANPAOLO	GLE FP Equity	SOCIETE GENERALE SA
94	0,6565	0,4310	CS FP Equity	AXA SA	ACA FP Equity	CREDIT AGRICOLE SA
95	0,6553	0,4294	FP FP Equity	TOTAL SA	ENI IM Equity	ENI SPA
96	0,6524	0,4256	G IM Equity	ASSICURAZIONI GENERALI	ALV GY Equity	ALLIANZ SE-REG
97	0,6523	0,4256	SU FP Equity	SCHNEIDER ELECTRIC SA	BNP FP Equity	BNP PARIBAS
98	0,6522	0,4254	MB IM Equity	MEDIOBANCA SPA	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA
99	0,6516	0,4246	TEF SQ Equity	TELEFONICA SA	ORA FP Equity	ORANGE
100	0,6508	0,4235	DBK GY Equity	DEUTSCHE BANK AG-REGISTERED	ACA FP Equity	CREDIT AGRICOLE SA

101	0,6506	0,4233	LG FP Equity	LAFARGE SA	HEI GY Equity	HEIDELBERGCEMENT AG
102	0,6497	0,4222	DAI GY Equity	DAIMLER AG-REGISTERED SHARES	CON GY Equity	CONTINENTAL AG
103	0,6491	0,4213	UCG IM Equity	UNICREDIT SPA	GLE FP Equity	SOCIETE GENERALE SA
104	0,6491	0,4213	REP SQ Equity	REPSOL SA	ENI IM Equity	ENI SPA
105	0,6480	0,4198	UCG IM Equity	UNICREDIT SPA	ACA FP Equity	CREDIT AGRICOLE SA
106	0,6467	0,4183	CS FP Equity	AXA SA	CNP FP Equity	CNP ASSURANCES
107	0,6461	0,4175	ENEL IM Equity	ENEL SPA	EGPW IM Equity	ENEL GREEN POWER SPA
108	0,6457	0,4170	VOW3 GY Equity	VOLKSWAGEN AG-PREF	CON GY Equity	CONTINENTAL AG
109	0,6456	0,4169	KBC BB Equity	KBC GROEP NV	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
110	0,6454	0,4165	DAI GY Equity	DAIMLER AG-REGISTERED SHARES	ALV GY Equity	ALLIANZ SE-REG
111	0,6433	0,4138	POP SQ Equity	BANCO POPULAR ESPANOL	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
112	0,6430	0,4134	DAI GY Equity	DAIMLER AG-REGISTERED SHARES	BNP FP Equity	BNP PARIBAS
113	0,6429	0,4133	SAN SQ Equity	BANCO SANTANDER SA	MAP SQ Equity	MAPFRE SA
114	0,6426	0,4130	VOW3 GY Equity	VOLKSWAGEN AG-PREF	DAI GY Equity	DAIMLER AG-REGISTERED SHARES
115	0,6420	0,4122	SU FP Equity	SCHNEIDER ELECTRIC SA	ALV GY Equity	ALLIANZ SE-REG
116	0,6417	0,4118	TEF SQ Equity	TELEFONICA SA	G IM Equity	ASSICURAZIONI GENERALI
117	0,6406	0,4103	DIA SQ Equity	DISTRIBUIDORA INTERNACIONAL	CA FP Equity	CARREFOUR SA
118	0,6405	0,4103	PAH3 GY Equity	PORSCHE AUTOMOBIL HLDG-PRF	DAI GY Equity	DAIMLER AG-REGISTERED SHARES
119	0,6403	0,4100	ALV GY Equity	ALLIANZ SE-REG	ACA FP Equity	CREDIT AGRICOLE SA
120	0,6378	0,4067	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA	ALV GY Equity	ALLIANZ SE-REG
121	0,6370	0,4057	BAS GY Equity	BASF SE	ALV GY Equity	ALLIANZ SE-REG
122	0,6366	0,4052	ENEL IM Equity	ENEL SPA	BNP FP Equity	BNP PARIBAS
123	0,6359	0,4044	SAN SQ Equity	BANCO SANTANDER SA	KBC BB Equity	KBC GROEP NV
124	0,6356	0,4040	PAH3 GY Equity	PORSCHE AUTOMOBIL HLDG-PRF	CON GY Equity	CONTINENTAL AG
125	0,6355	0,4038	CA FP Equity	CARREFOUR SA	BNP FP Equity	BNP PARIBAS
126	0,6350	0,4032	UBI IM Equity	UBI BANCA SCPA	G IM Equity	ASSICURAZIONI GENERALI

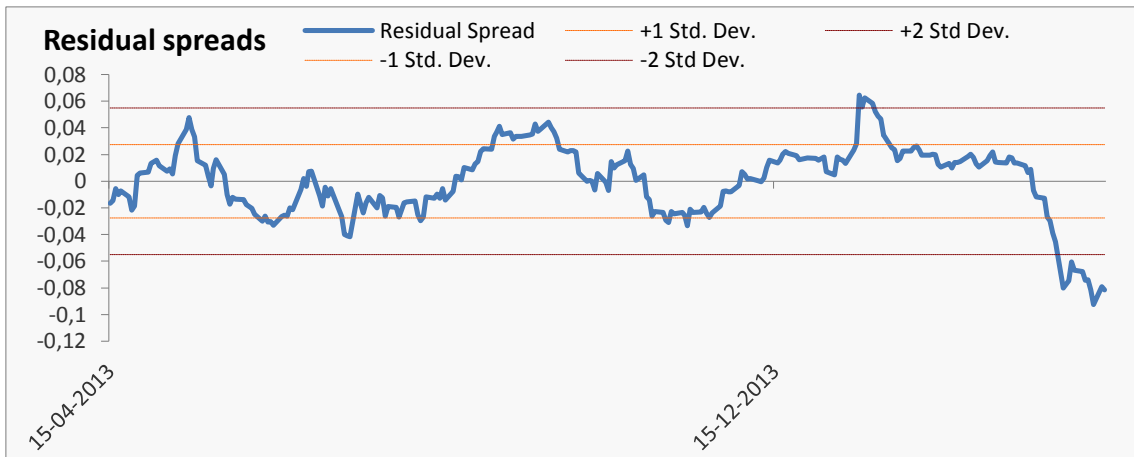
127	0,6342	0,4022	BAYN GY Equity	BAYER AG-REG	ALV GY Equity	ALLIANZ SE-REG
128	0,6337	0,4016	FP FP Equity	TOTAL SA	BNP FP Equity	BNP PARIBAS
129	0,6337	0,4015	POP SQ Equity	BANCO POPULAR ESPANOL	CABK SQ Equity	CAIXABANK S.A
130	0,6335	0,4013	BKT SQ Equity	BANKINTER SA	ACA FP Equity	CREDIT AGRICOLE SA
131	0,6335	0,4013	FGR FP Equity	EIFFAGE	DG FP Equity	VINCI SA
132	0,6330	0,4007	ML FP Equity	MICHELIN (CGDE)	DAI GY Equity	DAIMLER AG-REGISTERED SHARES
133	0,6320	0,3994	SAN SQ Equity	BANCO SANTANDER SA	ALV GY Equity	ALLIANZ SE-REG
134	0,6315	0,3988	IBE SQ Equity	IBERDROLA SA	GAS SQ Equity	GAS NATURAL SDG SA
135	0,6313	0,3985	MB IM Equity	MEDIOBANCA SPA	G IM Equity	ASSICURAZIONI GENERALI
136	0,6312	0,3984	DG FP Equity	VINCI SA	ALV GY Equity	ALLIANZ SE-REG
137	0,6309	0,3981	REP SQ Equity	REPSOL SA	BNP FP Equity	BNP PARIBAS
138	0,6306	0,3977	FR FP Equity	VALEO SA	DAI GY Equity	DAIMLER AG-REGISTERED SHARES
139	0,6305	0,3975	UCG IM Equity	UNICREDIT SPA	BP IM Equity	BANCO POPOLARE SC
140	0,6302	0,3972	MUV2 GY Equity	MUENCHENER RUECKVER AG-REG	ALV GY Equity	ALLIANZ SE-REG
141	0,6301	0,3971	EXO IM Equity	EXOR SPA	ENEL IM Equity	ENEL SPA
142	0,6300	0,3969	DBK GY Equity	DEUTSCHE BANK AG-REGISTERED	ALV GY Equity	ALLIANZ SE-REG
143	0,6300	0,3968	FP FP Equity	TOTAL SA	ALV GY Equity	ALLIANZ SE-REG
144	0,6295	0,3962	PAH3 GY Equity	PORSCHE AUTOMOBIL HLDG-PRF	BMW GY Equity	BAYERISCHE MOTOREN WERKE AG
145	0,6294	0,3962	MAP SQ Equity	MAPFRE SA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
146	0,6292	0,3958	CS FP Equity	AXA SA	AGN NA Equity	AEGON NV
147	0,6290	0,3957	SAN SQ Equity	BANCO SANTANDER SA	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA
148	0,6285	0,3950	SU FP Equity	SCHNEIDER ELECTRIC SA	SIE GY Equity	SIEMENS AG-REG
149	0,6284	0,3949	ALV GY Equity	ALLIANZ SE-REG	AGS BB Equity	AGEAS
150	0,6282	0,3947	LHA GY Equity	DEUTSCHE LUFTHANSA-REG	AF FP Equity	AIR FRANCE-KLM
151	0,6280	0,3944	SAN SQ Equity	BANCO SANTANDER SA	INGA NA Equity	ING GROEP NV-CVA
152	0,6268	0,3929	INGA NA Equity	ING GROEP NV-CVA	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA

153	0,6266	0,3926	G IM Equity	ASSICURAZIONI GENERALI	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA
154	0,6265	0,3925	CABK SQ Equity	CAIXABANK S.A	BBVA SQ Equity	BANCO BILBAO VIZCAYA ARGENTA
155	0,6255	0,3912	UCG IM Equity	UNICREDIT SPA	INGA NA Equity	ING GROEP NV-CVA
156	0,6250	0,3906	IBE SQ Equity	IBERDROLA SA	BNP FP Equity	BNP PARIBAS
157	0,6249	0,3905	INGA NA Equity	ING GROEP NV-CVA	DBK GY Equity	DEUTSCHE BANK AG-REGISTERED
158	0,6243	0,3898	MC FP Equity	LVMH MOET HENNESSY LOUIS VUI	KER FP Equity	KERING
159	0,6236	0,3888	GLE FP Equity	SOCIETE GENERALE SA	G IM Equity	ASSICURAZIONI GENERALI
160	0,6235	0,3887	VIV FP Equity	VIVENDI	TEF SQ Equity	TELEFONICA SA
161	0,6227	0,3877	UCG IM Equity	UNICREDIT SPA	KBC BB Equity	KBC GROEP NV
162	0,6226	0,3876	FR FP Equity	VALEO SA	CON GY Equity	CONTINENTAL AG
163	0,6222	0,3871	VOW3 GY Equity	VOLKSWAGEN AG-PREF	BMW GY Equity	BAYERISCHE MOTOREN WERKE AG
164	0,6211	0,3858	INGA NA Equity	ING GROEP NV-CVA	CNP FP Equity	CNP ASSURANCES
165	0,6208	0,3854	INGA NA Equity	ING GROEP NV-CVA	G IM Equity	ASSICURAZIONI GENERALI
166	0,6202	0,3846	ISP IM Equity	INTESA SANPAOLO	CS FP Equity	AXA SA
167	0,6198	0,3841	DWNI GY Equity	DEUTSCHE WOHNEN AG-BR	DEQ GY Equity	DEUTSCHE EUROSHOP AG
168	0,6196	0,3839	KN FP Equity	NATIXIS	GLE FP Equity	SOCIETE GENERALE SA
169	0,6192	0,3834	LIN GY Equity	LINDE AG	AI FP Equity	AIR LIQUIDE SA
170	0,6192	0,3833	G IM Equity	ASSICURAZIONI GENERALI	EXO IM Equity	EXOR SPA
171	0,6187	0,3828	KBC BB Equity	KBC GROEP NV	ISP IM Equity	INTESA SANPAOLO
172	0,6181	0,3821	ENEL IM Equity	ENEL SPA	CS FP Equity	AXA SA
173	0,6176	0,3814	TEF SQ Equity	TELEFONICA SA	BKT SQ Equity	BANKINTER SA
174	0,6175	0,3813	SAN SQ Equity	BANCO SANTANDER SA	DG FP Equity	VINCI SA
175	0,6168	0,3805	SU FP Equity	SCHNEIDER ELECTRIC SA	CS FP Equity	AXA SA
176	0,6167	0,3803	DBK GY Equity	DEUTSCHE BANK AG-REGISTERED	CS FP Equity	AXA SA
177	0,6161	0,3796	RNO FP Equity	RENAULT SA	CS FP Equity	AXA SA
178	0,6161	0,3796	CO FP Equity	CASINO GUICHARD PERRACHON	CA FP Equity	CARREFOUR SA

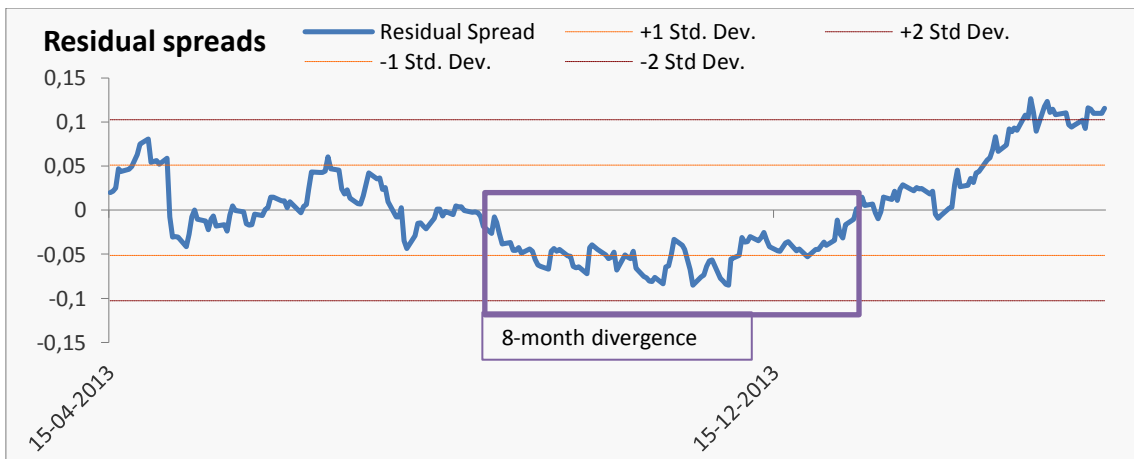
179	0,6160	0,3794	SAMAS FH Equity	SAMPO OYJ-A SHS	CS FP Equity	AXA SA
180	0,6160	0,3794	KBC BB Equity	KBC GROEP NV	G IM Equity	ASSICURAZIONI GENERALI
181	0,6159	0,3794	RNO FP Equity	RENAULT SA	CON GY Equity	CONTINENTAL AG
182	0,6156	0,3790	CON GY Equity	CONTINENTAL AG	BMW GY Equity	BAYERISCHE MOTOREN WERKE AG
183	0,6145	0,3776	UNA NA Equity	UNILEVER NV-CVA	BN FP Equity	DANONE
184	0,6144	0,3775	ISP IM Equity	INTESA SANPAOLO	BKT SQ Equity	BANKINTER SA
185	0,6144	0,3774	ENI IM Equity	ENI SPA	BNP FP Equity	BNP PARIBAS
186	0,6142	0,3772	HEIO NA Equity	HEINEKEN HOLDING NV	ABI BB Equity	ANHEUSER-BUSCH INBEV NV
187	0,6130	0,3758	SAN SQ Equity	BANCO SANTANDER SA	ENI IM Equity	ENI SPA
188	0,6125	0,3752	KER FP Equity	KERING	CDI FP Equity	CHRISTIAN DIOR
189	0,6125	0,3752	MAP SQ Equity	MAPFRE SA	GLE FP Equity	SOCIETE GENERALE SA
190	0,6120	0,3746	SGO FP Equity	COMPAGNIE DE SAINT-GOBAIN	DG FP Equity	VINCI SA
191	0,6116	0,3740	TEF SQ Equity	TELEFONICA SA	CS FP Equity	AXA SA
192	0,6114	0,3739	FP FP Equity	TOTAL SA	CS FP Equity	AXA SA
193	0,6113	0,3737	GLE FP Equity	SOCIETE GENERALE SA	DAI GY Equity	DAIMLER AG-REGISTERED SHARES
194	0,6106	0,3729	MAP SQ Equity	MAPFRE SA	AGS BB Equity	AGEAS
195	0,6098	0,3718	GLE FP Equity	SOCIETE GENERALE SA	EBS AV Equity	ERSTE GROUP BANK AG
196	0,6096	0,3716	BNP FP Equity	BNP PARIBAS	AGS BB Equity	AGEAS
197	0,6094	0,3713	G IM Equity	ASSICURAZIONI GENERALI	BKT SQ Equity	BANKINTER SA
198	0,6093	0,3713	ML FP Equity	MICHELIN (CGDE)	FR FP Equity	VALEO SA
199	0,6085	0,3703	DAI GY Equity	DAIMLER AG-REGISTERED SHARES	ACA FP Equity	CREDIT AGRICOLE SA
200	0,6084	0,3702	ENEL IM Equity	ENEL SPA	BPE IM Equity	BANCA POPOL EMILIA ROMAGNA

[4] Spread evolution (including current divergence) for the tradable pairs

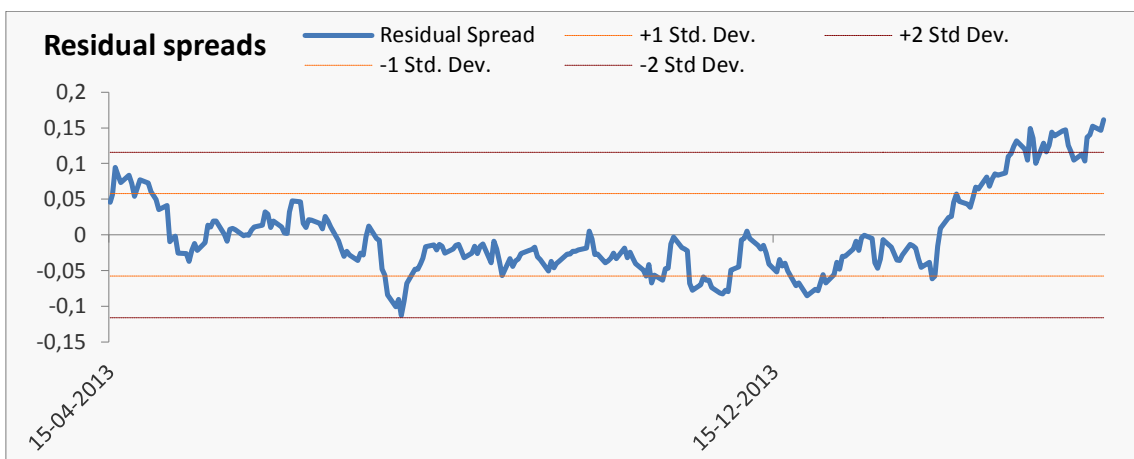
Santander vs BBVA



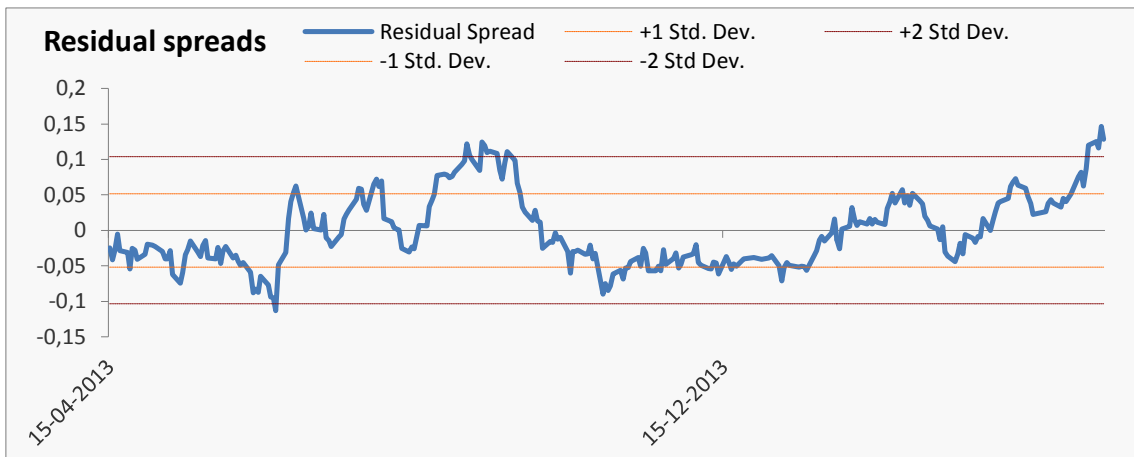
Societe Generale vs Credit Agricole



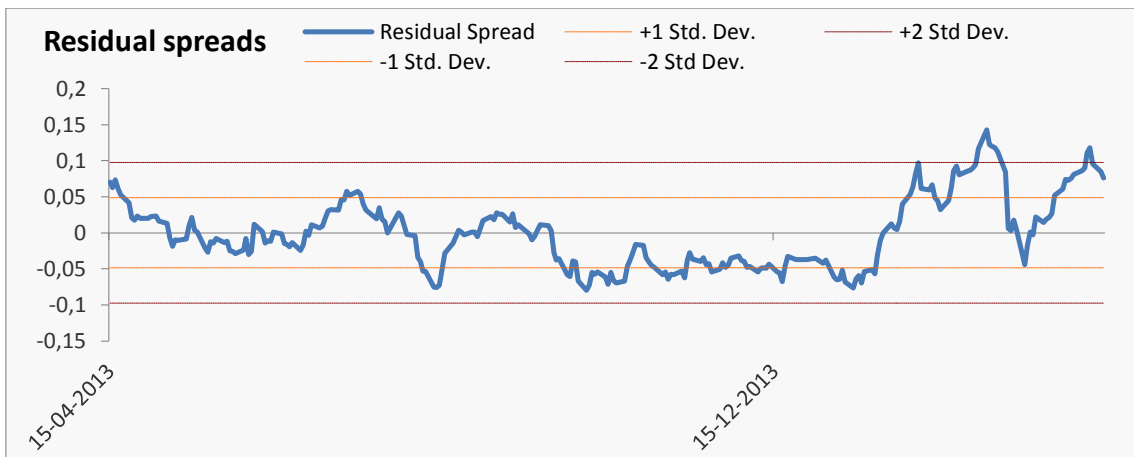
BNP vs Credit Agricole



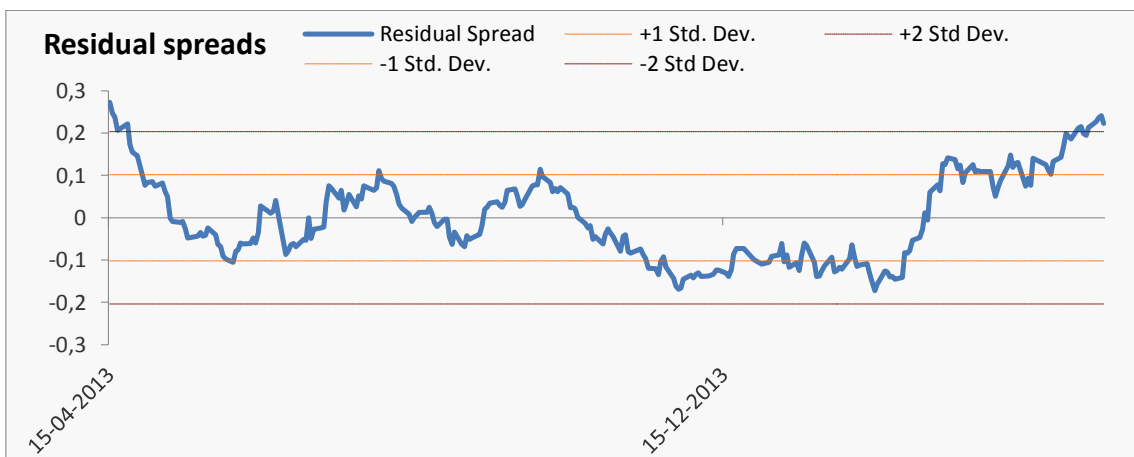
Mediobanca vs Intesa Sanpaolo



Unicredit vs Intesa Sanpaolo



Banca Popolare dell'Emilia Romagna vs Banca Popolare di Milano



[5] Summary of the positives and negatives of each tradable pair

STOCK 1	STOCK 2	FINAL SCORE	POSITIVES	NEGATIVES
BNP PARIBAS	CREDIT AGRICOLE SA	0,620	-Top performer on statistical score -Strongly correlated (top 14 pair) -Largest divergence (27,1%) -Lowest average maximum loss	-Smallest average profit -Lowest average maximum gain
MEDIOBANCA SPA	INTESA SANPAOLO	0,572	-Second best performer for both statistical and backtesting scoring -Highest profits -Top number of zero crosses last year	-Second largest maximum loss -Third lowest maximum gain
UNICREDIT SPA	INTESA SANPAOLO	0,539	-Second strongest correlation (top 7) -Low average crossing period	-Divergence is not that high (11% - the second lowest)
BANCA POPOLARE DI MILANO	BANCA POPOL EMILIA ROMAGNA	0,404	-Largest maximum gain in a single trade -Second largest in terms of profits	-Weakest performance statistically -Low correlation (top 81) -Smallest number of zero crosses and highest crossing period
SOCIETE GENERALE SA	CREDIT AGRICOLE SA	0,402	-Low average crossing period -Strong correlation (top 6 pair)	-Worst backtesting result -Negative performance last year -Largest downside
BANCO SANTANDER SA	BANCO BILBAO VIZCAYA ARGENTA	0,338	-Strongest correlation value (top 2) -Second lowest maximum loss	-Small upside (7,2%) -Second lowest number of zero crosses and second highest crossing period