Trend following in non-symmetric markets

July 2016

In our July 2016 newsletter we wrote about the non-linear and non-symmetric behavior of markets. We illustrated how ignoring these market characteristics can result in the underestimation of portfolio risks. And how this market behavior, when it is taken into account, may actually create opportunities for a diversified trading strategy. The strong performance of our Diversified Trend Program (DTP) around the Brexit referendum illustrates this well. The following text is an excerpt from that newsletter.

Hedging

During the early 2000s there was a popular debate whether CTAs should be categorized as hedge funds. Those claiming against argued: "CTAs are not hedge funds, because they do not hedge." In itself a true remark. The *raison d'être* of futures markets is an exchange of risks, with on one side the risk-averse producers and consumers that want to hedge their supply or demand, and on the other side the (speculative) investors like CTAs that take on that risk expecting to earn a risk premium. As such, CTAs like Transtrend do not hedge.

In any case, 'hedge fund' is a collective term, just like 'pet'. This already makes most remarks about hedge funds rather meaningless. When hedge funds are criticized, it often sounds like: "Pets bite people. So pets should wear a muzzle when they are outside." Now what to do with the grass carps in the pond in your garden? Different hedge funds have different characteristics.[1] But there is one characteristic they have in common: they all do not hedge. And there is a simple reason for that. The only sustainable sources of investment returns are risk premia. Investment managers can hedge some risks, but that can only be to better focus on the risks they aim to exploit. Never invest with an investment manager that claims to have hedged all risks, because that leaves only two possible outcomes: either no return or, more probable, the investment manager runs a risk that he is not aware of. And that will hit the investment once it inevitably shows up.

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[1] We have never had the ambition to be regarded as a hedge fund. An important reason being that the risk profile of most hedge fund styles is completely different from that of DTP.

A diversified investment strategy like DTP is running many different positions. Each of these positions is effectively running many different risks. Any pair of positions can share (or add to) one risk, while partly offsetting (or hedging) another risk. The real challenge of investing is to balance all these risks, without hedging them all away. We aim to be sizeably invested in different trends. But also to be not exposed too much to any single risk factor. And since major trends are often driven by just one or two risk factors, these goals are likely to conflict. In the next paragraphs we will walk through some of the choices we have made in this respect. We will revisit a number of remarks we have made on related subjects in previous newsletters. And we will illustrate how these choices guided DTP through the Brexit-referendum-induced market volatility.

The simple case of two positions

Let's start with a hypothetical position in two markets. Both positions carry risks. Do these positions add to each other's risks? Or do they partly offset those risks? Confronted with these questions, standard practice in finance is to immediately calculate the correlation of (historical) returns of these markets using Pearson's popular correlation measure. This may seem convenient, but before we calculate anything, we should realize that Pearson's correlation measure assumes a linear relationship between the two markets. Whether this is a reasonable assumption depends on the source of the relationship. In financial markets, that source is most of the time a shared sensitivity to one or more common factors. So under which conditions would such a set of shared sensitivities result in a linear relationship? The two most important ones:

1. The sensitivity of both markets to a common factor should be (equally) proportional. This should hold for every common factor.
2. The sensitivity of both markets to all factors should be symmetrical.

Suppose one market is always (proportionally) sensitive to a certain factor, while the other market is not sensitive to that factor, until that factor reaches a certain threshold. Then the first condition would not be met. Does this happen in practice? It sure does. For instance, let the factor be "political discussions about the stability of the European Union". Many European markets are always sensitive to this factor – European politicians bicker every day. But is the New Zealand dollar versus the Japanese yen sensitive to this factor as well? Not until the bickering reaches a certain threshold, for instance when the British vote to leave the EU. Then it suddenly triggers a global risk-off move, which typically includes the unwinding of carry trades, including the popular longs kiwi/yen.

**Graph 1: New Zealand dollar / Japanese yen[2]**

This phenomenon is relevant for risk management purposes. It causes correlations to be higher above a certain threshold, or, in other words, in extreme circumstances. And since risk management should be focused on extreme circumstances, this phenomenon should be taken into account. Because Pearson's correlation does not do that, we had to come up with something more suitable when we started trading DTP. That something became our extreme correlation measure, which still is the backbone of DTP's extreme risk management.

Now let's look at the second condition. Suppose for two hypothetical markets I and II that they will both go up in reaction to factor A. But reacting to factor B, market I will go up and market II will go down. In this scenario there is no symmetry, so the second condition would not be met. And this is not only the case with opposing directions of the sensitivities to the different factors. Consider another hypothetical case: reacting to factor A, both markets will go up, but market I will rise more than market II. And reacting to factor B, both markets will go down, but market II will fall more than market I. Again, no symmetry.

Is this only hypothetical? Let's take the following two markets: the U.S. 30-year Treasury bond and the British pound versus the U.S. dollar.

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[2] Source of price data used in all price graphs in this newsletter: Thomson Reuters, Bloomberg and Transtrend.

Graph 2: U.S. 30-year Treasury bond
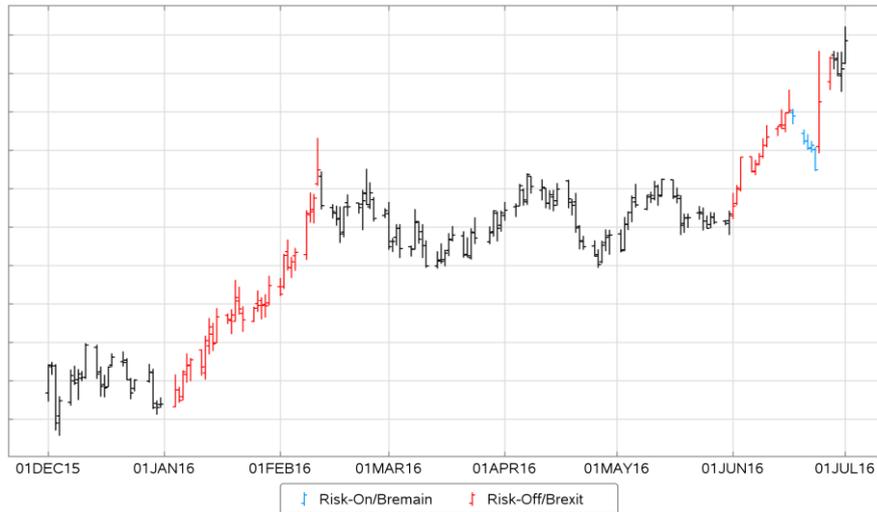
Graph 3: British pound / U.S. dollar

Consider the following common factors:

A. The Fed interest rate policy. Suppose the Fed will cut the interest rate. Or it signals that it will delay the anticipated raising of the interest rate. What will happen? U.S. bonds will rise. And the dollar will decline, so the pound will rise. Factor A: both markets up.

B. The interest rate policy of the Bank of England. Suppose the BoE will cut the interest rate. What will happen now? The pound will decline. And U.S. bond traders will, at least for a short while, think that

because of this rate cut by the BoE, the Fed might delay its next rate rise. So U.S. bonds will rise, albeit not that much. Factor B: U.S. bonds up a little bit, pound down.

C. A global market sell-off. Triggered by disappointing Chinese growth numbers, or anything else that has a similar impact as what happened during the first six weeks of 2016. U.S. bonds are a popular safe haven, so they will rise. The U.S. dollar is also a popular safe haven, so it will rise too, causing the pound to decline. Factor C: U.S. bonds up, pound down.

D. The British vote for a Brexit. This triggers a risk-off move, with U.S. bonds and the U.S. dollar being popular save havens again. And on top of that, the pound will decline. So versus the U.S. dollar it will collapse. Factor D: U.S. bonds up, pound collapses.

Something to keep in mind here is that there is a relevant difference between fundamental factors and statistical factors. Most of the factors mentioned above, including Brexit, are fundamental factors. Brexit, however, is not a statistical factor, if only for the simple reason that we do not have a database available with historical Brexits to draw statistics from. A systematic trading program like DTP can only deal with statistical factors. In practice, the market impact of various in itself different once-in-a-lifetime fundamental factors like Brexit tend to be so comparable that they can be described by one statistical factor that nowadays is often referred to as risk-off. For this reason, in all graphs in this letter, one color (red) is used for typical risk-off periods – the ones during the first six weeks of this year as well as the more or less Brexit-induced risk-off moves in June.[3]

Many other pairs of markets traded in DTP exhibit similar non-symmetry: U.S. bonds versus U.S. stocks, German bunds versus Italian bonds, oil versus gas, corn versus soybeans, coffee versus the Brazilian real, the British pound versus the FTSE 100, etcetera. And therefore, Pearson's correlation measure was banned from our research floor since the very beginning. (Karl Pearson would surely not have objected.) Does that leave us with a problem? Sure, it makes the simple case of two positions more complex. But if we accept the non-linearity and the non-symmetry, we will find our way out of what now appears to be a jungle and explore unknown opportunities.

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[3] The interaction between fundamental factors and statistical factors is similar to the interaction between fundamental analysis and technical analysis. DTP is a purely technical program. But technical analysis starts with choosing the appropriate techniques, meaning techniques that fit the fundamentals. A linear correlation measure like Pearson's does not meet this requirement, so it should not be used in a technical program for this purpose. One should not use a hammer to fasten a screw.

Before we start praising the virtues of non-symmetry for a diversified investment strategy in the next sections of this newsletter, let's first have a closer look at the Brexit referendum itself. Like most other referenda, it had a binary outcome. It was either yes or no. But a binary outcome does not imply a symmetric outcome. What would happen in case of a 'yes' would not be the opposite of what would happen in case of a 'no'. It was not: in case of a 'yes', a lot of EU-jobs would leave the UK versus in case of a 'no', a lot of additional EU-jobs would be created in the UK. It was not: in case of a 'yes', Britain would pay less to the EU versus in case of a 'no', Britain would pay more to the EU. Etcetera. 'No' was the current state; nothing would change. So markets would just go back to normal. In case of a 'yes', however, unknown territory would be entered. Nothing was planned, nothing was prearranged, so no one knew what would happen. But one thing was clear: 'yes' would not be the mirror image of 'no'. This made the referendum in itself already a non-symmetric event. Making it even more grist to the mill of an investment strategy that is designed for dealing with non-symmetric markets.

From a market dynamics perspective, Brexit was not even one factor (with a negative 'sign' standing for Bremain). No, effectively Brexit and Bremain were two opposing factors, with the factor Bremain not only standing for 'no Brexit', but also for that even if there would be a Brexit, it would not impact markets X, Y and Z (for instance the Brazilian real, depicted in graph 4). This also implies that the Bremain factor was not immediately extinguished by the Brexit outcome of the referendum. In fact, this ongoing Bremain factor was the main driver behind DTP's strong performance during the last days of June, i.e. after the referendum.

Graph 4: Brazilian real / U.S. dollar
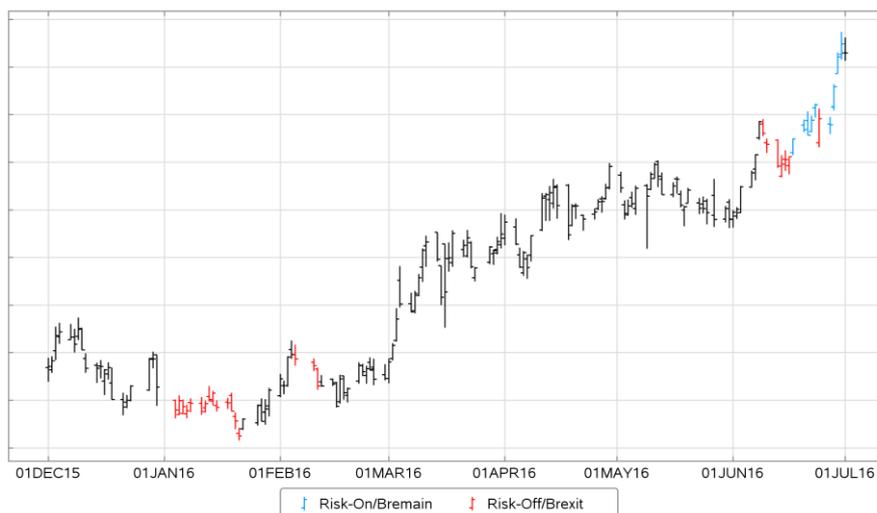
## The less simple but promising case of two positions

What is the beauty of non-symmetric markets? Let's again look at the first hypothetical situation for two markets from the previous section: reacting to factor A, both markets will go up; reacting to factor B, market I will go up and market II will go down. Suppose that for a number of weeks now, factor A has been the dominant factor (with B slumbering), causing both markets to be in an uptrend. A trend following strategy should be long in both markets. But how should positions be sized? That depends on the answer to another question: What are the risks? In this particular situation with two markets and only two factors, two things could happen. Factor A could lose strength or even reverse, in which case the uptrend in both markets will break. Or factor B could strengthen (gradually or suddenly), in which case the uptrend in market I will accelerate while the uptrend in market II will break.

From a risk management perspective, the only relevant factor in this situation is factor A. The common sensitivity of both markets to this factor determines the coinciding losses on both positions in the worst-case scenario. With a linear correlation measure, estimated using the historical returns of markets I and II, the calculated correlation will be an average of a) the positive correlations observed during the periods when factor A was dominant and b) the negative correlations observed during the periods when factor B was dominant. The resulting correlation would therefore underestimate the in this case relevant common dependency. Stated differently: while riding the trend driven by factor A, the risk associated with factor A is underestimated.

However, if we use a non-linear correlation model allowing the relevant correlation to be measured correctly, the picture changes completely. We can size our long positions in both markets such that our total 'bet' on factor A matches the risk associated with factor A. And if factor B would flare up, the impact on the portfolio will be limited. The sensitivity of the position in market II to factor B is (partly) offset by the sensitivity of market I to factor B. This 'hedge' also works if factor B would flare up in the opposite direction.

Let's translate this hypothetical situation into a real life example. Let market I be the 10-year German bund and market II the 10-year Italian bond.

Graph 5: 10-year German bund
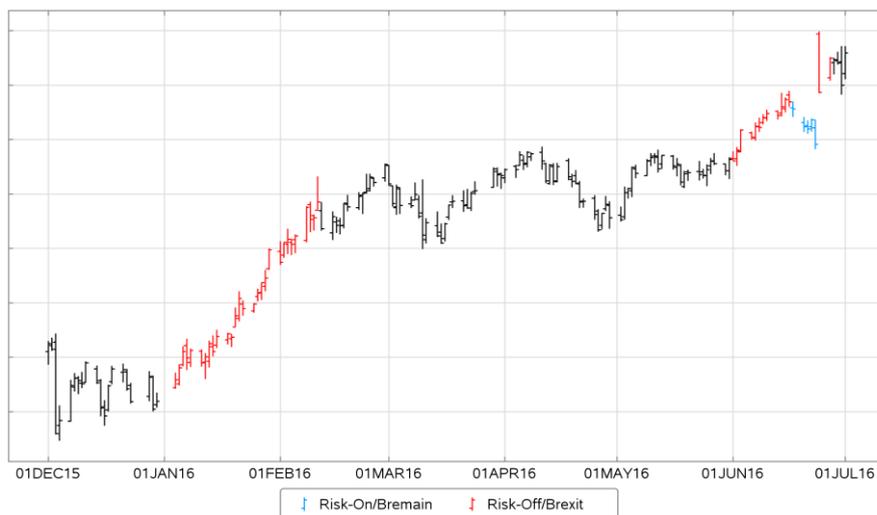
Graph 6: 10-year Italian bond

What constitutes factor A in this pair of markets will be clear: the ECB QE-policy. And let factor B be "doubts about the stability of the Eurozone". The Greek debt crisis in the summer of 2011 illustrated the potential effect of this factor well.

Factor A has often been a dominant factor in the past few years. Also at the start of June, DTP had a large risk concentration around 'long ECB QE'. Longs in the German and Italian bonds where a significant part of that risk concentration. In June, every now and then factor B flared up. This happened for instance in the

second week of June, when markets seemed to be preparing for a potential Brexit. And this also happened, even more fiercely, immediately at the start of trading on Friday 24 June, when the outcome of the referendum was made public. DTP's long ECB QE-position was effectively (partly) hedged against factor B. And over the full month, DTP managed to profit from both its longs in the German bund and its longs in the Italian bond. Here, DTP did not profit from Brexit, but from ECB QE while being (partly) hedged for Brexit.[4]

The even more promising but treacherous case of two positions

Now let's consider the second non-symmetric hypothetical situation for two markets again. Reacting to factor A, both markets will go up, but market I will rise more than market II. And reacting to factor B, both markets will go down, but market II will fall harder than market I. So these factors are somewhat opposing forces. If both factors are active, using a trend following strategy should result in a long position in market I, driven by factor A, and a short position in market II, driven by factor B. Every time (be it an hour, a day or a week) factor A dominates, the portfolio will lose money in market II, but profit more in market I. And every time factor B dominates, the portfolio will lose in market I, but profit more in market II. This is an ideal situation.

This even sounds too good to be true. And as a rule of thumb in investing: when something sounds too good to be true, there must be a hidden risk. And indeed there is. This situation is precisely one of the cases we described in our January 2016 newsletter[5] to illustrate why a standard value-at-risk (VaR) measure is not appropriate for measuring the risk of an actively traded long/short portfolio. Here, the long position in market I and short position in market II make up an implicit spread. When factor A dominates somewhat too long or somewhat too strongly, a trend following strategy could at some point liquidate its shorts in market II. And if subsequently factor B would start to dominate again, the strategy will lose on its longs in market I without profiting from the fall in market II. In that January newsletter we explained how our extreme risk measure (and also our therefrom derived proprietary VaR measure – exVaR) accounts for this hidden risk. At the time we observed: "Every time when DTP is sizeably invested in different trends, often resulting in many implicit spreads, a standard VaR tends to show a significantly lower risk than the exVaR."

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[4] This illustrates why (discretionary) risk measures of the type "let's size down our Brexit risk before the referendum" can be tricky. It could result in lifting a hedge.

[5] An excerpt from this newsletter is available on the 'publications' section of our website (www.transtrend.com).

Being aware of this hidden risk and measuring it, is one necessary element of managing this risk. Another element is to make the strategy less vulnerable to this risk. Reverting to a market situation we described in our July 2013 newsletter[6] to further illustrate this challenge: during the first half of 2013, global markets were dominated by two somewhat opposing factors. A QE-policy-driven risk-on trend in among others U.S. markets, and a 'concerns about the Chinese growth'-driven emerging markets (and commodities) downtrend. DTP held long positions riding the first 'factor' and short positions riding the second 'factor'. We evaluated DTP's behavior in this particular situation and concluded that somewhat too often and somewhat too much, DTP liquidated parts of its shorts in the China factor as the QE factor dominated for a while (for instance during what we described back then as the 'emerging market hump' – many markets driven by the China factor experiencing a short-lived revival between mid-April and mid-May 2013), and it liquidated parts of its longs in the QE-factor as the China factor dominated for a while, which together did hurt the performance of DTP.

This observation inspired us to search for a number of improvements that should make the program less vulnerable to these dynamics. One of the solutions was to improve the robustness of our trend-identification systems, i.e. to make them "less easily wrong-footed by a short-lived [price] hump". Another way to reduce this vulnerability is to use synthetic markets. If in the above example market I and II are traded as an explicit spread, DTP will take a position in the spread instead of in the two outright markets and the two legs will not be broken apart. Other improvements to the robustness of the program were found in the risk management and trade execution layers of the program. Since the summer of 2013, many of these desired improvements of DTP have been thoroughly researched and implemented step-by-step. The fruits of these improvements could clearly be seen in the behavior and the performance of the program around the Brexit referendum.

As explained earlier, Brexit and Bremain are typical examples of two somewhat opposing factors. And in June, DTP held sizeable positions that could be regarded as 'driven by Brexit', as well as sizeable positions that could be regarded as 'driven by Bremain'. This combination of positions contained a lot of implicit spreads. This is reflected in graph 7, which compares a standard 97.7% VaR with the 95% and 99% exVaR (which is an extension of the same graph in our January newsletter). As noted at the time: "If the VaR and exVaR measures would be comparable, the reddish 97.7% VaR should always be somewhere in the middle between the two blueish lines." In practice, it is not. Approaching the referendum, the VaR moves way below

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[6] This newsletter is available on request.

the exVaRs. Exactly what we expect in case of a lot of implicit spreads. And the fact that the VaR remained below the exVaRs indicates that DTP had not significantly been liquidating individual legs of these implicit spreads, despite some periods in which either Brexit or Bremain was clearly dominating. DTP would not have performed so well without the improved robustness.

Graph 7: Various value-at-risk measures in perspective[7]
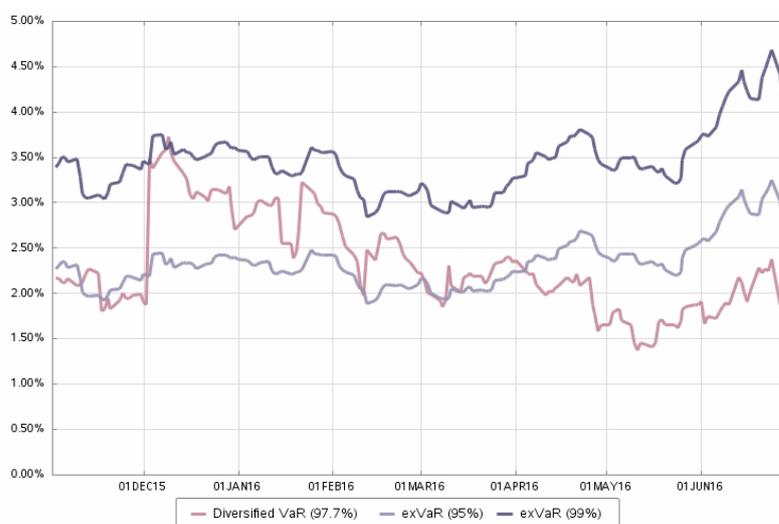
Let's analyze this situation more closely. We can split DTP's positions at the start of June in four categories:

1. Positions that were effective Brexit-positions, meaning positions in trends that were to a large extent driven by (the fear for) a potential Brexit. This included short positions in the British pound versus other currencies, long positions in British interest rate instruments and, even though concerns about the stability of Italian banks were another relevant factor, short positions in European banks (depicted in graph 8).

2. Typical safe haven positions, such as longs in U.S. and German interest rate instruments, long gold (depicted in graph 9), long Japanese yen and long U.S. dollar. Even though the trends in most of these markets were initially driven by other factors than Brexit such as the (assumed) Fed policy, approaching the referendum, Brexit became a driving factor too.

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[7] Source of risk data used in this graph: RPM Risk & Portfolio Management and Transtrend.

3. A large group of typical <u>risk-on positions</u>. These were also almost completely driven by other factors than Brexit, but given their risk-on characteristic, it could be foreseen that a Brexit would have a (most probably only short-term) negative impact on them. This category included various longs in global (non-British, non-financial) stock markets, longs in Italian and Spanish bond markets, longs in emerging market currencies and longs in various commodities. In addition to the Brazilian real (graph 4) and 10-year Italian bond (graph 6), the MSCI Emerging Markets Index depicted in graph 10 also illustrates these market dynamics well.

4. Some positions that were almost completely <u>insensitive to Brexit</u>. This included many positions in synthetic markets that by design are fairly insensitive to more global factors such as 'risk-off'. In these positions, Brexit was effectively hedged away.

To simplify the situation further, we will group together the first two categories as Brexit positions. We will call the third category the Bremain positions. And even though DTP profited from the fourth category in June, we will ignore these positions for now.

As can be seen in most charts used in this letter, the Brexit factor was the dominant factor during the first half of June (red color). Initially, DTP on a net basis profited from these market moves, but that reversed around the second weekend of the month, when losses on Bremain positions outsized profits on Brexit positions. During this period, DTP liquidated some risk-on positions, above all shorts in the Swiss franc, but it showed enough robustness to hold on to the largest part of its Bremain positions. Larger was the impact on the size of the Brexit positions: DTP increased these positions by building up larger shorts in European banks and larger longs in gold.

The second (and more difficult) robustness test took place in the week running up to the referendum, after the murder of Member of Parliament Ms. Jo Cox. Bremain-polls triggered strong reverse-Brexit moves. This resulted in large losses on DTP's Brexit positions, partly offset by profits on Bremain positions which DTP held on to. DTP passed this robustness test successfully – neither the Brexit positions nor the Bremain positions were significantly adjusted.

Graph 8: Stoxx 600 Banks Index

Graph 9: Gold

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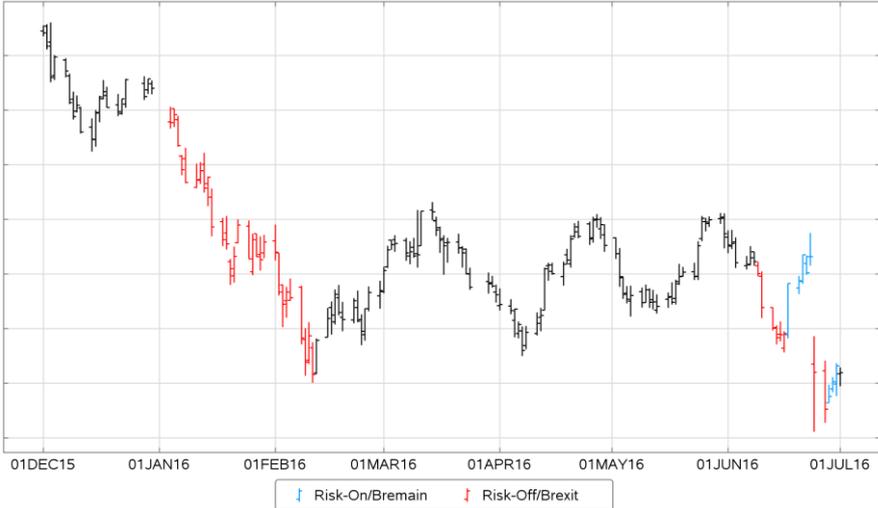
Graph 10: Mini MSCI Emerging Markets Index
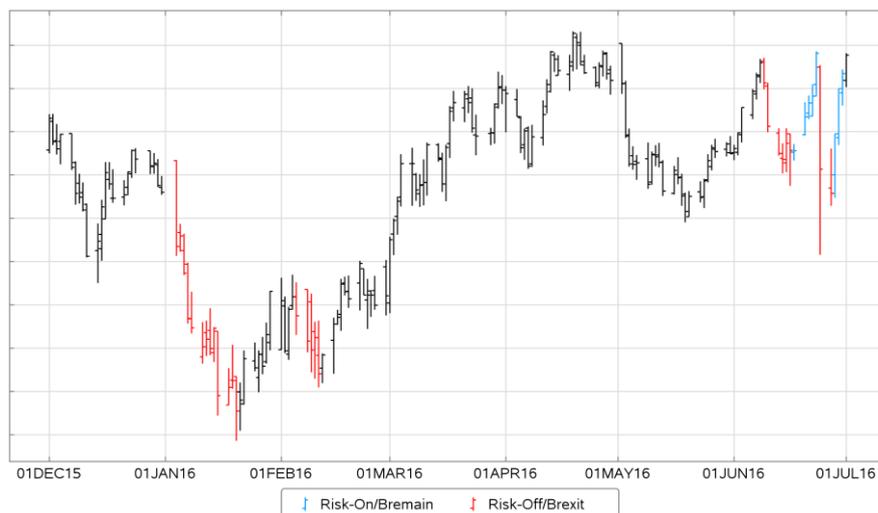
Then, on 24 June, the outcome of the referendum became clear. This immediately triggered huge Brexit moves again (or maybe we should call them: reverse-reverse-Brexit moves). The Brexit positions which DTP held on to, more than made up for their losses suffered earlier that week. But somewhat hidden behind DTP's large net profit on that day were large losses on the Bremain positions. In total, DTP lost roughly 5% on its Bremain positions that Friday.[8] And some of these losses even increased during the next Monday, especially the losses on longs in U.S. equity markets. So holding on to these temporarily losing positions was yet another robustness test. Which all elements of the program passed again. And during the last few days of the month DTP profited the most from the strong Bremain moves with exactly these positions.

The case of more than two positions – and more than two factors

Investing would be a very easy job if the scenarios of two positions as described above would describe all possible scenarios. So easy, in fact, that we at Transtrend probably wouldn't have a job. The real complexity appears when we raise the dimensions to the dimensions of the real world. As the sharp reader will have understood, the crucial element in the analysis above was not the limitation to only two markets or to only

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[8] These dynamics are typical of DTP. On days when markets are very volatile, DTP typically doesn't do well in each and every market. The program instead tends to experience a combination of large gains and large losses. We observed similar dynamics on Black Monday 2015, for instance, when DTP scored a healthy positive return for the day, despite losing in aggregate approximately 4% on various positions.

two positions. No, it really was the limitation to (effectively) only two factors. In real life situations like the period around the referendum, when two (preferably somewhat opposing) factors are dominating most markets, everything still works well. But most of the time we are effectively dealing with more than two factors. In itself, this offers even more opportunities to an investor. To profit from these opportunities, however, is less straightforward than in the two-factor case. The resulting portfolio dynamics are littered with paradoxical situations, often rooted in the non-symmetry of markets. This makes investing a constant challenge; it continues to invite wondering, learning and developing.

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