Carry and Consequence: Understanding the Recent Resilience of Emerging Market Currencies.

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Abstract

This research paper is intended to place the strong performance of emerging market currencies of late into global context. While our analysis includes a global set of currencies, our case study will be on the South African rand. The rand's recent appreciation came despite the local economy being plagued by political uncertainty and low growth, worrying state capture allegations and the unceremonious firing of two esteemed finance ministers. Ultimately, this also culminated in a series of costly credit rating downgrades. Despite this, the currency displayed unexpectedly high levels of resilience and continued strength. In this paper we explore the fortuitous timing of both a global risk-on sentiment and attractive carry prospects for the rand during this turbulent time, and argue that it helped to ensure its value were kept afloat. Our study extends to EM currencies as a whole, across the development spectrum, where our findings suggest that global risk appetite and carry trade played an unexpectedly sizeable role in determining Emerging Market (EM) currency movements, globally, and that individual country idiosyncracies were far outweighed by these factors. This challenges traditional thinking surrounding the role and core importance of local fundamentals in determining spot rates, with the latter having effectively been rendered the rabbit in a horse and rabbit stew. The ultimate implication of this, however, holds a particularly worrying message in store for the future of currencies like the rand - while it has benefitted from positive carry trade forces of late, the build-up of these positions might well have created underlying currency fragility. If current calm global conditions with high yield differentials were to change in the near future, we might see an opposite effect through an unwinding of carry positions - which would arguably have a far greater bearing on the currency than local political or economic developments in coming months.

Keywords: Principal Components Analysis, Elastic Nets Regressions

JEL classification C38, G15, F31

1. Introduction

In this note, we explore the main factors contributing to the high levels of currency co-movement experienced globally. This will be explored in two parts. First, by focusing on emerging market (EM) currencies, we utilize dimension reduction techniques that enable us to gauge the extent to which global factors underpin movements in these currency spot returns. We find, unsurprisingly, that since 2000 there has been a clear and consistent increase in the aggregate co-movement of currency pairs versus the US Dollar (as has been reported for most asset classes during this period as well). The homogeneity peaked during the large scale US quantitative easing programs, but

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have since the start of 2016 continued trending upward. Thereafter, we utilise dimension reduction techniques to estimate the extent to which a small subset of common (global) components explain EM spot returns over time. We also use these representative global components so identified and study its association to various macroeconomic and financial indices. This is done in an attempt to gauge what the key drivers of EM spot return co-movements are during different periods in our sample.

Next we focus on the rand, a currency that was expected by most analysts to be particularly exposed to weak fundamentals and deteriorating economic conditions. We apply statistical models to gauge the extent to which its movements can be explained by various global and local factors. We conclude from this analysis that the majority of movement in the rand tend to be explained, firstly, by global factors (in particular related to risk), and also factors influencing its attractiveness as a carry instrument. We deduce from this that the rand's unexpected resilience since 2016 could, despite controversial political decisions, speculation of state-capture, general economic malaise and a looming recession, largely be explained by factors outside of our own borders. While this might not be a surprising finding in and of itself, it is striking for two reasons. First, the *amount* of weekly spot return variation explained by a few key global components are unexpectedly high, to which we provide statistical evidence. Second, many currency analysts and economists overstate the impact that local political developments and economic indicators would have on the value of the rand. This is evidenced by the consistently inaccurate projections made over the last two years, particularly since the rand bottomed out on January 11 2016 to the USD. The rand subsequently strengthened by more than 23% for the 12 months thereafter.[1] This was largely unexpected, as evidenced by the Bloomberg aggregate analyst currency forecast estimate[2] at the time suggesting the rand had very limited upside potential, despite the already sharp weakening through most of 2014 and 2015, and improving EM sentiment and commodity prices at the time. The analysts polled by Bloomberg at this time, on aggregate, predicted the spot rate to be at R16.10, R16.23, R16.25 and R16.50 to the USD for the remaining quarters of 2016. The rand, in contrast, recovered to well below R14 to the USD by Q4 of the same year, defying the general negative sentiment to the currency at the time. In 2017 analysts once again underestimated the resilience of the rand underpinned by global factors, following then finance minister Pravin Ghordan's highly unpopular sacking and subsequent rating downgrades. Our findings here suggest, in contrast, that global factors and changes in overall risk-sentiment played (and continue to play) an outsized role in determining the value of the rand, and other EM currencies, in a global economy where capital flows are yield starved and portfolio managers increasingly risk tolerant.

Our conclusion is that the rand has been kept afloat largely as a result of this higher risk appetite from within yield depressed developed markets (DMs), combined with the rand's relative attractiveness as a carry instrument. This serves as an illustration of the extent to which EM currencies are at present more reflective of attractive yield

[1] During this period, the rand became one the best performing (albeit most volatile) of all major currencies for the rest of 2016 and early 2017.

[2] Bloomberg surveys roughly 50 analysts from different institutions to arrive at their estimate, which is widely regarded as a good proxy for the market's aggregated view.

prospects, as opposed to underlying country fundamentals. This benefit to EM currency valuations possibly comes at the cost of forward stability if risk appetite should wane in coming months. Our note should thus serve as both an explanation for the recent unexpected resilience of EM currencies, and in particular the rand, as well as a caution to future EM currency stability following from the source of said resilience. Our suggestion to portfolio managers are thus to look past the short term local political and economic noise, which explain at most a small part of shorter frequency spot movements. Instead, focus should be on the factors affecting global capital movements, in order to assess the likely direction of EM currencies.

2. Why Do Currencies Change Their Spots?

2.1. Can Theory Explain?

In theory, forecasting exchange rate changes should be a simple exercise. The uncovered interest parity (UIP) theory suggests that exchange rates should fully reflect the interest differential between countries.[3] Price differentials across borders should also, it is theorized, provide an anchor for spot rate determination (termed the Purchasing Price Parity theory). Yet, as bluntly put by Rogoff (1996), warm and fuzzy feelings toward these intuitively appealing theories cannot replace hard evidence. As practice has shown, the standard textbook theories explaining exchange rate movements ignore a much more complex and opaque set of influences that determine such movements. This has led to the creation of various puzzles (or anomalies; see Froot and Thaler (1990)). In fact, for over three decades a central puzzle in the financial literature has been the inaccuracies of forward exchange rates in forecasting future spot rates (this puzzle has over time neither been arbitraged away, nor shown any sign of losing its appeal in academic studies). Most studies find a surprisingly sizable negative bias when studying the forward discount anomaly, implying currencies with a forward premium tend to depreciate (c.f. Froot and Frankel (1989), Engel (1996), Lewis (1995), Maynard and Phillips (2001) and Burnside et al. (2010) for reviews of earlier and more recent literature. Also see Clarida, Davis, and Pedersen (2009) for a particularly interesting discussion on this topic).

While various theories have been proposed attempting to explain why theoretic models and forward rates fail to account for what determines spot returns (Lewis (1995) details time-varying risk premia, peso-problems and market inefficiency effects), to date the efforts have not led to a concise and accurate means of forecasting exchange rates (see Sarno and Taylor (2002) for a detailed breakdown of the theories put forth and empirical evidence of exchange rate determination).[4] What is clear, though, is that from the perspective of countries with floating currencies, like the rand, measurable influences on the exchange rate can be classified broadly into global and local

[3] The strong form of UIP implies that a regression on exchange rates when including the interest differential should yield a unit slope with a zero intercept.

[4] Some evidence have been suggested for the predictive power of interest differentials over high frequencies (such as intra-day), as for example shown by Chaboud and Wright (2002), but this is presumably of far less importance to the majority of economic participants and portfolio managers apart from those speculating on short-term spot movements.

(idiosyncratic) factors. This simple classification, however, belies the complexity of measuring the same. First, analysts tasked with forecasting spot returns face the daunting prospect of accurately identifying relevant global and domestic factors. Second, and most importantly, the arduous task then remains of weighting the importance of these factors on the currency being forecast. As both these inputs vary considerably over time, forecasting a freely fluctuating currency exposed to international capital flows is an exceedingly complex task (as evidenced by generations of economists providing exchange rate forecasts with accuracy that often resemble a random process). This is complicated even more by the additional impact of speculative trading based on technical analysis and behavioural traits, all culminating in the perceived ability of currencies to deviate from their fundamental levels[5] for extended periods.

In this note, we study the distinction between global and idiosyncratic factors in influencing currencies across the development and liquidity spectrum. Our focus is on identifying the common narrative behind what has been driving global spot returns over the past decade and a half, and harnessing this information to shed some light on the components driving EM currencies', and in particular the South African rand's, unexpected resilience of late. Being highly exposed to improving global risk sentiment and a search for yield has been a source of strength to EM currencies of late, notably as high interest differentials have made it an attractive carry instrument, despite highly heterogenous political stability and economic conditions.

2.2. What Carries a Currency?

Carry trade refers to a trading strategy that exploits cross-country interest rate differentials. This involves borrowing (going short) assets in a low-yielding currency to fund the purchasing of assets in a high-yielding target currency. If the interest differentials are not simply off-set by equal depreciation (as expected under UIP), investors earn carry returns, which have been shown to be surprisingly high and persistent over time.[6] Such carry trades are particularly attractive and profitable where interest rate differentials are high and currency volatilities are low. The effect of carry positions typically is asymmetric - often contributing to the strengthening of target currencies (with high interest rates) *vis-a-vis* funding currencies (with low interest rates), beyond UIP predictions.

Since the start of 2016, carry has re-emerged as an attractive strategy.[7] This can be seen simply by admiring the performance of the popular Deutsche Bank cross-currency carry trade ETFs for both the G10 and wider global currency basket, which has provided investors with welcome returns in an otherwise low yield environment (returning at the time of writing 7.06% and 13.76%, respectively, since January 20 2016). This has coincided with easy monetary policy conditions and relatively large DM-EM yield differentials, and a global risk-on environment

[5]These levels are itself highly contentious and variable.

[6]Other sources, such as Burnside et al. (2010) and Gourio, Siemer, and Verdelhan (2013), devote more to outlining possible explanations for why this effect tends to persist than we are offering here.

[7]Measuring the true extent of carry is a particularly difficult exercise, as outlined in Evans and Rime (2017). We will forthwith consider the attractiveness of carry as a proxy to its use, as opposed to calculating an approximate measure thereof.

(as can be viewed by, for example, persistently low equity and G10 currency market implied volatilities), which have created particularly fertile conditions for carry flows to higher yielding EM currencies. In fact, this has served to keep the value of several EM currencies afloat (notably the three R's, the Russian ruble, Brazilian real and South African rand, which appreciated by 19.09%, 25.75% and 14.27%, respectively, since January 2016), despite significant local political and economic pressures in several of these economies.

2.2.1. The Carry Contest

Below we use a simple exercise of estimating which of our studied currencies would have been most attractive from a carry perspective over the last few years. We follow Heath, Galati, and McGuire (2007) (and various others) in defining a currency's attractiveness to carry by dividing the interest differential with respect to a specific funding currency (for example the USD) by a measure of the target currency's implied volatility. Our measure for the aforementioned are the 1 month deposit interest differentials and the three month daily realized downside-deviation measure.[8]

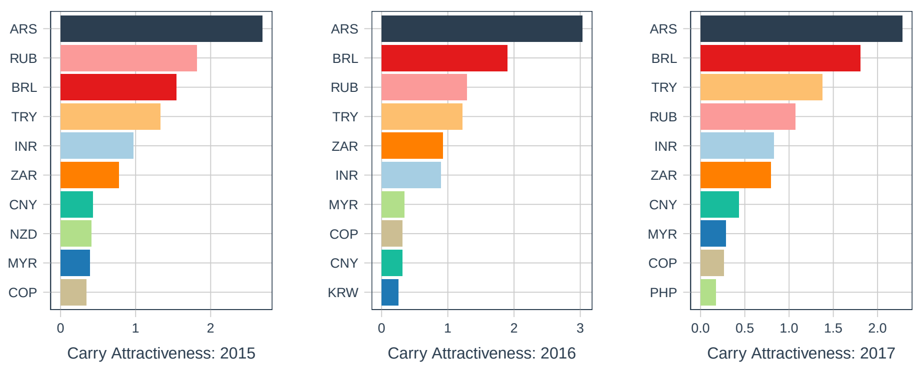

Figure 2.1: *Carry Attractiveness: USD Funding Currency*

Figure 2.1 suggests that the rand has been one of the most attractive carry prospects for global investors in recent years (see Figures 7.2 and 7.3 in the Appendix for, respectively, attractiveness from a Yen and Euro funding currency perspective). This follows despite the high levels of currency volatility during this period that was also experienced by the ruble, real and the lira. Liquidity is also an important carry consideration, which scores in favour of the rand, ruble and real (the Argentine Peso ranks significantly lower on currency liquidity scores, as well as on its fixed income credit rating scores. Coup attempts and subsequent capital controls might be largely to blame for the lira not benefitting more from the present favourable carry conditions.).[9] The Argentine peso and Turkish lira both

[8] Although Heath, Galati, and McGuire (2007) use currency option implied volatility estimates, we are instead opting for using a measure of "unattractive" downside volatility to reduce our measure of carry attractiveness. See Figure 7.1 in the Appendix to compare the use instead of IV in the carry attractiveness denominator.

[9] See Bank For International Settlements (2016, 10) for more information on the liquidity estimates for these and various other currencies.

experienced significant depreciation since 2016, and will thus be excluded from this defined carry group,[10] which consists, for the purpose of simple exposition, of the rand, ruble and real.

3. The Global Currency Tango

In this section we study currency co-movements globally and how it has evolved over time. First, we consider bi-variate co-movements as illustrated in Figure 3.1 below. It displays the spot return correlations[11] of currencies relative to the US Dollar. Figure 3.1 is interpreted as follows. The proximity of the variables to each other represents the overall magnitude of their correlations[12], while the width and transparency of the lines connecting the spot bubbles represent the strength of correlations (wider and less transparent lines imply stronger correlations). The webs correspond to the periods between 2000 - 2010, 2010 - 2013, 2013 - 2016[13], and Jan 2016 - Sep 2017, while Table 7.1 in the Appendix defines the spot exchanges abbreviated below.

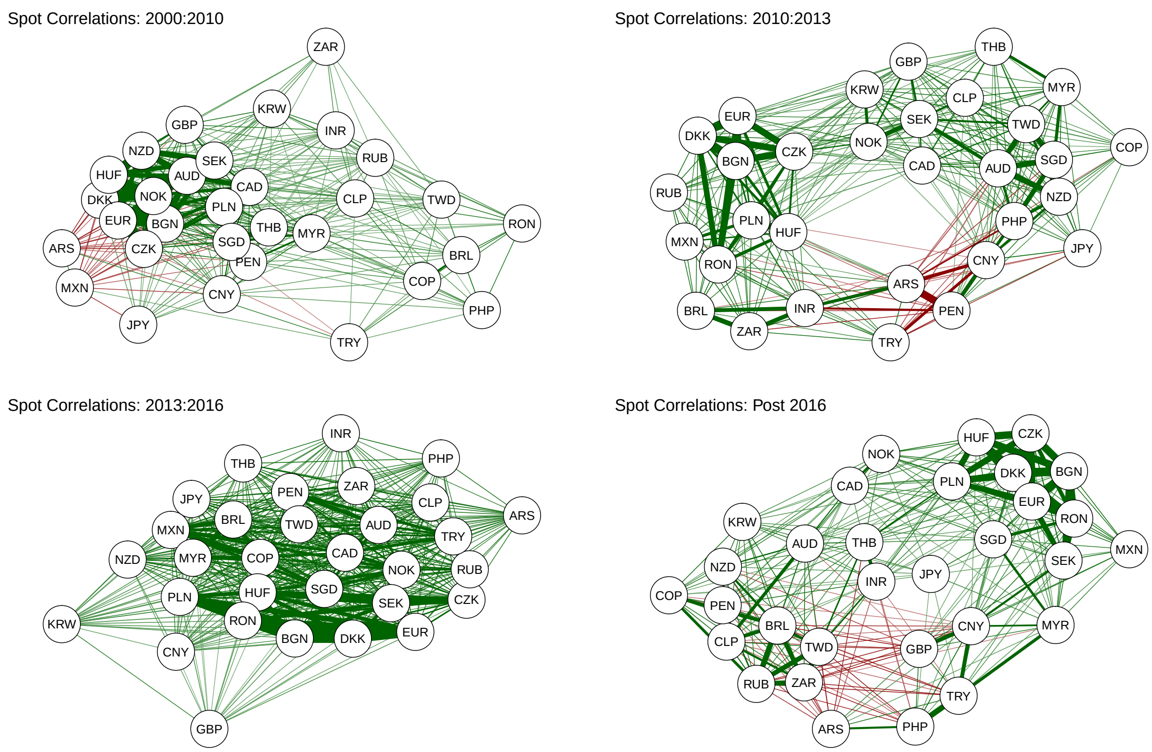

Figure 3.1: *Weekly spot return correlation web*

[10]At time of writing, the peso and lira depreciated by approximately 35.23% and 33.03%, respectively.

[11]Throughout the remainder of this report, all spot returns are calculated on a weekly frequency (Wednesday to Wednesday closing) to limit noise and account for non-synchronicity of explanatory variables considered later.

[12]The positioning is handled by multidimensional scaling of the absolute values of the correlations. We also use 40% as an inclusion cut-off point.

[13]The start of the 2013 - 2016 period corresponds to the unprecedented high level of liquidity injected into the US market by the QE3 program. In December 2012, the US Fed increased the open-ended purchases to $85 billion per month. These purchases were halted end of 2014.

From Figure 3.1, we note the following. First, the rand's inter-dependence with other exchange rates has noticeably evolved over time. Before 2008, the correlations between EM currencies were much lower and arguably driven more by local idiosyncrasies. After 2010 we see several EM currencies become more intertwined, with the ZAR tracking more closely the EUR spot rates and displaying less proximity to the pound (GBP) than before. The period between 2013 and 2016 was characterised by unprecedented levels of quantitative easing in the US, culminating in a general homogenization of asset price movements (and currencies) as a result of the QEIII capital injection.

The period since 2016 showed close proximity of the rand to other EM- and commodity exporting (CE) currencies since 2016 (particularly between the rand, real, ruble, the Chilean peso, and the Aus- and NZ dollar, over this period). It is particularly interesting to note the lack of proximity between this group of currencies and the pound, euro and yen, which, together with the dollar, were likely prominent carry funding currencies considering the low domestic yields in these economies. These increased co-movements between EM and CE currencies could also be attributed to increased optimism toward these regions that were buoyed during this period by cyclical recoveries in Brazil and Russia, expectations of improved earnings yield potential in India and China, and improving and more stable (albeit still low) commodity prices.

In addition to the changing correlation structures, one needs to also consider the distribution of each of the spot returns. This follows as several of the currencies display a high concentration around the mean, while others (notably the rand), exhibit fat tails and skewness (such distributional characteristics will be hidden without its explicit consideration as correlation estimates do not convey level change information). This can be clearly compared in Figure 3.2 below. Notice that in these distributions, the left tail signifies appreciation (and *vice versa*):

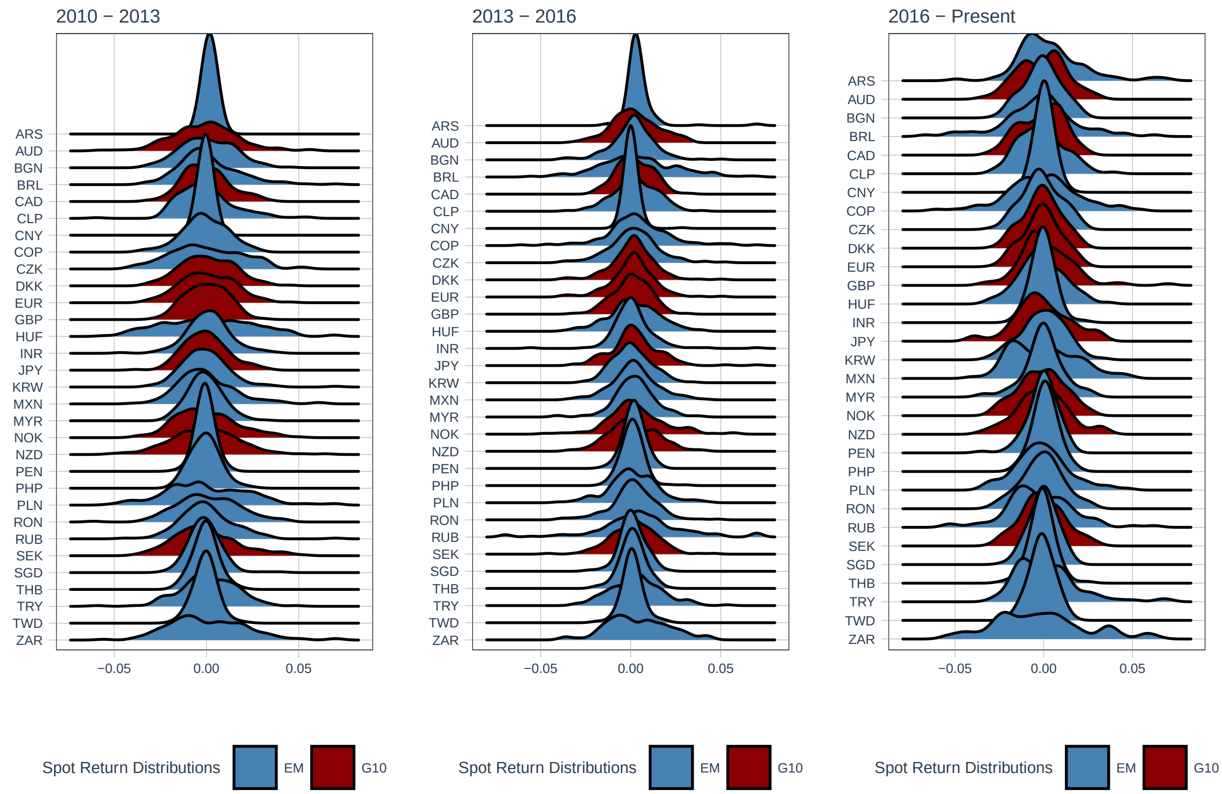

Figure 3.2: *Weekly spot return distribution comparison*

From the distribution plots above, note the striking multi-modality of the rand (and the other carry currencies) since 2016, which speaks of the very high levels of realised volatility. It also suggests that, as a general rule, when speaking of the rand, rubel or real's projected future movement, it must always be done within the context of the economic regime that is expected to prevail. Also, when studying the factors that influence these currencies, it must likewise be done either in a time-varying manner or after stratifying the sample according to some measure that would likely influence the shape of the distribution plotted above. For this reason our deeper analysis on EM currency movement in section 5.1 is done after stratifying according to implied equity volatility and a proxy for EM sentiment. Failure to do so would likely lead to spurious results due to the clear incomparable nature of the different periods under consideration.

We next utilize dimension reduction techniques that would serve to facilitate our inference as to the actual level of multi-dimensional co-movement over time. Our focus will thereafter turn to the rand and how local and global factors determine its direction.

4. Patterns from Noise: Dimension Reduction

4.1. Principal Components Estimation

Using Principal Components Analysis (PCA) to reduce the dimensionality of a complex and inter-connected system is a well known and widely applied technique in the financial literature. First suggested by Karl Pearson in 1901, and later expanded upon by Harold Hotelling in the 1930s,[14] PCA transforms a set of information (N-variables) into a set of linearly orthogonal (independent) components, called Principal Components (PC). The transformation procedure is done such that the first linear component explains the majority of variance in the original dataset, with each succeeding orthogonal component explaining less than each preceding it, to which it is orthogonal. The dataset is therefore transformed into N-linearly independent components each explaining a unique and decreasing proportion of the variation in the initial set (ultimately adding up to 100% of the variation explained). This is a particularly useful transformation procedure as it reveals the internal dependency structure of our initial dataset.[15]

Throughout we use centered and scaled weekly spot returns vs the USD, $S = (s_1, ..., s_N)$,[16] for the currencies listed in Table 7.1 in the Appendix. Please note that we exclude the G10 currencies so as to allow us to focus on EM currency co-movement. From this set of EM currencies, we then calculate the corresponding sample covariance matrix $C = S^T S/N$, which can be represented in terms of its eigen-decomposition:

$$C^T C = V D^2 V^T \tag{4.1}$$

From this we define the eigenvectors, v_i (the columns of V), as the Principal Component directions of the spot returns. This can also be used as weights (after adjusting for earlier scaling and centering) to construct each individual PC index. The downside, however, to this approach is that the components themselves have no meaningful interpretation other than conveying the level of commonality in variation.[17] To overcome this, we include various supplementary variables (given in Table 7.2 in the Appendix) in our analysis that will offer us insight into what the

[14] These canonical papers are: Pearson, K. (1901). "On Lines and Planes of Closest Fit to Systems of Points in Space". Philosophical Magazine. 2 (11): 559–572. & Hotelling, H. (1933). "Analysis of a complex of statistical variables into principal components". Journal of Educational Psychology, 24, 417–441, and 498–520.

[15] This process can be understood intuitively as follows. Suppose we have 5 variables that are correlated. We can then use a PCA procedure to determine how much of the variation in the dataset can be attributed to a single (or subset of) component(s). PCA would in this example produce 5 orthogonal components, which are each a linear combination of the 5 variables. If, for example, the first component explained 90% of the variation, it implies that the 5 series are closely linked, and that 90% of the total variation in the dataset is due to a single component. If, on the other hand, each of the 5 series were completely independent (uncorrelated) - each component would only explain a fifth of the variation (i.e. each component explains exactly one series' variance).

[16] We do centering and scaling as PCA is not a scale invariant procedure. Failing to do so would imply exchange rates with larger spot returns would have a higher impact on the net result. This is particularly important noting the differences in the return distributions shown in Figure 3.2.

[17] This follows as the PC indices are linear combinations of the variables in the information set, here spot returns, and offer no insight into what *causes* the common variation.

derived PC indices represent. Supplementary variables, in turn, do not influence the loadings or results of a PCA procedure, but are rather projected onto the results drawn from the active variables (the currency spot returns).

Below we calculate the PC indices on a rolling two year basis for our set of currencies. This implies for each week in our sample, we take the preceding 104 weeks, do the PCA decomposition and then save the eigenvectors and eigenvalues. We use these next to construct time-varying PC indices that explain the movement of our currency set over time.[18] Figure 4.1 below then has a straightforward interpretation: it is the amount of variation in our dataset, on a 104 week rolling basis, that can be explained by the first three common components through time. It is particularly striking to see the high level of common spot return co-movement, that we described earlier, between 2013 and 2016 (and can be seen clearly in Figure ??). Also note the gradually increasing level of co-movement after 2016.

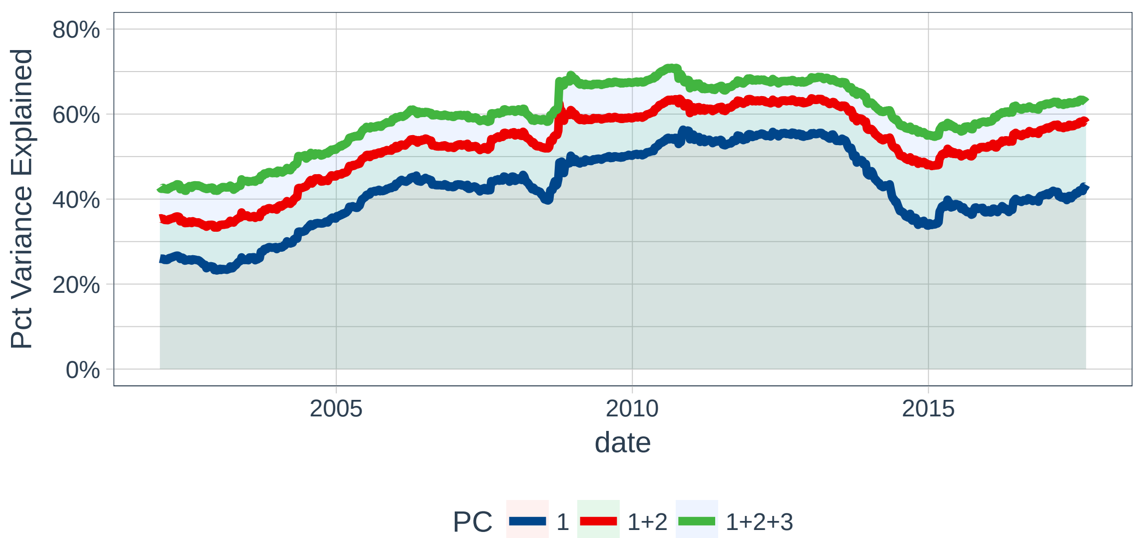

Figure 4.1: *Rolling 104 week PCA cumulative variance explained by PC1 : PC3*

From Figure 4.1 above we see that over the last two years nearly 45% of EM currency variation can be attributed to a single common component, while nearly 60% and over 65% of the variation in EM currency spot returns can be explained by the first two and three components together, respectively. This is a surprisingly high amount of commonality in the weekly spot returns of EM currencies.

Below we give a visual representation of the range of loadings found on a time-varying basis for our included supplementary variables. Notice that we have grouped the indices below according to their type.[19] The loadings

[18] We confirmed the validity of the inclusion of all the currencies in our set using the Kaiser, Mayer, Olkin (KMO) test.

[19] TOT: Terms-of-Trade; IV: Implied Volatility; FI: Fixed Income; Comdty: Commodity Indices; Infl: Inflation; Risk_CDS: default risk as proxied for by aggregate CDS indices.

below refer to the correlation with each respective index included, and each of the time-varying component indices derived from equation 4.1. As the PCA process has no absolute interpretive value in the sign of the component loadings (only relative to one another), we preserve the aggregate sign information and consider otherwise the absolute loadings at each period (before multiplying by the majority sign). This gives us an indication of the 104 week loadings range of the included factor indices on our estimated component indices over time (with the dot indicating the sample mean loading, and the line the 20th and 80th percentile boundaries):

Figure 4.2: *Rolling 104 week supplementary variable barbell plot along PC1 : PC3.*

Figure 4.2 produces some interesting insights. First, note that PC 1 (which describes consistently about half of EM currency movements as seen in Figure 4.1) is highly correlated to measures of global risk. In particular, the global aggregate bond index, the performance of equity indices and commodity indices all load strongly on this component. Most compelling, though, is that the dollar strength index (BBDXY) and the CDS spread index (ITRXTX51) loads significantly and consistently onto this component, implying we can treat PC 1 rather safely as a global risk-appetite component.[20] Also interesting to note is the sizeable and opposite direction loading of the EM currency index (MXEF0CX0), which highlights the duality in movement between DM and EM asset classes as risk tolerance evolves over time. In fact, the dollar and EM strength indices have a high, negative correlation of roughly -0.7.

The second component, which describes consistently about 15% of EM spot return movements (and during the last 2 years described close to 20%) is particularly of interest for the present study. We tend to accept intuitively the impact that global risk factors have on currency movements (particularly toward higher risk EM locations), but what is often less appreciated is the sizeable influence that the changing importance of yield differentials have on such returns. We see from Figure 4.2 that the DB Global Carry Indices (DBHVGUSI and DBHVG10U), as well as the EM bond indices (JPEIGLBL and BEMS) and the EM REITS index (MXWO0RE) all load strongly onto PC 2. This component index can then be interpreted as the carry component, particularly also noting the lack of loadings from commodity indices and the risk components we referred to for PC 1.[21]

This interpretation of the PC indices is interesting from the perspective of the changing level of variation explained by component 2 *vis-a-vis* component 1 (as noted in Figure 4.1). In particular, in the risk-on environment, as experienced over the last year and a half, we see that currency carry became an increasingly important component in describing EM spot returns. This clearly speaks of the increased attractiveness of yield differentials offered by EM currencies contemporaneous with a higher appetite for risk taking, which created fertile ground for the movement of funds to EM regions. This, combined with our earlier observation of the multi-modality of the rand, underscores our earlier statement for the need to consider the movement of the rand within the context of the period it is in.

For this reason, we consider next the 104 week time-varying index loadings for the main indices discussed above. These include the respective EM and USD currency strength indices (MXEF0CX0 and BBDXY); the DB Global Carry Index (DBHVGUSI), which proxies for the attractiveness of currency carry strategies; the CRY commodity index, used to describe the attractiveness of a specific basket of commodity exporting assets, the JPMVXYGL and JPMVXYG7 indices, measuring DM and EM currency stability, respectively; and also the MXEF and SPXT (SP500) indices, to approximate the attractiveness of EM and US equities, respectively. For each of these, we plot the time-varying loadings of each index's weekly returns series onto PC 1 and 2 below:

[20] The reader should not be confused by the use of the Dollar strength index, despite the USD denominator in the spot exchange rates. This follows as the spot returns used in defining the component indices all have the USD in the denominator, effectively neutralizing the relative dollar movement. The BBDXY index rather reflects factors that cause a movement either toward or away from safe haven assets priced in USD. Also note that increases in these indices imply a strengthening of the dollar, and increased CDS risk, respectively.

[21] We expect the loadings onto a carry component to reflect in equity indices as well (particularly those of the EM type, such as MXEF), as this would be one of the vehicles (in addition to properties and FI instruments) to hold for positioning carry strategies.

Figure 4.3: *Rolling Factor Index Loadings: PC1 and PC2*

From Figure 4.3 we note that the first principal index is a clear and consistent reflection of global risk appetite. This is evidenced by the consistency and strength of the dollar- and EM strength indexes, as well as the CDS spread index's loadings. As the importance of global risk-sentiment on the movement of capital into EM regions, generally, is well documented and clearly understood, arguably of more interest is the changing loadings onto component 2.

We see from Figure 4.2 that the second component has become increasingly important and concentrated toward the end of our sample. In the build-up to the GFC we see large loadings onto the carry index (DBHVGUSI), as well as a strong and opposite loading onto the currency stability indexes (JPMVXYG7 and JPMVXYGL). Note that this coincides with the well documented build-up of EM currency carry positions at this time (c.f. BIS (2007) for a detailed account of this). The figure then also shows that since mid-2015 we see similar loadings onto the second component, which is indicative of another build-up of carry positions. This follows as the combination of loadings from the carry index and currency stability indexes clearly underscore the second component's sensitivity toward features that make carry more attractive.[22] The sobering message from the BIS (2007) report at the time had been that a sudden disruption of then contemporaneous stability and risk-on factors would likely precipitate a strong EM carry unwind. Today we face the same prospect, as evidenced by the even greater importance the carry component in underpinning EM currency movements. A trigger event that could upset the prevailing global asset market stability and risk-on environment may well, similar to what transpired in 2008, cause a concerted and costly unwinding of EM carry positions.

As a robustness check to the above and to shed more light specifically on this latter point, we next stratify our sample to consider loadings during different periods of equity implied volatility and economic stability. This ultimately allows us to consider which currencies are likely the most sensitive to a coordinated unwinding of carry positions should asset managers globally seek to reduce inherently risky carry positions.

5. Stratifying our sample

In addition to truncating our sample on a rolling two year basis, we also include an overview of the loadings as stratified according to proxies for market stability and EM sentiment. We do so by comparing, firstly, values above the upper 80th and below the lower 20th percentile of the VIX index[23], which is an approximation of perceived global equity market stability. We also stratify according to the widely reported Citi Economic Surprise Index for Emerging Markets (CESI-EM), which is used to assess the impact that economic sentiment would have on the index loadings discussed before.[24] We report the mean loadings of several key factor indices onto the first three components for the respective stratified periods in Figures 5.1 to 5.3 below. We also supply a table (Table 5.1) indicating the overall index returns for each stratified period. This can, in turn, be combined with the figures preceding it (Figures 5.1 to 5.3) to approximate each factor's influence on EM currency returns during each stratification. These effects will be interpreted in detail below.

[22] As explained in the introduction, currency carry is more attractive where yield differentials are high and currencies stable.

[23] The CBOE VIX Index shows the market's expectation of 30-day volatility as implied from a wide range of SP500 options. This index is widely used as a barometer of expected asset market stability globally.

[24] The CESI indices can be defined as weighted historical standard deviations of economic data surprises from consensus forecasts. Positive values indicate that economic releases have on balance been beating consensus, while the converse also applies.

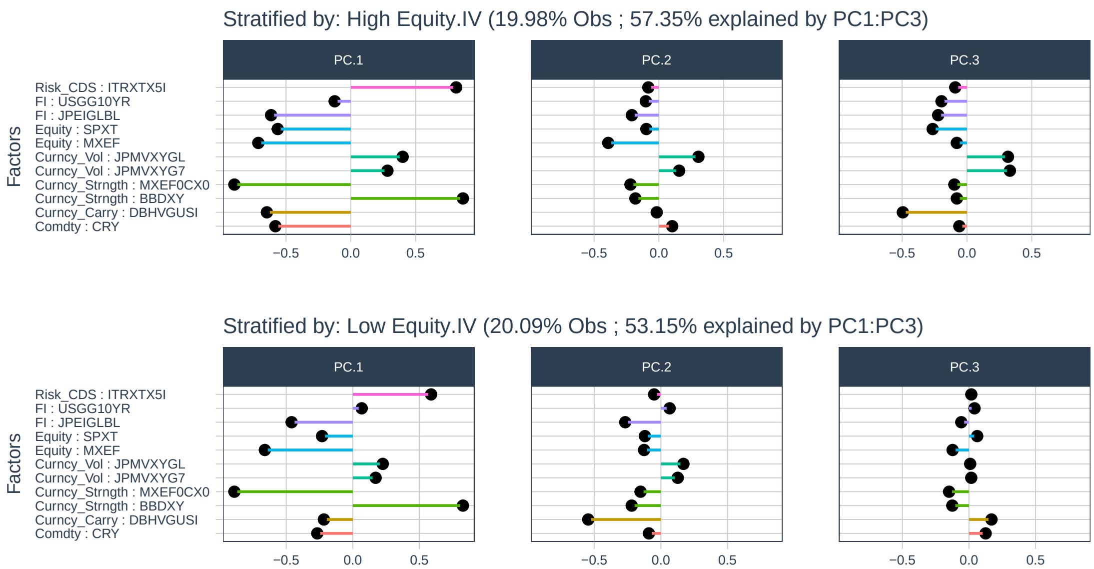

Figure 5.1: *Equity IV Stratified Loadings: PC1 - PC3*

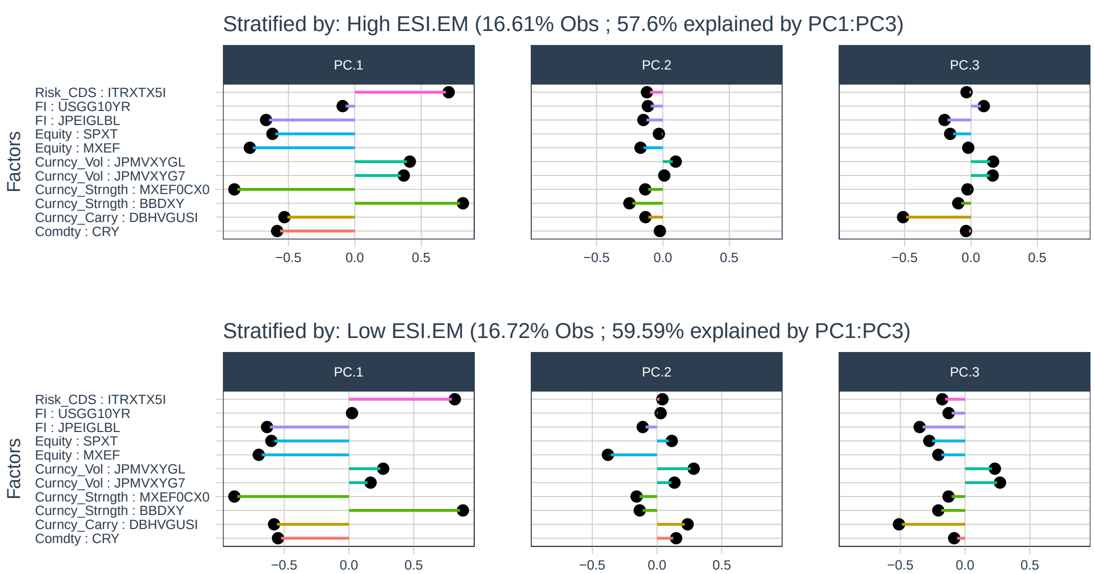

Figure 5.2: *CESI-EM Stratified Loadings: PC1 - PC3*

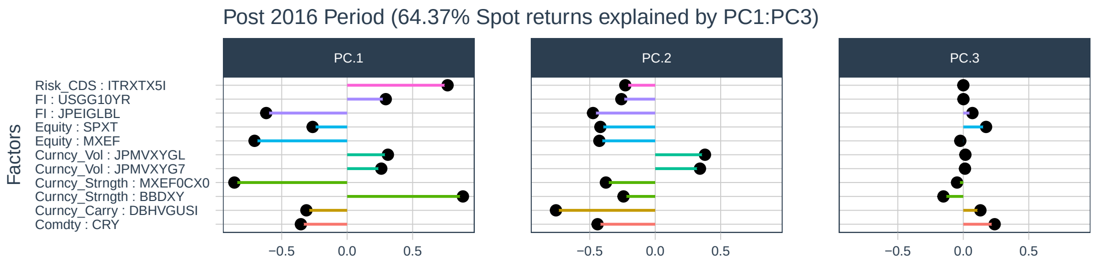

Figure 5.3: *Post 2016 Loadings: PC1 - PC3*

Index	Equity IV High	Low	CESI EM High	Low	Post 2016 Return
BBDXY	15.1%	2%	-16.8%	16.3%	-6.1%
CRY	-57.8%	5.3%	28.2%	-22.3%	1.1%
DBHVGUSI	-40.9%	40.3%	11.3%	-2.5%	7.5%
ITRXTX5I	45.8%	-27%	-37.7%	-13.5%	-16.4%
JPEIGLBL	-1.1%	41.6%	56.2%	28.7%	19.5%
JPMVXYG7	630.8%	-41.7%	-56.5%	-35.6%	-10.8%
JPMVXYGL	532.7%	-47.5%	-53.6%	-37%	-17.2%
MXEF	-82.5%	302.6%	78.2%	26.9%	37.5%
MXEF0CX0	-18.3%	41.1%	32.7%	4.4%	12.7%
SPXT	-80%	180.6%	35.4%	34%	23.4%
USGG10YR	-32.8%	-9.1%	-9.4%	2.4%	-9.1%

Table 5.1: *Stratified Net Returns Comparison: Equity IV, CESI (EM) and Post 2016 Period*

From the equity IV stratified loadings we make the following observations. We note that during periods of high equity IV, the global CDS spread (ITRXTX5I) and dollar strength (BBDXY) indices load heavily onto component 1. This indicates, as before, the strong depreciating impact that negative global risk sentiment has on EM currency movements relative to the dollar. The JPEIGLBL (EM Bond) index also loads strongly onto component 1, and experienced an overall contraction in value. This suggests that when the VIX is high, flight-to-safety behaviour has a significant depreciating influence on EM currencies as their respective bond instruments are viewed as less attractive conduits for hedging risk (note for comparison the significant reduction in yields of the US 10 year instruments, USGG10YR, showing strong appreciation). Similarly, EM equities also experienced a sizeable contraction during high VIX periods, with the high loading on component 2 suggesting that the first two components are both functions of global risk-off sentiment influencing capital flows. Considering the carry index (DBHVGUSI), we note that it loads primarily onto the first and third components, with a large net negative return suggesting a net depreciating effect on EM currencies. From this we can posit that exploiting yield differentials not only becomes a much less attractive strategy when VIX is high, but that many portfolio managers choose to unwind such positions when risk sentiment is negative. This is underscored by the high positive loadings and returns of the currency volatility indices (JPMVXYG7 and JPMVXYGL) on components 1 and 3, which further highlights that the implied risk underlying existing carry positions could become untenable to many portfolio managers. The strong effect, particularly on EM currencies, can also be gleaned from the large depreciation of the EM currency strength index, MXEF0CX0 (-18.3%), compared to the strongly appreciating dollar index, BBDXY (15.1%). Overall, the stratified loadings suggest that global risk-off and carry-push factors play key roles in explaining nearly 60% of EM currency movements when the VIX is above its 80th percentile.

For periods of low implied volatility, we find the opposite to most of what applied for periods of high VIX. Notice, in particular, the change in fortunes of the dollar index (2.6%) and EM currency strength index (39.9%) when compared to periods of high VIX levels. The impact of a global risk-on sentiment on EM currencies is further evidenced by the sharp decrease in the global CDS spread index, while EM equities experienced a significant contemporaneous appreciation. In addition to the capital flows to EM regions in such a global risk-on environment, generated by lower perceived risk, we see global currency implied volatilities contract significantly too. This creates a particularly fertile environment for exploiting carry yields, which is verified by the large loading of DBHVGUSI on the second component (notice that for the first and third components the effect is neutralized, implying the effect is largely focussed on the second component), combined with the large positive overall returns of the carry index. Thus a large part of the strength in EM currencies, experienced when the VIX index has been comparatively low in our sample, can be explained by global risk-on sentiment and the carry-pull factor (which can arguably be attributed to the confluence of attractive yield differentials, more stable spot returns and an inflation of EM asset valuations, which together, imply particularly attractive carry prospects).

During periods where EM economic data, on aggregate, outperformed consensus forecasts (CESI-High periods), we see again much of the strengthening of EM currencies (32.7% overall) and corresponding dollar weakness (-16.8%) occur as a result of prevailing risk-on sentiment. We deduce this from the component loadings, as well as the high EM bond- and equity index returns (approximately 56.2% and 32.7%, overall, respectively). We also see that with improving EM sentiment the carry index loads strongly onto component 1 and 3. This, together with the DBHVGUSI (carry) index's positive overall returns, can be interpreted as sentiment having a sizeable carry-pull effect on EM currency movements when said sentiment improves.

During periods where EM economic data disappointed, on aggregate, we see only a modest reduction in the DBHVGUSI index. EM currencies also did not experience an overall depreciation (as experienced when VIX is high), nor did the EM-bond or -equity indices contract during low CESI-EM periods. Our interpretation of this is that periods of negative EM sentiment, resulting from weaker fundamental data, have less of an impact on EM capital flows, and by extension exchange rate valuations, than corresponding periods of global risk aversion (as proxied for by high VIX). This would imply that weaker EM fundamentals matter less to the direction of flow of capital than a general risk-off sentiment, which generally precipitates significant EM capital outflows. We concede, though, that this latter interpretation is debatable due to the implicit assumption that the VIX and CESI provide accurate proxies for global risk- and EM sentiment levels, respectively.[25]

Lastly, if we consider only the period since January 2016 we see that the generally positive EM sentiment and stable markets (from January 2016 to September 2017, the VIX index has been below its 17 year 20th percentile level for 55.4% of the time.) have been associated with higher EM bond and -equity valuations, lower currency implied volatilities and a strengthening of the EM currency index. We also see from the loadings that the carry-pull factor has been particularly strong on component 2. To the extent that 59% of EM currency movements over this period could be explained by only the first two component indices, we argue that since January 2016 a general risk-on sentiment and attractive carry return prospects can be credited with explaining the majority of stronger EM currency spot returns.

5.1. Stratified predictive efficacy?

While the previous section is illuminating in shaping our understanding of the drivers of EM currencies, broadly, the focus of this section will be on explaining the EM currency's movement over the above stratified periods. In doing so, we run the following regressions for each currency (including G10 currencies) in our sample, and aggregate the results to place the rand's movement into global perspective:

$$S_{i,t} = c + \beta_{idiff}(i_{US} - i_i) + \beta_{PC1}(PC1) + \beta_{PC2}(PC2) + \beta_{PC3}(PC3) \tag{5.1}$$

where $S_{i,t}$ is the weekly spot return for currency i at time t versus the dollar, while β_{idiff} accounts for the US interest differential as highlighted in the introduction. PC1 - PC3 are the Principal Component indices defined earlier. After fitting we compare the predictive accuracy for these regressions (as measured by the R^2) for the global average as well as the rand. We also stratify according to the following time-periods below:

- **Pre-GFC**: Jan 2000 - Sept 2008 ; **GFC**: Sept 2008 - Jan 2010 ;
- **Post-GFC**: Jan 2010 - Jan 2013 ; **Pre-16**: Jan 2013 - Jan 2016 ;
- **Post-16**: Jan 2016 - Sept 2017

The full regression results are summarized in the Appendix in Table 7.7.

[25]CESI-EM stratification also does not distinguish between periods of corresponding higher and lower US- or global CESI index values.

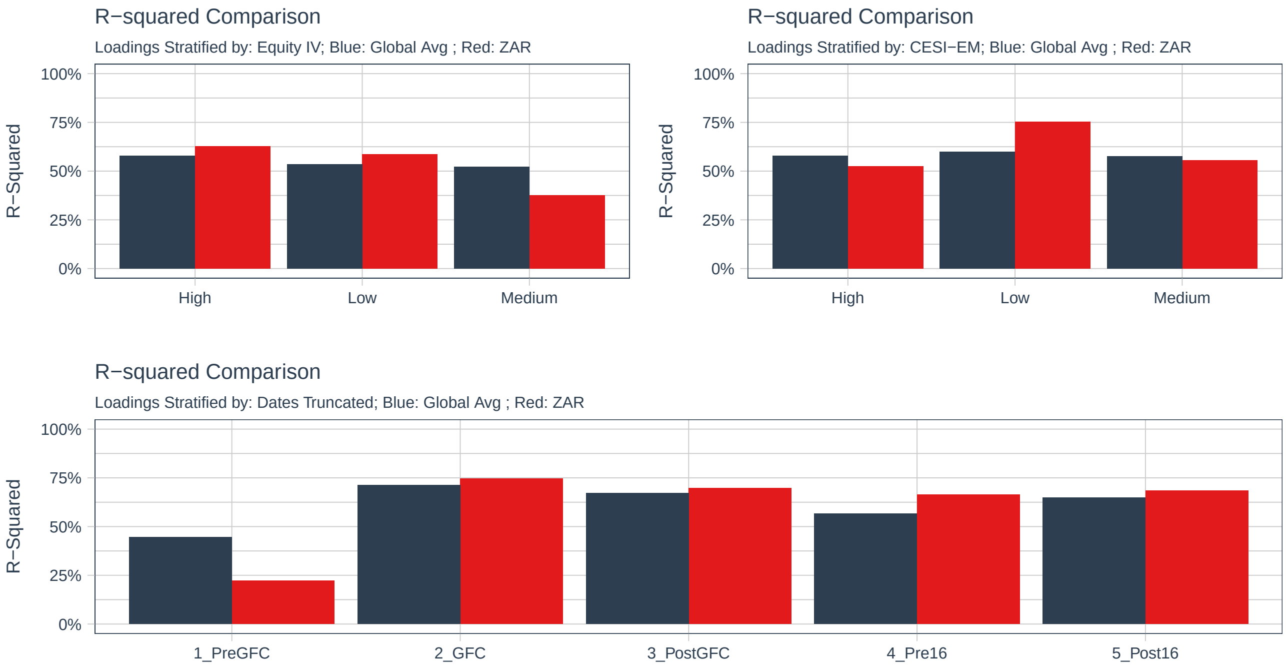

Figure 5.4: *Stratified predictive efficacy when including PC1 - PC3*

From the figures above, notice how high the predictive efficacy are for the rand and global currencies on aggregate, when considering only the three PC indices and interest differentials from equation 5.1. This echoes Figure 4.1's interpretation that the majority of EM currency spot returns are well explained by a small set of global factors. We also see for the rand that after the GFC there has been a clear structural break in terms of the importance of global factors in determining the direction of the currency. While this has been the case for other currencies as well, it is far more pronounced for the rand.[26] Notice also from Tables 7.7 to 7.9 the negative coefficients of the interest differential term for all the regressions. This is in line with the anomalous findings in the literature on UIP theories, mentioned in the introduction (see Clarida, Davis, and Pedersen (2009) for a deeper discussion on this).

Our results suggest that during periods of high equity implied volatility, the rand's spot returns are particularly well explained by the first three components. Table 7.7 in the Appendix shows that most of this explanatory power for the rand falls on the first and third components (having strongly significant and positive coefficient signs). This is particularly insightful when considering the loading directions in Figure 5.1 and net return directions in Table 5.1, combined with the significant third coefficient falling largely on the carry component. Together, this can be interpreted as suggesting that during periods of high implied volatility, much of the rand's experienced depreciation can be explained by unwinding carry positions. In comparison, the impact of this carry unwinding is significantly more pronounced on the rand when compared to the other currencies studied (the median coefficients for our global

[26] Only TRY, PEN, CNY and ARS had lower R^2 estimates during this period.

set of currencies studied on PC1 to PC3 are 0.64, 0.14 and -0.01, respectively. The rand also has an outsized sensitivity to the carry-push component (PC 3) relative to the other carry currencies referred to earlier, the ruble and real).

In contrast, during periods of low IV, or relative stability (as largely experienced since 2016), we see again the same first and third component split for the rand, although now with opposite signs, while the second component explains very little (and is statistically insignificant). Notice that this once again implies that the rand's movement during these periods are strongly determined by the global risk-on sentiment and particularly the carry-pull effect. The carry component's loadings in Figure 5.1 multiplies out with the coefficients in Table 7.7 to produce a strong appreciating effect on the rand, which is significantly above the impact on its global currency counterparts (with the EM median coefficients being 0.54, -0.017 and -0.08, respectively). However, as compared to the other carry currencies, the carry pull factor is slightly less strong on the rand, but still globally comparatively high.

For periods where EM economic data surprise on the positive side (high), we see that the rand once again shows high sensitivity to the global risk-on component 1, and the carry-pull third component. In particular, the third component's coefficient is significantly higher than both the global median, as well as that of the other carry currencies. The converse also applies, with the rand suffering comparatively more from weaker sentiment toward EM countries, as also indicated by the very high R^2 value (over 75%). In fact, the rand's high negative coefficient to the third component (suggesting sensitivity to carry) of 0.35 contrasts strikingly to the EM median loading to this component of -0.02, when CESI-EM is low.

Taken together, this implies that both the appreciating and depreciating influence of the carry-component during periods of high and low CESI values (EM sentiment) and high and low VIX periods (global risk-sentiment) seen for EM currencies, generally, are particularly pronounced for the carry currencies and specifically the rand. The rand can therefore, unsurprisingly considering its relative attractiveness as a carry currency depicted in Figure 2.1, be regarded as highly sensitive to factors influencing said attractiveness.

Since January 2016, the carry-pull effect has been particularly pronounced for the rand (as hinted at in the introduction). Notice the strong appreciating impact on the rand from the global sentiment and carry components as seen by the high and significantly positive coefficients on PC1 and PC2 from Table 7.9 in the Appendix. Together with Figure 5.3's loadings on the carry index, this clearly suggests once again a larger appreciating influence on the local currency compared to its global currency counterparts (having coefficients of 0.69 and 0.13, respectively for PC 1 and PC2). Also, roughly 70% of the rand's weekly movements since January 2016 can be explained by the first three global components and the US interest differential alone, highlighting how little influence local idiosyncrasies have had on the rand during this period.

Our findings above highlight the high levels of sensitivity the rand has relative to its EM peers to factors influencing global risk perception. The amount of variation in the local currency's returns so explained suggests analysts forecasting the rand's movements during periods of risk-on or risk-off (or similarly EM optimism or pessimism) should largely focus on predicting the persistence of the same, as opposed to focussing mostly on local idiosyncrasies. Considering the low levels of equity market IV and general EM optimism since January 2016 to present, the resilience of the rand despite domestic political and economic turmoil, rating downgrades and serious allegations of misappropriation of state funds, can largely be attributed to global factors driving capital flow during this period. In fact, one can quite plausibly conclude that the rand was blissfully carried above the domestic noise by global forces simply reacting to highly favourable carry return conditions and a general risk-on mood during this period.

5.1.1. What explains STEFI?

In what follows we validate our above claims that the most important factors in explaining the rand during periods of market stress / calm and positive / negative sentiment are global (and also carry push- and pull-) factors. In this concluding exercise, we consider the predictive power of our earlier estimated PC indices at explaining the STEFI.[27].

If our earlier interpretations are correct, then the domestic yield curve, and in particular its short end, should play a key role in determining the value of the rand through its direct impact on its attractiveness as a carry instrument. The anecdote typically offered by the market is that local bond yields and the currency are closely related, but that international factor impacts are more difficult to disentangle. Our view agrees with the first half of this statement, but relates this directly to the impact of international capital flows. We prove this point by expanding our earlier regressions on the rand defined in equation 5.1 by including various other possible explanatory variables (listed in Table 7.3), as well as the first three component indices. We make use of elastic nets regressions to fit these equations.[28]

Our results, summarised in Table 7 in the Appendix, confirms that the STEFI is a core component explaining the value of the rand. Note that it loads consistently and highly, with the regressions' R^2 values also significantly raised (compared to the already high R^2 values depicted in Figure 5.4). This warrants a closer examination of whether the PC indices also explain a similarly large amount of the STEFI's weekly changes. This follows as it should act as a robustness check to our above interpretations, as the STEFI should also be similarly driven largely by global factors if that is truly the case for the rand. To test this conclusion, we run regressions similar to that which was defined in equation 5.4 (although we now exclude the yield differential term), with the target variable now being the

[27] The Short Term Fixed Interest Index (STEFI) measures the performance of the short-end of the yield curve, effectively considered the benchmark for cash equivalents up to 12 months in South Africa.

[28] We omit a deeper discussion of elastic nets here. Readers interested in the theoretic foundations of elastic nets can consult Friedman, Hastie, and Tibshirani (2010) and Friedman, Hastie, and Tibshirani (2001). Also see the condensed discussion of these techniques at: http://web.stanford.edu/~hastie/TALKS/enet_talk.pdf. We make use of the glmnet package in R, maintained by the referenced authors. For the sake of brevity, we note that the technique effectively limits the effects of multi-collinearity via regularisation, as well as renders the analysis less sensitive to outliers via robust (L1) methods. We select the Lambda that gives the minimum mean cross-validated error, using a default of 10 fold cross-validations.

weekly returns of the STEFI. From the R^2 estimates depicted in Figure 5.5, we note that the principal component indices also explain a great deal of movement in the STEFI's weekly returns.

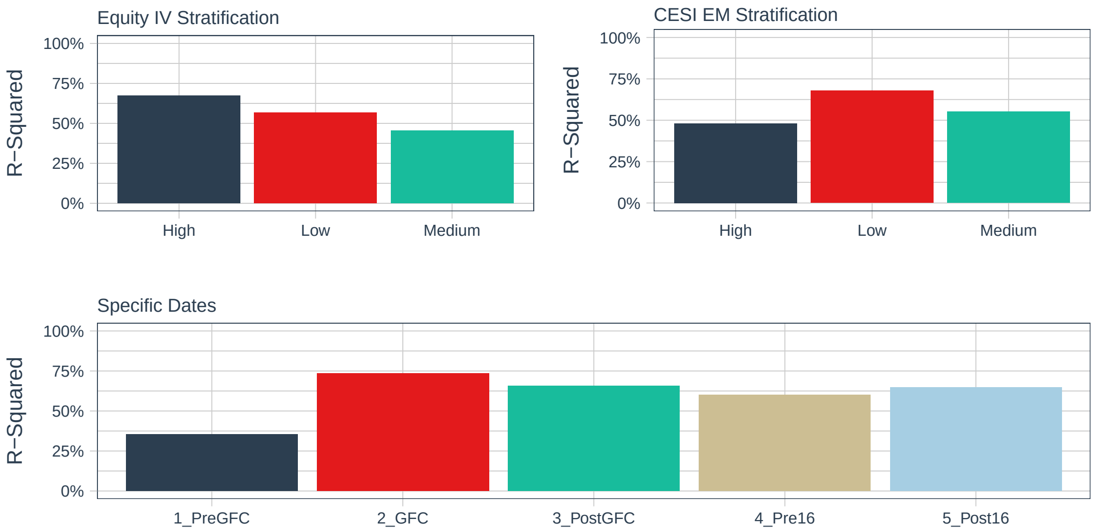

Figure 5.5: *STEFI: Explanatory power of PC1 - PC3*

The high explanatory power of the global PC indices in determining the STEFI tie into the previous section's discussion on the importance of global sentiment and the carry push- and pull factors on the rand. This underscores our interpretation of earlier results suggesting that in order to understand what is driving the rand, we need to focus more attention on unpacking the factors that will drive capital flow and make the carry-trade aspect of the rand attractive in the future. As shown in Figure 5.5, these factors also directly affect the STEFI (and are rather similar in their explanatory power of the rand, as shown on Figure 5.4). We also provide the following insightful figure, speaking to the importance of foreign bond purchases in driving the STEFI, and thereby exerting its influence on the rand. Figure 5.6 depicts the one year rolling daily correlations between the South African Bond Flows (SABO) index, which measures the net sales of bonds to foreigners, and daily changes to the STEFI, as well as the 5-year interest swap (SASW5, of which we take the inverse).

Figure 5.6: *Rolling 12 Month Correlation: SABO and STEFI, and SABO and 5Yr Swap*

Notice from Figure 5.6 the higher level of correlation after 2013, with the level once again picking up after January 2016. Most recently, the 12 month level of correlation has peaked above 20% for both, which is a clear sign of the influence that foreign bond flows and sentiment has on the value of both the STEFI and SASW5. We thus postulate that the effect of improved global risk sentiment since January 2016 has exerted a strong positive influence on the rand, cushioning much of the projected negative impact on both from poor local fundamentals during this period.

6. Conclusion: the Consequence of Carry?

The question that we want to address, in conclusion, is what the potential consequences are (if any) of the fortuitous carry-pull benefit that befell EM currencies over the last two years. Much has been made, e.g., of the rand's resilience despite credit rating downgrades, general economic malaise and explosive revelations of the extent of state fund mismanagement since the firing of former finance minister Nhlanhla Nene in December 2015. Economists during this time speculated, without much accuracy, that the likely impact on the rand, should any of these events transpire, were to be dire. Similar pessimistic views were generally held toward the rubel and the real, as well as various other EM currencies that faced weak fundamentals and had serious political challenges during this time. It is clear now, in retrospect, that such assessments ignored the strong influence that an improving global risk appetite and the generally favourable carry yields would exert as it served to carry these fragile currencies above the domestic noise. For the rand, economists became wedded to a view that politics and ratings narratives would ultimately burst through even an EM carry rally – which with hindsight was wrong. It is also worth noting that our results echo that of Polakow and Flint (2015), who show that South African equities were similarly driven largely by global factors and that an understanding of local idiosyncrasies have proven of less value than typically assumed.

While the positive carry effect highlighted in this study might seem like a pure windfall for several EM currencies, most notably the rand, rubel and real in the context of local developments, it comes at the cost of exposing these currencies to possible future volatility and downside risk as a direct result. Specifically, the rand could face sharp reversals if changing global factors reverse the attractiveness of EM currencies, precipitating a possibly destabilising unwinding of carry positions. An example of the effect that such an unwinding could have on currency valuations occurred at the onset of the Global Financial Crisis (GFC). The build-up of EM carry positions was well documented in the Bank For International Settlements (2007) report a year before, with sharp reversals subsequently following from September 2008. The global DB carry ETF (DBHVGUSI), for example, lost 27.87% in just over two months from peak to trough. Other examples of costly carry-reversals include EM reversals from May-June 2007, the Icelandic Krone in February 2006 and the Yen-USD in October 1998.

Unfortunately, several plausible scenarios could be suggested that might precipitate such a carry reversal. DM economic conditions and inflation forecasts could start improving markedly, thereby placing upward pressure on DM yields as the decade long spell of uniquely accommodative monetary policies start tightening (the rand has shown heightened sensitivity to any news possibly suggesting the same, as evidenced most recently in response to the Fed's September suggestions of rate hikes toward year's end). Global sentiment toward risk might also change relatively abruptly considering the plethora of geo-political risk factors that can quite easily trigger a sentiment reversal. Going forward, portfolio managers should consider weighing these global factors influencing carry attractiveness and risk-on sentiment more highly than local political and economic factors, at least in coming months. This does not discard the impact that local news or economic data should have on EM currency projections (indeed it would be foolish to believe that disruptive political actions and economic stagnation would have no influence), but rather failing an abrupt change in global risk-on sentiment, we believe local factors would remain the rabbit in a horse and rabbit stew to EM currencies.

7. Appendix

List of Currencies considered

Country	ShortName	Spot	Group
Russia	Ruble	RUB	EM
South Africa	Rand	ZAR	EM
Peru	Sol	PEN	EM
Columbia	Peso	COP	EM
Brazil	Real	BRL	EM
Chile	Peso	CLP	EM
Taiwan	Dollar	TWD	EM
India	Rupee	INR	EM
Thailand	Baht	THB	EM
Philipines	Peso	PHP	EM
China	Renminbi	CNY	EM
Argentina	Peso	ARS	EM
Singapore	Dollar	SGD	EM
Romania	Leu	RON	EM
Bulgaria	lev	BGN	EM
Czech	Koruna	CZK	EM
Hungary	Forint	HUF	EM
Malaysia	Ringgit	MYR	EM
South Korea	Won	KRW	EM
Poland	Zlotly	PLN	EM
Mexico	Peso	MXN	EM
Turkey	Lira	TRY	EM
Norway	Krone	NOK	G10
UK	Pound	GBP	G10
EU	Euro	EUR	G10
NZ	Dollar	NZD	G10
Canada	Dollar	CAD	G10
Denmark	Krone	DKK	G10
Japan	Yen	JPY	G10
Sweden	Krona	SEK	G10
Australia	Dollar	AUD	G10

Table 7.1: *Currency Spot Information*

List of Factor indices considered

Index	Description
CO1	Brent Crude Oil
XAU	Gold Spot
GC1	Gold Spot Futures
BCOM	Bloomberg Commodity Index 1 M Fwd
USCRWTIC	Oil WTI Spot
CRY	TR/CC CRB Excess Return Index (average of commodity futures prices)
SPXT	SP500

Continued on next page

Index	Description
SXXE	EURO Stoxx
MXWO	The MSCI World Index (free-float weighted)
TJA30U	All Africa Ex ZA
MIRUREIT	MSCI World Real Estate
MXWO0RE	MSCI Emerging Markets REITs Trust USD
M1WDEWGT	The MSCI ACWI Equal Weighted Net Index
MXEF	Emerging Markets Index
JPEIGLBL	JPMORGAN EM BOND INDEX
MXEF0CX0	The MSCI EM Currency Index
GTEUR10Y	Current EU 10Y Bund
USGG10YR	US 10Y Bond
VIX	VIX
V2X	Euro VIX
CESIEM	EM Citi Econ Surprize Index
CESIUSD	US Citi Econ Surprize Index
CESIEUR	EU Citi Econ Surprize Index
CESICNY	China Citi Econ Surprize Index
G7FXVOL3	EW of G7 currency 3M Implied Vols ATM
CTOTCNY	Citi TOT China (Positive: export prices out-performed import prices)
CTOTUSD	Citi TOT US (Positive: export prices out-performed import prices)
USGGBE10	US Break-even Inflation rates 1 YR
FWISEU55	EU Inflation swap 5y5y
FWISUS55	US Inflation swap 5y5y
US0012M	Libor 12 M Index
EPUCGLCP	Global Economic Policy Uncertainty Index (Baker Bloom Davis)
EPUCNUSD	US Economic Policy Uncertainty Index (Baker Bloom Davis)
EPUCCEUM	EU Economic Policy Uncertainty Index (Baker Bloom Davis)
BBDXY	USD Strength (basket of ten leading global currencies vs USD)
EUR003M	EU 3M Bond Index
US0003M	US 3M Bond Index
EMUSTRUU	Bbg Barclays EM USD Hard Currency Agg TRI (EM debt benchmark)
JGAGGUSD	JPM Global Aggregate Bond (TR, Unhedged USD)
BGSV	Bloomberg Global Developed World Sovereign Bond
BRIT	Bloomberg UK Sovereign Bond
FEDL01	US Federal Funds Effective Rate
BEMS	Bloomberg USD Emerging Market Sovereign Bond
USGG3M	US Generic Govt 3 Month Yield
GTEUR3M	Generic Eurozone 3M Govt Bond
ERIXITEU	Markit iTraxx Europe Main 5-year Excess Return
ITRXTX5I	iTraxx Crossover 5 Year Total Return
JPMVXYG7	Aggregate volatility in currencies of G7, three-month ATM forward options
JPMVXYGL	Aggregate volatility in currencies of EM, three-month ATM forward options
DBHVG10U	G10 Carry Index (The Deutsche Bank Currency Harvest Index)
DBHVGUSI	Global Carry Index (The Deutsche Bank Currency Harvest Index)
DBPPPUSF	Global Currency Value Index (Deutsche Bank)
DBMOMUSF	Global Currency Momentum Index (Deutsche Bank)
SAVIUSD	SA JSE Dollar Rand Volatility Index
SAPMI	SA BER PMI
SACBLI	SA Leading Indicator Bus Cycle
SACTGDP	SA CAD
SAEQ	SA Eqty Sales to Foreigners
SABO	SA Bond Sales to Foreigners

Continued on next page

Index	Description
ALBIP	SA Bond Yield Index priced in Dollar
STEFI	Stefi index
JIBA3M	SA 3M JIBA
GTZARII10Y	SA Generic 10Y Yield
TOP40TR	JSE Top 40
J433PR	SWIX ALSI
J430PR	SWIX top40
JALSHTR	JSE All Share
RESI20TR	JSE Resources 10
INDI25TR	JSE Industrial 25
FINI15TR	JSE Financial 15
JSMLC	JSE Small Cap
MIDCAPTR	JSE Mid Cap
JSAPYTR	JSE Listed Property
SAGGBE10	SA BE Inflation
SATBAL	SA Balance of Trade
REPSOU	SA CDS
SASW10	Interest Rate swaps
SASW5	Interest Rate swaps

Table 7.2: *Currency Spot Information*

Local indices considered

Index	Description
SAVIUSD	SA JSE Dollar Rand Volatility Index
SAPMI	SA BER PMI
SACBLI	SA Leading Indicator Bus Cycle
SACTGDP	SA CAD
SAEQ	SA Eqty Sales to Foreigners
SABO	SA Bond Sales to Foreigners
STEFI	Stefi index
JIBA3M	SA 3M JIBA
TOP40TR	JSE Top 40
JALSHTR	JSE All Share
SAGGBE10	SA BE Inflation
SATBAL	SA Balance of Trade
REPSOU	SA CDS
SASW10	Interest Rate swaps
SASW5	Interest Rate swaps
PC 1	First Component Index
PC 2	Second Component Index
PC 3	Third Component Index

Table 7.3: *Local factors included in elastic net estimations*

Elastic Nets Regression results

Table 7.4: *2010 - 2013*

Coef	Value
(Intercept)	0.0000000
Dim.1	0.0409206
STEFI	-0.7799998

[a] Rsq: 92.1%; Lm: 0.017

Table 7.5: *2013 - 2016*

Coef	Value
(Intercept)	0.0000000
Dim.1	0.0612301
Dim.3	-0.0912653
STEFI	-0.7219643

[a] Rsq: 87.7%; Lm: 0.006

Table 7.6: *Post 2016*

Coef	Value
(Intercept)	0.0000000
Dim.1	0.0257454
Dim.3	-0.0370018
SAVIUSD	0.0144231
STEFI	-0.8432370

[a] Rsq: 92.7%; Lm: 0.033

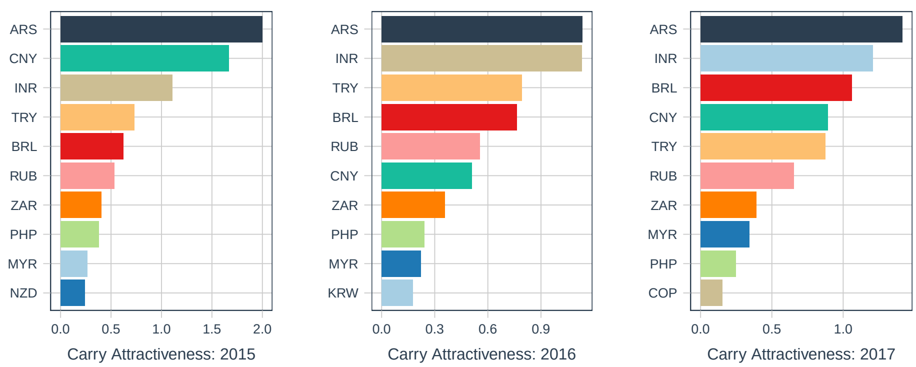

Figure 7.1: *Carry Attractiveness: USD Funding Currency (using Implied Volatility)*

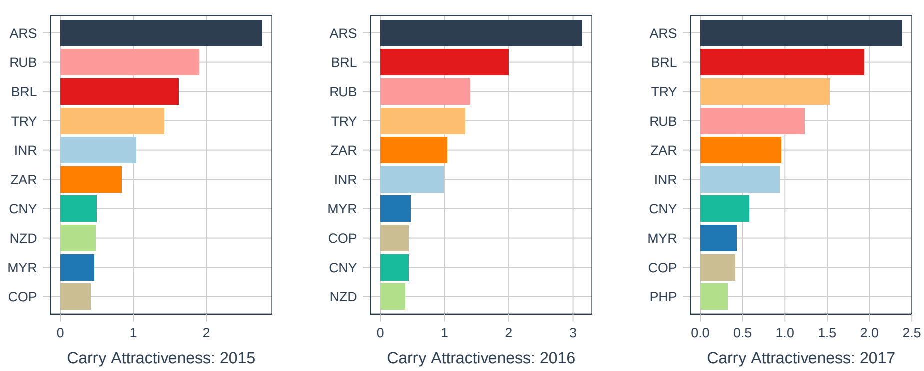

Figure 7.2: *Carry Attractiveness: Yen Funding Currency*

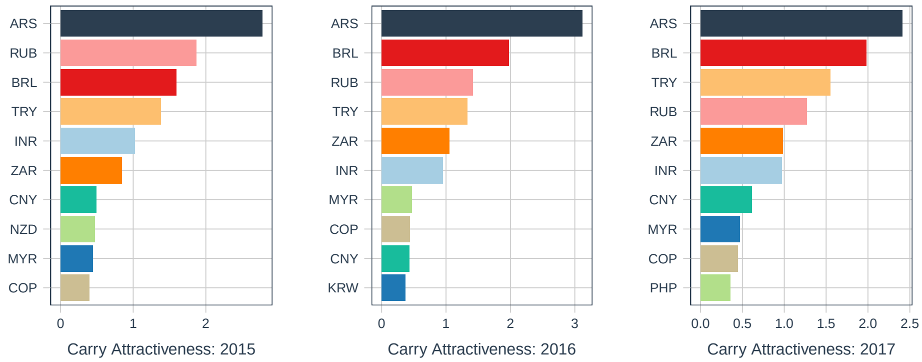

Figure 7.3: *Carry Attractiveness: Euro Funding Currency*

7.1. Stratified regression results: ZAR Spot Exchange vs USD

Table 7.7: *Equity IV Stratified Regression results*

	High	Low	Medium
(Intercept)	0.420 **	0.184	0.221
	(0.150)	(0.165)	(0.114)
Dim.1	0.635 ***	0.693 ***	0.575 ***
	(0.046)	(0.048)	(0.034)
Dim.2	-0.281 ***	0.083	0.054
	(0.046)	(0.048)	(0.034)
Dim.3	0.322 ***	-0.315 ***	0.188 ***
	(0.046)	(0.048)	(0.034)
US_idiff	-0.053 **	-0.038	-0.037 *
	(0.018)	(0.033)	(0.018)
N	184	185	552
R2	0.629	0.587	0.375

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 7.8: *Economic Surprise Index (EM) Stratified Regression results*

	High	Low	Medium
(Intercept)	0.084	0.396 **	0.195
	(0.179)	(0.137)	(0.101)
Dim.1	0.639 ***	0.659 ***	0.707 ***
	(0.057)	(0.041)	(0.031)
Dim.2	-0.143 *	-0.421 ***	0.065 *
	(0.057)	(0.041)	(0.031)
Dim.3	0.303 ***	0.354 ***	-0.230 ***
	(0.057)	(0.041)	(0.031)
US_idiff	-0.014	-0.061 **	-0.032 *
	(0.029)	(0.020)	(0.016)
N	153	154	459
R2	0.525	0.754	0.556

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 7.9: *Period Stratification Regression results*

	1_PreGFC	2_GFC	3_PostGFC	4_Pre16	5_Post16
(Intercept)	0.156	0.592	0.663	0.740	2.008 *
	(0.099)	(0.376)	(0.374)	(0.449)	(0.824)
Dim.1	0.447 ***	0.693 ***	0.796 ***	0.709 ***	0.733 ***
	(0.042)	(0.062)	(0.045)	(0.047)	(0.063)
Dim.2	-0.069	-0.503 ***	0.032	0.167 ***	0.194 **
	(0.042)	(0.062)	(0.045)	(0.047)	(0.063)
Dim.3	0.099 *	0.123	-0.243 ***	-0.372 ***	-0.343 ***
	(0.042)	(0.062)	(0.045)	(0.047)	(0.062)
US_idiff	-0.025	-0.072	-0.118	-0.134	-0.302 *
	(0.015)	(0.045)	(0.066)	(0.081)	(0.124)
N	449	72	156	157	87
R2	0.222	0.746	0.698	0.664	0.685

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

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