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Currency Hedging for Emerging Market Value Portfolios

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Currency Hedging for Emerging Markets Value Portfolios

Master thesis by Ole Bergesen and Osmund Bø-Rygg

Abstract

In this thesis we study currency hedging from the perspective of a developed market (DM) value investor who invests in emerging markets (EM). We construct emerging market equity portfolios sorted on P/E, P/B, and both P/E and P/B. For all portfolios we look for evidence of a value premium, and analyze hedged and unhedged performance. Our analysis shows that value stocks outperform growth stocks, and that hedging a value portfolio can provide marginally higher risk-adjusted returns. The hedged portfolios do on the other hand provide potential diversification benefits due to lower correlation with their respective benchmarks. We conclude that there is a significant value premium, but currency hedging does not significantly outperform an unhedged strategy. For diversified portfolios consisting of 50% global stocks and 50% emerging markets value stocks, risk adjusted returns are lower than for the undiversified counterparts. However, in this scenario currency hedging emerging markets can provide significantly higher risk-adjusted returns.

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Preface

This thesis marks the end of our master's program in Business Administration with a specialization in applied finance at UiS Business School. These past two years have been very rewarding for us, and we have gained a strong interest in investment strategies and portfolio theory.

The topic of this thesis, hedging currency risk for value portfolios in emerging markets, was one of three that portfolio managers at Skagen Funds suggested. There were two reasons why we saw this topic as especially interesting. First, the topic is at the intersection of three subjects; value investing, currency hedging and emerging markets. Combining various subjects and techniques are a fitting challenge for a master thesis. Second, we wanted to address an issue that has real-world applications for financial firms. The main question to be answered in this thesis, whether to hedge or not to hedge emerging market value investments, is one that both Skagen Funds and their investors want answered.

We would like to kindly thank our supervisor Loran Grady Chollete for clear and concise guidance. Lastly we would like to express gratitude to Torkell Eide, Knut Harald Nilsson, Erik Landgraff and Trygve Meyer at Skagen Funds for inspiration and help in providing data.

Introduction

Since the advent of modern portfolio theory it has been established that by combining uncorrelated assets, higher risk-adjusted portfolio returns can be achieved. Markowitz (1952) demonstrates that diversification lowers risk without the cost of reducing expected returns, and Solnik (1974) shows that this holds for international assets as well.

Basu (1977), Fama and French (1992) and Lakonishok, Vishny, and Shleifer (1993) all find that there are significant value premiums in equities. However, when investing in international markets one has to bear in mind that currency exchange fluctuations can pose additional risk. A hedging strategy may therefore be advantageous.

There has been considerable debate in academic circles on the effect that hedging exchange rate risk has on returns, but there is no consensus on the impact of hedging. While some early research on developed markets argues that currency hedging provides substantial risk reduction without reducing expected returns (Perold & Schulman, 1988), others such as Jorion (1989) conclude that the price of hedging can be too high to compensate for the reduction in volatility.

Emerging markets have not received the same attention when it comes to the issue of hedging exchange rate risk. Early research by Hauser, Marcus, and Yaari (1994) advises against hedging emerging market equity for a diversified investor. Bisen and Rao (2012) describes the shortcomings of hedging when faced with periods of sustained high volatility.

With increased investments in emerging markets, the application of value strategies becomes feasible. Emerging markets have historically been associated with high currency risk, which can be reduced through hedging. We investigate the impact of currency hedging on emerging market value portfolios and analyze how currency hedging affects portfolio performance.

Hedging foreign exchange rate risk in emerging market value portfolios has to the best of our knowledge not been covered in previous research. This is an open question for the Norwegian management company Skagen Funds and their investors. Skagen Funds has a considerable emerging market value portfolio, but does not hedge currency risk.

We address this issue by collecting equity data, spot and forward currency prices, interbank rates and index returns for EM and World. Based on these data we construct emerging market

value portfolios and evaluate their hedged and unhedged performance. Our perspective is that of a developed market investor, evaluating performance in USD, the international reserve currency. We use traditional performance measures as recommended by Bodie, Kane, and Marcus (2011) to evaluate portfolios. To determine which portfolio is superior the Sharpe ratio developed by Sharpe (1994) is a key performance measure. As the normal z-test is not adequate to evaluate differences in z-values between portfolios, we employ the test of Jobson and Korkie (1981), as corrected by Memmel (2003).

Our analysis shows that value stocks significantly outperforms growth stocks, and that hedging a value portfolio can provide marginally higher risk-adjusted returns. We also consider a more realistic scenario, with a diversified portfolio of 50% global equity and 50% emerging markets value portfolio. The inclusion of 50% global equity leads to lower risk-adjusted returns, but highlight benefits of hedging. For the diversified portfolios, hedging the emerging market portion of the portfolio provides significantly higher risk-adjusted returns. The portfolio that includes hedged emerging markets value stocks has a Sharpe ratio of 0,41, while the corresponding portfolio without hedging has a Sharpe ratio of 0,37. The difference in Sharpe ratio is significant at the 5% level. Our findings suggest that currency hedging should be considered for the emerging market portion of a diversified EM-DM portfolio.

The thesis is organized in four parts. Section 1 reviews the background and literature of value investing, currency hedging and emerging markets. Based on this we construct a portfolio model for use in the analysis. Section 2 covers the data used, with subsections on equities and exchange rates. The analysis is in section 3. We start with distributional characteristics, and country returns and correlation, before proceeding to performance evaluation. In section 4 we summarize our findings and conclude. Finally, in the appendix we provide some additional information on equity data from Bloomberg, country correlations and returns, as well as details on regressions, autocorrelation and Runs test for randomness.

1. Background and Literature

Value investing

Value investing as an investment approach can be traced back to the late 1920s. In 1928 Benjamin Graham began teaching a course in security analysis at Columbia University (Greenwald, Kahn, Sonkin, & Van Biema, 2004). Based on his teaching Benjamin Graham and David Dodd wrote «Security Analysis» (1934) which was to become very influential. The core of Graham and Dodd´s investment philosophy is to find securities that can be purchased at a bargain price. To accomplish this they use various screens, such as price-to-earnings ratio (P/E), dividend yield, price-to-book value (P/B), debt-to equity ratio, earnings per share and similar measures. The approach of using passive screens has come to define value investing in financial research[1]. This approach requires both quantitative and qualitative research, and if a stock is chosen, it is held with a long time horizon. Stocks where the ratios indicates underpricing are value stocks, while those where the ratios indicates overpricing are growth stocks. For example, value stocks have low ratios of P/B and P/E, while growth stocks have high ratios.

The concept of value investing, that a premium can be found in "value" stock, challenges some central assumptions in modern portfolio theory (MPT); that investors are rational and that markets are efficient. MPT also assumes that returns are normally distributed and that risk is defined as the standard deviation of returns. Originally introduced by Markowitz (1952), MPT is the theory that a risk-averse investor can construct optimal portfolios to maximize expected returns for a given level of risk. By combining assets that are uncorrelated with each other, portfolio risk is lowered and higher risk-adjusted returns can be achieved. Mathematically it was the first time someone had formulated the idea of minimizing portfolio risk through diversification.

In the 1960s Eugene Fama formulated the Efficient Market Hypothesis (EMH). Malkiel and Fama (1970) advocates that markets are efficient in the sense that all public information is reflected in market prices and therefore reflects fundamental value. According to the EMH it is not possible to consistently generate excess risk-adjusted returns. The EMH implies that changes in stock prices are unpredictable, as they follow a "random walk"[2]. The EMH gained

[1] For a broader definition of value investing, see Damodaran (2012)
[2] This concept was popularized by Malkiel (1973) in his book «A Random Walk Down Wall Street»

widespread acceptance in the 1970s. Many researchers have looked at value investing as an approach to disproving the EMH. Basu (1977) examined the performance of portfolios sorted on P/E. Based on 14 years of data he found that stocks with low P/E ratios significantly outperformed stocks with high P/E ratios in addition to the market portfolio. It is worth noting that the low P/E portfolio also outperformed a randomly selected portfolio with the same level of risk (beta). The mispricings were attributed to exaggerated investor expectations. Basu's and similar research was not seen as conclusive proof against the EMH. This is due to the joint hypothesis problem. When testing the EMH, researchers are not only testing the EMH, but also the method for risk-adjusting returns. This means that the evidence against the EMH could be due to incorrect risk-adjustment.

Fama and French (1992) looked at apparent contradictions to the EMH, like the one demonstrated by Basu. By using equity data from NYSE, AMEX and NASDAQ[3] for the time period 1962-1989, they constructed portfolios based on market capitalization (size), P/B, and P/E. The pattern was that smaller firms outperform larger firms, and that there was a strong relationship between returns and P/B. For P/E they found that low P/E firms outperform high P/E firms. They attributed this to correlation between P/E and P/B. Based on their findings they constructed an alternative to the Capital Asset Pricing Model (CAPM) that could explain the contradictions to the EMH. This was the first version of their three-factor model of asset pricing. Lakonishok et al. (1993) researched value strategies in the context of contrarian investment. Their theory was that overreaction among investors led to overpricing for "glamour" stocks that had performed well in the past, and the underpricing of "value" stocks that had performed poorly. Their findings were that value stocks outperformed glamour stocks with 10-11 percent in excess returns per year, supporting that there does in fact exist a value premium.

While most research on value strategies focused on the US or Japan, Fama and French (1998) looked at the international evidence. In this article they classify firms with low P/B, P/E, price to cash flow, and high dividend yield as value stocks. Value stocks are found to outperform growth stocks in 12 of 13 markets, and the global portfolios. In an out-of-sample test Fama and French investigate emerging markets and find a value premium significant at the 5% level for P/B, both when comparing with equal weighted index, and value weighted index. Value

[3] NASDAQ stocks only 1973-1989

portfolios formed on P/E are also superior, but the difference is only significant when using the equal weighted index, and only at the 10% level.

While there is consensus on the existence of a value premium, the reason for the premium is disputed. The traditional finance school of thought, who regards markets as efficient, argues that the premium exists because value stocks are riskier than growth stocks (Fama & French, 1993). Adherents to behavioral finance argue that mispricing occur due to market inefficiencies (Shleifer, 2003).

Currency hedging

Exchange rate risk is often a major discouragement to international investments. A hedging strategy may therefore be advantageous. The main question in the literature on currency hedging is whether it entails a "free lunch", resulting in higher risk-adjusted returns. Perold and Schulman (1988) argue that in the long run currency hedging has zero expected return, and provides substantial risk reduction at no cost. They find significant risk reduction with hedging for a US investor that invests in stocks and bonds in Japan, UK and Germany. In an asset allocation exercise, Jorion (1989) examines the risk and return characteristics of foreign stocks and bonds for international investments in Europe, Australia and the Far East. He concludes that hedging should be attractive for investors to limit the impact of exchange rate movements given that over the long run the average opportunity cost is at a "modest" 2% per year. The positive impact on volatility is not applicable if investments in foreign assets are small. Glen and Jorion (1993) examined the performance of international stock and bond portfolios with and without currency hedging. They consider a US investor that invests in five markets, The United States, Japan, Germany, United Kingdom and France. Using monthly observations in the period 1974 to 1990, they find that hedged foreign assets display a substantial reduction in the volatility of returns at a cost between 0,87% and 2,7% per year.

Hauser et al. (1994) investigate currency hedging for an emerging market equity portfolio. They conclude that an unhedged portfolio generally outperforms a hedged portfolio, and demonstrate that for an investor with a diversified portfolio with 10-15% invested in emerging markets, hedging makes the investor worse off. Walker (2008) takes a different approach, examining currency hedging from the perspective of an emerging market based global investor. He found that hedging on average increases volatility, and concludes that no "free lunch" exists. The reason is that hard (developed) currencies are a natural hedge against global portfolio losses. Walker's findings raise the question of whether the opposite is true for

a developed market based investor with an emerging market value portfolio. If equity and currency losses are correlated, then hedging currency risk could provide a free lunch, provided the cost of hedging is not prohibitive.

Emerging markets

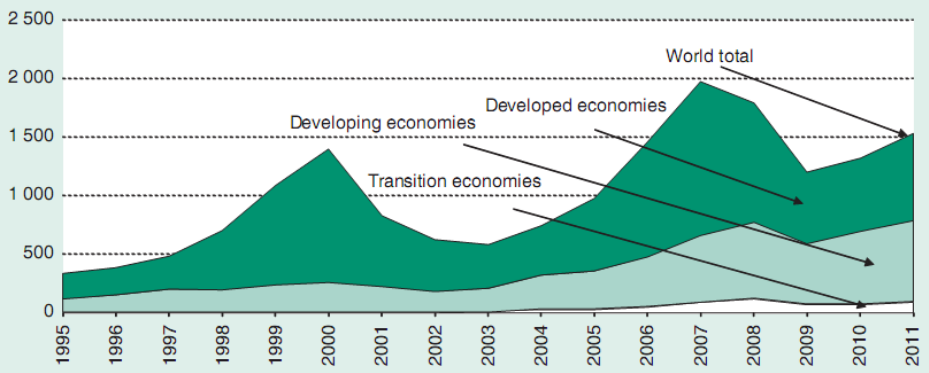
Since the term «emerging markets» was introduced in the 1980s there has been some debate over what the term actually entails. Mody (2004) highlights their high degree of volatility and transitions in economic, political, social and demographic dimensions. Broadly speaking the size and openness of the economy, income per capita, global market integration, financial-, legal- and political institutional strengths will all be defining factors. Goetzmann and Jorion (1999) show that many of today's emerging markets are in fact re-emerging markets. They point out that China, India, Egypt, Columbia, Chile and Mexico among others had active equity markets in the 1920s where international investors were present. Due to various political, economic and institutional reasons, investor interest and confidence was lost. These markets subsequently deteriorated and emerged again several decades later. Goetzmann and Jorion (1999) find that average returns in markets that have re-emerged are temporarily high, and argue that basing investment decisions on past EM performance is likely to lead to disappointing results

For many years emerging markets have experienced superior economic growth compared to developed economies, and has grown to be one of the largest drivers of world economic growth. Whilst developed countries such as the US and Japan have shown average economic growth of about 2%, growth in emerging markets have been about 6% and it is estimated by the IMF (2013) that emerging economies will account for 50% of world GDP in 2013. With the emergence of a new middle class in emerging economies such as the BRICS (Brazil, Russia, India, China and South Africa), which make up about 43% of the MSCI EM index, demand for everything from commodities to consumer goods have increased substantially.

Foreign direct investment (FDI) can be indicative of regions potential for production and economic growth. Borensztein, De Gregorio, and Lee (1998) tests the effect of FDI on economic growth and finds that FDI is an important driver for the transfer of technology,

which has a higher contribution to growth than domestic investment[4]. From 2003 to 2008 foreign direct investment in the BRICS grew from $77 billion to $281 billion with investment in China and the Russian federation accounting for the largest share of the growth (UNCTAD, 2012). The IMF reports that growth in emerging economies is expected to reach 5.7% in 2014, versus 3.0% and 1.1% in the United States and Europe respectively (IMF, 2013). According to the UNCTAD (2012), developing countries accounted for almost half of global FDI, mainly driven by investments in Asia and high growth in Latin America as shown by the figure below.

Figure 1 FDI inflows, global and by group of economies 1995-2011



Values in billions of dollars. Figure from UNCTAD (2012).

Emerging markets are in a capital development phase, and are in greater need of investments than developed markets, as domestic capital markets are not large enough. In order to meet these needs, interest rates are usually higher in emerging markets than in developed markets to attract foreign investment. These investors have the opportunity of earning excess returns measured in local currency by lending in the emerging currency's money market (JP Morgan). Bekaert and Harvey (2003) set out to empirically answer policy makers criticism, that foreign capital inflows can complicate monetary policy, drive up real exchange rates and increase volatility of local EM equity markets. They are unable to find robust results of increased volatility after liberalization or any negative effects of foreign investment in EM.

The common notion is that economic growth is followed by higher equity returns, as economic growth is usually accompanied by high earnings growth and rising equity prices. The empirical evidence from emerging and developed markets does not suggest that there is a

[4] This only holds when the country has the necessary available human capital.

direct relationship between economic growth and equity returns (Dimson, Marsh, & Staunton, 2013). Dimson et al. find that the correlation between long run real growth in GDP per capita and real equity returns is -0.39. Ritter (2012) argues that future economic growth is irrelevant for predicting future equity returns since these depend on dividend yields and growth of dividends per share. The current earnings yield, (inverse of P/E ratio, smoothed out for business cycles) is according to Ritter the best predictor of future equity returns.

Derivatives in emerging markets

Although derivative markets in emerging markets are significantly smaller than in developed markets, the use of derivatives in emerging markets has increased significantly in recent years.

Figure 2 Derivatives turnover in emerging markets

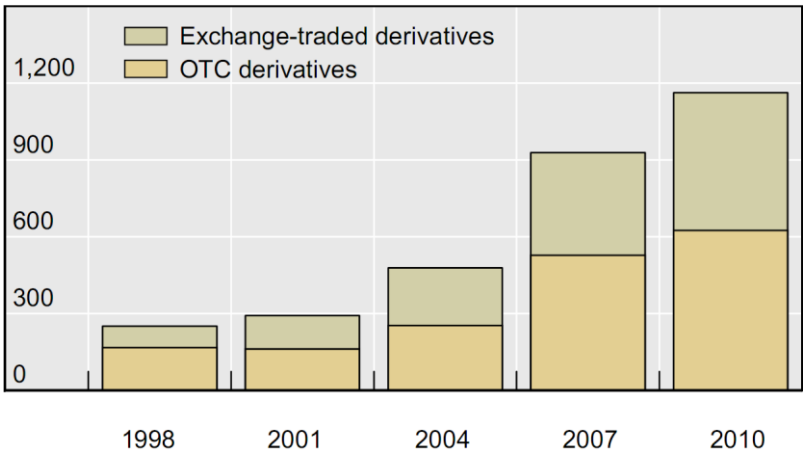


Figure from Mihaljek and Packer (2010).

In a comprehensive report on global foreign exchange market activity in 2010 from Bank for International Settlements (BIS) by von Kleist et al. (2010), and the related paper from Mihaljek and Packer (2010), it is reported that average daily turnover in derivatives in emerging markets increased 300% from 2001 to 2010. Derivatives turnover in emerging markets are growing more rapidly than in developed countries with Korea, Brazil, Hong Kong and Singapore as the main drivers, and where foreign exchange (FX) derivatives are the most commonly traded. The growth in FX derivatives appear to be positively correlated to trade, financial activity and per capital GDP (Mihaljek & Packer, 2010).

Currency hedging and emerging markets

A developed market investor who hedges emerging market currency wishes to protect his investment by locking in the exchange rate at which a future settlement is to be exchanged. If

an investor leaves a position unhedged he risks the possibility of his home currency appreciating, resulting in his investment loosing value in domestic terms. The forward rate is generally determined by the difference in interest rates between two currencies, and this represents the cost of hedging. This implies that the cost of hedging may also be negative, if the local interest rate is higher than the emerging market interest rate. In emerging economies with capital account restrictions, the forward rates are determined by the supply and demand for forward contracts, with the difference in interest rates serving as a proxy, and spot volatility influencing the forward premium (Bisen & Rao, 2012).

Derivatives in emerging markets are mainly used to hedge or speculate on exchange rate risk. Currency derivatives account for about 80% of the derivatives market in EM. This large share has a number of reasons: Many countries have moved from fixed to flexible exchange rate regimes; greater integration with the global economy due to structural reform and trade liberalization; and the liberalization of foreign exchange and capital controls making these markets vulnerable to changes in the global capital market. A drastic increase in the inflows of capital can cause domestic exchange rates to appreciate, and during times of economic fluctuations and crises, volatility in exchange rates has been a key characteristic. This was last seen during the financial crisis of 2007-2008 (Bisen & Rao, 2012). To hedge against this uncertainty, forward contracts have been one of the most widely used instruments.

Bisen and Rao (2012) looks at challenges to hedging emerging markets currency risk. They highlight the combination of periods of high currency volatility[5] and illiquid long-term contracts. Long-term forward contracts in emerging currencies are generally quite illiquid due to high interest differentials between developed and emerging economies. This means that long-term currency risk must be hedged with short-term forward contracts. EM currencies tend to experience sustained high volatility in times of macroeconomic stress. An investor forced to roll-over a short term hedge during a period of high volatility will face a much higher forward premium. The bid-ask spread can be as much as 100 basis points (Kim, 2012).

MSCI EM Index

The different views on emerging markets are illustrated by the countries included by different stock market index providers for emerging markets. Broad emerging market indices are

[5] Bisen and Rao call these periods «volatility clusters».

usually skewed toward the largest companies, often state owned, export orientated, and dependent on commodity prices (Kapadia, 2013). The MSCI indices are leading benchmarks to measure the performance of stock markets around the world. The MSCI Emerging Market Index (MSCI EM), created by Morgan Stanley Capital International, launched in 1988 and was the first comprehensive emerging market index. It is a float-adjusted market capitalization index designed to represent real investment opportunities in emerging markets, as opposed to all-share indices, which often cannot be fully replicated due to illiquidity of shares or volume. The index consists of 23 emerging markets from the Americas, Europe, Middle East, Africa and Asia, covering over 2,700 securities (MSCI, 2013b). Effective from November 2013 Greece will be added to the MSCI EM, reclassified from developed market, while Morocco will be reclassified from emerging market to frontier market. Table 1 lists the countries included in the MSCI EM index at the end of the sample period in 2012.

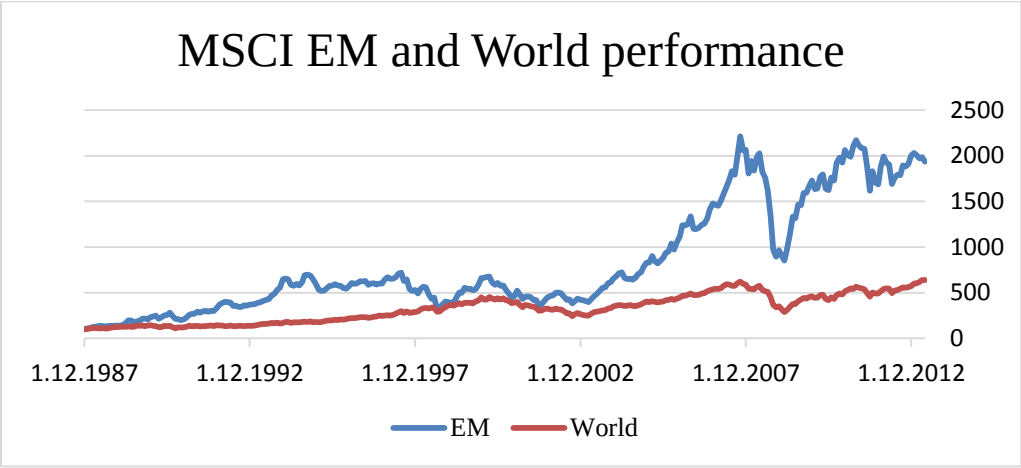
Table 1 Countries in the MSCI EM index

Americas	**Europe, Middle East & Africa**	**Asia**
Brazil	Czech Republic	China
Chile	Egypt	India
Columbia	Hungary	Indonesia
Mexico	Morocco	Korea
Peru	Poland	Malaysia
	Russia	Philippines
	South Africa	Taiwan
	Turkey	Thailand

Emerging Market Performance

The MSCI EM has substantially outperformed MSCI World since the start of the index. The MSCI World index is a common benchmark for global developed markets, and covers 23 developed countries.

Figure 3 MSCI EM and World performance



Historical performance since the start of the index in 1987. Graph based on data from MSCI (2013b).

Though experiencing substantial growth in the early 1990s, the Asia-crisis in 1997 and its aftermath affected emerging markets harder than developed markets. 2003 to 2007 was a period of extraordinary growth for the MSCI EM, with an annualized average return of 33.6%. Over the same period the MSCI World index had an annualized average return of 14.9%. The MSCI EM was more than halved by the financial crisis of 2008, but in 2009 the index had a strong recovery of 78%.

Bekaert, Erb, Harvey, and Viskanta (1998) observes that EM returns are abnormal and argue that the standard mean-variance analysis framework is problematic with respect to EM as these markets cannot be characterized by the traditional measures of expected returns, variances and covariance. They find that there is significant skewness and kurtosis in EM, where 17 of 20 markets exhibit positive skewness, and 19 of 20 countries had excess kurtosis. They point out that skewness and kurtosis changes through time, and that for EM there could be drastic changes in the characteristics of asset returns, as markets move from a state of segmentation to a state of integration.

Harvey (1995) sets out to explore why EM have such high expected returns. The traditional framework of asset pricing implies that higher returns are associated with higher risk. Harvey finds that exposure to the common risk factors are low for EM. Thus the capital asset-pricing model is unable to explain the cross section of expected returns, and betas are unable to explain any of the cross-sectional variation in expected returns. In an attempt to find an appropriate measure of risk, Estrada (2000) proposes a model based on downside risk, measured by the semi deviation of returns with respect to the mean. The main advantages are

that it captures the unwanted downside volatility, and is a consistent measure of the costs of equity for partially integrated markets.

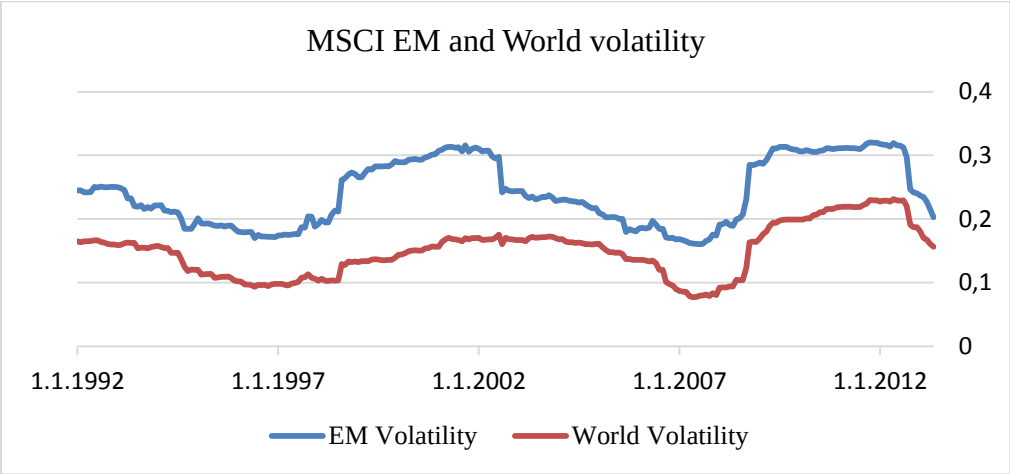
In an attempt to understand the long run market efficiency and predictability of developed and emerging market asset returns, Sharma and Thaker (2013) conducts tests for the weak-form[6] of the EMH. Their findings are that weekly returns in both EM and DM indicate market efficiency while significant serial correlations and Runs test for randomness indicate market inefficiency and predictability of monthly returns in DM.

Emerging Market volatility

In the 1990s and early 2000s there were six important financial crises in EM; Mexico (1994), Argentina (1995), Asian Crisis (1997), Russia (1998), Brazil (1999), Argentina (2002). Chamon, Ghosh, and Kim (2012) note that there are striking similarities in the underlying vulnerabilities, which are almost always maturity or currency mismatches on public or private sector balance sheets. One key characteristic of the Mexican and Asian Crisis was that currencies were significantly weakened, mainly through the coexistence of high economic growth and fixed exchange rates (Gil-Diaz, 1997). During the Asia crisis, the pegged exchange rates complicated the ability for monetary policies to deal with overheating pressure. As several currencies in East Asia were pegged to the U.S. dollar, the volatility of the dollar/yen exchange rate contributed in elevating the crisis through shifts in international competitiveness (IMF Staff, 1998). Spillover effects from the Asia crisis adversely affected the Russian economy as demand for oil and other commodities declined. This culminated in August 1998, when Russia was forced to default on its sovereign debt, devalue the ruble, and declare a suspension of payments by commercial banks to foreign creditors (Chiodo & Owyang, 2008). Contagions from the Russian default were triggers for Brazil and Argentina's crises in 1999 and 2002, respectively. In Brazil, inconsistency between currency board arrangement and fiscal policy triggered the freezing of deposits causing further contagion in Uruguay as Uruguayan banks experienced a bank run (Chamon et al., 2012). Umutlu, Akdeniz, and Altay-Salih (2010) find that during times of crisis the aggregated total volatility increases in emerging markets.

[6] Stock prices reflect all available public information.

Figure 4 MSCI EM and World volatility



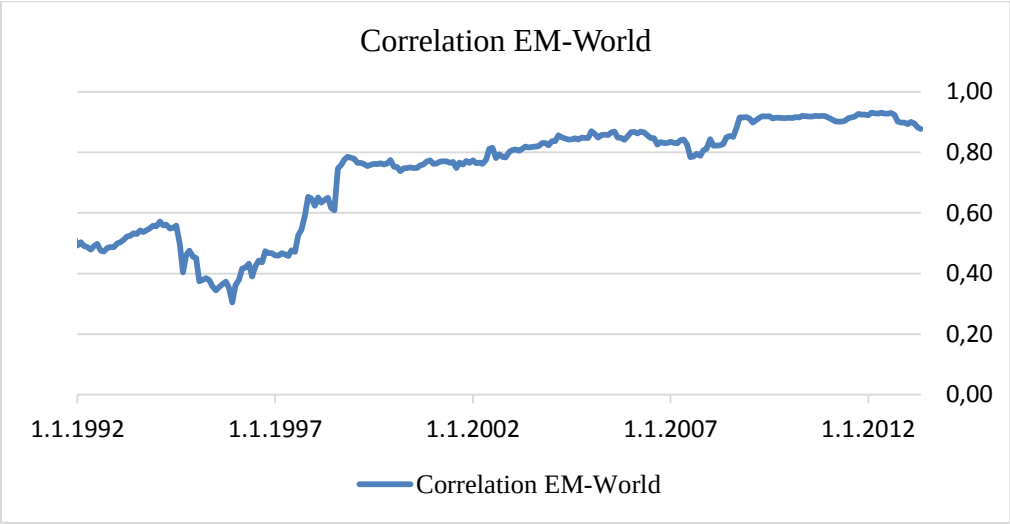
Historical annualized volatility with a lookback period of 48 months using monthly data and log returns. Graph based on data from MSCI (2013b).

Figure 4 shows that the EM index is much more volatile than the World index. Since 2001 the annualized standard deviation of the MSCI EM is 23.5% vs. MSCI World of 16.04%. There is a strong correlation in the volatilities of the two indices. During periods of macroeconomic stress the volatility of MSCI EM sees a significant increase over MSCI World. Two such periods can be identified. The first period starts with the Asian crisis, and ends after the Argentine crisis of 2002. The second period starts with the financial crisis of 2007-2008, and ends with recovery from that crisis.

Correlation between emerging and developed markets

Historically, low correlations between EM and DM have offered attractive diversification strategies for developed market investors. With correlation increasing from the mid-nineties however, the potential gain from diversification has decreased.

Figure 5 Correlation EM-World



Historical correlation between monthly returns on MSIC EM and MSCI World, with a lookback period of 48 months. Graph based on data from MSCI (2013b).

The low correlation with developed markets is an important characteristic. MPT states that portfolios should be constructed by including assets that have low, or preferably negative, correlation. French and Poterba (1991) show that investors tend to overinvest in domestic markets rather than allocating internationally. This is known as the home equity bias. Bekaert and Harvey (2003) suggest that the possibility to exploit high EM returns through low correlation can be an explanation for the increase in capital flows to EM. They do however point out that DM investors should bear in mind that an integration process can lower expected returns and increase correlations between EM and world market returns.

Portfolio model

Portfolio construction

Using MSCI EM constituents, five portfolios are constructed for each of P/E, P/B, and combined P/E and P/B. For the P/E and P/B portfolios, stocks are sorted on their respective ratios on the 31.12. Only stocks with available ratios are included. The lowest rated quintile is portfolio A, the second lowest quintile is portfolio B, and so on. For the combined portfolio, both P/E and P/B are ranked form 1 to N[7]. Stocks are then sorted on the combined rank. For each set of portfolios, portfolio A represents value stocks, while portfolio E (the top quintile)

[7] Where N is the number of stocks with both P/E and P/B at the end of the year.

represents growth or glamour stocks. The portfolios are equally weighted, and held for the following year. The first set of portfolios are based on ratios from 31.12.2000, and held for the year 2001. This approach resembles Basu (1977), and Fama and French (1998). Basu (1977) sort stocks on P/E and divides into quintiles while Fama and French (1998) use P/E, P/B, and size.

For each set of portfolios we calculate local, dollar, and hedged returns. For the hedged portfolios, we use monthly forwards to hedge the exchange rate risk. Portfolio return calculations follow the same procedure as Glen and Jorion (1993). We take the perspective of a US investor who measures returns in dollars. BBA Libor 1M is used as a proxy for the risk-free rate (MSCI, 2013a).

Portfolio return

We use formulas and notation from Glen and Jorion (1993), with minor changes to make it consistent with Kim (2012).

Table 2 Notation for portfolio return

$S_{i,t}$	Spot price of foreign currency i at time t
$P^*_{i,t}$	Foreign currency asset value (inclusive of reinvestments)
$F_{i,t}$	One month forward price of currency i at time t
$x_{i,t}$	Fraction invested in each asset i at time t
$h_{i,t}$	Hedge ratio

Notation used in calculating portfolio return.

The return on equity in the home currency is calculated as follows:

$$\tilde{R}_{i,t+1} = \frac{\tilde{P}^*_{i,t+1}\tilde{S}_{i,t+1}}{P^*_{i,t}S_{i,t}} - 1 \quad (1)$$

We can then calculate unhedged portfolio return:

$$\hat{R}^{NOH}_{i,t+1} = \sum_{i=1}^{N_1} x_{i,t}\tilde{R}_{i,t+1} \quad (2)$$

We note that the payoff on a long forward contract is given by:

$$\tilde{f}_{i,t+1} = \frac{\tilde{S}_{i,t+1} - F_{i,t}}{S_{i,t}} \quad (3)$$

This means that hedged portfolio return is calculated as follows:

$$\tilde{R}_{t+1}^{h} = \hat{R}_{i,t+1}^{NOH} + \sum_{i=1}^{N}(-h_{i,t}x_{i,t})\tilde{f}_{i,t+1} \quad (4)$$

For a portfolio with unitary hedging the return is:

$$\tilde{R}_{t+1}^{FUH} = \tilde{R}_{t+1} + \sum_{i=1}^{N}(-x_{i,t})\tilde{f}_{i,t+1} \quad (5)$$

Portfolio performance

There are several risk-adjusted performance measures to choose from when evaluating portfolio performance. While each has their uses and limitations, they are only useful for comparison when computed with similar benchmarks. A widely used method for performance evaluation is the Sharpe ratio. This ratio measures the tradeoff of excess returns with regards to added volatility, where a high Sharpe ratio indicates higher excess returns relative to the added risk. Similar to the Sharpe ratio, the Sortino ratio gives a measure of risk-adjusted returns. While the Sharpe ratio does not differentiate between positive and negative volatility, the Sortino ratio only penalizes the downside risk.

Currently the standard for comparing Sharpe ratios in applied finance is the z-test of Memmel (2003) who corrected Jobson and Korkie's (1981) original test. This is the test employed by Kim (2012).

Table 3 Notation for portfolio performance

$\hat{\mu}_{NOH}$	Sample mean of the excess return of unhedged portfolio
$\hat{\sigma}_{NOH}$	Sample standard deviation of the excess return of unhedged portfolio
Sh_{NOH}	Sharpe ratio of the excess return of unhedged portfolio
$\hat{\mu}_{FUH}$	Sample mean of the excess return of hedged portfolio
$\hat{\sigma}_{FUH}$	Sample standard deviation of the excess return of hedged portfolio
Sh_{FUH}	Sharpe ratio of the excess return of hedged portfolio
N	Sample number of return observations
$\hat{\rho}$	Sample correlation between excess returns of the unhedged portfolio and the hedged portfolio

Notation used in calculating portfolio performance.

The Sharpe ratio is calculated by dividing sample mean by sample standard deviation;

$Sh = \frac{\hat{\mu}}{\hat{\sigma}}$.

We formulate the following hypothesis:

$H_0: Sh_{NOH} = Sh_{FUH}$

$H_1: Sh_{NOH} \neq Sh_{FUH}$

Under the null hypothesis this z-value is normally distributed:

$$z = \frac{Sh_{FUH} - Sh_{NOH}}{\sqrt{V}} \quad (6)$$

Where

$$V = \frac{1}{N}[2 - 2\hat{\rho} + \frac{1}{2}(Sh_{NOH}^2 + Sh_{FUH}^2 - 2Sh_{NOH}Sh_{FUH}\hat{\rho}^2)] \quad (7)$$

Interpretation of z-value

A large positive z-value indicates that the hedged portfolio is superior, while a negative z-value indicates that the unhedged portfolio is superior.

While the Sharpe ratio is widespread in measuring real performance and in empirical research, it has been shown that Memmel's test is not valid when returns have tails heavier than the normal distribution or if the returns are time series, as discussed by Ledoit and Wolf (2008). But as Kim (2012) points out, "there is no test which is as simple and intuitive as this test". While it falls outside the scope of this thesis, it is worth recognizing the problems of the normality assumptions and the implications it has on performance evaluation.

2. Data

We primarily use three sets of data for our analysis: Spot and forward exchange rates, interbank deposit rates and equity data from MSCI Emerging Markets Index. All data were obtained from Bloomberg with the exception of BBA Libor rates, which were collected from Datastream. Our data covers the time period from 2000 to 2012, where year 2000 is used as a base for constructing portfolios the first year.

Equity data

The dataset covers MSCI emerging market constituents, and includes end of month closing price, P/B and P/E. Closing prices are adjusted to account for a variety of factors, most importantly dividends, spinoffs and stock splits. Full details are in the appendix. The following table lists the number of stocks in the index per year, and availability of valuation ratios. A stock was considered part of the index if it had a closing price on 31.12 of that year. The P/E and P/B columns show the number of stocks with the corresponding ratio both in absolute numbers and as a percentage of stocks in the index. Valuation ratios were calculated on 31.12 of each year.

Table 4 Stocks and ratios per year

Year	Stocks	P/E		P/B		P/E and P/B	
		#	%	#	%	#	%
2000	482	248	51 %	303	63 %	245	51 %
2001	518	340	66 %	384	74 %	337	65 %
2002	544	443	81 %	474	87 %	440	81 %
2003	567	494	87 %	511	90 %	490	86 %
2004	598	536	90 %	554	93 %	535	89 %
2005	632	579	92 %	590	93 %	578	91 %
2006	666	620	93 %	634	95 %	620	93 %
2007	718	664	92 %	679	95 %	664	92 %
2008	745	718	96 %	724	97 %	717	96 %
2009	762	740	97 %	744	98 %	739	97 %
2010	791	768	97 %	772	98 %	768	97 %
2011	813	786	97 %	789	97 %	786	97 %

Number of stocks in index per year, and available P/E, P/B, and P/E and P/B ratios.

Both the number of stocks in the index, and the percentage with key ratios available increase throughout the period. Table 5 shows number of stocks included for each currency at any point in the dataset. The currency codes are used throughout this thesis.

Table 5 Currency codes and stocks in dataset

Code	Country	# of stocks
BRL	Brazil	81
CLP	Chile	21
COP	Colombia	14
CZK	Czech	3
EGP	Egypt	6
HKD	Hong Kong	137
HUF	Hungary	3
IDR	Indonesia	26
INR	India	72
KRW	South Korea	103
MAD	Morocco	3
MXN	Mexico	26
MYR	Malaysia	42
PHP	Philippines	18
PLN	Poland	22
RUB	Russia	18
THB	Thailand	25
TRY	Turkey	25
TWD	Taiwan	114
USD	United	14
ZAR	South Africa	50

# of stocks per country is the number of stocks is the total number of stocks included from that country in the original dataset.

The most important markets by number of stocks are Hong Kong, Taiwan and South Korea, with Brazil and India following.

Exchange rates

The dataset covers end of month spot and forward rates in USD for currencies with stocks in the MSCI EM index. Exchange rates were not available for Chile. Returns on Chilean stocks are calculated in local currency. We ran a t-test for the differences in mean returns while excluding Chilean stock from the sample and found that we could not reject the null hypothesis of zero differences of the means between the two samples even at 1% significance. Thus we are confident that the results are not affected by not excluding Chilean local returns.

[8] USD includes 14 stocks from China, Egypt, Peru and Russia listed in USD.

For some currencies we were unable to obtain complete data on forward rates for the whole sample period. For consistency we did not exclude any equities whose forward rates were not included. Thus the «hedged» portfolios are hedged in the respect that all possible hedged positions are taken. While this is not ideal, the number of positions affected is negligible.

3. Analysis

Our analysis is divided into two main parts. We begin with the distributional characteristics of all portfolios and a detailed review of country returns and correlations. This is followed by performance evaluation where we employ Memmel's z-test to compare Sharpe ratios of both the undiversified emerging market portfolios and diversified EM-DM portfolios. All correlations and betas are calculated with respect to the MSCI All-Country World Index. This is the same approach as Estrada (2000) the only difference being that we use the equally weighted index. Portfolio betas are calculated by regressing the portfolio returns on the ACWI EM index. The MSCI EM EW incorporates both developed and emerging markets, and is designed to be a global benchmark.

Time series analysis of the value and growth portfolios reveal the presence of autocorrelation, which is the degree two different series moves to its own lagged values, and are frequently used to test the independence of random variables in times series. Positive autocorrelation signal mean aversion and higher volatility of returns, whereas negative autocorrelation signal mean reverting returns and lower standard deviations than if returns were independent. Significant autocorrelation rejects the "random walk" hypothesis implying that historical prices can predict future prices, while insignificant autocorrelation means that the weak form of the EMH is applicable (Sharma & Thaker, 2013). We find that the ACWI has significant (larger than two standard errors) positive autocorrelation at lag 1 and that all six value portfolios show significant positive autocorrelations at lag 1 and 2. We suspect that the positive autocorrelations are due to momentum, as suggested by behavioral models[9]. The growth portfolios on the other hand only show autocorrelation in two cases; negative at lag 13 for the unhedged P/E portfolio and positive at lag 1 for the unhedged P/B portfolio.

To test the independence assumptions of the EMH we ran Runs test for randomness with the mean return as a cutoff point, where the number of runs a sequence is above or below the cutoff point is counted and tested for significance. Runs test is a non-parametric test that does not rely on the normal distribution. A significant difference indicates that returns are systematic, which would violate the independence assumption of the EMH. The null hypothesis of randomness was rejected for all value portfolios except the hedged PE value portfolio. For the growth portfolios, only the unhedged growth portfolio was rejected.

[9] For example «Inefficient Markets» (Shleifer, 2003).

Details on regressions, autocorrelation and Runs Test can be found in the appendix.

Summary statistics

Summary statistics for each valuation ratio are presented in tables 6, 7 and 8. These tables summarize the distributional statistics for all portfolios formed on each valuation ratio, the annual returns in excess of the BBA Libor rate and of the entire sample population for the period denoted by Market. The market portfolio is constructed by equally weighting all stocks that have available price information for a full year. A key benefit of an equal weighted index is that it will not be skewed towards the largest markets. As the MSCI EM index is a free-float adjusted market capitalization index, it is not suitable for comparing our equally weighted portfolios. MSCI also provides an equal weight version of the MSCI EM index that could have been suitable as a benchmark for calculating excess returns. However we found that the difference in return profiles for the two indices were unexplainably large, making it unsuitable for comparison. We suspect that a large part of this difference is due to the limited number of shares at the start of the sample period, as the difference in returns are markedly lower at the end of the period.

The summary statistics confirm the presence of significant value premiums. The mean returns of value stocks consequently outperform growth stocks for all portfolio formations. The hedged mean returns are overall weaker than the unhedged returns, but for the P/B and combined portfolios the value premium is marginally higher than for their unhedged counterparts. In fact, the ratio of the average return to its standard error is lower for the hedged portfolios formed on P/E (4.88) and the combined portfolio (5.05). On average the value portfolios are 1.59% and 1.63% higher than growth portfolios for the unhedged and hedged portfolios respectively. Further, portfolios A and B (the highest 40%) are the only portfolios that beat our market benchmark for both the hedged and unhedged portfolios. In line with Fama and French (1998), we find that these apparent high excess returns have similarly large standard errors, signaling highly volatile returns.

P/E portfolios

Monthly returns for hedged and unhedged portfolios formed on P/E, with EM Market (All) for comparison.

Table 6 Summary statistics monthly return for P/E portfolios

		P/E_{NOH}						P/E_{FUH}					
		A	B	C	D	E	Market	A	B	C	D	E	Market
Mean		3,28 %	2,36 %	1,95 %	1,91 %	1,66 %	2,23 %	3,07 %	2,13 %	1,80 %	1,78 %	1,45 %	2,05 %
Variance		0,0031	0,0019	0,0020	0,0022	0,0028	0,0021	0,0025	0,0015	0,0016	0,0017	0,0022	0,0016
Std. Dev.		5,53 %	4,37 %	4,52 %	4,64 %	5,25 %	4,61 %	5,03 %	3,93 %	4,00 %	4,08 %	4,64 %	3,98 %
Skewness		0,437	-0,156	-0,785	-0,610	-1,033	-0,554	0,777	0,247	-0,260	-0,267	-0,861	-0,231
Kurtosis		1,833	0,992	2,618	1,988	2,830	2,067	2,522	1,413	1,329	0,873	1,936	1,431
Median		0,031	0,022	0,021	0,020	0,019	0,021	0,028	0,019	0,020	0,019	0,018	0,022
Mean Abs. Dev.		0,039	0,033	0,033	0,035	0,039	0,034	0,036	0,029	0,030	0,031	0,035	0,029
Mode		0,017	-0,018	0,017	0,011	0,008	0,019	-0,004	0,018	0,018	0,011	0,037	0,022
Minimum		-12,07 %	-12,13 %	-17,65 %	-17,32 %	-21,56 %	-16,15 %	-10,49 %	-10,20 %	-11,47 %	-12,78 %	-16,37 %	-11,93 %
Maximum		21,54 %	13,56 %	12,30 %	14,07 %	13,13 %	14,03 %	22,73 %	15,21 %	12,59 %	11,98 %	11,37 %	14,22 %
Range		0,336	0,257	0,300	0,314	0,347	0,302	0,332	0,254	0,241	0,248	0,277	0,262
		Annual Equal Weight Returns in Excess of BBA Libor Rate											
		P/E_{NOH}						P/E_{FUH}					
	Market	A	B	C	D	E	$A - E_{NOH}$	A	B	C	D	E	$A - E_{FUH}$
Mean	27,00 %	37,25 %	26,22 %	21,32 %	20,85 %	17,83 %	19,41 %	34,69 %	23,46 %	19,56 %	19,30 %	15,36 %	19,33 %
Std. Dev	16,27 %	19,15 %	15,12 %	15,62 %	16,10 %	18,18 %	12,14 %	17,37 %	13,56 %	13,78 %	14,12 %	16,06 %	13,73 %
t(Mn)	5,75	6,74	6,01	4,73	4,49	3,40	5,54	6,92	5,99	4,92	4,74	3,31	4,88
t-stat							2.55						2,82
		Annual Equal Weight Returns in Excess of Dollar Return on Market											
Mean		12,35 %	1,33 %	-3,57 %	-4,05 %	-7,06 %		9,79 %	-1,44 %	-5,34 %	-5,59 %	-9,54 %	
Std.		8,54 %	4,97 %	3,75 %	4,74 %	5,63 %		12,48 %	9,44 %	8,15 %	8,48 %	8,21 %	
t(Mn)		5,01	0,93	-3,30	-2,96	-4,35		2,72	-0,53	-2,27	-2,28	-4,02	

t(Mn) is the ratio of the average return to its standard error and t(stat) is the t-statistic testing whether the difference of a value and growth portfolio is different from zero.

P/B portfolios

Monthly returns for hedged and unhedged portfolios formed on P/B, with EM Market (All) for comparison.

Table 7 Summary statistics monthly return for P/B portfolios

		P/B_{NOH}						P/B_{FUH}					
		A	B	C	D	E	Market	A	B	C	D	E	Market
Mean		3,21 %	2,27 %	2,01 %	1,84 %	1,84 %	2,23 %	3,03 %	2,14 %	1,82 %	1,64 %	1,58 %	2,04 %
Variance		0,0034	0,0025	0,0020	0,0022	0,0024	0,0022	0,0028	0,0019	0,0015	0,0016	0,0020	0,0017
Std. Dev.		5,86 %	5,00 %	4,48 %	4,65 %	4,86 %	4,70 %	5,34 %	4,35 %	3,86 %	4,05 %	4,51 %	4,08 %
Skewness		0,369	-0,480	-0,362	-0,822	-1,011	-0,527	0,529	-0,193	-0,069	-0,452	-0,572	-0,199
Kurtosis		1,195	1,793	1,468	3,857	2,648	2,025	1,311	1,346	1,496	3,012	1,176	1,497
Median		0,031	0,023	0,018	0,017	0,021	0,021	0,024	0,023	0,018	0,015	0,016	0,022
Mean Abs. Dev.		0,044	0,037	0,034	0,034	0,035	0,035	0,040	0,032	0,028	0,029	0,033	0,030
Mode		0,006	0,016	0,018	0,004	0,021	0,048	0,024	0,024	0,004	0,033	0,016	-0,009
Minimum		-13,34 %	-16,83 %	-13,01 %	-19,45 %	-18,85 %	-16,30 %	-8,68 %	-11,98 %	-11,54 %	-14,49 %	-13,70 %	-12,08 %
Maximum		23,28 %	14,83 %	13,82 %	16,98 %	10,87 %	15,15 %	23,64 %	15,12 %	13,88 %	16,70 %	11,89 %	15,33 %
Range		0,366	0,317	0,268	0,364	0,297	0,314	0,323	0,271	0,254	0,312	0,256	0,274
		Annual Equal Weight Returns in Excess of BBA Libor Rate											
		P/B_{NOH}						P/B_{FUH}					
	Market	A	B	C	D	E	$A-E_{NOH}$	A	B	C	D	E	$A-E_{FUH}$
Mean	27,00 %	36,47 %	25,18 %	21,98 %	19,94 %	19,93 %	16,54 %	34,24 %	23,63 %	19,74 %	17,59 %	16,86 %	17,38 %
Std. Dev	16,27 %	20,29 %	17,32 %	15,51 %	16,09 %	16,85 %	13,74 %	18,45 %	15,05 %	13,33 %	14,00 %	15,61 %	14,45 %
t(Mn)	5,75	6,22	5,04	4,91	4,29	4,10	4,17	6,43	5,44	5,13	4,36	3,74	4,17
t-stat							2,17						2,48
		Annual Equal Weight Returns in Excess of Dollar Return on Market											
Mean		11,57 %	0,28 %	-2,91 %	-4,96 %	-4,97 %		9,35 %	-1,27 %	-5,15 %	-7,30 %	-8,03 %	
Std.		7,98 %	4,31 %	3,96 %	5,07 %	7,37 %		10,81 %	7,67 %	8,21 %	8,82 %	11,16 %	
t(Mn)		5,02	0,23	-2,55	-3,39	-2,34		2,99	-0,57	-2,17	-2,87	-2,49	

t(Mn) is the ratio of the average return to its standard error and t(stat) is the t-statistic testing whether the difference of a value and growth portfolio is different from zero.

Combined portfolios

Monthly returns for hedged and unhedged portfolios formed on combined P/E and P/B, with EM Market (All) for comparison.

Table 8 Summary statistics monthly return for combined portfolios

		$Comb_{NOH}$						$Comb_{FUH}$					
		A	B	C	D	E	Market	A	B	C	D	E	Market
Mean		3,38 %	2,33 %	2,04 %	1,84 %	1,59 %	2,24 %	3,21 %	2,17 %	1,86 %	1,65 %	1,38 %	2,05 %
Variance		0,0032	0,0022	0,0021	0,0020	0,0025	0,0021	0,0026	0,0016	0,0016	0,0015	0,0021	0,0016
Std. Dev		5,63 %	4,71 %	4,55 %	4,45 %	5,03 %	4,61 %	5,12 %	4,06 %	4,00 %	3,88 %	4,58 %	3,98 %
Skewness		0,408	-0,392	-0,311	-0,756	-1,403	-0,549	0,610	-0,030	0,023	-0,423	-1,058	-0,226
Kurtosis		1,249	1,592	1,198	2,142	4,528	2,063	1,277	1,237	1,152	1,150	2,816	1,429
Median		0,031	0,023	0,023	0,015	0,020	0,021	0,026	0,023	0,022	0,015	0,019	0,022
Mean Abs. Dev.		0,041	0,035	0,035	0,033	0,036	0,034	0,038	0,030	0,030	0,029	0,034	0,029
Mode		0,033	0,019	0,047	0,011	0,017	0,012	0,037	0,029	0,031	0,037	0,021	0,044
Minimum		-12,51 %	-14,93 %	-13,73 %	-16,38 %	-23,18 %	-16,15 %	-10,05 %	-10,59 %	-10,65 %	-12,00 %	-17,93 %	-11,93 %
Maximum		20,50 %	15,08 %	14,27 %	11,59 %	11,93 %	14,01 %	20,79 %	15,62 %	14,42 %	11,23 %	10,09 %	14,16 %
Range		0,330	0,300	0,280	0,280	0,351	0,302	0,308	0,262	0,251	0,232	0,280	0,261
		Annual Equal Weight Returns in Excess of BBA Libor Rate											
		$Comb_{NOH}$						$Comb_{FUH}$					
	Market	A	B	C	D	E	$A - E_{NOH}$	A	B	C	D	E	$A - E_{FUH}$
Mean	27,00 %	38,43 %	25,85 %	22,41 %	20,02 %	17,03 %	21,40 %	36,40 %	23,89 %	20,17 %	17,70 %	14,51 %	21,90 %
Std. Dev	16,27 %	19,51 %	16,30 %	15,75 %	15,41 %	17,45 %	13,81 %	17,68 %	14,01 %	13,81 %	13,38 %	15,86 %	15,01 %
t(Mn)	5,75	6,82	5,49	4,93	4,50	3,38	5,37	7,13	5,91	5,06	4,58	3,17	5,05
t-stat							2,83						3,19
		Annual Equal Weight Returns in Excess of Dollar Return on Market											
Mean		13,53 %	0,95 %	-2,48 %	-4,88 %	-7,86 %		11,51 %	-1,00 %	-4,72 %	-7,20 %	-10,39 %	
Std.		8,46 %	4,38 %	3,92 %	3,94 %	7,03 %		11,79 %	7,94 %	8,73 %	8,45 %	9,92 %	
t(Mn)		5,54	0,75	-2,19	-4,28	-3,87		3,38	-0,44	-1,87	-2,95	-3,63	

t(Mn) is the ratio of the average return to its standard error and t(stat) is the t-statistic testing whether the difference of a value and growth portfolio is different from zero.

The standard deviations for value stocks are consistently higher than that of growth stocks both for hedged and unhedged portfolios. However, the hedged portfolios do exhibit consistently lower volatility compared to their unhedged counterparts though these differences are marginal. In our sample the use of forward contracts have reduced the volatility of the hedged portfolios with an average of 1.85%. For statistical inference, hypothesis tests were conducted to test for differences in mean returns with the null hypothesis of zero difference in means. The tests confirm that the value premium is significant, as all null hypotheses were rejected at 5% significance level. When testing the differences in mean returns for hedged and unhedged portfolios using the same methodology none of the null hypotheses were rejected at the 5% significance level. Thus we can conclude with 95% certainty that there does indeed exist a value premium, but not that hedging is significantly better or worse than not hedging.

The cost of hedging is calculated by annualizing the difference between the unhedged and hedged mean returns. The cost of hedging ranges from 1,56% to 3,12%, and the average annual cost of hedging for all portfolios is estimated at 2,24% per year. This is also the average cost of hedging for all value portfolios and the market portfolio. For growth portfolios the cost of hedging is slightly higher, at 2,72% per year.

Skewness and kurtosis indicates that there are deviations from normality in the distributions of portfolio returns. However, the Chi-Square test for normality with the null hypothesis of a normal fit returns a p-value of 0.09447 and 0.21331 for the unhedged and hedged portfolios respectively, thus we cannot reject normality at the 5% significance level.

Figure 6 Distribution all markets unhedged

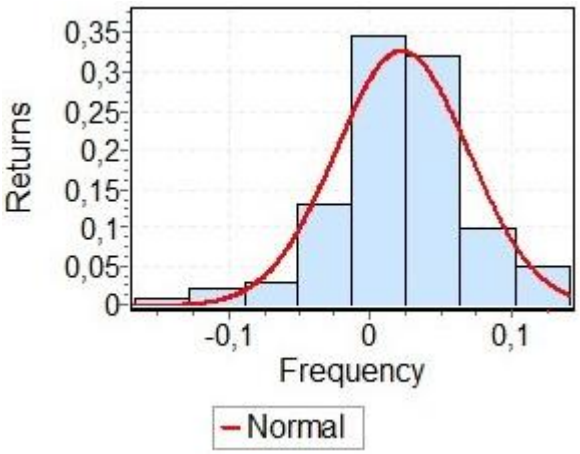
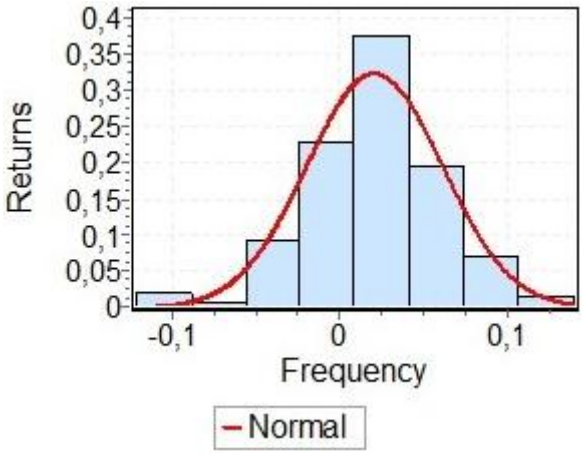


Figure 7 Distribution all markets hedged



In line with Lakonishok et al. (1993) we find that value portfolios are positively skewed. This is the case for all value portfolios, while all other portfolios are negatively skewed. The positively skewed value portfolios signals that the standard deviation will overestimate risk since extreme positive deviations from the expected return is not cause for concern for an investor. Perhaps not surprisingly, the growth portfolios have the highest negatively skewed distributions. Comparing the skewness of the hedged and unhedged portfolios reveals that the forward contracts have contributed in altering the distributions of the hedged portfolios.

All hedged portfolios exhibit a reduction in skewness compared to the unhedged portfolios. Further, all portfolios show excess kurtosis, called "fat tails" or leptokurtic distributions. Higher kurtosis signals the possibilities of extreme values, be that positive or negative. Bearing in mind that growth portfolios all had negative skewness, the excess kurtosis may signal a higher frequency of extreme negative returns. The effect of hedging with forward contracts with regard to kurtosis is that all hedged value portfolios show higher kurtosis than the unhedged portfolios, whilst the hedged growth portfolios all show lower kurtosis. From a risk perspective the reduced negative skewness and the added kurtosis indicate that forward contracts can be beneficial in reducing the vulnerability to extreme negative returns.

To illustrate the different distributional characteristics of the value and growth portfolios, we fitted distributions to the hedged P/E value and growth portfolios. When we employed the Anderson-Darling test, the highest ranked distribution for goodness of fit was the Burr distribution, known to be useful in modeling skewed and leptokurtic distributions. The normal distribution was also tested, and was found to be significant at the 5% level for all distributions.

Figure 8 Fitted distribution for P/E portfolio A hedged

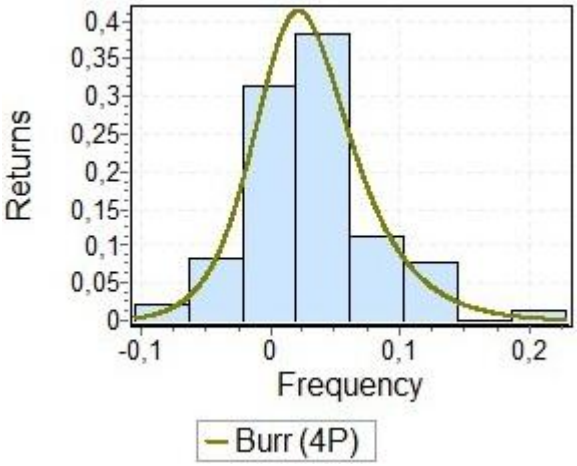
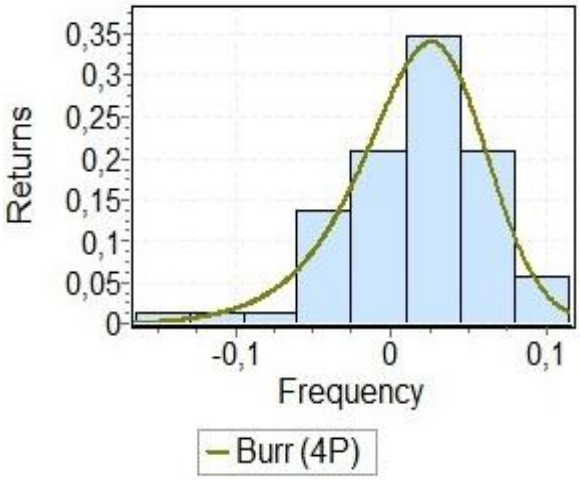


Figure 9 Fitted distribution for P/E portfolio E hedged



The hedged value portfolio has a long right tail, while the growth portfolio has a similar long left tailed distribution. Contrary to Bekaert et al. (1998), who found positive skewness in 85% of the examined markets, our statistics shows that it is only the value portfolios that exhibit positive skewness. All other portfolios show negative skewness with the growth portfolios having the lowest values. This would indicate that skewness does indeed change over time as advocated.

Country Returns and Correlations

Country returns

We look for evidence of a value premium from country returns by subdividing the value (A) and growth (E) portfolios, and evaluating the difference in excess returns over BBA Libor between the two. A positive t-stat for Value-Growth indicates a value premium. Market is all stocks for a given country. Tables with all markets can be found in the appendix.

Table 9 Annual excess returns for selected countries

		P/E_{NOH}			P/B_{NOH}			$Comb_{NOH}$		
	Market	Value	Growth	Value-Growth	Value	Growth	Value-Growth	Value	Growth	Value-Growth
BRL	16,09 %	27,13 %	17,45 %	9,67 %	24,66 %	25,99 %	-1,32 %	27,92 %	20,78 %	7,14 %
	13,01 %	20,12 %	32,58 %	**0,88**	27,39 %	23,56 %	**-0,13**	21,68 %	30,01 %	**0,67**
INR	26,50 %	39,88 %	22,45 %	17,44 %	41,45 %	27,45 %	14,00 %	39,88 %	25,53 %	14,35 %
	22,32 %	39,59 %	28,78 %	**1,16**	44,52 %	24,76 %	**0,81**	43,27 %	24,61 %	**0,93**
HKD	16,48 %	44,99 %	17,26 %	27,73 %	46,22 %	11,77 %	34,44 %	53,95 %	7,80 %	46,15 %
	22,93 %	44,57 %	31,26 %	**1,76***	41,62 %	34,83 %	**2,20****	43,88 %	33,05 %	**2,91****
KRW	19,83 %	36,74 %	22,63 %	14,11 %	34,18 %	9,17 %	25,01 %	37,67 %	12,27 %	25,41 %
	19,70 %	29,47 %	26,67 %	**1,23**	29,03 %	28,14 %	**2,14****	27,73 %	25,41 %	**2,34****
TWD	14,49 %	28,38 %	7,27 %	21,11 %	28,83 %	18,19 %	10,64 %	25,53 %	14,96 %	10,57 %
	20,48 %	38,31 %	27,58 %	**1,55**	33,74 %	29,75 %	**0,82**	25,38 %	24,79 %	**0,99**
		P/E_{FUH}			P/B_{FUH}			$Comb_{FUH}$		
BRL	10,42 %	19,18 %	9,50 %	9,67 %	16,71 %	18,04 %	-1,32 %	19,97 %	12,83 %	7,14 %
	21,04 %	31,18 %	41,24 %	**0,65**	35,13 %	34,61 %	**-0,09**	30,92 %	39,42 %	**0,49**
INR	24,40 %	37,74 %	19,66 %	18,08 %	39,06 %	24,66 %	14,40 %	37,73 %	22,74 %	14,99 %
	21,03 %	36,98 %	28,04 %	**1,27**	41,68 %	24,51 %	**0,88**	40,94 %	24,23 %	**1,02**
HKD	16,74 %	45,39 %	17,66 %	27,73 %	46,62 %	12,18 %	34,44 %	54,35 %	8,20 %	46,15 %
	22,90 %	44,54 %	31,24 %	**1,77***	41,58 %	34,83 %	**2,20****	43,86 %	33,02 %	**2,91****
KRW	17,89 %	34,20 %	20,09 %	14,11 %	31,64 %	6,63 %	25,01 %	35,13 %	9,73 %	25,41 %
	22,63 %	31,52 %	29,98 %	**1,12**	30,98 %	32,30 %	**1,94***	30,32 %	29,73 %	**2,07****
TWD	15,38 %	29,41 %	8,29 %	21,11 %	29,86 %	19,22 %	10,64 %	26,37 %	15,78 %	10,59 %
	19,69 %	37,93 %	26,46 %	**1,58**	32,68 %	29,21 %	**0,84**	24,75 %	24,37 %	**1,01**

The first row for each country is the average annual return, the second is the standard deviation of the annual returns (in percentages), or the t-statistic testing whether Value-Growth is different from zero (in bold).

* indicate significance at the 10% level, ** indicate significance at the 5% level.

From table 9 we find that for the unhedged portfolios, the value premiums are positive in 14 of 15 countries. However, the value premiums are only significant in Hong Kong and South Korea. It is interesting to note the similarities between Hong Kong and South Korea. Both have a higher value premium for P/B than P/E, which is significant at the 5% level. Contrast this to Taiwan, where the value premium is smaller and strongest for P/E, but not significant

at even the 10% level. All three are Asian economies that are highly integrated in the world economy. Hong Kong, South Korea and Taiwan have 137, 103 and 114 stocks in the dataset respectively, enough that we consider the results robust.

Results for the hedged portfolios are similar. 14 of 15 hedged portfolios show evidence of a value premium. Again, the value premiums are only significant in Hong Kong and South Korea. The general pattern is that the value premium is less pronounced for hedged portfolios. For Hong Kong the difference is virtually none, since its currency is pegged to the USD in a narrow band. For South Korea and Taiwan the value premium is actually marginally larger with hedging.

Country correlations

To investigate the benefits of diversification we begin by examining the correlations of country and global returns. Country portfolio constituents are all stocks with price information at the end of the previous year. MSCI ACWI is used as a proxy for global returns. A table with all markets can be found in the appendix.

Table 10 Correlation for selected countries

	AWCI	BRL	HKD	INR	KRW	TWD
AWCI	1,00	**-0,28**	**0,83**	**0,56**	**0,14**	**0,61**
BRL	0,27	1,00	**-0,25**	**0,06**	**0,14**	**-0,07**
HKD	0,83	0,25	1,00	**0,45**	**-0,01**	**0,51**
INR	0,73	0,33	0,62	1,00	**0,29**	**0,42**
KRW	0,52	0,28	0,32	0,46	1,00	**0,34**
TWD	0,71	0,25	0,60	0,52	0,48	1,00

Correlation between all stocks in selected countries and ACWI. Unhedged correlation lower left, hedged correlation top right in bold.

The general pattern is that unhedged portfolio correlation is lower, both with global returns, and between countries than for developed markets. Hong Kong displays the highest correlation with global returns, 0,83. Taiwan follows with 0,71. The correlation between the two is 0,60. South Korea displays only 0,52 correlation with global returns, and 0,32 and 0,48 with Hong Kong and Taiwan, respectively.

For hedged returns, correlations are much lower[10], both with the market, and between countries. For South Korea, correlation with global returns falls to 0,14, while Taiwan drops

[10] Hong Kong is a notable exception, since its currency is pegged to the USD in a narrow band.

to 0,61. Correlation between South Korea and Taiwan drops to 0,32. Lower correlations for hedged portfolios suggest potential gains from diversification.

Table 16 (in the appendix) shows that correlations between EM and DM and between individual EM countries vary substantially, and are generally quite low with the exception of the most globally integrated Asian economies. The hedged correlations indicate that there are larger diversification benefits from hedged country portfolios than unhedged country portfolios. Brazil for example goes from a correlation of 0.27 to the ACWI to -0.28 and Mexico from 0.52 to 0,05. As the correlations of several countries are calculated on varying and often limited number of observations, it is difficult to make a strong case for correlations and value premiums for the majority of the countries included in the sample.

Performance evaluation

Table 11 summarizes monthly excess returns of our constructed portfolios over the excess returns of the ACWI EW and performance statistics for the hedged and unhedged portfolios formed on each valuation ratio.

Table 11 Performance statistics

			Average	Std dev	Beta	Sharpe	Correl	R^2	Sortino
P/E	NOH	A	2,35 %	5,53 %	0,71	0,43	0,74	0,54	4,59
		B	1,43 %	4,37 %	0,59	0,33	0,77	0,59	3,57
		C	1,02 %	4,51 %	0,61	0,23	0,78	0,61	2,31
		D	0,98 %	4,65 %	0,63	0,21	0,78	0,61	2,22
		E	0,73 %	5,25 %	0,72	0,14	0,79	0,62	1,49
	FUH	A	2,14 %	5,01 %	0,36	0,43	0,41	0,17	5,27
		B	1,20 %	3,92 %	0,30	0,31	0,44	0,20	3,78
		C	0,88 %	3,98 %	0,35	0,22	0,50	0,25	2,63
		D	0,86 %	4,08 %	0,36	0,21	0,51	0,26	2,53
		E	0,53 %	4,64 %	0,46	0,11	0,56	0,32	1,47
P/B	NOH	A	2,29 %	5,86 %	0,74	0,39	0,73	0,53	4,18
		B	1,35 %	5,00 %	0,70	0,27	0,80	0,64	2,60
		C	1,08 %	4,48 %	0,63	0,24	0,80	0,65	2,58
		D	0,91 %	4,64 %	0,63	0,20	0,78	0,61	2,04
		E	0,91 %	4,86 %	0,62	0,19	0,73	0,53	1,85
	FUH	A	2,10 %	5,33 %	0,43	0,39	0,46	0,21	4,56
		B	1,22 %	4,34 %	0,42	0,28	0,55	0,31	3,03
		C	0,89 %	3,85 %	0,35	0,23	0,52	0,27	2,88
		D	0,71 %	4,04 %	0,35	0,18	0,50	0,25	2,14
		E	0,65 %	4,51 %	0,34	0,14	0,43	0,19	1,77
$Comb$	NOH	A	2,45 %	5,63 %	0,72	0,44	0,73	0,54	4,80
		B	1,40 %	4,70 %	0,65	0,30	0,80	0,64	2,96
		C	1,12 %	4,55 %	0,61	0,25	0,77	0,60	2,65
		D	0,92 %	4,45 %	0,62	0,21	0,80	0,63	2,19
		E	0,67 %	5,04 %	0,66	0,13	0,75	0,56	1,42
	FUH	A	2,28 %	5,10 %	0,39	0,45	0,44	0,19	5,56
		B	1,24 %	4,04 %	0,37	0,31	0,53	0,28	3,50
		C	0,93 %	3,99 %	0,32	0,23	0,47	0,22	2,88
		D	0,72 %	3,86 %	0,34	0,19	0,50	0,25	2,36
		E	0,46 %	4,58 %	0,40	0,10	0,50	0,25	1,37

Monthly excess returns, and performance statistics.

The relatively low betas are surprising. One would expect that risky emerging market portfolios would exhibit high betas. Caution must be taken not to assume that the low betas signal lower risk. As pointed out by Harvey (1995), the capital asset pricing model is unable to explain the cross section of expected returns due to the low integration of emerging

market capital markets. Similar to Harvey (1995), who only found Portugal to have a beta greater than one, we find that of the 21 countries in our sample, only Hong-Kong has a beta that exceeds one for the sample period. This is not surprising as Hong Kong, in comparison to the other countries in the sample, is possibly the most integrated in the world economy. The differences between the unhedged and hedged portfolio betas are substantial. The hedged betas are on average 29% lower than the unhedged portfolios. This must be seen in relation to the similar reduced correlations with the world portfolio, which is 28% lower for the hedged portfolios.

The correlation matrix is constructed by calculating the average monthly returns for each country included in the sample. Betas are calculated by regressing country returns on the ACWI EW index. Following Estrada (2000), our cross section analysis correlation matrix (Table 12) provides further evidence that mean returns are not highly correlated with betas, with correlations of 0.44 and 0.43 for the hedged and unhedged portfolios respectively.

Table 12 Cross section analysis correlation matrix

	Unhedged						
	Mean	Beta	Std	Std.res.	D. Beta	Semi Std.	VAR
Mean	1						
Beta	0,44	1					
Std.	0,32	0,66	1				
Std. res.	0,2	0,3	0,9	1			
D. Beta	0,33	0,98	0,61	0,25	1		
Semi Std.	0,25	0,77	0,92	0,73	0,79	1	
VAR	0,09	0,59	0,97	0,9	0,56	0,9	1
	Hedged						
	Mean	Beta	Std	Std.res.	D. Beta	Semi Std.	VAR
Mean	1						
Beta	0,43	1					
Std.	-0,08	0	1				
Std. res.	-0,18	-0,28	0,93	1			
D. Beta	0,36	0,98	0,02	-0,27	1		
Semi Std.	-0,03	0,31	0,86	0,7	0,35	1	
VAR	-0,28	-0,09	0,98	0,93	-0,06	0,84	1

Std. res. is the standard deviation of the residuals, D. Beta is the downside beta calculated by excluding all positive values of returns, Semi Std. is the semi-standard deviation, where only the variation below the mean is considered. VAR is the value-at-risk at one month and 95% confidence interval.

Estrada (2000) finds a strong correlation between total risk and idiosyncratic risk (.98) and semi deviation with respect to the mean and idiosyncratic risk (0.97) suggesting that mean

returns and total risk largely goes through downside risk. He also points out that there is a high correlation between systematic risk and the downside risk variables. We find that there is indeed a strong relationship between total risk and idiosyncratic risk (0.90 & 0.93 for the unhedged and hedged returns respectively), and to a lesser degree for idiosyncratic and downside risk (0.73 & 0.70). We also notice that there is a high level of correlation between systematic and the downside risk variables (0.98 and 0.77) for the unhedged portfolios, while the unhedged portfolios show lower correlation between systematic risk and the semi deviation with respect to the mean (0.31). In fact, differences in correlations from the unhedged and hedged portfolios are large, and often go from positive to negative. Most notably the correlation between beta and total risk changes from 0.66 in the unhedged portfolio to zero in the hedged portfolio, and the decreased correlations between beta and downside beta with VAR. Overall the implementation of forward contracts has altered the correlations of mean returns to the various risk measures to a large degree.

In all cases, value portfolios have higher Sharpe ratios than growth portfolios. On average the value portfolios have 39% higher Sharpe ratios than growth portfolios, where the largest difference can be found between the unhedged value and growth portfolios formed on combined P/E and P/B. Differences in Sharpe ratios between the hedged and unhedged portfolios are small. The Sharpe ratio ranks the hedged combined value portfolio highest (0.45), closely followed by the unhedged combined value portfolio (0.44) and both PE portfolios (0.43). Keeping in mind that in our sample, all unhedged portfolios show a higher (though insignificant) average return than the hedged portfolio, the higher Sharpe ratios must come from a decrease in volatility in the hedged portfolios. The reduction in volatility is in line with the findings of Glen and Jorion (1993).

The Sortino ratio provides similar rankings, though the differences in Sortino ratios between the hedged and unhedged portfolios are greater than that of the Sharpe ratios. This indicates that the hedged portfolios do indeed have lower downside risk than the unhedged portfolios. There are only two portfolios differing in ranks namely the hedged value portfolio formed on PE (from 3rd to 2nd) and the unhedged combined portfolio (from 2nd to 3rd). The highest difference in ranking between the Sharpe and Sortino can be found for the hedged portfolio D formed on PE&PB, ranked as 23rd for the Sharpe ratio, whilst the Sortino ratio ranks it at 19th place. One interesting observation is for the combined hedged portfolio, where the value portfolio is ranked 1st for both ratios, while the growth portfolio is ranked last at 30th place for both ratios, again illustrating the significant value premium.

Sharpe ratios of the unhedged and hedged portfolios, and the z-value that compares them, are presented below in Table 13 under the heading "Ratio portfolios". Our approach differs from Kim (2012) as he assumes an investor's portfolio only consists of stocks of one EM country. Sharpe ratios are calculated using portfolio excess returns over the BBA Libor rate, and z-values are calculated from equation (6). The z-values show that there are no significant differences in Sharpe ratios for any of the constructed portfolios. The sign of the z-values are positive for all value portfolios while negative for all growth portfolios. While Kim finds that the z-value is more often negative than positive, we find an opposite pattern. Our results indicate that hedging is not significantly worse than not hedging.

Comparison with diversified portfolio

We now move on to examine currency hedging from the perspective of an investor who allocates his assets in both developed and emerging markets. This is a more realistic scenario as investors seek to exploit the effects of diversification through low correlations between emerging and developed markets. In order to investigate this perspective we form three new sets of portfolios, where each portfolio consists of 50% EM and 50% DM stocks. For example, a value portfolio constructed on P/E would be allocated 50/50 between the EM value (A) portfolio and the MSCI World (equally weighted). Table 13 presents Sharpe ratios of the unhedged and hedged portfolios, and the z-value that compares them, under the heading "50/50 portfolios".

Table 13 Diversified performance

		Ratio portfolios			50/50 portfolios		
		Sharpe ratio		Z-value	Sharpe ratio		Z-value
		NOH	***FUH***	***NOH vs FUH***	***NOH***	***FUH***	***NOH vs FUH***
P/E	A	0,56	0,58	0,35	0,36	0,40	1,79*
	B	0,50	0,50	-0,03	0,30	0,32	1,08
	C	0,39	0,41	0,41	0,25	0,27	1,27
	D	0,37	0,39	0,59	0,24	0,26	1,45
	E	0,28	0,28	-0,23	0,20	0,21	0,26
P/B	A	0,52	0,54	0,48	0,35	0,38	1,77*
	B	0,42	0,45	0,97	0,27	0,30	1,80*
	C	0,41	0,43	0,47	0,26	0,27	1,20
	D	0,36	0,36	0,14	0,24	0,25	0,86
	E	0,34	0,31	-0,81	0,23	0,23	0,02
Comb	A	0,57	0,59	0,64	0,37	0,41	2,07**
	B	0,46	0,49	0,89	0,29	0,31	1,76*
	C	0,41	0,42	0,27	0,26	0,28	1,25
	D	0,37	0,38	0,18	0,24	0,25	0,90
	E	0,28	0,26	-0,56	0,20	0,20	0,07

A positive z-value indicates that the hedged portfolio is superior, while a negative z-value indicates that the unhedged portfolio is superior. * indicate significance at the 10% level, ** indicate significance at the 5% level.

The comparisons of the diversified portfolios yield several interesting results. All the z-values are positive, even for the growth portfolios, indicating that hedging is advantageous. Second, four Sharpe ratios are significant at the 10% level, while the 50/50 DM and combined P/E and P/B portfolios are significant at the 5% level. As was the case with the undiversified portfolios, none of the portfolios containing growth stocks have significant z-values.

Referring back to the summary statistics in tables 6,7 and 8, we recall that all hedged portfolio returns are lower than their unhedged equivalent. Thus the higher Sharpe ratios of the hedged portfolios can only be explained by a reduction in the volatility of returns. The Sharpe ratios for the 50/50 portfolios are lower than their undiversified counterparts. There are two main reasons for this. First, the mean returns of the 50/50 portfolios are significantly lower than portfolios consisting of EM stock only. This is not surprising as EM performed strongly compared to DM for the sample period. Second, the reduction in volatility is not large enough to yield higher Sharpe ratios.

Kim (2012) considered a diversified scenario with 50% domestic stocks, and 50% split among 11 EM countries. For the US portfolio the z-value comparing the unhedged and hedged portfolios is -1,62. While not significant, it is still a notable difference from our results. This indicates that there could be specific benefits when hedging emerging market value stocks. However when considering the significance of the differences in Sharpe ratios of the 50/50 portfolios, one should keep in mind that the diversified portfolios are inferior compared to the undiversified ratio portfolios.

4. Conclusions

Emerging markets have historically been associated with high volatility, low correlations to developed markets and fluctuating exchange rates. In this thesis we have examined how currency hedging affects the performance of emerging market equity portfolios. Using emerging market constituents of the MSCI EM index we constructed portfolios based on P/E and P/B ratios to reflect value and growth investment strategies. Hedging was implemented using 1-month forward contracts, and performance was evaluated by comparing Sharpe ratios.

We estimate the opportunity cost of hedging the market portfolio to be 2,24% per year. This is similar to Jorion (1989) who found the average cost of hedging for global portfolios to be around 2% per year. Glen and Jorion (1993), who only study DM, have a larger range, 0,87% to 2,7%, where 0.87% was for Germany, while Japan, UK and France all had annual costs of hedging exceeding 2%. It would seem that an estimate of around 2% per year is a fair estimation for the opportunity cost of hedging. However, Glen and Jorion (1993) point out that the cost of hedging can be unstable and period specific. While the cost of hedging in our analysis measures the "forgone" returns of the unhedged portfolio, the cost of hedging does not include transaction costs in relation to entering forward positions or the yearly rebalancing of portfolios. These costs would have to be considered before a hedging strategy is implemented.

For all three sets of portfolios we found that there are significant value premiums. This is in line with previous research, most notably Fama and French (1998). We consider this to be a robust result, since it confirms previous research on other markets, and other time periods. We note that where Fama and French (1992) found that the value premium was most pronounced for P/B, we found P/E and combined P/E and P/B to be better predictors of value premiums. It is interesting to see that apparent mispricing can persist for extended periods of time, challenging the fundamentals of the EMH.

We have shown that hedging reduces both mean returns and volatility. The substantial reduction in volatility results in marginally higher risk-adjusted returns as measured by the Sharpe ratio. The result mirrors Walker (2008), who found that for investors based in emerging markets, hedging a global portfolio increases volatility. As the improvement is not statistically significant, we do not consider it to be a confirmation of a "free lunch". In contrast, Kim (2012) found that more often than not, hedging reduced risk-adjusted returns.

For a diversified portfolio the reduction in volatility means that significantly higher risk-adjusted performance can be achieved by hedging the emerging markets value portion. The benefit of hedging is only significant when including value stocks. It is important to remember that risk adjusted performance of the diversified portfolios, both hedged and unhedged, are lower than their undiversified counterparts.

There are some limitations to our results that are worth mentioning. The dataset is relatively short in length. Our sample period, which starts in 2001, captures the aftermath of the dotcom bubble and the subsequent bear market up until the financial crisis of 2008. History has shown that shocks and regime shifts can have profound effects on emerging market returns and exchange rates. Lastly, we only calculated returns in USD, so the results are sensitive to the relative strength of the dollar during the sample period.

Despite these limitations, and the fact that hedging is only significant for the inferior diversified portfolios, the benefit of currency hedging value stocks in a diversified portfolio is a significant result. This indicates that there could be specific benefits to currency hedging emerging markets value stocks. A study that covers a longer sample period, including the EM crises of the 1990s, and includes other currencies could yield more robust results.

Appendix

Data from Bloomberg

Adjusted equity prices

Bloomberg includes the option to adjust historical pricing. On recommendation from Skagen Funds we used the following adjustments:

Normal Cash Dividends

Adjust historical pricing to reflect: Regular Cash, Interim, 1st Interim, 2nd Interim, 3rd Interim, 4th Interim, 5th Interim, Income, Estimated, Partnership Distribution, Final, Interest on Capital, Distribution, Prorated.

Abnormal Cash Dividends

Adjust historical pricing to reflect: Special Cash, Liquidation, Capital Gains, Long-Term Capital Gains, Short-Term Capital Gains, Memorial, Return of Capital, Rights Redemption, Miscellaneous, Return Premium, Preferred Rights Redemption, Proceeds/Rights, Proceeds/Shares, Proceeds/Warrants.

Historical Pricing

Adjust historical pricing and/or volume to reflect: Spin-Offs, Stock Splits/Consolidations, Stock Dividend/Bonus, Rights Offerings/Entitlement.

P/E

Ratio of the price of a stock and the company's earnings per share. For all countries not otherwise mentioned below it is calculated as Last Price(PR005, PX_LAST) divided by Trailing 12M EPS before XO items(RR819, TRAIL_12M_EPS_BEF_XO_ITEM) or Basic EPS Before XO(IS064, IS_EARN_BEF_XO_ITEMS_PER_SH) if only annual earnings exist.

US and Canada:

Calculated as Last Price(PR005, PX_LAST) divided by Trailing 12M Diluted EPS From Cont OPS(RR844, T12M_DIL_EPS_CONT_OPS) or Diluted EPS From Continuing Ops(IS147,(IS_DIL_EPS_CONT_OPS) if only annual earnings exist.

South Africa:

Calculated as Last Price(PR005, PX_LAST) divided by Trailing 12M Special EPS(RR816, (TRAIL_12M_SPECIAL_EPS).

Equity Index:

Current Price/Earnings Ratio. Calculated as Last Price (PR005, PX_LAST) divided by Trailing Weighted EPS (IN001, T12_EPS_AGGTE).

RR900 is not computed if the earnings per share is negative.

P/B

Ratio of the stock price to the book value per share. Calculated as:

Price to Book Ratio = Last Price / Book Value Per Share

Data from the most recent reporting period (quarterly, semi-annual or annual) used in the calculation.

Country returns and correlations

One should be careful about drawing conclusions about specific countries based on the following, as the number of stocks per country can be quite small (see Table 5).

Table 14 Annual unhedged excess returns by country

		P/E_{NOH}			P/B_{NOH}			$Comb_{NOH}$		
	Market	Value	Growth	Value-Growth	Value	Growth	Value-Growth	Value	Growth	Value-Growth
BRL	16,09 %	27,13 %	17,45 %	9,67 %	24,66 %	25,99 %	-1,32 %	27,92 %	20,78 %	7,14 %
	13,01 %	20,12 %	32,58 %	**0,88**	27,39 %	23,56 %	**-0,13**	21,68 %	30,01 %	**0,67**
CLP	15,90 %	38,85 %	14,79 %	24,07 %	33,09 %	22,95 %	10,13 %	36,78 %	15,31 %	21,46 %
	15,02 %	23,70 %	19,86 %	**1,81***	32,03 %	21,51 %	**0,81**	32,32 %	20,69 %	**1,47**
COP	17,86 %	59,08 %	13,04 %	46,04 %	33,14 %	23,92 %	9,22 %	53,29 %	4,57 %	48,72 %
	14,98 %	40,28 %	21,62 %	**2,33****	31,35 %	20,02 %	**0,41**	42,85 %	18,99 %	**2,28****
CZK	10,47 %	4,53 %	NA	NA	18,96 %	NA	NA	19,09 %	NA	NA
	23,88 %	25,79 %	NA	NA	24,49 %	NA	NA	25,20 %	NA	NA
EGP	25,66 %	18,17 %	14,03 %	4,15 %	11,99 %	20,67 %	-8,69 %	34,67 %	66,29 %	-31,63 %
	33,65 %	41,83 %	87,29 %	**0,09**	35,78 %	59,92 %	**-0,23**	35,39 %	146,22 %	**-0,22**
HKD	16,48 %	44,99 %	17,26 %	27,73 %	46,22 %	11,77 %	34,44 %	53,95 %	7,80 %	46,15 %
	22,93 %	44,57 %	31,26 %	**1,76***	41,62 %	34,83 %	**2,20****	43,88 %	33,05 %	**2,91****
HUF	6,65 %	13,54 %	NA	NA	-9,05 %	28,13 %	-37,18 %	2,47 %	13,88 %	-11,42 %
	24,78 %	31,42 %	NA	NA	24,10 %	28,49 %	**-1,63**	23,56 %	27,45 %	**-0,40**
IDR	28,46 %	87,29 %	16,44 %	70,85 %	68,22 %	24,45 %	43,77 %	80,44 %	17,98 %	62,46 %
	19,88 %	34,60 %	30,45 %	**4,63****	48,63 %	24,02 %	**2,48****	47,95 %	24,22 %	**3,41****
INR	26,50 %	39,88 %	22,45 %	17,44 %	41,45 %	27,45 %	14,00 %	39,88 %	25,53 %	14,35 %
	22,32 %	39,59 %	28,78 %	**1,16**	44,52 %	24,76 %	**0,81**	43,27 %	24,61 %	**0,93**
KRW	19,83 %	36,74 %	22,63 %	14,11 %	34,18 %	9,17 %	25,01 %	37,67 %	12,27 %	25,41 %
	19,70 %	29,47 %	26,67 %	**1,23**	29,03 %	28,14 %	**2,14****	27,73 %	25,41 %	**2,34****
MAD	3,95 %	NA	-5,76 %	NA	NA	4,06 %	NA	NA	-7,86 %	NA
	17,05 %	NA	39,77 %	NA	NA	20,52 %	NA	NA	31,41 %	NA
MXN	23,16 %	45,07 %	21,07 %	23,99 %	40,39 %	19,17 %	21,22 %	44,88 %	17,44 %	27,44 %
	13,47 %	27,81 %	23,44 %	**2,28****	26,79 %	18,70 %	**2,25****	28,79 %	18,06 %	**2,80****
MYR	10,58 %	26,33 %	5,22 %	21,11 %	21,30 %	6,15 %	15,15 %	27,96 %	4,50 %	23,46 %
	12,20 %	25,73 %	27,64 %	**1,90***	21,13 %	15,99 %	**1,93***	20,89 %	24,18 %	**2,44****
PHP	21,32 %	42,10 %	12,10 %	30,00 %	48,40 %	7,95 %	40,45 %	51,94 %	8,15 %	43,79 %
	20,23 %	31,13 %	26,01 %	**2,42****	59,52 %	16,61 %	**2,08****	35,04 %	23,18 %	**3,38****
PLN	7,97 %	25,04 %	10,20 %	14,84 %	27,88 %	13,57 %	14,30 %	18,60 %	11,19 %	7,41 %
	13,61 %	29,14 %	29,00 %	**1,14**	30,96 %	32,66 %	**1,05**	25,51 %	28,18 %	**0,63**
RUB	17,37 %	14,48 %	28,87 %	-14,39 %	5,00 %	25,33 %	-20,33 %	11,99 %	-3,80 %	15,79 %
	20,82 %	30,78 %	44,86 %	**-0,74**	33,71 %	57,80 %	**-0,69**	31,33 %	49,55 %	**0,59**
THB	19,75 %	19,55 %	30,42 %	-10,88 %	26,87 %	25,10 %	1,76 %	25,44 %	29,27 %	-3,84 %
	19,81 %	27,74 %	42,02 %	**-0,73**	28,03 %	26,05 %	**0,16**	24,47 %	30,48 %	**-0,33**
TRY	27,17 %	43,53 %	46,22 %	-2,69 %	45,71 %	45,09 %	0,62 %	43,63 %	32,25 %	11,38 %
	25,48 %	38,87 %	37,30 %	**-0,17**	40,12 %	42,68 %	**0,04**	40,47 %	31,49 %	**0,76**
TWD	14,49 %	28,38 %	7,27 %	21,11 %	28,83 %	18,19 %	10,64 %	25,53 %	14,96 %	10,57 %
	20,48 %	38,31 %	27,58 %	**1,55**	33,74 %	29,75 %	**0,82**	25,38 %	24,79 %	**0,99**
ZAR	22,53 %	37,38 %	5,63 %	31,75 %	42,50 %	23,16 %	19,34 %	37,85 %	16,71 %	21,14 %
	18,39 %	26,13 %	33,91 %	**2,57****	35,93 %	21,56 %	**1,60**	28,27 %	24,95 %	**1,94***

The first row for each country is the average annual return, the second is the standard deviation of the annual returns (in percentages), or the t-statistic testing whether Value-Growth is different from zero (in bold).

* indicate significance at the 10% level, ** indicate significance at the 5% level.

Table 15 Annual hedged excess returns by country

		P/E_{FUH}			P/B_{FUH}			$Comb_{FUH}$		
	Market	Value	Growth	Value-Growth	Value	Growth	Value-Growth	Value	Growth	Value-Growth
BRL	10,42 %	19,18 %	9,50 %	9,67 %	16,71 %	18,04 %	-1,32 %	19,97 %	12,83 %	7,14 %
	21,04 %	31,18 %	41,24 %	**0,65**	35,13 %	34,61 %	**-0,09**	30,92 %	39,42 %	**0,49**
CLP	13,23 %	35,96 %	9,59 %	26,37 %	28,83 %	17,76 %	11,07 %	34,70 %	10,12 %	24,58 %
	16,36 %	24,70 %	20,38 %	**1,91***	32,62 %	22,41 %	**0,86**	32,05 %	21,04 %	**1,69***
COP	14,26 %	49,05 %	6,64 %	42,41 %	29,77 %	10,87 %	18,90 %	46,59 %	-3,68 %	50,27 %
	19,27 %	41,66 %	30,47 %	**1,94***	37,34 %	22,86 %	**0,73**	44,24 %	25,95 %	**2,12****
CZK	5,73 %	0,98 %	NA	NA	11,21 %	NA	NA	12,93 %	NA	NA
	31,88 %	35,42 %	NA	NA	32,76 %	NA	NA	34,41 %	NA	NA
EGP	19,14 %	7,81 %	4,23 %	3,58 %	2,62 %	11,30 %	-8,68 %	24,30 %	62,31 %	-38,00
	33,17 %	40,97 %	86,59 %	**0,08**	35,11 %	59,40 %	**-0,24**	34,82 %	145,95	**-0,26**
HKD	16,74 %	45,39 %	17,66 %	27,73 %	46,62 %	12,18 %	34,44 %	54,35 %	8,20 %	46,15 %
	22,90 %	44,54 %	31,24 %	**1,77***	41,58 %	34,83 %	**2,20****	43,86 %	33,02 %	**2,91****
HUF	-0,08 %	16,98 %	NA	NA	-9,08 %	27,75 %	-36,83	-2,73 %	0,39 %	-3,12 %
	31,29 %	37,80 %	NA	NA	34,25 %	33,86 %	**-1,30**	32,04 %	36,18 %	**-0,08**
IDR	22,33 %	76,41 %	8,71 %	67,70 %	62,04 %	16,75 %	45,29 %	71,03 %	10,29 %	60,74 %
	19,51 %	34,41 %	30,38 %	**4,45****	48,41 %	24,40 %	**2,57****	47,79 %	24,44 %	**3,32****
INR	24,40 %	37,74 %	19,66 %	18,08 %	39,06 %	24,66 %	14,40 %	37,73 %	22,74 %	14,99 %
	21,03 %	36,98 %	28,04 %	**1,27**	41,68 %	24,51 %	**0,88**	40,94 %	24,23 %	**1,02**
KRW	17,89 %	34,20 %	20,09 %	14,11 %	31,64 %	6,63 %	25,01 %	35,13 %	9,73 %	25,41 %
	22,63 %	31,52 %	29,98 %	**1,12**	30,98 %	32,30 %	**1,94***	30,32 %	29,73 %	**2,07****
MAD	2,37 %	NA	-7,15 %	NA	NA	3,12 %	NA	NA	-9,24 %	NA
	21,12 %	NA	43,45 %	NA	NA	25,91 %	NA	NA	36,28 %	NA
MXN	21,39 %	42,90 %	18,91 %	23,99 %	38,23 %	17,01 %	21,22 %	42,72 %	15,27 %	27,44 %
	16,79 %	29,86 %	25,69 %	**2,11****	26,97 %	22,51 %	**2,09****	30,10 %	22,09 %	**2,55****
MYR	9,42 %	25,27 %	3,86 %	21,41 %	20,24 %	4,79 %	15,45 %	26,91 %	3,39 %	23,52 %
	13,26 %	26,41 %	27,16 %	**1,92***	21,81 %	17,60 %	**1,86***	21,47 %	24,25 %	**2,41****
PHP	16,32 %	36,81 %	6,50 %	30,31 %	42,25 %	1,07 %	41,19 %	46,65 %	2,54 %	44,10 %
	20,35 %	31,39 %	25,73 %	**2,44****	58,94 %	18,06 %	**2,12****	35,14 %	23,16 %	**3,40****
PLN	5,81 %	22,02 %	5,43 %	16,59 %	23,85 %	8,91 %	14,94 %	15,58 %	6,02 %	9,56 %
	19,68 %	33,81 %	37,97 %	**1,03**	37,17 %	40,52 %	**0,90**	31,48 %	35,63 %	**0,65**
RUB	14,83 %	10,81 %	27,33 %	-16,52	0,62 %	22,16 %	-21,54	8,32 %	-3,85 %	12,16 %
	20,81 %	30,76 %	43,62 %	**-0,86**	33,31 %	55,17 %	**-0,76**	31,79 %	48,24 %	**0,47**
THB	22,30 %	22,14 %	34,20 %	-12,06	29,46 %	27,70 %	1,76 %	28,71 %	31,87 %	-3,16 %
	20,02 %	27,52 %	42,76 %	**-0,80**	27,98 %	26,41 %	**0,16**	24,40 %	30,85 %	**-0,27**
TRY	22,13 %	36,40 %	36,23 %	0,18 %	38,58 %	37,96 %	0,62 %	36,50 %	18,22 %	18,28 %
	30,12 %	46,54 %	45,74 %	**0,01**	47,13 %	51,04 %	**0,03**	47,84 %	35,45 %	**1,05**
TWD	15,38 %	29,41 %	8,29 %	21,11 %	29,86 %	19,22 %	10,64 %	26,37 %	15,78 %	10,59 %
	19,69 %	37,93 %	26,46 %	**1,58**	32,68 %	29,21 %	**0,84**	24,75 %	24,37 %	**1,01**
ZAR	18,70 %	33,27 %	1,51 %	31,75 %	38,38 %	19,04 %	19,34 %	33,73 %	12,59 %	21,14 %
	32,26 %	39,99 %	45,85 %	**1,81***	49,12 %	36,24 %	**1,10**	41,79 %	38,86 %	**1,28**

The first row for each country is the average annual return, the second is the standard deviation of the annual returns (in percentages), or the t-statistic testing whether Value-Growth is different from zero (in bold).
* indicate significance at the 10% level, ** indicate significance at the 5% level.

Table 16 Country correlations

	AWCI	BRL	CLP	COP	CZK	EGP	HKD	HUF	IDR	INR	KRW	MAD	MXN	MYR	PHP	PLN	RUB	THB	TRY	TWD	ZAR
AWCI	1,00	**-0,28**	**0,09**	**-0,17**	**0,07**	**0,53**	**0,83**	**0,08**	**0,32**	**0,56**	**0,14**	**-0,30**	**0,05**	**0,27**	**0,39**	**-0,12**	**0,39**	**0,55**	**-0,03**	**0,61**	**-0,26**
BRL	0,27	1,00	**0,10**	**0,31**	**0,21**	**-0,24**	**-0,25**	**0,04**	**0,02**	**0,06**	**0,14**	**0,06**	**0,30**	**0,14**	**0,00**	**0,28**	**0,07**	**-0,10**	**0,23**	**-0,07**	**0,14**
CLP	0,60	0,22	1,00	**0,10**	**0,20**	**0,08**	**0,09**	**0,19**	**0,02**	**0,16**	**0,13**	**0,07**	**0,17**	**0,30**	**0,18**	**0,18**	**0,21**	**-0,03**	**0,15**	**0,03**	**0,06**
COP	0,15	0,22	0,14	1,00	**0,12**	**-0,02**	**-0,17**	**0,10**	**0,02**	**0,07**	**0,14**	**0,12**	**0,23**	**0,19**	**0,12**	**0,24**	**0,23**	**-0,09**	**0,02**	**-0,08**	**0,09**
CZK	0,35	0,29	0,28	0,14	1,00	**0,00**	**0,00**	**0,70**	**0,19**	**0,14**	**0,44**	**0,29**	**0,23**	**0,34**	**0,26**	**0,66**	**0,29**	**0,13**	**0,12**	**0,23**	**0,17**
EGP	0,55	0,07	0,32	0,16	0,16	1,00	**0,40**	**0,02**	**0,10**	**0,23**	**-0,06**	**-0,01**	**-0,04**	**0,04**	**0,13**	**-0,07**	**0,22**	**0,21**	**-0,03**	**0,27**	**-0,15**
HKD	0,83	0,25	0,48	0,10	0,21	0,42	1,00	**-0,01**	**0,30**	**0,45**	**-0,01**	**-0,36**	**-0,04**	**0,16**	**0,25**	**-0,13**	**0,30**	**0,41**	**-0,01**	**0,51**	**-0,28**
HUF	0,46	0,19	0,38	0,14	0,65	0,24	0,31	1,00	**0,13**	**0,16**	**0,42**	**0,28**	**0,12**	**0,29**	**0,25**	**0,61**	**0,34**	**0,08**	**0,13**	**0,22**	**0,20**
IDR	0,61	0,25	0,41	0,18	0,28	0,32	0,54	0,32	1,00	**0,30**	**0,32**	**-0,04**	**0,09**	**0,29**	**0,34**	**0,06**	**0,16**	**0,25**	**-0,01**	**0,20**	**-0,06**
INR	0,73	0,33	0,45	0,22	0,25	0,38	0,62	0,36	0,54	1,00	**0,29**	**-0,02**	**0,32**	**0,37**	**0,40**	**0,19**	**0,37**	**0,43**	**0,07**	**0,42**	**0,01**
KRW	0,52	0,28	0,40	0,18	0,48	0,16	0,32	0,48	0,41	0,46	1,00	**0,20**	**0,18**	**0,39**	**0,31**	**0,38**	**0,32**	**0,33**	**0,12**	**0,34**	**0,23**
MAD	-0,12	-0,09	-0,05	-0,01	0,05	0,09	-0,21	0,00	-0,05	-0,05	-0,02	1,00	**0,12**	**0,15**	**-0,01**	**0,47**	**0,13**	**-0,07**	**0,08**	**0,04**	**0,22**
MXN	0,52	0,36	0,36	0,27	0,32	0,22	0,36	0,25	0,40	0,49	0,33	-0,06	1,00	**0,42**	**0,15**	**0,40**	**0,30**	**0,12**	**-0,05**	**0,21**	**0,13**
MYR	0,51	0,28	0,45	0,20	0,34	0,19	0,39	0,34	0,47	0,43	0,41	0,04	0,49	1,00	**0,34**	**0,41**	**0,42**	**0,27**	**0,06**	**0,42**	**0,12**
PHP	0,55	0,20	0,41	0,20	0,32	0,25	0,39	0,40	0,52	0,50	0,42	-0,06	0,39	0,41	1,00	**0,25**	**0,29**	**0,36**	**0,05**	**0,39**	**-0,01**
PLN	0,37	0,32	0,28	0,17	0,60	0,20	0,29	0,58	0,33	0,38	0,41	0,19	0,42	0,43	0,44	1,00	**0,37**	**0,04**	**0,13**	**0,18**	**0,22**
RUB	0,61	0,32	0,40	0,24	0,28	0,37	0,52	0,43	0,40	0,47	0,42	0,05	0,42	0,39	0,37	0,41	1,00	**0,27**	**0,16**	**0,46**	**0,00**
THB	0,69	0,28	0,40	0,16	0,24	0,34	0,55	0,29	0,51	0,59	0,49	-0,06	0,47	0,42	0,52	0,36	0,45	1,00	**0,03**	**0,45**	**-0,18**
TRY	0,37	0,28	0,27	0,05	0,28	0,21	0,26	0,31	0,15	0,35	0,30	-0,01	0,10	0,24	0,23	0,26	0,33	0,27	1,00	**0,12**	**0,14**
TWD	0,71	0,25	0,37	0,06	0,30	0,35	0,60	0,35	0,37	0,52	0,48	0,06	0,44	0,50	0,45	0,39	0,57	0,55	0,29	1,00	**0,03**
ZAR	0,07	0,09	0,05	0,08	0,19	0,03	-0,02	0,16	0,00	0,16	0,23	0,07	0,14	0,14	0,10	0,14	0,04	-0,02	0,16	0,16	1,00

Correlation between all stocks in the dataset and ACWI. Unhedged correlation lower left, hedged correlation top right in bold. Correlations for USD omitted,

Regressions

Table 17 Details on regressions

			a	t-value (a)	SE (a)	b	t-value (b)	SE (b)	R^2	Adj R^2	StErr of Estimate	F-Ratio	p(F-Ratio)
P/E	***NOH***	A	0,03	8,18	0,0031	0,71	13,06	0,0542	0,55	0,54	0,0374	170,4448	<0.0001
		B	0,02	7,47	0,0023	0,58	14,50	0,0403	0,60	0,59	0,0278	210,1488	<0.0001
		C	0,01	5,55	0,0024	0,61	14,94	0,0409	0,61	0,61	0,0282	223,1002	<0.0001
		D	0,01	5,16	0,0025	0,63	14,88	0,0423	0,61	0,61	0,0292	221,3336	<0.0001
		E	0,01	3,48	0,0027	0,72	15,37	0,0468	0,62	0,62	0,0323	236,2049	<0.0001
	FUH	A	0,03	6,80	0,0039	0,36	5,38	0,0665	0,17	0,16	0,0459	28,9740	<0.0001
		B	0,02	5,84	0,0030	0,30	5,94	0,0510	0,20	0,19	0,0352	35,2450	<0.0001
		C	0,01	4,71	0,0029	0,35	6,88	0,0501	0,25	0,24	0,0346	47,3881	<0.0001
		D	0,01	4,53	0,0029	0,36	7,16	0,0509	0,27	0,26	0,0351	51,1995	<0.0001
		E	0,01	2,91	0,0032	0,45	8,17	0,0556	0,32	0,32	0,0384	66,7795	<0.0001
P/B	***NOH***	A	0,02	7,32	0,0034	0,74	12,63	0,0585	0,53	0,53	0,0403	159,4500	<0.0001
		B	0,02	6,26	0,0025	0,70	16,04	0,0434	0,64	0,64	0,0299	257,2970	<0.0001
		C	0,01	6,09	0,0022	0,63	16,23	0,0386	0,65	0,65	0,0266	263,3277	<0.0001
		D	0,01	4,88	0,0024	0,63	15,06	0,0419	0,61	0,61	0,0289	226,6589	<0.0001
		E	0,01	4,27	0,0028	0,62	12,72	0,0484	0,53	0,53	0,0334	161,8889	<0.0001
	FUH	A	0,03	6,36	0,0040	0,43	6,19	0,0688	0,21	0,21	0,0474	38,3151	<0.0001
		B	0,02	5,43	0,0030	0,42	7,96	0,0526	0,31	0,30	0,0362	63,3855	<0.0001
		C	0,01	5,00	0,0028	0,35	7,30	0,0477	0,27	0,27	0,0329	53,3356	<0.0001
		D	0,01	4,08	0,0029	0,35	6,95	0,0508	0,25	0,25	0,0350	48,2578	<0.0001
		E	0,01	3,36	0,0034	0,34	5,75	0,0591	0,19	0,18	0,0407	33,0726	<0.0001
Comb	***NOH***	A	0,03	8,27	0,0032	0,72	12,93	0,0555	0,54	0,54	0,0383	167,2919	<0.0001
		B	0,02	6,99	0,0024	0,65	15,89	0,0411	0,64	0,64	0,0283	252,4015	<0.0001
		C	0,01	5,81	0,0024	0,61	14,61	0,0418	0,60	0,60	0,0288	213,4041	<0.0001
		D	0,01	5,32	0,0023	0,62	15,73	0,0391	0,64	0,63	0,0270	247,4558	<0.0001
		E	0,01	3,30	0,0028	0,66	13,57	0,0484	0,56	0,56	0,0334	184,0734	<0.0001
	FUH	A	0,03	7,09	0,0039	0,39	5,85	0,0667	0,19	0,19	0,0460	34,2575	<0.0001
		B	0,02	5,91	0,0029	0,37	7,40	0,0500	0,28	0,27	0,0345	54,7666	<0.0001
		C	0,01	4,84	0,0030	0,32	6,32	0,0513	0,22	0,21	0,0354	39,8810	<0.0001
		D	0,01	4,34	0,0028	0,34	7,00	0,0485	0,26	0,25	0,0334	49,0517	<0.0001
		E	0,01	2,72	0,0033	0,40	6,93	0,0576	0,25	0,25	0,0397	48,0579	<0.0001

Autocorrelation

Table 18 Autocorrelation

	P/E_{NOH}		P/E_{FUH}		P/B_{NOH}		P/B_{FUH}		$Comb_{NOH}$		$Comb_{FUH}$		AWCI - BBA
	A	E	A	E	A	E	A	E	A	E	A	E	
# of Values	144	144	144	144	144	144	144	144	144	144	144	144	144
Standard Error	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833
Lag #1	0,2531	0,1098	0,2589	0,0296	0,2613	0,1700	0,2143	0,0958	0,3063	0,1417	0,3001	0,0599	0,2271
Lag #2	0,2004	0,0933	0,2716	0,1012	0,1692	0,1274	0,2057	0,1435	0,2439	0,0960	0,3167	0,0978	-0,0016
Lag #3	0,1249	0,0980	0,1402	0,0738	0,1063	0,0401	0,0857	0,0135	0,1364	0,0497	0,1510	0,0314	0,1548
Lag #4	0,0499	0,0904	0,0148	0,0478	0,0091	0,0887	-0,0345	0,0308	0,0558	0,0927	0,0173	0,0235	0,1137
Lag #5	-0,0672	-0,0317	-0,0339	-0,0508	-0,0564	-0,0642	-0,0481	-0,0871	-0,0478	-0,0561	-0,0230	-0,0896	-0,0280
Lag #6	-0,0370	-0,1211	0,0380	-0,0321	-0,1301	-0,0910	-0,0705	0,0211	-0,0537	-0,1144	0,0155	-0,0179	-0,1199
Lag #7	-0,0232	0,0506	-0,0225	-0,0059	-0,0631	0,0009	-0,0906	-0,0374	-0,0447	0,0497	-0,0507	0,0213	-0,0645
Lag #8	-0,0608	-0,1091	0,0503	-0,0894	-0,1217	-0,0627	-0,0703	-0,0195	-0,0458	-0,0997	0,0564	-0,0814	-0,0555
Lag #9	-0,0044	0,0449	0,0441	0,0798	0,0186	0,0359	0,0694	0,0840	0,0093	0,0659	0,0651	0,1037	-0,0849
Lag #10	-0,0007	-0,0332	0,0108	-0,0327	0,0104	-0,0406	0,0248	-0,0022	-0,0111	-0,0501	0,0047	-0,0470	-0,0687
Lag #11	-0,0099	-0,0674	0,0053	-0,0303	-0,0080	-0,0556	0,0226	-0,0053	-0,0218	-0,0538	-0,0002	0,0008	-0,0471
Lag #12	-0,0530	-0,0162	-0,1311	-0,0226	0,0097	-0,0748	-0,0314	-0,1021	-0,0408	-0,0475	-0,1083	-0,0498	0,0137
Lag #13	-0,1298	-0,1828	-0,1219	-0,1647	-0,1002	-0,1074	-0,1081	-0,1076	-0,1080	-0,1080	-0,1034	-0,0794	-0,0754
Lag #14	-0,1101	-0,0785	-0,1358	-0,0948	-0,0572	-0,1123	-0,0862	-0,1391	-0,0845	-0,0859	-0,1199	-0,0952	-0,0472
Lag #15	-0,0618	-0,0321	-0,0525	-0,0485	-0,0766	-0,0068	-0,1015	-0,0309	-0,0815	-0,0271	-0,1122	-0,0460	0,0533
Lag #16	-0,1083	-0,1393	-0,1102	-0,1633	-0,1443	-0,0717	-0,1421	-0,1169	-0,0922	-0,0768	-0,0970	-0,0949	0,0312
Lag #17	-0,0530	-0,0206	-0,0431	-0,0443	-0,0494	-0,0416	-0,0857	-0,0464	-0,0608	-0,0557	-0,0908	-0,0662	-0,0984
Lag #18	-0,0451	0,0074	-0,0830	0,0101	-0,0336	0,0146	-0,0720	0,0105	-0,0440	0,0122	-0,1015	0,0337	0,0168
Lag #19	-0,0040	0,1131	-0,0231	0,1055	0,0276	0,1391	0,0266	0,1237	0,0164	0,1290	-0,0047	0,1079	0,1055
Lag #20	-0,1405	-0,0392	-0,1442	-0,0318	-0,0940	-0,0037	-0,0789	0,0031	-0,1108	-0,0144	-0,1176	-0,0134	-0,1097
Lag #21	-0,0313	-0,0245	-0,0145	0,0215	0,0124	-0,0586	0,0627	-0,0170	-0,0191	-0,0526	0,0059	-0,0069	-0,0567
Lag #22	-0,0016	0,0126	-0,0425	-0,0150	0,0324	-0,0174	0,0227	-0,0317	0,0227	0,0086	0,0017	0,0014	-0,0315
Lag #23	-0,0726	-0,0569	-0,0918	-0,0715	-0,0190	-0,0797	-0,0261	-0,0986	-0,0457	-0,0524	-0,0509	-0,0632	-0,0442
Lag #24	0,0050	0,0067	-0,0220	0,0227	0,0284	-0,0036	0,0290	0,0343	0,0280	0,0163	0,0158	0,0636	-0,0346
Lag #25	0,0521	0,0052	0,0511	0,0025	0,0142	0,0161	0,0138	-0,0037	0,0539	0,0197	0,0672	0,0071	-0,0486
Lag #26	-0,0313	-0,1125	-0,0033	-0,0992	-0,0561	-0,1076	-0,0210	-0,0857	-0,0462	-0,1274	-0,0083	-0,1147	-0,1118
Lag #27	0,0089	0,0032	-0,0314	-0,0125	-0,0396	0,0260	-0,1007	0,0060	0,0006	0,0042	-0,0318	-0,0094	-0,0429
Lag #28	0,0061	0,0047	0,0371	0,0225	-0,0382	0,0491	-0,0057	0,0498	-0,0034	0,0235	0,0345	0,0105	-0,0534
Lag #29	-0,0228	0,0007	-0,0331	0,0218	-0,0138	-0,0124	-0,0154	-0,0214	-0,0228	-0,0031	-0,0234	-0,0184	-0,0243
Lag #30	0,0123	-0,0814	0,0553	-0,0306	0,0461	-0,0837	0,0693	-0,0091	0,0374	-0,1148	0,0781	-0,0625	-0,0362
Lag #31	0,0866	0,0032	0,0867	0,0138	0,0750	-0,0229	0,0905	-0,0207	0,0956	-0,0195	0,0982	-0,0197	0,0532
Lag #32	0,1129	0,0537	0,1352	0,0399	0,1197	-0,0208	0,1110	-0,0496	0,1101	-0,0245	0,1251	-0,0559	0,0115

Runs Test for Randomness

Table 19 Runs Test for Randomness

	P/E_{NOH}		P/E_{FUH}		P/B_{NOH}		P/B_{FUH}		$Comb_{NOH}$		$Comb_{FUH}$		AWCI - BBA
Portfolio	A	E	A	E	A	E	A	E	A	E	A	E	
Observations	144	144	144	144	144	144	144	144	144	144	144	144	144
Below Mean	74	70	79	64	72	64	79	70	79	60	80	61	65
Above Mean	70	74	65	80	72	80	65	74	65	84	64	83	79
Number of Runs	59	71	61	71	61	62	53	66	57	59	57	66	63
Mean	0,0310	0,0149	0,0289	0,0128	0,0304	0,0166	0,0285	0,0141	0,0320	0,0142	0,0303	0,0121	0,0075
E(R)	72,9444	72,9444	72,3194	72,1111	73,0000	72,1111	72,3194	72,9444	72,3194	71,0000	72,1111	71,3194	72,3194
StdDev(R)	5,9743	5,9743	5,9221	5,9046	5,9790	5,9046	5,9221	5,9743	5,9221	5,8117	5,9046	5,8384	5,9221
Z-Value	-2,3341	-0,3255	-1,9114	-0,1882	-2,0070	-1,7124	-3,2623	-1,1624	-2,5868	-2,0648	-2,5592	-0,9111	-1,5737
P-Value (two-tailed)	0,0196	0,7448	0,0560	0,8507	0,0447	0,0868	0,0011	0,2451	0,0097	0,0389	0,0105	0,3622	0,1156

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