BI Norwegian Business School - campus Oslo

GRA 19703

Master Thesis

Thesis Master of Science

Currency Hedging in Emerging Markets

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Start:	15.01.2019 09.00
Finish:	01.07.2019 12.00

Master Thesis

MSc in Business, major in Finance

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Examination code: GRA 19703
Hand-in date: 30.06.2019
Campus: BI Oslo

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Abstract

We study the effectiveness of currency hedging in emerging markets, focusing on portfolio performance employing both a minimum variance and a unitary hedging strategy. The perception is that the currency in emerging markets experience higher volatility than developed countries. We find that the minimum variance hedge significantly reduces the portfolio standard deviation for all countries, while the unitary hedge statistically increases portfolio standard deviation. We also find that periods of financial distress may cause large outliers for some countries. Implementing a conditional approach of the minimum variance hedge manage to reduce the vulnerability to large interest rates and currency fluctuations. We conclude that both applications of the minimum variance strategies are beneficial for investors in the emerging markets we investigate.

Introduction

The question of whether currency risk hedging and variance risk reduction is a "free lunch" plays an important role in the research on currency risk. Campbell, Serfaty-De Medeiros & Viceira (2010) among others have been concerned with identifying if currency risk hedging makes a portfolio perform better in terms of risk-return trade-off. Many researchers have tried to explain if this is the case in developed countries, with various results.

The purpose of this master's thesis is to find out if a minimum variance hedging strategy and/or a unitary hedging strategy outperforms an unhedged international portfolio for an investor located in an emerging market. Following the method of Campbell et. al. (2010) and De Roon, Eiling, Gerard & Hillion (2012), we consider currency hedging for an emerging market-based investor who is investing in developed countries (G10 currency countries). The two strategies will be examined through mean excess returns, portfolio standard deviation and Sharpe ratio. We also consider the portfolio measure on skewness and kurtosis, though we do not include statistical tests on these measures.

Following Glen and Jorion (1993), Campbell et.al. (2010) and De Roon et.al. (2012), we consider the benefits of risk hedging beyond the traditional focus on volatility. De Roon et.al. (2012) considers several moments for investors like portfolio average returns, Sharpe ratios, portfolio skewness and Kurtosis. Glen and Jorion (1993) wanted to find out if adding forward contracts to international portfolios improves the risk-return trade-off for global investors. Testing if adding currency hedges in the form of forward contracts improves the performance of diversified portfolios, they found that it significantly improves the performance for bond portfolios. Following the same framework, we can test if what is found in these papers are applicable for investors with a domestic currency with higher presumed average volatility. Investors intuitively want to hold a currency position that is negatively correlated with equity returns (Campbell, Medeiros, & Viceira, 2010). For risk-minimizing equity investors, we want to find out to what extent they need to hedge currency risk, considering the returns on currencies and whether they should hedge their international equity positions.

We believe it is important to find out if the results found in developed countries may help an investor located in an emerging market to better understand if hedging their domestic currency makes their portfolio perform better. Given that the wide academic coverage of currency hedging has yielded different results in the past, it is interesting to see whether the arguments and assumptions mentioned above holds when considering emerging markets. Secondly, it is interesting for industry players in emerging markets to get a perception of whether the same conditions suggested for developed economies holds. Countries in the Asia region has experienced great growth in the later years, which has increased the focus on investment and portfolio management. It is thus important that the research considering these countries are highlighted and investigated. To the best of our knowledge, the research field considering these types of analysis on emerging markets are not well developed.

The second part of the thesis will explain the models and theories followed by the literature review in section 3. Section 4 will consist of the empirical methods applicable for the analysis. Section 5 is a description of the data used in the thesis followed by a summary statistics for the data. Section 6 will present the final results from the thesis along with a discussion of the results. We use section 7 to analyze the empirical results and propose a conditional approach to the minimum variance hedge. Section 8 concludes.

Theory

Currency baskets

Our analysis uses a variant of currency baskets as a baseline for foreign exchange rates. We want to analyze the impact of foreign exchange rate changes on portfolio performance. Since we investigate an emerging markets-based investor who invests in the same international equity portfolio consisting of indexes from developed economies, we also basket together the foreign exchange rates of these G10 developed countries with respect to each of our emerging markets countries. This basket is used as the exchange rate and can be interpreted as an average equally weighted exchange rate between the respective emerging economy and the G10 currencies. The value of the equally weighted currency basket will thus fluctuate and capture the appreciation or deprecation to each of our emerging

markets countries in our sample. If the value of the currency basket quoted in for example THB increases, i.e. that the Thai Baht price of the currency basket increases, it represents a depreciation of the Thai Baht with respect to the G10 currencies in our sample. This method is somewhat different to what Aloosh & Bekaert (2018) uses, since we use the currency spot prices, and not the change of the currency in the basket. This will yield some different results however the difference is marginal. Thus, the basket for a country i is calculated

$$CB_i = \frac{1}{10}\sum_{j=1}^{10} s_{j,i}$$

where $s_{j,i}$ is the spot exchange rate of currency j with respect to currency i. We form currency baskets for all emerging markets countries with respect to G10 currencies. Thus, for Thailand the currency basket CB_{THB} consists of an equally weighted average of all exchange rates with respect to AUD, CAD, NOK, SEK, JPY, CHF, USD, GBP, NZD and EUR. In other words, CB_{THB} is the exchange rate for one foreign currency expressed in THB at time t. Since we are investing in an equally weighted equity portfolio which is originating from the same countries as the currencies in the basket, we consider this method applicable for use as an exchange rate. To find historical foreign exchange rates we have used the ratio between the local and dollar-denominated MSCI indexes for each country (see appendix for explanation), which in the absence of triangular arbitrage allows you to construct cross rates between each country. Calculating the change in exchange rates are then possible, even if the "value" of the exchange rate is not equal to the quoted spot price. The above method has also been implemented to form equity baskets, where we use an equally weighted average of all MSCI indexes from the G10 countries listed above. The foreign interest rates are based on the same principle, where we use an average of all the G10 currency countries' interest rates to form an interest rate basket. Both the equity basket and interest basket thus represent the equity and interest for the same developed economies as the currency basket.

Currency Risk Hedging

Investments in foreign assets expose investors to foreign currency risk. The returns for an international investor who invests abroad will be affected by the changes in foreign currency when converted back domestically. As shown below, the return R_{t+1} for a Thai investor investing in the international equity basket is given by

$$R_{t+1} = \frac{P^*_{t+1} S_{t+1}}{P^*_t S_t} - 1 = (1 + R^*_{t+1})(1 + R^{curr}_{t+1}) - 1$$

where P^*_t is the price of the international equity basket at time t denoted in CB$_i$ and S_t is the spot exchange for one CB$_i$ expressed in Thai Baht. R^{curr}_{t+1} is the exchange rate returns: $R^{curr}_{t+1} = S_{t+1}/S_t - 1$. To offset some of the exposure to exchange rate risk the Thai investor can buy/sell forward contracts in the international currency basket. Denote $F_{t,t+1}$ as the predetermined forward exchange rate for CB$_i$ the return for the Thai investor will be given by

$$R^h_{t+1} = R_{t+1} + w^{hedge}_t f_{t+1}$$

where $f_{t+1} = \frac{F_{t,t+1} - S_{t+1}}{S_t}$.

So, since the exchange rates may change over time, that means an investor can experience different returns on the foreign investment. In the above equation, the returns in local currency are subject to changes in the currency exchange rate. To make it clear, the returns are a combination of the returns on the foreign investment and the foreign exchange rate. Thus, since the foreign exchange rates are variable, this potentially leads to increased/decreased volatility compared to the volatility of the equity portfolio. That is, when the correlation between foreign exchange rate and the equity returns are positive, the volatility of the portfolio will potentially increase. Intuitively, it is optimal to adjust the currency exposure to minimize the total portfolio volatility if the currency expected returns are zero.

Assuming zero expected returns on currencies and that the correlation of currencies and equity returns are uncorrelated, the optimal hedge ratio would be a unitary hedge where $w^{hedged}_t = -1$ (Solnik, 1974). When currencies and equity returns are correlated however, we use the gain/loss in the spot exchange to offset

the gain/loss of the equity investment. In cases where the two are correlated, a full hedge might not minimize risk. Instead, the investor will adjust the position, and the optimal hedge will work as the minimum variance hedge. To find the minimum variance hedge, i.e. the hedge that minimizes the variances of the total position, we calculate the slope coefficient when running an OLS regression of the unhedged portfolio returns on a constant and the returns on currency forward returns. The quantity of the position that the emerging market investor should choose to hedge the position can be shown as

$$w^{hedged} = -\frac{Cov(R^*, f)}{Var(f)}$$

When the currency return and equity return are positively correlated, the foreign currency depreciates when returns in foreign equity investments are negative. Thus, taking a short position in the foreign currency will offset some of the losses in equity. When the relationship is negative, the investor will take a long position in the foreign currency.

Another way to hedge currency exposure of the portfolio is to use the universal hedging strategy proposed by Black (1995). This strategy implicates that, if an investor in one country wants to reduce their risk, and another investor in a different country wants to increase their expected returns, in equilibrium both investors will hedge to accomplish their respective goals. The strategy then assumes that they will hedge equally their exposure, since when one investor lends another must borrow. The universal hedging strategy thus means that the investors hedge in proportion to their stock holdings (Black, 1995, p. 161-162). The universal hedge ratio depends on three averages. The average across countries of the excepted excess returns on the world market portfolio, the average across countries of the volatility of the world market portfolio and the average across all pairs of countries of exchange rate volatilities. (Black, 1995, p. 161-162) The universal hedging formula are calculated as follows:

$$\frac{\mu_m - \sigma_m^2}{\mu_m - \frac{1}{2}\sigma_e^2}$$

In our analysis, we will not include the universal hedging strategy even if it's might consider customary when it comes to research on currency hedging. This is

due to several factors. First of all, we want to assess the theory of the unitary hedge being the best alternative when assuming that zero expected returns on currencies and that the correlation of currencies and equity returns are uncorrelated (Solnik, 1974). Second, when currency and equity returns are correlated, the minimum variance strategy which minimizes the variance of the total portfolio have shown some promising results (De Roon, Eiling, Gerard, & Hilion, 2012) (Campbell, Medeiros, & Viceira, 2010). When assessing 10 different emerging economies against the economies of the G10 currency countries, we consider the analysis to be of large enough scope.

Background and Literature

Currency Hedging

Extensive research has been done to investigate whether currency hedging in developed markets can be seen as a free lunch. Currency hedging to reduce portfolio variance has in some of the academic literature been viewed as a free lunch, though few cover the underlying theory that currencies in emerging markets might behave differently. Glen and Jorion (1993) examine the addition of forward contracts in an international bond and equity portfolio. Important in currency hedging is that it will only be beneficial if the reduction of volatility returns is not offset by a large reduction in performance. Glen and Jorion (1993) use forward contracts both as a risk and speculative component to conclude that the addition of forward contracts results in a statistically improved performance for international bond portfolios. The strategy, however, does not significantly outperform unitary or universal hedging strategies and conclude that there is little evidence that portfolios with a predetermined position in either stocks or bonds does not benefit from adding currencies.

They find that a conditional strategy where the hedging coefficient are introduced improves an unhedged portfolio. To predict the expected return on forward contracts by regressing the forward premium they use the regression suggested by Giovannini and Jorion (1989) shown below,

$$\frac{(\tilde{S}_{t+1} - F_t)}{S_t} = a + b(i_t^* - i_t) + \tilde{e}_{t+1}$$

where $i_t^*(i_t)$ is the domestic (foreign) riskless interest rate, and the difference between the two is the forward discount. The sign of the forward discount is used to determine the sign of the hedging coefficient. The result shows statistically significantly performance improvement by actively hedging exchange rate risk and outperforms unitary and universal hedging strategies. The results by Glen and Jorion (1993) describe currency hedging as a free lunch, where it reduces overall portfolio variance without reducing overall performance. The interpretation of a free lunch is also supported by Black (1989, 1993), Eun and Resnick (1988), Pérold and Schulman (1988), and Campbell et al. (2010).

Newer ongoing research, however, argues against the hailed practice of a free lunch in currency hedging and states that even though hedging lowers the overall volatility it also lowers the return (De Roon, Eiling, Gerard, & Hilion, 2012). Evidence related to the carry trade, where investors invest in countries with higher interest rates, show that adding a speculative component such as a carry trade to a hedged portfolio equals the position of an unhedged portfolio. By first statistically conclude that the carry trade contributes to positive returns, they are able to see how the speculative component and the hedged component interact. Further, this baseline makes it possible to investigate how the hedged component contributes to lower returns, and that it is strong enough to offset the positive returns from the carry trade.

Campbell et al. (2010) show that the U.S. dollar, Euro, and the Swiss franc has a negative correlation to equities which makes them attractive currencies for investors looking to minimize risk. Positive correlations between equities and the Australian dollar, Canadian dollar, Japanese yen, and British pound are found, which indicate that a short position in these currencies can be used to minimize equity risk. Long positions should be taken in currencies that correlate negatively with equity returns, (e.g. the US dollar, the Euro, and Swiss francs). For bond portfolios, they show that an optimal hedge is close to a unitary hedge as there are low correlation between bond returns and currency returns (Campbell, Medeiros, & Viceira, 2010).

Campbell et al (2010) points to the research conducted by Lustig & Verdelhan (2007) and Walker (2008), who examines the emerging market currencies jointly with developed markets currencies. Walker (2008) acknowledges that previous

research argues both for and against currency hedging being a free lunch, and investigate whether the higher expected return for currencies in emerging markets would change the perception. Walker (2008) argue against the perception of a free lunch, and argue that *hard currencies* act as a *natural hedge* against portfolio losses due to their correlation with global equities. A depreciation of global equities often leads to a depreciation of emerging markets currencies, which makes the foreign equity position increase in value for an emerging-market-based investor. The paper concludes that currency hedging in emerging markets cannot be described as a free lunch, whereas even though it on average results in an increased return it also increases volatility. The perception of "flight to quality" is argued to be one of the possible explanations, whereas the emerging markets currencies are less attractive during recessions and higher worldwide economic uncertainty. The paper focuses mostly on Latin-American countries, where later years large volatility is included in the research data (Walker, 2008). This paper will extend the research to include Asian countries, and to a larger extent examine the methods used in later research and compare how it might yield different results.

Non-Zero Expected Currency Returns

While the minimum variance hedge aims to reduce overall portfolio variance, it does not consider overall portfolio return. An important assumption to the minimum variance hedge is that the expected currency return is zero. Studies by Dumas and Solnik (1995), De Santis and Gerard (1998) and Lustig and Verdelhan (2007) however suggest evidence of a premium for currency risk, which further affect the overall return of a hedged portfolio. Fama (1984) also states that currencies with high short-term interest rates tend to have high returns by implementing the carry trade by exploiting uncovered interest parity (Fama, 1984) (De Roon, Eiling, Gerard, & Hilion, 2012). De Roon et. Al. (2012) is one of a few papers that examine the consequences of non-zero expected currency returns when implementing the minimal variance hedge. The paper points out that the minimal variance hedge is designed under the assumption that the expected currency return is zero. Even though investors only cares about reducing the variance of their portfolio, the strategy is sub-optimal if the assumption is

violated. This further suggest that currency hedging might come with a price, and that even though portfolio variance is lowered the overall Sharpe ratio decreases. De Roon et. al. (2012) states that if the expected currency return is non-zero it should be considered a separate asset class rather than using it purely for hedging.

Harvey (1995) argues that there are predictably high currency returns for emerging markets, which much of it might be due to currency risk. This makes Walker (2008) argument of a currency hedge not being a free lunch in emerging markets with open exchange rate regimes, as the increase in return also comes with an increased risk. Given the countries he investigates he concludes that except Argentina and Venezuela, whose exchange rate variations have a lot of idiosyncratic risk, much of the minimum variance portfolio consists of unhedged positions. Further, and especially for Chile, Colombia and Mexico, currency hedging has no place in a global portfolio with the aim of reducing risk. Given the evidence of a high-risk premium and consequently high return for emerging markets currencies, the only function for currency hedging is to increase portfolio returns.

This paper examines the currency risk premium for currencies in emerging markets and use the result to further investigate the effect of currency hedging in a minimum variance portfolio for emerging-markets-based investors. Few papers also investigate other factors beyond variance and return. Previous research suggests that adding a hedged component to international portfolios worsen portfolio kurtosis, skewness and Sharpe ratio (De Roon, Eiling, Gerard, & Hilion, 2012), which will be considered from the standpoint of an emerging-markets-based investor.

Empirical methodology

This section first describes the out-of-sample optimal variance reducing hedging strategy, followed by the techniques used to test the difference in means and volatility for the different strategies. In addition, we describe the test for differences in Sharpe ratio between the hedged and unhedged portfolios. Lastly, we show how the measure for skewness and kurtosis is computed.

In our analysis we apply the same framework similar to De Roon et.al. (2012), first using an unhedged equally weighted international equity portfolio and add currencies to the portfolio returns. Our analysis is performed on ten emerging market economies: Chile, Indonesia, Jordan, South-Korea, Mexico, Malaysia, Philippines, Taiwan, Thailand and Turkey. Assuming that the investor in each of the countries invests in the same global equity portfolio, we are able to capture the effects of the changes in exchange rates and interest rates on the performance of the portfolio. This means that we consider each investor to not be related, and only invest in the same global portfolio basket over the same time horizon, neglecting transaction costs.

The hedge ratio for the minimum variance hedging strategy (w_t) is calculated by regressing the investor's unhedged portfolio returns on forward currency returns over the past 60 months (De Roon et. al., 2012, p. 9).

$$r_t^u = \ a + b' r_t^c + u_\tau \ \ for \ \ \tau = t-1, \dots, t-60$$

Here r_t^u are the returns on the unhedged international equity portfolio, while r_t^c are the returns on N currency forwards. We obtain the slope coefficients and use these to find the optimal variance-minimizing hedge ratios:

$$\omega^{hedge} = -b$$

The hedged country returns are then calculated using the minimum variance hedge ratios and the unhedged country portfolio returns (De Roon et. al., 2012, p. 9):

$$r_t^h = r_t^u - b' r_t^c .$$

For the unitary hedging strategy, we use the same way to calculate the country hedged returns, however the hedging ratio is set to $w = -1$.

Testing changes in mean, variance and Sharpe ratio

The statistical significance on the differences in means are calculated using simple t-tests on the differences. That is, we want to find evidence if the difference is the same, lower or higher for the hedged country returns than unhedged.

Tests for changes in volatility between hedged and unhedged portfolios are based on the standard F-test. The idea is that we can hedge most of the variance in the unhedged portfolio returns with the currency forward returns if the R^2 in

$$F_{T-K,K} = \frac{R^2}{1 - R^2} \frac{T - K}{K - 1}.$$

Since we find the hedged country returns as $r_t^h = r_t^u - b' r_t^c$, we can define the returns on the currency components as $\hat{h}_t = \hat{r}_{b,t}^h - \hat{r}_{b,t}$. Following this argument, the variance of the hedged country returns is:

$$Var[\hat{r}_{b,t}^h] = Var[\hat{r}_{b,t}] + Var[\hat{h}_t] + 2Cov[\hat{r}_{b,t}, \hat{h}_t]$$

Further, in light of volatility reduction, we want to figure out if the variance of the hedged portfolio is lower than the variance of the unhedged country portfolio. Rearranging the variance term under the condition $Var[\hat{r}_{b,t}^h] < Var[\hat{r}_{b,t}]$ allows us to test the difference in variance and thus the effectiveness of the hedging if the term

$$-\frac{1}{2} > \frac{Cov[\hat{r}_{b,t}, \hat{h}_t]}{Var[\hat{h}_t]}$$

is satisfied. We can thus regress $\widehat{r_{b,t}} = \gamma_0 + \gamma_1 \widehat{h_t} + u_t$ to test if the coefficient is lower than -1/2. A significant slope coefficient of lower than -1/2 implies that the volatility of the hedged country returns is statistically significantly lower than of the unhedged country returns.

The Sharpe Ratio is considered by us as a risk-return (risk-volatility) trade-off, thus gives a measure of what is given up of returns to lower the risk taken by the investor. The Sharpe Ratio is computed as follows:

$$Sharpe = \frac{E[R_t] - r_f}{\sigma_p}$$

To test the differences in Sharpe ratio, we use the approach derived by J.D. Opdyke (2007). According to Opdyke, the model is valid under general conditions, both ergodic and stationary returns, which means that the results is applicable to our analysis. The test results are shown in section IV. More data and instructions regarding the test are available at Opdyke's website (Opdyke J. , 2007). The tests will show us if there is any statistical evidence of changes in the Sharpe ratio, which implies that the risk-return trade-off is better or worse after hedging with forward returns.

Skewness and Kurtosis

Deviations from normality in portfolio returns are quite significant and must not be ignored by the investor (Bodie, Kane, & Marcus, 2014). By calculating the higher moments of return distributions, we can discern deviations from normality. Two higher moments are often used to identify these, Skewness and Kurtosis.

Skewness is a measure of asymmetry and uses the ratio of the average cubed deviations from the average, to the cubed standard deviation to measure asymmetry (skewness) of a distribution (Bodie, Kane, & Marcus, 2014). We consider this measure important to our analysis because it allows us to see if the standard deviations over- or underestimates the risk due to possible extreme surprises which can increase/decrease the estimate of the volatility. A positively skewed distribution overestimates the risk because investors are not concerned with extreme positive surprises (Bodie, Kane, & Marcus, 2014).

For our sample, following the same approach as De Roon et.al (2012), we estimate the skewness using the following formula.

$$Skew = \frac{E[(r_t - \mu)^3]}{\sigma^3}$$

Kurtosis is the measure of the degree of fat tails (Bodie, Kane, & Marcus, 2014). It encounters the potential deviation from normality and concerns the likelihood

of extreme values on either side of the mean in the distribution. For the investor, this means that the standard deviation is underestimating the likelihood of an extreme event, which means potentially larger losses and larger returns (Bodie, Kane, & Marcus, 2014). To measure this, we use the following approach.

$$K = \frac{E[(r_t - \mu)^4]}{\mu^4}$$

These measures can have an economical significance if the volatility of the portfolio is higher, which is the initial hypothesis we are testing. A combination of negative skewness and fat tails are disliked by investors, and we want to measure if the returns in our sample indicates this potential problem.

Testing whether the differences in skewness and kurtosis are out of the scope for this study, so we will only report the observed measures.

Data and Summary Statistics

The analysis is based on monthly equity returns in ten emerging markets: Chile, Indonesia, Jordan, Korea, Malaysia, Mexico, Philippines, Taiwan, Thailand and Turkey. We consider an international dataset, to try and capture the effect of hedging from a standpoint of an investor in a developing country in either part of the world. We construct an equally weighted international equity portfolio using equity indices from ten developed countries: Australia, Canada, Germany, Japan, New Zealand, Norway, Sweden, Switzerland, United Kingdom, and United States. These developed countries also form the G10 in respect to currencies. For investments in EUR we have chosen to use the German MSCI index due to its dominant position in the eurozone. We use monthly observations in the analysis conducted in this thesis. Stock returns are retrieved from the MSCI database through Thomson Reuters DataStream (MSCI, 2012). Foreign exchange rates are calculated using the ratio between the local denominated MSCI index and dollar denominated MSCI index, which by triangular arbitrage allows you to construct cross rates between each country. Exchange rates between USD and the G10 currencies are retrieved from MSCI through Thomson Reuters DataStream. Interest rates for G10 currencies are also retrieved from Thomson Reuters DataStream, while the interest rates for the emerging economies were extracted

from the IMF database and the Korean National Bank. We use one-month interest rate differentials to construct forward rates. The interest rates used are nominal.

The sample begins in January 1988, which is the start date of the MSCI index recordings in emerging markets and ends in March 2019. The interest rate data for Jordan ends in November 2018 and Mexico ends in February 2019. GDP and GDP per capita are download from Oxford Economics. It is usually customary to end the sample in each calendar year to avoid potential impact of calendar effect, however we still chose to include some periods in 2019 as it extends are sample set.

Table I

Interest Rates

The table describes the monthly mean interest rates return and standard deviation for the full sample. The table also report the monthly mean interest rate and standard deviation for the international interest basket and the correlation of each country´s interest rate to the international interest basket.

	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean	0,54 %	1,26 %	0,48 %	0,47 %	0,32 %	0,57 %	0,45 %	0,00 %	0,40 %	2,68 %
St. Dev	0,40 %	0,37 %	0,15 %	0,32 %	0,14 %	0,68 %	0,27 %	0,00 %	0,27 %	1,63 %
Corr Interest Basket	0,69	0,65	0,79	0,85	0,62	0,71	0,80	0,00	0,74	0,77
Interest Basket Developed Markets										
Mean				0,24 %						
St. Dev				0,14 %						

Table I describes the monthly mean and standard deviation interest rates for the emerging markets countries in our sample. We also include the monthly mean and standard deviation for the developed markets interest basket, in addition to the correlation between the local currency with respect to the international interest basket for the full sample period. The results show a particularly high interest rate for Turkey (2,68%) and Indonesia (1,26%). We also note that the interest basket constructed by developed markets interest rates are lower than all of the emerging markets in our sample with exception of Taiwan which is equal. The sample period includes the Turkey currency crisis in both 1994 and 2001, which contributes to a high average for the whole period. During the years 1994-1996 Turkey experienced interest rate peaks as high as 200%. Several of the countries in our sample also experienced similar crisis, whereas many of our Asian countries for instance where involved in the Asian crisis in 1997. We have still

chosen to include these countries in our sample as it is one of the characteristics emerging markets investors could expect to experience. We also include sub-sample tests that excludes/includes periods of economic stability to assess different standpoints and results.

Table II

The table describes the monthly mean and standard deviation on the excess return on currency forwards.

Mean Currency Return

	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean	0,08 %	0,17 %	0,21 %	0,01 %	-0,12 %	-0,33 %	-0,08 %	-0,08 %	0,04 %	0,21 %
St. Dev	2,66 %	7,53 %	1,90 %	4,44 %	3,24 %	4,08 %	2,54 %	1,74 %	2,87 %	5,25 %

Table II describes the excess return on currency forwards and describes the average appreciation or depreciation of each country´s currency with respect to the international currency basket. The return is thus the return an investor would have achieved by exchanging to the foreign currency basket and earning the foreign interest rate basket. We subtract the local interest rate to make it excess returns. If the returns on currency are positive, i.e. that the price of the foreign currency basket is higher quoted in one of the local emerging markets currencies, it shows that the local currency has on average depreciated compared to the foreign currency basket. We see that most countries have a positive currency forward return. Jordan and Turkey have the largest return on currency forwards with a monthly return of 0,21%. Malaysia, Mexico, Philippines, and Taiwan are the only countries which report a negative mean currency forward return. Mexico has the lowest return of -0,33%, meaning that the currency appreciated against the foreign currency basket.

Table III

Correlation Matrix Currency Return

The table display the correlation between each country´s excess return on currency forwards.

	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Chile	1,00									
Indonesia	0,09	1,00								
Jordan	0,18	0,06	1,00							
Korea	0,14	0,04	0,34	1,00						
Malaysia	0,18	0,27	0,37	0,13	1,00					
Mexico	0,22	0,07	0,21	0,10	0,22	1,00				
Philippines	0,22	0,39	0,48	0,20	0,45	0,21	1,00			
Taiwan	0,25	0,25	0,67	0,42	0,40	0,26	0,47	1,00		
Thailand	0,16	0,53	0,32	0,19	0,36	0,10	0,66	0,50	1,00	
Turkey	0,21	0,09	0,06	0,05	0,09	0,15	0,11	0,04	0,06	1,00

Table III shows the correlation matrix for the excess return across each country. We observe a positive relationship across all countries. The positive relationship is however not very strong, where most of the correlation coefficients range between 0-20. The countries with the highest correlation are Taiwan & Jordan, while the countries with the lowest correlation are Taiwan & Turkey and Indonesia & Korea.

Results - Hedging performance

We begin by constructing an equally weighted equity portfolio, where every investor from each country invests in the same international equity portfolio. We compute the unhedged portfolio returns, which incurs the investors to currency risk. Then we add two different currency risk hedging strategies: minimum variance and a unitary full hedge. We use nominal interest rates in the analysis. Performance of the hedged portfolios are tested against the unhedged portfolios, and we report the test statistics for mean, standard deviations and Sharpe ratios. Due to the nature of currencies in emerging markets, namely the volatility, we have chosen not to remove outliers in the analysis. Similarly, we have not created a real interest rate, which means that the results are nominal, and with the periodically high interest rates experienced by some of the emerging economies, the excess returns may be affected largely. First, we report the findings for the full sample, then for two sub-sample periods. The first sub-sample period will incorporate economic downturns for the individual countries in our sample such as the Asian Financial Crisis, Mexican Peso crisis and the Turkish currency crisis,

such that we can investigate the effects of these crisis on the returns for the Asian countries and the others.

Full sample

Minimum Variance Hedge

The main findings of the minimum variance hedge are presented in table IV. The table describes the monthly mean returns of the portfolios and presents the t-statistics of the difference (MinVar – Unhedged), and the monthly standard deviations for each country with the respective beta values of the variance tests described in the Methodology section. We test for variance reduction by regressing the difference between the minimum variance hedge and the unhedged portfolio (MinVar – Unhedged). We report the bias adjusted Sharpe ratios for both the unhedged and minimum variance portfolio. We choose to use the bias adjusted Sharpe ratios suggested by Opdyke (2007), as it provides an adjustment to the small sample size and adjust for the restriction of i.i.d. normality. Opdyke states that since the Sharpe ratio is a convex function, its estimator will be biased due to Jensen´s inequality (Opdyke J. , 2007). Opdyke (2007) uses the approach by Christie (2005) and Lo (2002) to derive a bias adjusted Sharpe ratio which avoids the use of an estimate of the variance. We note that there is only a marginal difference when using the biased adjusted Sharpe ratio, and that the bias adjusted Sharpe ratios also tend to be smaller. We also report the difference between Sharpe ratios, which is the unhedged Sharpe ratio (SRB) minus the minimum variance one (SRA), and the p-values testing $H_0: SRB \leq SRA$ against the alternative hypothesis $H_a: SRB > SRA$.

We find that the portfolio standard deviation is reduced for all countries when implementing the minimum variance hedge. The reduction in portfolio standard deviation are also severe for some countries. Indonesia for example implies nearly a 50% reduction when implementing the hedge, while the remaining countries experience a reduction between 10-25%. We test for changes in variance by regressing the returns of the hedging component on the unhedged returns. The coefficients for all countries are less than -1/2 and statistically significant at a 1% level. This implies a variance reduction for all countries when implementing the minimum variance hedge for all countries with statistical significance at a 1% level.

As the return in portfolio standard deviation are in line with the previous research, the most interesting results comes when examining the returns. We find that for six of the countries the portfolio mean excess returns actually increase when implementing the minimum variance hedge. Malaysia, Mexico, Philippines and Turkey are the only countries who report a reduction in returns. These results are in large contrast with previous research conducted on developed countries, which either find no change or negative change in returns when implementing the minimum variance hedge (Campbell et. al., 2010) (De Roon et. al. 2012). However, the results from a t-test shows that none of the countries except Jordan can prove any statistically significantly change between the unhedged returns and the hedged returns. For Jordan we see a large increase in mean excess returns when implementing the hedge and report a t-stat of 1,84. Malaysia, on the other hand, report the largest decrease when implementing the hedge with a t-stat of -0,70.

Given the results in portfolio standard deviation and mean excess returns we calculate the Sharpe ratio for the respective countries. Sharpe ratio differences are calculated to test whether the hedged portfolio experience a statistically significantly higher or equal Sharpe ratio than of the unhedged portfolio. In case of rejection we favor the alternative hypotheses that the Sharpe ratio for the unhedged portfolio is higher than the minimum variance portfolio. The test is proposed by Opdyke (2007) and the ratios and test statistics are reported in table IV.

We find that Malaysia and Turkey show a higher Sharpe ratio for the unhedged portfolio than for the minimum variance. The remaining countries all show a higher Sharpe ratio for the minimum variance hedge. We fail to reject the null hypothesis that the unhedged portfolio is higher or equal than the minimum variance hedge for all countries. These findings are interesting and differ from previous research conducted on developed markets (Campbell et. al., 2010) (De Roon et. al. 2012), which indicate that currency hedging in developed economies comes at a cost. Without taking into account higher moments of portfolio performance, we find that for the full sample our findings are in contrast with the research conducted by De Roon et.al. (2012), where the minimum variance hedge

underperforms compared to the unhedged portfolio in developed economies and comes at a serious cost with reduced portfolio return and Sharpe ratio. Our findings however suggest that for most of the emerging markets countries in our sample, the Sharpe ratio increases when hedging.

To sum up, we see a difference in results between our findings and previous research on developed markets. The minimum variance hedge indeed manages to reduce the standard deviation for all countries, though the mean excess return and Sharpe ratios actually increases for most countries. Jordan reports the largest increase in mean excess return when hedging, which in terms of Sharpe ratio makes it one of the best countries to hedge in compared to the unhedged portfolio. Indonesia has the largest decrease in standard deviation, which also makes hedging preferable in terms of Sharpe ratio. On the other hand, Malaysia is the country with the largest decrease in mean excess return when hedging. This also affects the Sharpe ratio, and is the country with the largest decrease when it comes to Sharpe ratio.

Implementing the minimum variance strategy seems to worsen the skewness for the hedged portfolio compared to the unhedged (See Table A-I in appendix). The results indicate a decrease in skewness for most countries. The most noticeable result appears for Indonesia and Turkey, where the respective skewness decreases from 4,51 to -0,44 and from 0,85 to -2,12 respectively. At the same time, the kurtosis of the hedged portfolios seems to be improved for most of the countries. The measure of the kurtosis of the unhedged returns may be affected by the higher standard deviations and more extreme observations compared to the hedged portfolio. Thus, even though the skewness measure decreases for most currencies, the kurtosis improves dramatically for some, indicating a distribution with less extreme outliers.

Looking at the mean excess return on currency forwards, we see that the four countries that report a negative mean excess return on currency forwards is also among the worst performing countries when implementing the hedge. Jordan and Turkey report the most positive mean excess return on currency forwards, and we see that Jordan is also the country that reports the largest differences in terms of Sharpe ratio when hedging. On the contrary though, Turkey reports a negative

effect when hedging. Worth noting however is the large standard deviation of the mean excess currency forwards returns for Turkey, where the large economic downturns and volatility might be the cause for the bad hedging performance.

Table IV

The table describes the mean excess return, standard deviation and Sharpe ratio for all countries when implementing the minimum variance hedge and the unhedged portfolio for the full sample. The table also display the respective test statistics when testing for differences between the two hedging strategies.

Mean

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean										
Unhedged	0,28 %	0,22 %	0,20 %	0,38 %	0,51 %	0,69 %	0,48 %	0,48 %	0,35 %	0,16 %
Mean										
Min Var Hedge	0,34 %	0,42 %	0,50 %	0,44 %	0,38 %	0,60 %	0,46 %	0,53 %	0,41 %	0,04 %
H0: Min Var - Unhedged										
T-stat	0,63	0,50	1,84	0,25	-0,70	-0,54	-0,10	0,46	0,33	-0,36
P-value	0,74	0,69	0,97	0,60	0,24	0,30	0,46	0,68	0,63	0,36

Standard Deviation

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
St. Dev										
Unhedged	4,60 %	8,73 %	5,21 %	6,23 %	5,38 %	5,22 %	5,21 %	4,78 %	5,28 %	6,23 %
St. Dev										
Min Var Hedge	4,38 %	4,71 %	4,31 %	4,66 %	4,55 %	4,51 %	4,49 %	4,38 %	4,47 %	5,19 %
Var difference: Min Var - Unhedged										
Coefficient	-0,828	-1,044	-1,026	-1,065	-0,917	-0,973	-0,964	-0,949	-0,914	-0,677
P-Value	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Sharpe Ratio

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,0614	0,0238	0,0386	0,0607	0,0937	0,1297	0,0915	0,0991	0,0662	0,0249
Sharpe Ratio Bias Corrected										
Min Var Hedge (SRA)	0,0784	0,0878	0,1151	0,0936	0,0838	0,1338	0,1028	0,1204	0,0911	0,0071
Sharpe Ratio Difference [Bias Corrected]	-0,0170	-0,0640	-0,0766	-0,0329	0,0099	-0,0041	-0,0113	-0,0212	-0,0249	0,0178
1-tailed p-value - Ho: (SRB - SRA) ≤ 0	0,7645	0,8994	0,9869	0,8009	0,3892	0,5520	0,6365	0,7781	0,7588	0,3754

Unitary Hedge

The results from the unitary hedge strategy are reported in Table V. In the same fashion as in the previous table, it presents results for the mean returns for the different portfolios, and the t-statistics for the difference in returns. Testing for changes in variance we have used the same test as for the minimum variance hedge, however we now consider the difference between the unhedged and the unitary hedge (Unhedged – Unitary). This means that if the coefficient is less than -1/2, the variance of the unhedged portfolio is lower than the hedged. The Sharpe ratios are calculated the same way as for the minimum variance hedge.

The results differ from our findings when implementing the minimum variance hedge. For the unitary hedge, the portfolio standard deviation is increased for all countries. By regressing the independent variable (Unhedged – Unitary) on the unhedged returns we show statistically significantly coefficients lower than -1/2 for all countries at a 5% level. We find that Indonesia and Turkey were the countries that experienced the largest increase in standard deviation, with an increase of 79% and 68% respectfully. Jordan and Taiwan were the ones that increases the least, with an increase of 23% and 17% respectfully.

Looking at the mean excess returns for the unitary hedge, we find that Malaysia, Mexico, Philippines and Taiwan are the only countries that increased portfolio mean excess returns when hedging. The remaining countries are all experiencing decreasing returns when hedging. We also find that the decrease in mean is statistically significant at the 5% level for Jordan, which went from a monthly mean excess return of 0,20% to 0%.

Looking at the Sharpe ratios, we see that all countries performed worse when implementing the unitary hedging strategy. Thus, the increased portfolio variance for a unitary hedged portfolio supported by a decrease in portfolio return creates a worse risk-return payoff in terms of Sharpe ratios for all countries. Jordan´s reduction in Sharpe ratio is also statistically significant at the 1% level. We thus reject the null hypothesis that the Sharpe ratio for the unitary hedge is higher or equal than the unhedged, in favor of the alternative hypothesis that the Sharpe ratio for the unhedged portfolio is larger than the unitary portfolio. The remaining countries in our sample however indicate no statistically significantly change at the 5% level. Jordan and Turkey are also two countries that imply a negative risk-return payoff in terms of Sharpe ratio when implementing the unitary hedge, bearing in mind these results are just barely below 0. The countries where the Sharpe ratio decreased the least are Malaysia, Mexico, Philippines and Taiwan.

We find from our results that the unitary hedge indicates to be performing worse compared both to the minimum variance hedge and the unhedged portfolio. An interesting finding from the unitary hedging strategy results is that the countries that performed the best are also the countries that performed the worst for the

minimum variance strategy. A country like Jordan for example who is among the worst performers when implementing the unitary hedge is also one of the best countries when using the minimum variance hedging strategy. Malaysia, Mexico, Philippines and Taiwan are the only countries who report a higher mean excess return when implementing the unitary hedge compared to the minimum variance hedge, though the implied higher portfolio standard deviation creates a worse risk-return relationship in terms of Sharpe ratio. Further, Malaysia, Mexico, Philippines and Taiwan are also among the worst performers under the minimum variance hedge. Assessing the skewness measure of the portfolio (Table A-I in the appendix), we observe a higher skewness for most of the countries in the unitary strategy compared to both the unhedged and minimum variance. The measure of kurtosis however seems to worsen. This indicates that the investors experience large outliers in the distribution which is not preferable for investors.

Table V

The table describes the mean excess return, standard deviation and Sharpe ratio for all countries when implementing the unitary hedge and the unhedged portfolio for the full sample. The table also display the respective test statistics when testing for differences between the two hedging strategies.

Mean

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean										
Unhedged	0,28 %	0,22 %	0,20 %	0,38 %	0,51 %	0,69 %	0,48 %	0,48 %	0,35 %	0,16 %
Mean										
Unitary	0,20 %	0,05 %	0,00 %	0,37 %	0,62 %	1,02 %	0,56 %	0,55 %	0,31 %	-0,06 %
H0: Unitary - Unhedged										
T-stat	-0,56	-0,40	-1,90	-0,05	0,63	1,43	0,54	0,81	-0,27	-0,72
P-value	0,29	0,34	0,03	0,48	0,74	0,92	0,71	0,79	0,39	0,24

Standard Deviation

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
St. Dev										
Unhedged	4,60 %	8,73 %	5,21 %	6,23 %	5,38 %	5,22 %	5,21 %	4,78 %	5,28 %	6,23 %
St. Dev										
Unitary	5,97 %	15,67 %	6,44 %	9,83 %	7,66 %	8,19 %	6,86 %	5,63 %	7,21 %	10,50 %
Var difference. Unhedged - Unitary										
Coefficient	-0,526	-0,993	-1,487	-0,969	-0,915	-0,691	-1,040	-0,970	-0,969	-0,796
P-Value	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Sharpe Ratio

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,0614	0,0238	0,0386	0,0607	0,0937	0,1297	0,0915	0,0991	0,0662	0,0249
Sharpe Ratio Bias Corrected										
Unitary (SRA)	0,0332	0,0028	-0,0005	0,0369	0,0803	0,1197	0,0808	0,0981	0,0422	-0,0053
Sharpe Ratio Difference [Bias Corrected]	0,0282	0,0211	0,0391	0,0238	0,0134	0,0100	0,0107	0,0010	0,0239	0,0301
1-tailed p-value - Ho: (SRB - SRA) ≤ 0	0,1346	0,0926	0,0040	0,1162	0,2712	0,3600	0,3034	0,4793	0,1246	0,0886

One of the reasons to the large difference between the performance of the unitary hedging strategy and the minimum variance strategy is the hedging weights. We find periodically very high positive hedging weights for some of the countries in the minimum variance hedge. Thus, the minimum variance hedge mostly takes the opposite position in the forward contracts compared to the unitary hedge. The minimum variance hedge mostly takes long position in the forward contracts, whereas the unitary hedge is constructed to go short. The unitary hedge operates with a constant hedge ratio of -1, which creates negative returns when the forward returns are positive. The results of Malaysia, Mexico, Philippines and Taiwan are the only countries which has a negative mean forward return, which thus makes it preferable to the unitary hedging strategy in terms of returns. These countries mostly all have positive hedging weights in the minimum variance strategy, which may also explain the reduced return for the minimum variance strategy.

Sub-sample Results

In this section we present the findings from the sub-samples. We have divided the full sample into two groups, where the first sample captures the period from January 1993 to December 2005 and the second from January 2006 to March 2019. Sub-sample 1 thus includes the many periods where the emerging markets countries in our sample experienced financial distress, such as the Asian Financial Crisis, the Turkish Lira devaluation and the Mexican Peso crisis. There are of course severe economic downturns captured in sub-sample 2 such as the world financial crisis in the late 2000´s, though these affected all countries worldwide and not just individual countries. Thus, sub-sample 1 captures financial distress especially affecting several of the currencies we investigate. Investigating the different sub-samples allows us to analyze the robustness of the full sample results.

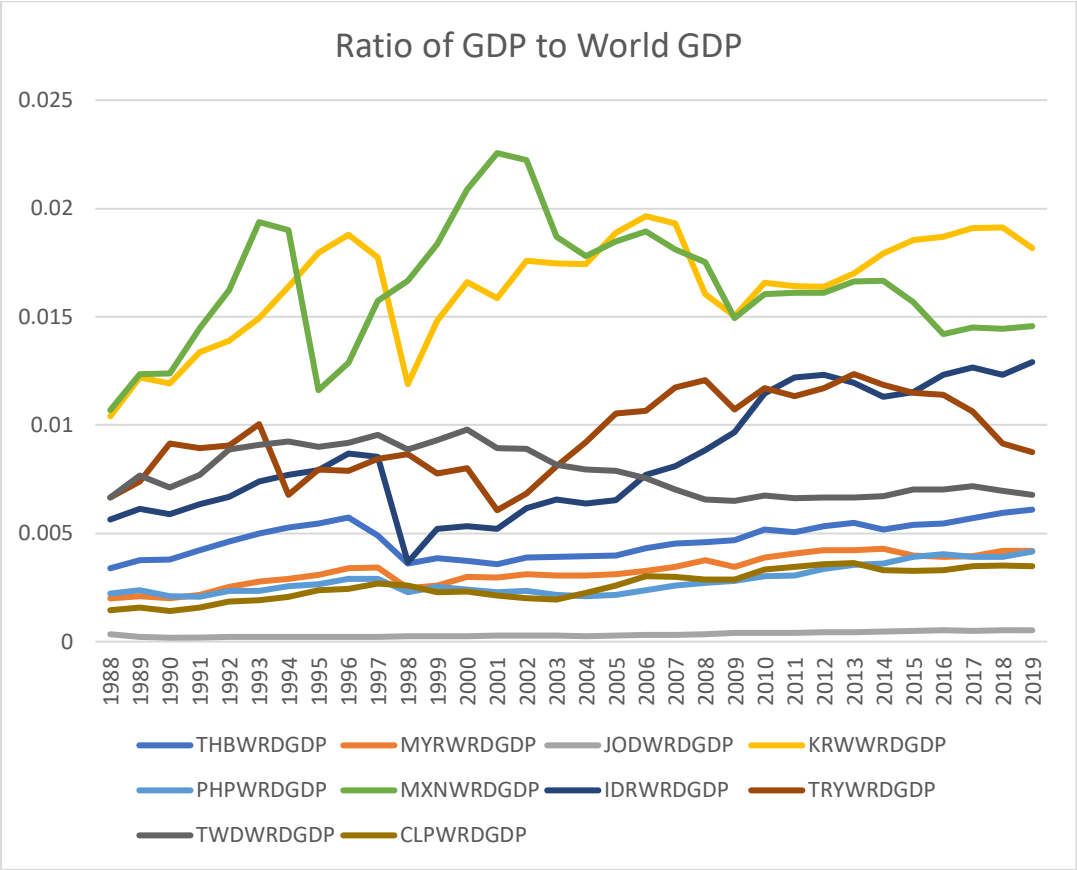

Figure 1

Figure 1 graphs the individual countries GDP ratio against the World GDP. The ratios are simply calculated by dividing the GDP of the individual emerging economies against the World GDP. As the figure indicates, Mexico experienced a severe drop in GDP compared to the world around the time of the Peso crisis. The figure also illustrates the effects of the Asian and Turkish financial crisis´ in the 1990´s.

Sub-Sample 1

Table VI presents the main findings from sub-sample 1. The results and tests are done the same way as in the previous tables, where the test for variance reduction is done the opposite way for the unitary and minimum variance hedge. From the results we only observe higher excess returns for Chile, Jordan and Korea when applying the minimum variance hedge. While for the full sample, the minimum variance hedging strategy yields higher mean returns for all except Malaysia, Mexico, Philippines and Turkey. In the unitary hedge, the mean excess returns are higher for several countries. Indonesia and Malaysia experience the highest mean returns, closely followed by Mexico and the Philippines. However, the findings

are not statistically significant for neither the minimum variance hedge nor the unitary hedge. Therefore, we cannot argue that the minimum variance nor the unitary hedging strategy increases or decreases the mean excess returns.

Assessing the standard deviations of the first sub-sample, we observe some similarities with the full sample findings. The minimum variance hedge does decrease standard deviations for all countries, except for Taiwan where there is no change. Unitary hedging seems to increase the standard deviations compared to the unhedged portfolio, for example in Indonesia the standard deviation increases from 11.46% to 21.32%. We stress that the standard deviations are reported monthly, which means that a yearly estimate for an investor in this country would have been extreme. The test for difference in variance shows that for the minimum variance hedging strategy, the variance reduction is significantly lower for all currencies except Taiwan, where we cannot reject the coefficient from being different from zero. Considering the unitary hedge, we keep in mind that the variance is lower for the unhedged portfolios since the difference is quoted the opposite way than the minimum variance strategy. The findings show that the variance is lower for all currencies, though for the first time the results are not statistically significant for Taiwan.

The Sharpe ratios for the minimum variance strategy are lower for Malaysia, Philippines, Taiwan, Thailand and Turkey. However, the results show that the difference is not increased by a lot, also resulting in no statistically significant increase in the Sharpe ratios for any of the investors. This means that even if the returns are increasing and the standard deviations are decreasing for the minimum variance strategy, the Sharpe ratios cannot be said to bear any statistical change. For the unitary hedge, the Sharpe ratio is decreased for all currencies except Taiwan. However, we find no statistical evidence for any changes in the Sharpe ratio for neither of the countries our sample.

We find that the first sub-sample shows a reduction in mean excess returns for the minimum variance strategy in Turkey. Turkey suffered severe financial problems under the Turkish currency crisis in 1994, which may have an impact on the returns. The hedge ratios for Turkey during this sample period are also very high (in excess of 1), which indicates that the investors would take severe reductions in

returns to reduce volatility. However, the idea is that we want to investigate the performance of these hedging strategies in the emerging economies, and such crises are somewhat common for investors located there during our sample period. Contrary, the unitary hedge takes an opposite position, with the results of increasing volatility and reducing mean returns.

Observing the calculated skewness and kurtosis for the first sub-sample, we see that both the strategies shows the same tendencies as in the full sample. The minimum variance strategy decreases the skewness and kurtosis for most of the observations, while unitary does the opposite. Again, Turkey have the most extreme results. The skewness for the minimum variance strategy is -2,12 and the kurtosis increases from 6,26 in the unhedged to 15,62 in the minimum variance hedged. Such results for an investor are problematic when picking the optimal strategy.

Table VI

The table describes the mean excess return, standard deviation and Sharpe ratio for all countries when implementing the minimum variance hedge, unitary hedge and the unhedged portfolio for sub-sample 1. The table also display the respective test statistics when testing for differences between the two hedging strategies.

Mean

Subsample 1	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean										
Unhedged	0,40 %	0,88 %	0,46 %	0,49 %	0,88 %	0,84 %	0,86 %	0,75 %	0,77 %	0,43 %
Mean										
Min Var Hedge	0,52 %	0,72 %	0,53 %	0,61 %	0,58 %	0,74 %	0,66 %	0,70 %	0,58 %	0,09 %
Mean										
Unitary	0,25 %	1,18 %	0,33 %	0,41 %	1,18 %	1,14 %	1,14 %	0,94 %	0,97 %	0,29 %
H0: Min Var - Unhedged										
T-stat	1,29	-0,21	0,96	0,40	-1,01	-0,32	-0,89	-0,69	-0,72	-0,58
P-value	0,90	0,42	0,83	0,66	0,16	0,37	0,19	0,24	0,24	0,28
H0: Unitary - Unhedged										
T-stat	-0,73	0,36	-1,06	-0,19	0,91	0,72	1,16	1,24	0,70	-0,30
P-value	0,23	0,64	0,15	0,43	0,82	0,76	0,88	0,89	0,76	0,38

Standard Deviation

Subsample 1	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
St. Dev										
Unhedged	4,51 %	11,46 %	4,98 %	6,48 %	6,00 %	6,05 %	5,52 %	4,76 %	5,60 %	6,84 %
St. Dev										
Min Var Hedge	4,47 %	5,16 %	4,90 %	5,13 %	4,99 %	4,91 %	4,94 %	4,76 %	4,94 %	6,20 %
St. Dev										
Unitary	5,38 %	21,32 %	5,49 %	10,45 %	9,09 %	10,15 %	7,41 %	5,31 %	8,02 %	11,67 %
Var difference: Min Var - Unhedged										
Coefficient	-0,65	-1,05	-0,89	-1,04	-0,92	-0,97	-0,88	-0,51	-0,82	-0,58
P-Value	0,03	0,00	0,03	0,00	0,00	0,00	0,00	0,20	0,00	0,00
Var difference. Unhedged - Unitary										
Coefficient	-0,18	-1,00	-0,70	-0,86	-0,84	-0,72	-0,85	-0,32	-0,78	-0,77
P-Value	0,21	0,00	0,01	0,00	0,00	0,00	0,00	0,13	0,00	0,00

Sharpe Ratio

Subsample 1	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,088	0,073	0,091	0,073	0,145	0,134	0,156	0,157	0,136	0,062
Sharpe Ratio Bias Corrected										
Min Var Hedge (SRA)	0,116	0,138	0,108	0,118	0,116	0,150	0,133	0,146	0,116	0,014
Sharpe Ratio Difference [Bias Corrected]	-0,028	-0,065	-0,017	-0,045	0,029	-0,016	0,023	0,011	0,019	0,048
1-tailed p-value - Ho: (SRB - SRA) ≤ 0	0,853	0,812	0,772	0,809	0,294	0,624	0,312	0,352	0,352	0,295

Sharpe Ratio

Subsample 1	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,088	0,073	0,091	0,073	0,145	0,134	0,156	0,157	0,136	0,062
Sharpe Ratio Bias Corrected										
Unitary (SRA)	0,047	0,052	0,060	0,037	0,127	0,105	0,153	0,176	0,119	0,024
Sharpe Ratio Difference [Bias Corrected]	0,041	0,021	0,031	0,036	0,018	0,029	0,002	-0,018	0,017	0,038
1-tailed p-value - Ho: (SRB - SRA) ≤ 0	0,155	0,169	0,106	0,133	0,317	0,231	0,476	0,681	0,330	0,124

Sub-sample 2

Table VII presents the main findings for the second sub-sample, which ranges from January 2006 until March 2019. In this period, the first observation we make

is that some of the unhedged returns are negative, in fact comparing to the first sub-sample all the excess mean returns on the unhedged portfolio is lower. The minimum variance hedging strategy also yields lower returns compared to the minimum variance returns in sub-sample 1. We still however note that the returns are higher than the unhedged portfolio, which indicate the same trend as we find in both the full sample and the first sub-sample. Conducting the same tests as before on this sub-sample, we find that the increase in mean returns are statistically significant for Indonesia and Jordan with t-stats of 3.00 and 1.66 respectively. Incorporating a full hedge instead of the minimum variance yields different results. Korea and Mexico are now the only countries which experience a higher mean excess return in sub-sample 2 compared to the unhedged portfolio, though this is not statistically significant. Further, Indonesia and Thailand are now indicating a statistically significantly lower mean excess returns for the unitary portfolio compared to the unhedged. Looking at these results, we discover some differences to what is previously found in the full sample and the first sub-sample.

The standard deviations decrease for all countries when incorporating the minimum variance hedge in the second sub-sample. Interestingly for Indonesia, the standard deviation on the unhedged returns are less than half in the second sub-sample compared to the first sub-sample, indicating that this period shows more steady returns. All reductions in variance are statistically significant when applying the minimum variance hedge, showing us mostly the same trends as for the previous sample sizes. At the same time, the unitary hedging strategy increases volatility of the portfolio for all investors, contrary to the findings in sub-sample 1 where lower variance is not statistically significant for Taiwan and Chile.

The Sharpe ratios are higher for all countries in minimum variance hedge compared to the unhedged except Mexico, though we still fail to reject the null hypothesis at the 5% level. Incorporating a unitary hedge does the opposite, where we see a decrease in the Sharpe ratio for all portfolios except Mexico. We also manage to reject the null hypothesis for Indonesia, Jordan and Thailand at the 5% level in favor of the alternative hypothesis that the unhedged is higher.

Skewness and kurtosis measures in this sample indicates a distribution that is more normal than for the full and first sub-sample. We observe the skewness results to be mostly between -1 and 1, while the kurtosis measures mostly vary from 4-6 indicating fewer extreme observations. The distributions are then more "normal" which are not surprising because of the financial distress periods experienced in sub-sample one that is not present in this sub-sample.

The second sample shows some similarities with the other samples with regards to mean returns, standard deviations, changes in variance, and Sharpe ratios. Comparing the sub-samples, we find that the minimum variance mostly increases mean excess returns with a few exceptions. However, sub-sample 2 provide statistical evidence of an increase in returns implementing the minimum variance hedge for Indonesia and Jordan. Further, the volatility of the minimum variance hedged portfolios are lower overall, with significant reductions in variance. Sharpe ratios for the minimum variance hedge shows no evidence of statistically significant decreases, which implies that we cannot say the risk-return trade-off are higher for one portfolio than another. The results for the unitary hedge show a significantly higher Sharpe ratio for the unhedged portfolio for Indonesia, Jordan and Thailand in sub-sample 2. This differs from the full sample, where only Jordan is significantly higher for the unhedged, and sub-sample 1 where none of the countries are significant.

Figure A-2 in the appendix graphs the ratio of the variance between minimum variance hedged returns and the unhedged returns. Values are computed by taking the variance of both portfolios t - 60 months and dividing the hedged variance with the unhedged. So, if the value is above 1, the variance of the hedged portfolio is higher than the unhedged. In line with the previous results for variance reduction we see that the graph indicates a lower variance the minimum variance hedge.

Table VII

The table describes the mean excess return, standard deviation and Sharpe ratio for all countries when implementing the minimum variance hedge, unitary hedge and the unhedged portfolio for sub-sample 2. The table also display the respective test statistics when testing for differences between the two hedging strategies.

Mean

Subsample 2	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean										
Unhedged	0,17 %	-0,44 %	-0,06 %	0,28 %	0,14 %	0,54 %	0,10 %	0,20 %	-0,06 %	-0,11 %
Mean										
Min Var Hedge	0,17 %	0,12 %	0,46 %	0,27 %	0,19 %	0,47 %	0,27 %	0,36 %	0,24 %	-0,01 %
Mean										
Unitary	0,14 %	-1,07 %	-0,34 %	0,33 %	0,07 %	0,90 %	-0,02 %	0,18 %	-0,34 %	-0,39 %
H0: Min Var - Unhedged										
T-stat	0,01	3,00	1,66	-0,03	0,24	-0,71	0,80	0,73	1,34	0,34
P-value	0,50	1,00	0,95	0,49	0,59	0,24	0,79	0,77	0,91	0,63
H0: Unitary - Unhedged										
T-stat	-0,10	-3,18	-1,58	0,17	-0,46	1,78	-0,77	-0,17	-1,87	-0,79
P-value	0,46	0,00	0,06	0,57	0,32	0,96	0,22	0,43	0,03	0,22

Standard Deviation

Subsample 2	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
St. Dev										
Unhedged	4,69 %	4,65 %	5,43 %	6,00 %	4,68 %	4,26 %	4,88 %	4,80 %	4,92 %	5,57 %
St. Dev										
Min Var Hedge	4,30 %	4,23 %	3,63 %	4,16 %	4,09 %	4,08 %	4,00 %	3,97 %	3,96 %	3,98 %
St. Dev										
Unitary	6,52 %	6,27 %	7,27 %	9,21 %	5,91 %	5,65 %	6,24 %	5,93 %	6,28 %	9,23 %
Var difference: Min Var - Unhedged										
Coefficient	-0,89	-0,85	-1,03	-1,09	-0,91	-0,97	-1,05	-1,00	-1,03	-1,07
P-Value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Var difference. Unhedged - Unitary										
Coefficient	-0,80	-0,89	-1,84	-1,14	-1,26	-0,58	-1,46	-1,76	-1,59	-0,84
P-Value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Sharpe Ratio

Subsample 2	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,036	-0,093	-0,010	0,046	0,030	0,126	0,021	0,042	-0,012	-0,020
Sharpe Ratio Bias Corrected										
Min Var Hedge (SRA)	0,039	0,028	0,126	0,064	0,046	0,114	0,067	0,090	0,061	-0,003
Sharpe Ratio Difference [Bias Corrected]	-0,004	-0,121	-0,136	-0,018	-0,016	0,012	-0,046	-0,048	-0,072	-0,016
1-tailed p-value - Ho: (SRB - SRA) ≤ 0	0,537	0,996	0,981	0,622	0,638	0,352	0,844	0,842	0,931	0,613

Sharpe Ratio

Subsample 2	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,036	-0,093	-0,010	0,046	0,030	0,126	0,021	0,042	-0,012	-0,020
Sharpe Ratio Bias Corrected										
Unitary (SRA)	0,022	-0,170	-0,046	0,036	0,012	0,158	-0,003	0,030	-0,054	-0,041
Sharpe Ratio Difference [Bias Corrected]	0,014	0,077	0,036	0,011	0,018	-0,032	0,024	0,012	0,042	0,022
1-tailed p-value - Ho: (SRB - SRA) ≤ 0	0,333	0,018	0,020	0,327	0,214	0,776	0,130	0,267	0,021	0,243

Analysis

This section will analyze our findings in the results section and discuss possible explanations and implications. In addition, we investigate alternative modifications to optimize the portfolio performance.

We find that some periods in our sample set causes large changes in the mean and standard deviation for the full sample and sub-samples. As indicated when describing Table II in the Data and Summary Statistics section we see that Turkey has among the highest forward currency return in addition to a high forward standard deviation. Further, we see that when applying the minimum variance hedge the mean hedging weight is positive. However, the combination of a mostly positive hedging weight and among the highest currency forward returns still leads to lower mean returns when implementing the minimum variance hedge. We thus suspect that there are outliers with large negative returns which affects the results for the whole sample. Figure 2 display the hedging component for Turkey, which is the excess returns from the minimum variance hedge subtracted by the unhedged returns. We see a significant outlier in February 2001, were the combination of a hedging weight of 1,73 and a negative return on the forward of -36% equals a combined loss of -63%. This is a severe hit to the overall portfolio performance, and we find that removing the outlier from our sample Turkey shifts to have a higher mean excess return when applying the minimum variance hedge compared to the unhedged portfolio.

We find the same for Taiwan, which has a positive mean hedging weight but a negative mean forward return, however the combined mean excess return results in a higher return for the minimum variance strategy compared to the unhedged. Taiwan doesn't have severe outliers, but rather a few periods that yield a higher return for the hedged portfolio which drags up the overall mean. We choose to keep outliers like these in our main sample as explained above to be able to capture large shifts and shocks to emerging markets currencies, and rather use our findings to complement an alternative strategy that takes the outliers into account.

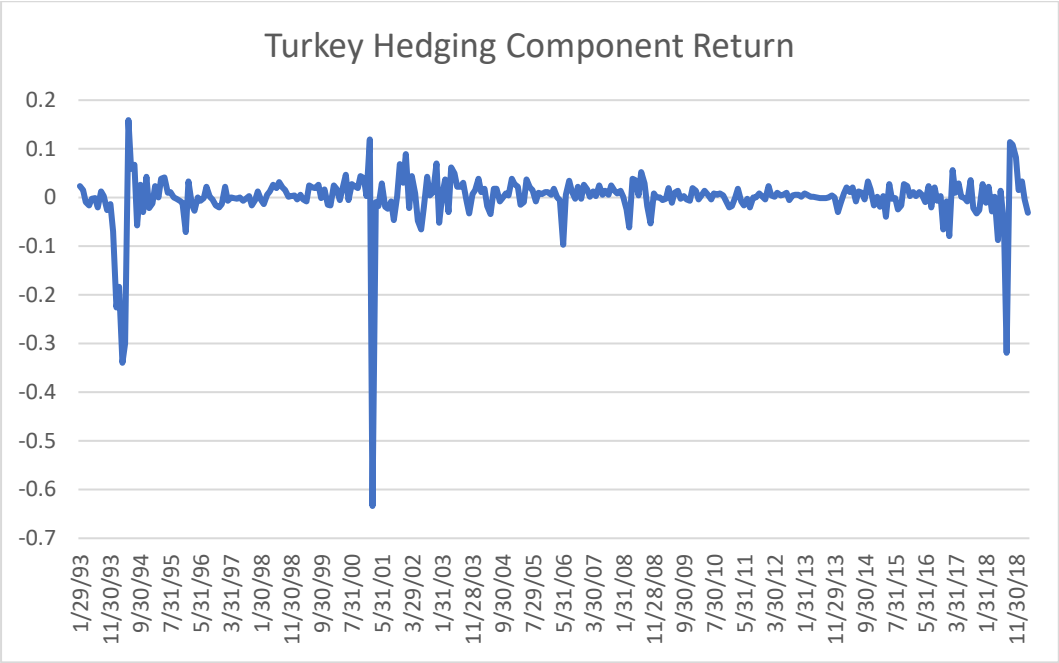

Figure 2

Conditional Minimum Variance Hedge

Having established that some of our emerging markets currencies are subject to large outliers when applying the minimum variance hedge, we propose a conditional hedging strategy that restricts the hedging weight to become lower (higher) than – 1 (1). The conditional strategy aims to reduce prominent outliers and find the optimal strategy for an emerging markets-based investor who may be exposed to periodically high interest rates and/or currency fluctuations. As the minimum variance hedge uses the past 60 observations to calculate the hedging weights, a period of financial distress will stay prominent in the calculations for a longer period than wanted. The observations from a period of financial distress will thus still be prominent in the calculations even if the economy has stabilized. Therefore, we have conducted an additional analysis where we limit the hedging weight in the minimum variance strategy to be within 1 and -1, which limits the investor to hedge more than their full exposure. It makes sense for an investor to limit their hedging exposure since a large hedging position is subject large changes in return, which again might cause large changes to both portfolio volatility and return. We thus implement the conditional hedge to limit dramatic changes in the return caused by our currency positions.

The results of this analysis are presented in Table VIII. The mean returns for the conditional strategy are lower for all countries except Chile, Malaysia, and Turkey. Mexico show the same return as the unconditional minimum variance hedge. The difference in return however is marginal, except for Turkey which now report a mean excess return of 0,15% compared to 0,04% for the unconditional. Testing the mean returns thus provide us with the same results as when using the unconditional approach, where only Jordan shows significant difference.

We also see a marginal difference in portfolio standard deviation for most countries, where most countries report around the same values. Thus, the portfolio standard deviation for the conditional approach is also reduced when compared to the unhedged portfolio. The variance reductions are also statistically significant compared to the unhedged portfolio. More interesting is the reduction in standard deviation for Turkey. As mentioned earlier, Turkey is one of the emerging economies that experience high hedging weights. When assessing the results for the full sample, Turkey have a standard deviation under the unconditional approach of 5,19% while the conditional standard deviation is 4,57%.

Comparing Sharpe ratios, we see the same trend. The one that differs again is Turkey, which now experience a negative difference, meaning that the Sharpe ratio for the hedged portfolio is now larger than for the unhedged, even though the increase is not statistically significant. However, comparing the standard deviations and mean returns, the conditional approach shows many similarities with the unconditional approach for the other countries.

As in the unconditional approach, we have analyzed the same sub-samples for the conditional minimum variance strategy. (See Table A-II and A-III in the appendix) Similar to the conditional results for the full sample, we see that the mean returns are the same for all countries except for Turkey in sub-sample 1. For sub-sample 1 the mean return for Turkey goes up from 0,09% in the unconditional approach to 0,32% in the conditional. The volatility of the hedged portfolio also follows many of the same characteristics as the unconditional hedged returns. Only marginal changes apply for the Sharpe ratio as well, except for Turkey,

where the Sharpe ratio is now marginally increased in the conditional minimum variance hedge.

In the second sub-sample we observe the same trends for mean returns as in the full and first sub-sample. The second sub-sample does not include some of the financial crises that were included in the first sub-sample, which means that the second sub-sample may not be very affected. Assessing the standard deviation, we see the same trends as in the unconditional approach. The minimum variance hedge indeed reduces variance, with statistically significant results for all currencies. Sharpe ratios are mostly the same, for some countries they marginally improve, while they marginally worsen for others. We note that the difference between the unconditional and conditional approach in sub-sample 2 is only marginal for Turkey. Sub-sample 2 has proved to be a more stable period for Turkey, which again reduces the effect of the conditional approach.

As a result, the conditional approach does show many of the same characteristics for the second sub-sample comparing the unconditional to the conditional approach. For the full sample and both sub-samples, the skewness and kurtosis in this strategy are very similar to the unconditional minimum variance hedge. However, we observe a decrease in kurtosis for Turkey in all samples. This indicates that there are fewer extreme values observed, thus narrowing the distribution of the returns.

Table VIII

The table describes the mean excess return, standard deviation and Sharpe ratio for all countries when implementing the condtional minimum variance hedge and the unhedged portfolio for the full sample. The table also display the respective test statistics when testing for differences between the two hedging strategies.

Mean

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean										
Unhedged	0,28 %	0,22 %	0,20 %	0,38 %	0,51 %	0,69 %	0,48 %	0,48 %	0,35 %	0,16 %
Mean										
Conditional Min Var	0,35 %	0,36 %	0,39 %	0,43 %	0,39 %	0,60 %	0,43 %	0,50 %	0,38 %	0,15 %
H0: Conditional Min Var - Unhedged										
T-stat	0,679	0,378	1,998	0,223	-0,734	-0,537	-0,355	0,398	0,229	-0,016
P-value	0,751	0,647	0,977	0,588	0,232	0,296	0,361	0,654	0,591	0,493

Standard Deviation

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
St. Dev										
Unhedged	4,60 %	8,73 %	5,21 %	6,23 %	5,38 %	5,22 %	5,21 %	4,78 %	5,28 %	6,23 %
St. Dev										
Conditional Min Var	4,38 %	4,68 %	4,48 %	4,66 %	4,53 %	4,51 %	4,49 %	4,43 %	4,50 %	4,57 %
Var difference: Conditional Min Var - Unhedged										
Coefficient	-0,84	-1,06	-1,75	-1,12	-1,02	-0,97	-1,15	-1,50	-1,07	-0,93
P-Value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Sharpe Ratio

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,0614	0,0238	0,0386	0,0607	0,0937	0,1297	0,0915	0,0991	0,0662	0,0249
Sharpe Ratio Bias Corrected										
Conditional Min Var	0,0793	0,0775	0,0873	0,0915	0,0856	0,1338	0,0958	0,1136	0,0851	0,0331
Sharpe Ratio Difference [Bias Corrected]	-0,0179	-0,0536	-0,0487	-0,0309	0,0081	-0,0041	-0,0043	-0,0144	-0,0189	-0,0082
1-tailed p-value - Ho: (SRB - SRA) ≤ 0	0,7782	0,8642	0,9928	0,8005	0,3994	0,5520	0,5627	0,7694	0,7402	0,5729

Conclusion

Several papers (Campbell, Medeiros, & Viceira, 2010) (De Roon, Eiling, Gerard, & Hilion, 2012) among others, examines the effect of currency hedging on an international portfolio, though all uses the viewpoint of an investor located in developed markets. We investigate the effects of currency hedging from an emerging market-based investor and test the effect of currency hedging by implementing the unitary hedging strategy and the minimum variance hedging strategy. We also add a conditional minimum variance hedge that aims to reduce large outliers caused by financial distress. We analyze the hedging performance by mean excess returns, standard deviation and Sharpe ratio. We also report the measure of skewness and kurtosis.

The results show that the minimum variance hedge indeed reduces portfolio standard deviation for all countries. The reduction in variance is also statistically significant. The results also indicate a higher Sharpe ratio when applying the

minimum variance hedge for all countries except Malaysia and Turkey, which is in contrast to e.g. De Roon et. al. (2012) which studies developed countries. Even though the changes in Sharpe ratio are not statistically significant, our results show no evidence of a reduced risk-return payoff when applying the minimum variance hedge, and that all countries except Malaysia and Turkey actually improves the portfolio risk-return trade-off.

The results for the unitary hedged portfolio however indicate an increased standard deviation. The increased standard deviation is also statistically significant. We find that the Sharpe ratio for the unitary portfolio is reduced, thus indicating a worse risk-return trade-off.

During our sample period from 1988-2019 the countries in our sample experienced many individual periods of financial distress, which caused large currency fluctuations. We also construct a conditional approach to the minimum variance hedge restricting the hedging ratios within 1 and -1. This is due to the periodically high outliers during periods of financial distress and aims to reduce large changes to the return during these periods. We find that the conditional strategy works very well and increases the Sharpe ratio for countries largely affected by outliers. Simultaneously it only reduces the performance of the remaining countries marginally. This makes the conditional hedge a good substitute for investors who wants to limit their exposure during periods of financial distress. The results thus indicate that the minimum variance hedge can be viewed as a "free lunch" for investors in emerging markets, even if they choose to limit the hedging weights.

Our results are important as it indicates that an emerging markets based investor should have a different approach on currency hedging compared to developed markets based investors. The implications of our results for an investor in emerging markets are high, as it indicates that both applications to the minimum variance hedge manages to reduce portfolio variance with no significant changes in return. The conditional minimum variance hedge also provides a modification to investors which limits the sensitivity to periods of financial distress. Further research on modifications to the minimum variance hedge in emerging markets can be a topic for future research, whereas it can extend the modifications to

optimize the results. We also don’t include the universal hedging strategy, which may add interesting insights on the topic.

Bibliography

Aloosh, A., & Bekaert, G. (2018). Currency Factors*. *NBER Working Papers*.

Black, F. (1990). Equilibrium Exchange Rate Hedging. *The Journal of Finance*.

Black, F. (1995). Universal Hedging: Optimizing Currency Risk and Reward in International Equity Portfolios. *Financial Analyst Journal*.

Bodie, Z., Kane, A., & Marcus, A. J. (2014). *Investments.* Berkshire: Mc Graw Hill Education.

Campbell, J. Y., Medeiros, K. S.-D., & Viceira, L. M. (2010). Global Currency Hedging. *The Journal of Finance*.

Christie, S. (2005). Is the Sharpe Ratio Useful in Asset Allocation? *MAFC Research Papers No.31*.

De Roon, F., Eiling, E., Gerard, B., & Hilion, P. (2012). Currency Risk Hedging: No Free Lunch - Working Paper.

De Santis, G., & Gerard, B. (1998). How Big is the Premium for Currency Risk? *Journal of Financial Economics 49*, 375-412.

Dumas, B., & Solnik, B. (1995). The World Price of Foreign Exchange Risk. *Journal of Finance 50*, 445-479.

Engel, C. (1996). The forward discuont anomaly and the risk premium: A survey of recent evidence. *Journal of Empirical Finance*, 123-192.

Eun, C. S., & Resnick, B. G. (1988). Exchange Rate Unceirtainty, forward contracts and international portfolio selection. *Journal of Finance 43*, 197-216.

Fama, E. F. (1984). Forward and Spot Exchange Rates. *Journal of Monetary Economics 14*, 319-338.

Gilmore, S., & Hayashi, F. (2008). Emerging Market Cyrrency Excess Returns. *NBER Working Paper No. 14528*.

Giovannini, A., & Jorion, P. (1989). The Time Variation of Risk and Return in the Foreign Exchange and Stock Markets. *Journal of Finance, 44*, 307-325.

Glen, J., & Jorion, P. (1993). Currency Hedging for Inernational Portfolios. *American Finance Association*.

Glick, R., & Rose, A. K. (1999). Contagion and trade - Why are currency crises regional? *Journal of International Money and Finance*, 603-617.

Harvey, C. (1995). Predictable Risks and Returns in Emerging Markets. *Rev Finance Stud*, 773-816.

Hovanov, N. V., Kolari, J. W., & Sokolov, M. V. (2004). Computing currency invariant indices with an application to minimum variance currency baskets. *Journal of Economic Dynamics & Control*, 1481-1504.

Lo, A. W. (2002). The Statistics of Sharpe Ratios. *The Financial Analyst Journal*, 36-52.

Lustig, H. N., & Verdelhan, A. (2007). The Cross-Section of Foreign Currency Risk Premia and consumption Growth Risk. *American Economic Review 97*, 89-117.

MSCI. (2012). *MSCI Index Calculation Methodology.* msci.com.

Nijman, T., de Roon, F., & Werker, B. (2001). Testing for Mean-Variance spanning with short sales constraints and transaction costs: The case of emerging markets. *Journal of Finance*, 721-742.

Opdyke, J. (2007). Comparing Sharpe Ratios: So Where are the p-values? *Journal of Asset Management*.

Opdyke, J. (2007). *DataMineIt*. Retrieved from http://www.datamineit.com/DMI_publications.htm

Perold, A., & Schulman, E. C. (1988). The Free Lunch in Currency Hedging: Implications for investment policy and performance standars . *Financial Analyst Journal 44*, 45-50.

Solnik, B. (1974). Why not Diversify Internationally rather than Domestically? *Financial Analysts Journal 30*, 48-54.

Thomson Financial and Morgan Stanley Capital International. (2005). *Morgan Stanley Capital International on DataStream.* Thomson Financial.

Walker, E. (2008). Strateig currency hedging and Global Portfolio Investments Upside Down. *Journal of Business Research 61*, 657-668.

Appendix

Tables

Table A - I

The table describes the measure of skewness and kurtosis for all countries when implementing the minimum variance hedge, condtional minimum variance hedge, unitary hedge and unhedged portoflio for the full sample, sub-sample 1 and sub-sample 2.

Skewness

	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Full Sample										
Unhedged	-0,41	4,51	-0,69	0,81	-0,38	1,72	-0,31	-0,71	-0,03	0,85
Minimum Variance	-0,62	-0,44	-0,72	-0,49	-0,62	-0,51	-0,71	-0,64	-0,62	-2,12
Unitary	-0,31	5,90	-0,69	1,99	0,49	4,13	0,18	-0,59	0,67	2,06
Conditional Min Var	-0,62	-0,43	-0,67	-0,47	-0,63	-0,51	-0,70	-0,65	-0,61	-0,68
Sub Sample 1										
Unhedged	-0,39	3,92	-0,49	1,83	-0,14	2,30	-0,02	-0,52	0,48	0,67
Minimum Variance	-0,53	-0,17	-0,59	-0,22	-0,51	-0,40	-0,63	-0,54	-0,56	-2,29
Unitary	0,06	4,60	-0,34	3,70	0,72	4,34	0,58	-0,27	1,23	1,79
Conditional Min Var	-0,53	-0,17	-0,59	-0,22	-0,50	-0,40	-0,63	-0,54	-0,53	-0,56
Sub Sample 2										
Unhedged	-0,42	-0,41	-0,83	-0,47	-1,01	-0,29	-0,79	-0,90	-0,85	1,05
Minimum Variance	-0,73	-1,02	-0,99	-1,03	-0,88	-0,71	-0,89	-0,86	-0,79	-0,96
Unitary	-0,50	0,10	-0,76	-0,49	-0,84	0,14	-0,58	-0,78	-0,70	2,43
Conditional Min Var	-0,74	-1,03	-0,84	-0,97	-0,92	-0,71	-0,88	-0,85	-0,80	-0,96

Kurtosis

	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Full Sample										
Unhedged	3,87	48,22	5,15	11,38	5,83	19,63	4,66	5,13	6,28	7,87
Minimum Variance	4,36	4,72	4,66	5,04	4,30	5,03	4,50	4,52	4,43	16,50
Unitary	3,87	66,82	5,90	23,18	14,88	48,03	5,23	5,40	11,06	14,54
Conditional Min Var	4,37	4,80	4,51	5,02	4,36	5,03	4,55	4,52	4,43	4,60
Sub Sample 1										
Unhedged	3,32	31,89	3,74	16,52	4,98	20,78	3,71	3,76	5,93	6,26
Minimum Variance	3,63	4,04	3,78	4,30	3,54	4,56	3,76	3,85	3,68	15,62
Unitary	2,84	38,55	3,51	33,68	13,80	40,70	4,86	3,17	11,92	11,56
Conditional Min Var	3,63	4,07	3,78	4,30	3,55	4,56	3,79	3,85	3,67	3,96
Sub Sample 2										
Unhedged	4,33	4,28	6,03	4,19	6,77	3,99	5,80	6,38	6,17	10,49
Minimum Variance	5,17	5,49	6,03	5,94	5,46	5,50	5,65	5,49	5,60	5,40
Unitary	4,12	3,99	6,04	5,07	6,41	3,34	5,04	6,58	5,75	19,33
Conditional Min Var	5,19	5,62	5,65	5,89	5,62	5,50	5,75	5,48	5,61	5,39

Table A - II

The table describes the mean excess return, standard deviation and Sharpe ratio for all countries when implementing the condtional minimum variance hedge and the unhedged portfolio for sub-sample 1. The table also display the respective test statistics when testing for differences between the two hedging strategies.

Mean

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean										
Unhedged	0,40 %	0,88 %	0,46 %	0,49 %	0,88 %	0,84 %	0,86 %	0,75 %	0,77 %	0,43 %
Mean										
Conditional Min Var	0,52 %	0,70 %	0,53 %	0,61 %	0,58 %	0,74 %	0,66 %	0,70 %	0,60 %	0,32 %
H0: Conditional Min Var - Unhedged										
T-stat	1,287	-0,229	0,909	0,403	-1,012	-0,320	-0,914	-0,693	-0,640	-0,247
P-value	0,900	0,410	0,818	0,656	0,157	0,375	0,181	0,245	0,262	0,403

Standard Deviation

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
St. Dev										
Unhedged	4,51 %	11,46 %	4,98 %	6,48 %	6,00 %	6,05 %	5,52 %	4,76 %	5,60 %	6,84 %
St. Dev										
Conditional Min Var	4,47 %	5,15 %	4,91 %	5,12 %	4,97 %	4,91 %	4,91 %	4,76 %	4,91 %	5,11 %
Var difference: Conditional Min Var - Unhedged										
Coefficient	-0,651	-1,061	-0,904	-1,042	-0,928	-0,973	-0,931	-0,510	-0,852	-0,863
P-Value	0,033	0,000	0,029	0,000	0,000	0,000	0,000	0,196	0,000	0,000

Sharpe Ratio

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,0882	0,0731	0,0914	0,0731	0,1450	0,1339	0,1556	0,1575	0,1357	0,0620
Sharpe Ratio Bias Corrected										
(SRA)	0,1163	0,1358	0,1070	0,1181	0,1164	0,1504	0,1347	0,1462	0,1220	0,0627
Sharpe Ratio Difference										
[Bias Corrected]	-0,0282	-0,0627	-0,0156	-0,0449	0,0286	-0,0165	0,0210	0,0112	0,0137	-0,0008
1-tailed p-value - Ho:										
(SRB - SRA) ≤ 0	0,8534	0,8071	0,7589	0,8103	0,2976	0,6238	0,3193	0,3522	0,3925	0,5045

Table A - III

The table describes the mean excess return, standard deviation and Sharpe ratio for all countries when implementing the condtional minimum variance hedge and the unhedged portfolio for sub-sample 2. The table also display the respective test statistics when testing for differences between the two hedging strategies.

Mean

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Mean										
Unhedged	0,17 %	-0,44 %	-0,06 %	0,28 %	0,14 %	0,54 %	0,10 %	0,20 %	-0,06 %	-0,11 %
Mean										
Conditional Min Var	0,18 %	0,03 %	0,26 %	0,25 %	0,20 %	0,47 %	0,20 %	0,31 %	0,17 %	-0,02 %
H0: Conditional Min Var - Unhedged										
T-stat	1,287	-0,229	0,909	0,403	-1,012	-0,320	-0,914	-0,693	-0,640	-0,247
P-value	0,900	0,410	0,818	0,656	0,157	0,375	0,181	0,245	0,262	0,403

Standard Deviation

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
St. Dev										
Unhedged	4,69 %	4,65 %	5,43 %	6,00 %	4,68 %	4,26 %	4,88 %	4,80 %	4,92 %	5,57 %
St. Dev										
Conditional Min Var	4,29 %	4,16 %	4,02 %	4,16 %	4,06 %	4,08 %	4,05 %	4,08 %	4,07 %	3,98 %
Var difference: Conditional Min Var - Unhedged										
Coefficient	-0,886	-1,015	-1,909	-1,218	-1,431	-0,973	-1,576	-1,881	-1,786	-1,069
P-Value	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Sharpe Ratio

Full Sample	Chile	Indonesia	Jordan	Korea	Malaysia	Mexico	Philippines	Taiwan	Thailand	Turkey
Sharpe Ratio Bias Corrected										
Unhedged (SRB)	0,0357	-0,0932	-0,0103	0,0463	0,0304	0,1262	0,0206	0,0419	-0,0115	-0,0196
Sharpe Ratio Bias Corrected										
Conditional Min Var (SRA)	0,0410	0,0075	0,0631	0,0598	0,0490	0,1142	0,0500	0,0761	0,0418	-0,0039
Sharpe Ratio Difference [Bias Corrected]	-0,0054	-0,1006	-0,0734	-0,0136	-0,0186	0,0120	-0,0294	-0,0342	-0,0533	-0,0157
1-tailed p-value - Ho: (SRB - SRA) ≤ 0	0,5562	0,9942	0,9923	0,6032	0,7343	0,3520	0,8319	0,9043	0,9741	0,6082

Figures

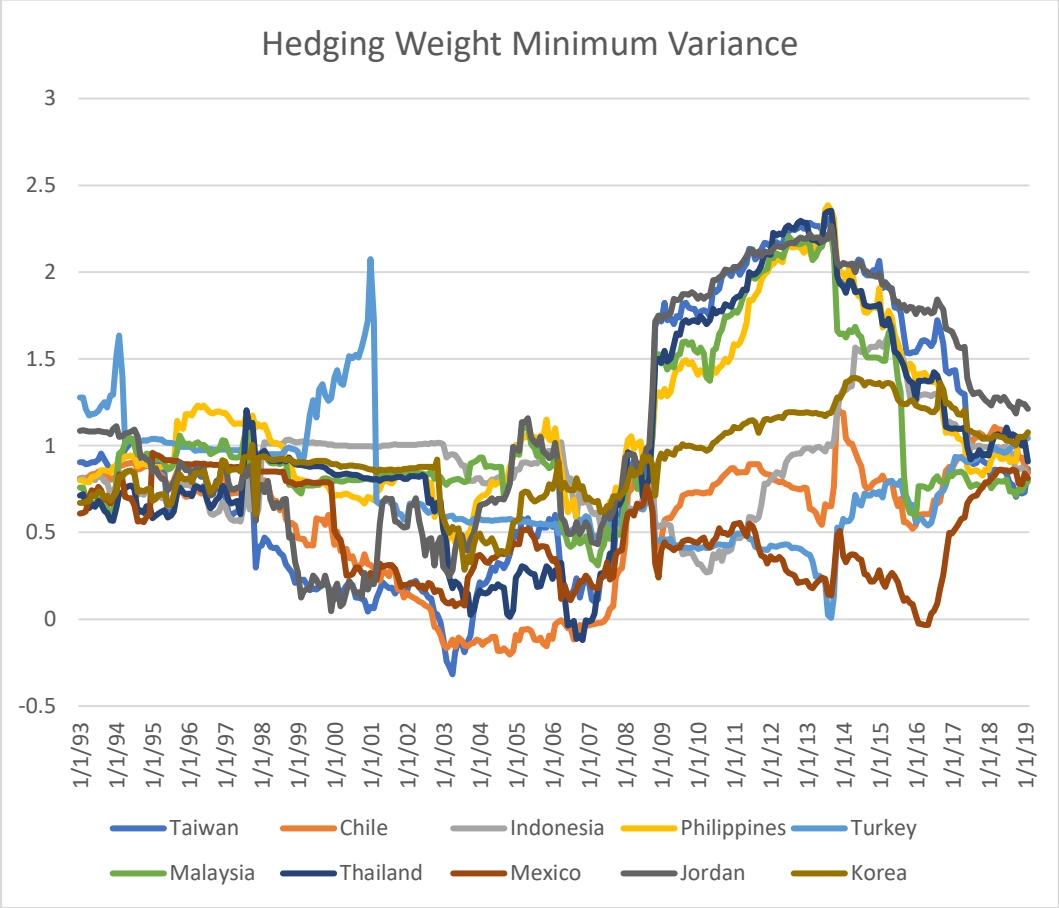

Figure A-1

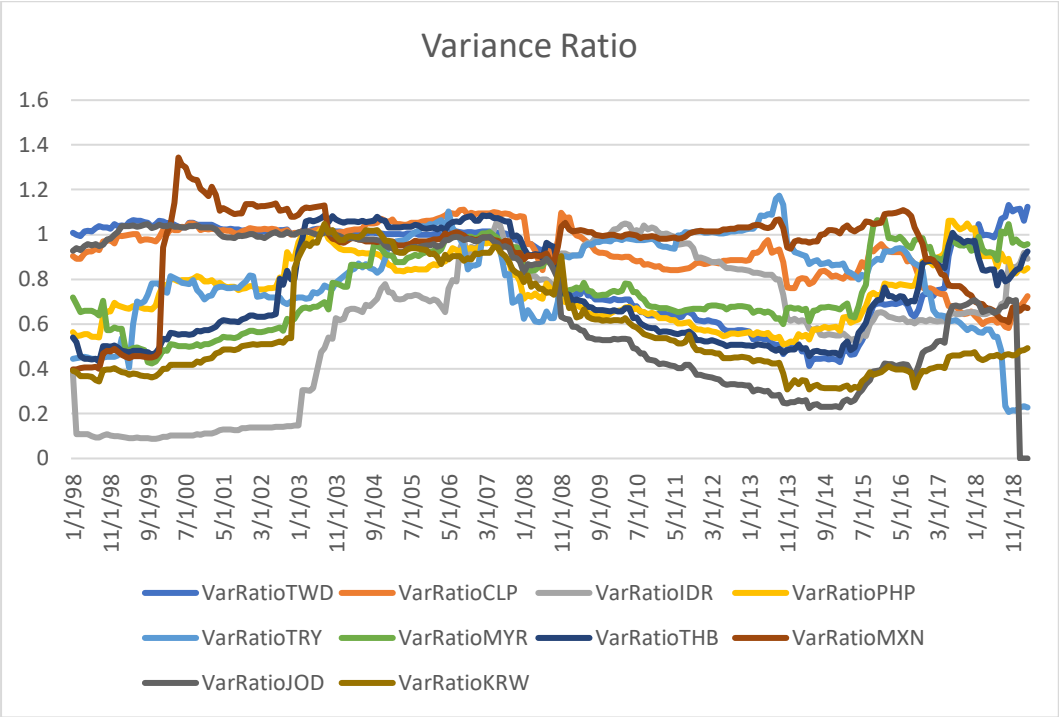
Variance Ratio
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
11/1/98
9/1/99
7/1/00
5/1/01
3/1/02
1/1/03
11/1/03
9/1/04
7/1/05
5/1/06
3/1/07
1/1/08
11/1/08
9/1/09
7/1/10
5/1/11
3/1/12
1/1/13
11/1/13
9/1/14
7/1/15
5/1/16
3/1/17
1/1/18
11/1/18
VarRatioTWD
VarRatioCLP
VarRatioIDR
VarRatioPHP
VarRatioTRY
VarRatioMYR
VarRatioTHB
VarRatioMXN
VarRatioJOD
VarRatioKRW

Figure A-2

MSCI index in local currency:

$$I_t = I_{t-1} \times \frac{\sum_{i=1}^{n} Price(i) \times Nosh(i)_{t-1} \times Adj(i)_t \times 1/exch\,rate_{t-1}}{\sum_{i=1}^{n} Price_{t-1} \times Nosh(i)_{t-1} \times 1/exch\,rate(i)_{t-1}}$$

$n = number\ of\ securities\ in\ index\ at\ time\ t$

$t = time\ of\ calculation$

$Adj(i)_t = \frac{security\ price\ before\ ex-date\ of\ corporate\ action}{theoretical\ price\ after\ ex-date\ of\ corporate\ action}$

$exch\,rate = value\ of\ 1USD\ in\ the\ local\ currency\ of\ stock\ i$

MSCI index in US Dollar:

$$I_t = I_{t-1} \times \frac{\sum_{i=1}^{n} Price(i)_t \times Nosh(i)_{t-1} \times Adj(i)_t\ 1/exch\,rate(i)_t}{\sum_{i=1}^{n} Price(i)_{t-1} \times Nosh(i)_{t-1} \times 1/exch\,rate(i)_{t-1}}$$

$n = number\ of\ securities\ in\ index\ at\ time\ t$

$t = time\ of\ calculation$

$Adj(i)_t = \frac{security\ price\ before\ ex-date\ of\ corporate\ action}{theoretical\ price\ after\ ex-date\ of\ corporate\ action}$

$exch\,rate = value\ of\ 1USD\ in\ the\ local\ currency\ of\ stock\ i$

The only difference between the equations is the impact of currency exchange rate changes. The local currency index is calculated using the same exchange rate in the numerator and denominator, which in turn removes the mentioned impact. Thus, the ratio between the two are applicable to find exchange rate changes between the two indices.
(MSCI, 2012) (Thomson Financial and Morgan Stanley Capital International, 2005, p. 112)