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Currency hedging effectiveness in a post-crisis world

Summary

I – Introduction

Study conducted

This study is based on a previous paper, "*When is hedging foreign assets effective*?", by Y. Benari (*1991, Journal of Portfolio Management*). Our paper aims at assessing if the setting, tools, and conclusions drawn at the end of the 20th century are still applicable in our 21st post-crisis world (from 2010 to 2019).

We know that the effectiveness of hedging consists in locking in today a future exchange, in order to cover the exposure towards changes in rates, which would increase the volatility of the underlying investment. This insurance comes at a price: we have to give up a potential upside, that will affect our returns. The aim of this study is also to see when this is convenient or not.

In theory, over the long run, that exchange rates move in accordance with the relative inflation of the two currencies considered. This is linked to the concepts of Purchasing Power Parity, or Covered Interest Parity.

Quoting the Bank of International Settlements: "Covered interest parity (CIP) is the closest thing to a physical law in international finance. It holds that the interest rate differential between two currencies in the cash money markets should equal the differential between the forward and spot exchange rates. Otherwise, arbitrageurs could make a seemingly riskless profit.".

Thus, this study is an implicit test on the CIP validity and its "power", that is, how long, and if, the market takes to clear arbitrage opportunities in response to short term shocks, to find an equilibrium between exchange rates, purely depending on inflation. This means we follow the CIP to hedge our exchange rate risk, to price how much we should pay in the next future today. It can be seen that CIP will likely hold in the long term, but, still nowadays, it is implemented for "shorter" term horizons. Clearly, it depends significantly on how we implement it.

Choices and instruments

Given that the CIP is given by definition as:

$$F_{a/b}^{t} = S_{a/b} \times \frac{1 + r_a^t \times t}{1 + r_b^t \times t}$$

Namely: *F*, the forward contract in t time, must be equal to the spot rate *S* (the today exchange rate) multiplied by the fraction of *r* "interest rates", which reflects the risk-free interest rates of the currencies "a" and "b", where "a" is the domestic or local currency and "b" is the foreign currency.

As we need a proxy for these *r*'s (risk free rates/cash money markets) we choose the Libor rates/Euribor. This choice is consistent even accounting for the credit risk implied in these rates, since the forward market is very liquid for maturities up to 18/24 months.

In addition, we assume that the forward rate is an unbiased forecast of future spot rates. Forward premium over a given time horizon equals expected exchange rate change over the same horizon (expectation theory).

Continuing from the previous relation we get (divide S both sides and take -1 from both sides):

$$\frac{F^t_{a/b} - S_{a/b}}{S_{a/b}} = \frac{r^t_a \times t - r^t_b \times t}{1 + r^t_b \times t} \cong r^t_a \times t - r^t_b \times t$$

This is the "forward premium". This premium should be an indicator of where the rates will move (appreciate or depreciate in the future in relative terms). If positive, "a" should appreciate versus "b", if negative, "b" should strengthen.

We use this relationship to hedge our currency risk by mean of the "forward". If we hedge, we should get the unhedged return plus the forward premium (or discount, if negative), because we try to forecast/approximate this premium with *t-period* interest rates (Libor), which should incorporate future rate changes.

Calculations and Processes

We approach this empirical research with the perspective of a US investor investing in Euro, Yen and Pounds, in the equity indices *DAX30, NIKKEI225, FTSE100*. We are going to assess if, from 2010 to 2019, hedging would have been effective (i.e. if we want to enter forward contracts "to fix today the future exchange rate" to avoid earning less than expected due to adverse exchange rates with the dollar).

Here we assume that hedging is rolled over every 6 months (6m), while the investment time horizon is much longer. As we want to test for this effectiveness, we do not use the expectations but the realized returns, so end of 6 months return vs. beginning of 6 moths Libor rates.

To do this we need the domestic and foreign *r*, so the local Libor 6m. We calculate the premium every 6m according to the formula above (*t=0.5*). We also collect the returns, on a 6m basis of the foreign index and the exchange rate.

The procedure is as follows: gather weekly raw data; approximate the investment in equity with the investment in the indices; compute linear returns; aggregate them over 6m; compound them. We also calculate the volatility and correlation for each data series. Then we compute return and volatility for every year for each index for both the hedged and unhedged case. We compound them over the three main data frames. Also, for each period we take the average correlation and volatility of the period.

We have that the hedged investment has volatility = the volatility of the equity index and return equal to the index return + premium paid (or discount). For the unhedged investment we have a variance = sum of variance. of the index and the exchange rate plus 2 times the correlation times the two volatilities.

To develop our analysis, we use the indicators used by Benari (1991) and introduce also a "new one". We shall see if these are still of some use nowadays.

The first indicator is the mainstream correlation (between index and exchange rate), the second one is the "volatility index" that is the ratio between the index standard deviation and the exchange rate standard deviation. We also introduce a "correlation threshold", that is the correlation we should experience if we want the unhedged volatility to be equal to the hedged one. This can give us a more sensible measure of how much correlation can impact our volatility analysis, as the simple absolute value can tell us little sometimes.

In general, for the volatility/risk of the investment, we shall see that if the volatility index is low (<<1) and the correlation is consistently positive, then hedging is very effective, as the greatest part of the volatility comes from the exchange rate, positively correlated to the index. On the contrary, if the volatility index is high (>>1) and the

correlation is consistently negative, then hedging is counter effective. Indeed, it would increase overall volatility as you would lose the natural hedge given by negative correlation, considering also that the index would bring most of the standard deviation.

In the cases in between, it depends on the relative levels of correlation (+/-) and volatility index (</> 1), here our "correlation threshold" could bring some more insights. For example, if the volatility index is under but near one, with a positive correlation, one has difficulty in saying if the hedging has been useful or not, it should have worked, but it depends on the correlation, here it could be useful to compare if it is under or over our threshold.

For the difference of returns, hedged vs unhedged, the comparison should be done between the premium "paid" ex-ante and the exchange rates movement ex-post on the same period. This difference should be small if the CIP and our theoretical framework works, with the caveats previously outlined.

II – The results over time

2010 - 2012: "After crisis"

This time frame is characterized by the aftermath of the financial crisis, here we shall see the start of accommodating monetary policies in some states, plus a series of local events which will alter our CIP equilibrium. Let us see what they are and how to explain these results.

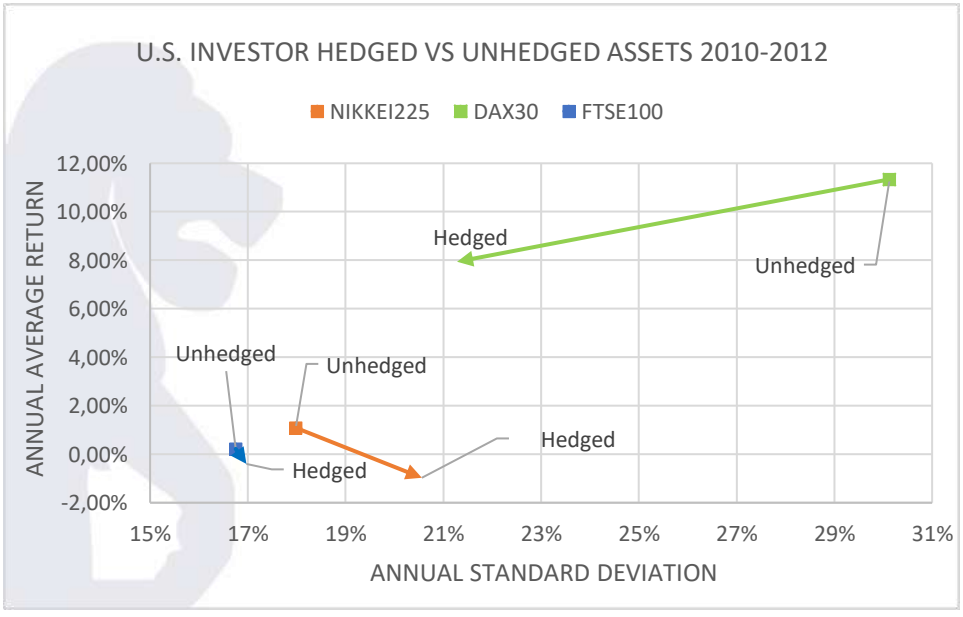

Figure 1. From the perspective of the US Investor, hedged vs unhedged investment in the three equity markets.

Hedged vs Unhedged 2010-2012

	DAX30	NIKKEI225	FTSE100
Correlation with ER	**-0.32**	**-0.50**	**-0.25**
Correlation threshold	**-0.69**	**-0.22**	**-0.23**
Volatility Index	**0.73**	**2.23**	**2.19**

DAX30

Analysing the 2010-2012 graph, it is possible to notice that, thanks to hedging, there is a reduction of the risk but a decrease in the return. We can see a decrease in return of around 3% in absolute terms and a decrease in volatility of the volatility of about 8.85% in absolute terms.

To evaluate the differences in return we must focus on the exchange rates.

In 2010 returns have been influenced by the beginning of the European debt crisis that weakened the Euro against the dollar. The USD/EUR exchange rate had a performance of +11.5%. After a temporary decrease in the first half of 2011 (-9.5%), the dollar rebounded around its 2010 level, with an annual return of 1.5%. In the first semester of 2012 the financial stress on the European banking sector weakened the euro, followed by a positive rebound at the end of the year, with a final result for USD/EUR of -4.7%.

The effectiveness of hedging in reducing risk depends on how high the correlation between the foreign asset and the exchange rate is, and how low is the volatility index. In this period, we experience a negative correlation between index and exchange returns, but with no relevant effect on overall volatility. The reduction of the risk is influenced only by a low volatility index.

FTSE100

During this period, we observe that hedging leads to an increase in risk of 0.22% in absolute terms and a reduction in average returns by 0.62% in absolute terms. The volatility index is high (2.18) and there is a negative correlation (-0.25).

Comparing unhedged versus hedged returns over this period, it can be supported that a negative correlation in 2010-2012 provides a diversification benefit since it offsets the effects of a volatile change in one of the two parameters, therefore providing a “natural hedging”. We notice that the critical correlation (the threshold) for the first subperiod is -0.29. Since the existent correlation rate, -0.25, is greater, in absolute value, than the critical correlation, hedging proves to be ineffective in reducing risk, causing, in fact, a slight increase in risk and a fall in returns.

In 2010, the implications of the European debt crisis and fears of ‘stagflation’ in the UK, culminated in the US/GBP exchange rate increasing by 3.23%, followed by a 0.01% increase in 2011. In 2012, the exchange rate decreased by -4.80%, a phenomenon which can be explained by the generally inverse relationship between oil prices and the US dollar, with 2012 witnessing a peak in oil prices partly due to supply restrictions (e.g. Arab Spring and Iran sanctions), growth in demand for oil by emerging markets and positive economic growth predictions (e.g. manufacturing in China).

During this period, the corporate earnings of several of the biggest market caps in the FTSE 100, such as BP and Royal Dutch oil, are directly affected by relatively increased oil prices. This result in the FTSE 100 undulating between high oil prices, often rallying the index, and a weak US dollar, pushing down index returns. This balance between the effects of a weak dollar and high oil prices can partly explain the negative correlation and the strong (above one) volatility index between exchange and index returns in this subperiod.

NIKKEI225

Some introductory facts about Japan:

- The economy of Japan is heavily dependent on export (in 2018, the export is 18.5% of the GDP). Consequently, when the yen depreciates it becomes cheaper for other countries to buy products from the Japanese companies and this causes a rise in the index NIKKEI225.
- The strong relationship between USD/JPN and NIKKEI225 is very high and negative for almost all the period from 2010 to 2019,
- The yen is well known for his status of 'Safe Haven' currency. Japan has more money invested abroad than any other nation in the world. During a crisis, the Japanese investors liquidate their risky investments and buy back the yen, their local currency. This is the reason why we have seen a strong boost of the yen during Covid-19 pandemic or other periods of crisis.
- Another important connection that we have to consider in our analysis is the one between the yen and the price of crude oil. Japan imports almost 99% of the crude oil and in general a large part of its total energy. Between yen and the price of the crude oil we observe a negative correlation, so, we expect an appreciation of the yen when the price of the oil decreases.

In this period the volatility index is high (around 2.3), because the average annualized volatility of the index is much higher than the average annualized volatility of the exchange rate, and also the correlation is very high and negative (-0.5).

As we expect the effect of the hedging is totally ineffective. With the hedging strategy, the annual standard deviation is increased by 2.58% in absolute terms and the return is reduced by 2.86% in absolute terms.

The most important event in this time span is the 9.1 magnitude earthquake occurred on 11 March 2011 in the north-western Pacific Ocean that causes a tsunami resulting in the nuclear reactor meltdown at Fukushima. During this day we register one of the largest drops of the NIKKEI225 (-14.1%) and an appreciation of 5% of the yen against the USD. On March 18th, the G7 announced to intervene by injecting yen to the global currency market, buying other currencies back, keeping the supply and demand of yen in balance in foreign exchange markets. This intervention stabilized the yen[1].

2013 - 2015: “The new normal”

Here we see that local events create a huge difference between geographies, we shall investigate their impact.

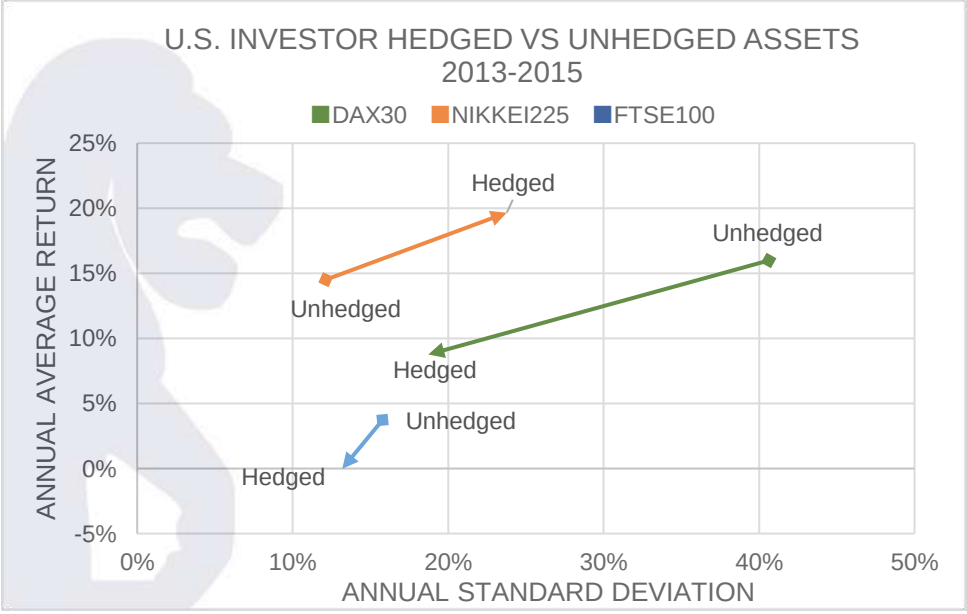

Figure 2. From the perspective of the US Investor, hedged vs unhedged investment in the three equity markets.

Hedged vs Unhedged 2013-2015

	DAX30	NIKKEI225	FTSE100
Correlation with ER	**0.25**	**-0.7**	**0.08**
Correlation threshold	**-0.83**	**-0.24**	**-0.28**
Volatility Index	**0.6**	**2.07**	**1.76**

DAX30

In this second graph for the subperiod 2013-2015, we can observe that the trend is very similar to the previous period except for a greater decrease in returns, around 7% in absolute terms, with a reduction of volatility of just over 21% in absolute terms.

2013 is characterized by the European recovery after the crisis with the USD losing ground against the euro (-4.11%). In 2014, we had a change of course with a rebound of the dollar (+2.06%). In 2015, the positive trend of

the dollar is confirmed also due the European instability caused by the several terrorist attacks, such as the one in Paris.

The risk in these three years registered a reduction of nearly 21%, as an effect of a low volatility index of about 0.61 and a positive correlation between the USD/EUR exchange rates and our index. Hedging remains useful for reducing risk but has a negative effect on returns.

FTSE100

During this period, the correlation is positive (0.084), and we observe a volatility index greater than one (1.762). In this case, as the natural hedging factor of a negative correlation does not apply, hedging reduces risk by 2.59% in absolute terms but also leads to a decrease in returns by 3.75% in absolute terms, since the appreciation of the US dollar is eliminated.

In 2013, the exchange rate continued to fall by -0,33%, one could say because of continued high oil prices and the tapering of quantitative easing by the Fed. The year 2014 saw a 7.31% increase in the exchange rate, as the onset of a 70% oil plunge between 2014-2016, owing to rising U.S. oil production, a slowdown in growing Eurozone and Japanese demand and efficiency gains. In 2015, we have the burst of the Chinese stock market bubble, as well as the Greek bailout crisis in 2015, plummeted the FTSE, with the exchange rate increasing by 2.50% in 2015.

It is important to mention that a parallel relationship is often observed between the USD/GBP exchange rate and the FTSE 100 since over 70% of index corporate earnings come from abroad. This, alongside with relatively low oil prices between 2014-2016, justifies the positive correlation during the subperiods 2013-2015 and 2016-2019.

NIKKEI225

Here, the situation in terms of risk is very similar to the 1st sub-period, we have a volatility index equal to 2.07 and a high and negative correlation, -0.7. The hedged portfolio has a risk that is higher than the unhedged one by 11.64% in absolute terms.

More interesting is the return. The forward risk premium is higher (0.13%) than the exchange rate of return (-5.5%), so the return of the hedged portfolio is higher than the unhedged. Usually, we expect the opposite. One way to explain is by analysing what happened in 2013. Through massive quantitative easing by the Bank of Japan (BOJ), the yen depreciated about 25% against the dollar. However, this sharp depreciation simply restored the purchasing power parity of the yen with the dollar[2].

This QE caused an increase in the volatility of the exchange rate, and this in 2013 Volatility index is lower (1.5).

In this 2nd sub-period, the critical value for the correlation is -0.24, so if the correlation had been lower or equal to -0.24 the hedging strategy would be effective.

2016 - 2019: “The recovery”

In this time frame all major equity markets have experienced a rebound and the economic outlook is positive, we still have the continuation of some monetary policies previously started.

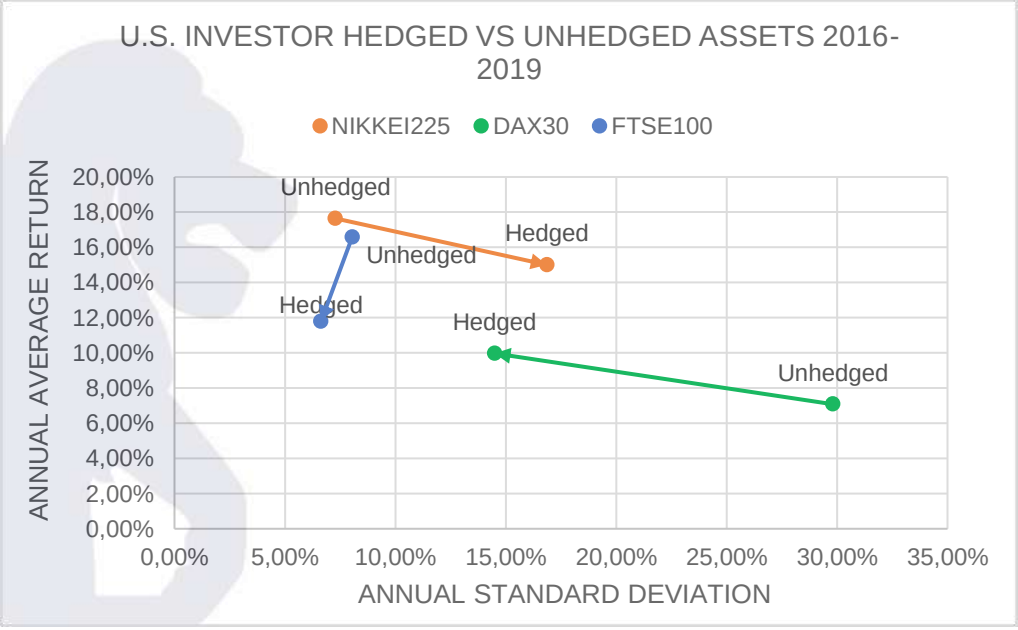

Figure 3. From the perspective of the US Investor, hedged vs unhedged investment in the three equity markets.

Hedged vs Unhedged 2016-2019

	DAX30	NIKKEI225	FTSE100
Correlation with ER	**0.17**	**-0.57**	**0.24**
Correlation threshold	**-0.82**	**-0.25**	**-0.39**
Volatility Index	**0.61**	**2.10**	**1.28**

DAX30

In the last four years of our analysis, hedging had a positive impact on return and in reducing risk.

Hedging reduced losses on currencies because the US dollar to euro exchange rate decreased. The positive forward premium helped the hedged portfolio performance. In the beginning of 2016, a correction of the US stock market had a negative influence on the USD, which then restored after the UK Brexit, that was considered a weakening of the European economy. In 2017 Europe experienced its best economic year in the last decade, making the Euro more desirable and therefore weakening the US dollar. 2018 was characterized by Trump's trade war that had a negative impact on the Eurozone. In 2019 the dollar continued his positive trend, but the overall 4 years USD performance has been negative.

FTSE100

During this period, we observe a high volatility index (1.27) and a positive correlation (0.23). Consequently, as this period has common characteristics with the sub-period 2013-2015, hedging reduces risk by 1.42% in absolute terms, but also reduces returns by 4.82% in absolute terms.

Following the plunge of the FTSE in 2015, the index started rebounding after the Bank of England (BoE) slashed the interest rates from 0.5% to 0.25% and initiated a new wave of quantitative easing in 2016, contributing to a 14.96% increase in the exchange rate and, thus, a hike in the FTSE. In 2017, the uncertainty of Brexit and the mercurial nature of the Sino-US trade war were balanced by gradually rising oil prices as the OPEC agreed to curtail supply, with the exchange rate falling by 8.96%. Starting from 2017 and continuing in 2018, BoE interest rates were increased from 0.5 to 0.75% alongside with discount rates by the Federal Reserve, fuelling the increase in the exchange rate by 6.89% in 2018. The exchange rate decreased in 2019 by -1.74%, following an appreciation of the pound after the Conservative party won a landslide majority election in the UK, invigorating hopes of passing a Brexit deal more easily through parliament.

NIKKEI225

In this last sub-period, we can do the same consideration done for the first sub-period. There is a volatility index very high 2.1 and a negative correlation, equal to -0.57. Hence, the hedge is ineffective in reducing volatility.

The hedged portfolio has a lower return (7.29%) and a higher annual standard deviation (17.64%) compared to the unhedged return (16.86%) and relative annual standard deviation (15%). So, also in this sub-period, hedging is very ineffective because the unhedged portfolio strictly dominates the hedged portfolio.

Even if this event does not affect the effectiveness of the hedging strategy is important to underline that in 2016 the BOJ started a new monetary policy and the two key policy shifts:

- the introduction of a target level for the 10-year JGB yield of around 0%
- a commitment to continue expanding its balance sheet until inflation exceeds 2% and "stays above the target in a stable manner"

This new framework brings a stimulus to the financial condition of Japan. On November 28th, the 10-year JGB yield has been capped close to zero (as the Bank of Japan promised), while the yen is 7% stronger versus the US dollar than it was on average in 2015, while the stock market is down by 5% [3] .

III – Conclusion

In conclusion we see that the results of hedging equities are mitigated by the relative volatilities and correlations, we can say that over a long-time horizon hedging is ineffective for equities. The CIP does not guarantee a premium reflective of the future exchange rate changes (we “overpay” most of the times) and having a global diversified equity portfolio with local currencies proves to be a better (cheaper) hedge.

What we do see is that for some currency pairs hedging is very effective and we are able to forecast with a good certainty it, even if it happens only a few times, looking at our indicators.

We want to conclude by saying that the high uncertainty and explosion of credit spreads for Libor rates / bid-ask are to blame for the unreliability of the CIP. But further studies are needed to understand what the other main drivers of it are, clearly, we do not experience clear arbitrage opportunities on the markets, but still we do not have a clear convergence to this parity.

IV – Appendix

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