October 2019

When you make a prediction about the future you are often wrong. Or, you can use math, and then you can be wrong in a sophisticated way.

Assessing the viability of inflation differentials as an input for forecasting exchange rate movements.

PRECIUM
INVESTMENTS

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Abstract

If you are a student going on a contiki tour through southeast Asia or a multinational conglomerate looking to hedge its exports of diamonds to the United States, we are all affected to various degrees, by the movements of exchange rates. The risk that we all face is what motivated us to look into what the factors are that affect exchange rate movements, and to potentially find a viable way to forecast these movements.

Introduction

An oft used method for "forecasting" exchange rate movements is by examining the exchange rate differential between the two currencies in the currency pair under consideration. Using the USD/ZAR exchange rate as an example, it would work as follows: historical US inflation has averaged ~2.1% p.a over the past 20 years and South African has averaged ~5.4% p.a over the same period. Thus, the inflation differential between the two countries is ~3.3%. This means that the currency of the country with the higher inflation rate (South Africa), should depreciate in value, over time, when compared to the currency of the country with the lower inflation rate (the USA), at a rate of ~3.3% p.a.

This thinking stems from the concept of purchasing power parity ("PPP"). The purchasing power of a currency refers to the quantity of the currency needed to purchase a given unit of a good, or common basket of goods and services. This means that if a currency's purchasing power deteriorates, due to price increases of goods and services, the demand for that currency will decrease and thus the currency will lose value. As inflation is omnipresent and all currencies will lose purchasing power over time, the relative purchasing power of a currency is determined by comparing the rate of purchasing power deterioration to that of another currency. The currency that has the faster rate of deterioration in purchasing power will depreciate over time at a rate equal to the difference in purchasing power deterioration of the two currencies.

That being said, one can look at the "price" of a currency, the exchange rate, in the same way as you would for any other good or service being purchased. It all boils down to supply and demand. The basic economic theory behind supply and demand is explained with the help of figure 1 below:

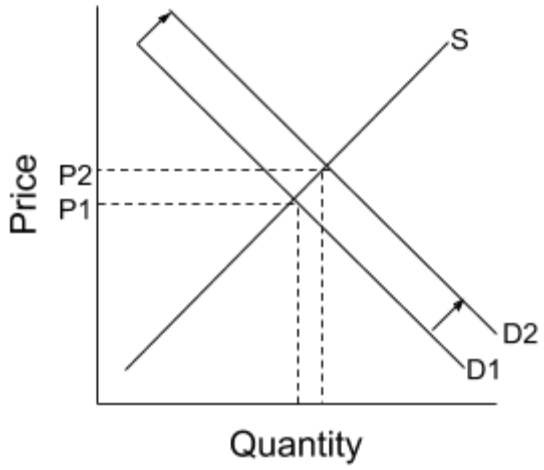


Figure 1: Supply and Demand curve

Basic economic theory of supply and demand states that as the demand for a good or service increases (e.g. the illustrated move from D1 to D2), with the

supply of that good or service remaining unchanged, the price for that good or service will increase (price P1 to price P2). The opposite is true for a decrease in demand, as this would lead to a decrease in price. Similarly an increase(decrease) in the supply of a good or service would lead to a decrease(increase) in the price of that good or service.

This study's aim is to build a model to effectively determine future exchange rate movements of various currency pairs based on factors affecting their supply and demand.

Hypothesis

Due to the prevalence of inflation differentials being used as a proxy for exchange rate movements, our hypothesis is that it is a usably accurate method that can be used in making exchange rate movement forecasts.

Other Factors That Affect Currencies

Inflation Rates

As explained before, a country with a consistently lower inflation rate exhibits an appreciation in its currency value in comparison to a country with a higher inflation rate. Inflation is measured using a consumer pricing index, which calculates the average price increases of a particular group of goods and services over time.

Interest/Coupon Rates

Interest/coupon rates represent a return an investor would get by investing their money in a specific country/currency. The higher the interest/coupon rate, the higher the potential return an investor could achieve. This leads to an increase in demand for that currency which ultimately leads to appreciation in the value of that currency. The impact of higher interest/coupon rates is mitigated however, if inflation in that country is significantly higher than in others. The opposite is true for lower interest/coupon rates, as it tends to depreciate the value of the currency. We measure Interest rates using government bond yields.

Country Economic Performance

As with individual businesses, countries that exhibit strong economic performance will attract more capital, thus, increasing the demand for that currency. Economic performance is measured using gross domestic product (GDP), which is calculated as the total value of all finished goods and services produced within a country's borders in a specific time period. Some examples of how countries calculate GDP are:

- South Africa, China and the UK use the production/output method, to calculate GDP. Here the final selling prices of goods and services are used to determine the total output. This method removes the complication of double counting that may arise due to the multiple stages of production.
- The US makes use of the expenditure approach, which on the whole achieves the same outcome as the production/output methods. Here the final amount of money actually spent by consumers is used to determine the total output.

- A third method for calculating GDP is the income approach. Total output is calculated by summing employee compensation, net interest received, rental income and royalties paid for the use of intellectual property and extractable resources. Very few countries use this approach.

All three of these methods should theoretically come to the same answer. However, they are far from perfect as they rely heavily on sample survey data.

Stock Market Performance

Just as higher interest rates and economic growth have the potential to increase the demand for a country's currency, superior returns achieved by local stocks grant investors another source of return for their capital. Thus, a higher(lower) return achieved by local stocks lead to an increase(decrease) in demand for that country's currency and ultimately increases(decreases) the value of the currency. Stock market performance is measured by calculating annual growth rates of the largest stock markets (using a large, commonly used, index for those stock markets) in a specific country, the closing prices of each calendar year is used for this calculation.

Government Debt

It is standard practise for countries to borrow large amounts of money in order to pay for large scale public projects or other governmental needs. If however, this debt amount grows unchecked and becomes too large, it can begin to cause concern as the probability of defaulting on this debt increases. Sovereign ratings agencies, such as Moodys, S&P and Fitch, rate countries on an investment grade scale based on the probability of them defaulting on their public debts. If a country loses its investment grade rating on their government bonds, the demand for that country's currency will decline, due to the fact that many hedge funds, bond indices, and other investors have investment policies limiting the amount of exposure that they are allowed to own of sub-investment grade bonds.

Current Account Deficits

The current account ("CA") is the balance of trade between a country and its trading partners, reflecting all payments between countries for goods, services, interest, and dividends. A deficit in the current account shows the country is spending more on foreign trade than it is earning, and that it is borrowing capital from foreign sources to make up the deficit. In other words, the country requires more foreign currency than it receives through sales of exports, and it supplies more of its own currency than foreigners demand for its products. This increase in supply of currency leads to a decrease in the value of that currency. We use central bank data, sourced from the central banks of the specific countries, to measure CA balances.

Unemployment

A higher(lower) unemployment rate leads to less(more) disposable income being available for spending by consumers. This leads to a decrease(increase) in inflation as demand for goods and services decreases(increases). This in turn increases(decreases) the purchasing power of the currency in question and leads to an increase(decrease) in the

demand for that currency and thus the value of the currency. Unemployment data is sourced from the World Bank.

Political Stability

A country's political state can affect its currency's value. A country with less risk for political turmoil is more attractive to foreign investors, as a result, drawing investment away from countries with more political and economic instability. Increases in foreign capital, in turn, leads to an appreciation in the value of its domestic currency. A country with sound financial and trade policy does not give any room for uncertainty in the value of its currency. But, a country prone to political confusions may see a depreciation in the value of its currency.

For political stability we used the World Bank's worldwide governance indicators, more specifically the Political Stability and Absence of Violence/terrorism Estimate. It measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. This indicator combines the views of a large number of enterprise, citizen and 'expert' survey respondents in industrial and developing countries. It is based on over 30 individual data sources produced by a variety of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms.

Many of the eight factors above are interdependent and may thus be correlated to one another. Some of these relationships are explained below.

Inflation and Interest Rates

A multitude of central banks around the world have price stability (a state where the increase in prices of goods and services do not vary wildly over time) as their main objective. This means keeping inflation in check. The main mechanism used by central banks to achieve this goal is the manipulation of interest rates. If interest rates are decreased(increased), more(less) individuals can afford to borrow money. This increases(decreases) the demand for goods and services thus increasing(decreasing) inflation.

Economic Performance and Stock Market Performance

Depending on the degree to which the stocks listed on the local stock exchange do business within the country on who's stock exchange they are listed, the economic performance of that country can have a direct impact on the performance of the underlying business of the listed entity.

Government Debt and Current Account Deficits

The relationship here is quite natural. If the current account deficit widens the amount of debt owed by the government will increase. The opposite is also true, if the current account deficit decreases the total amount of borrowings undergone by government will decrease.

Unemployment and Inflation

As explained under the unemployment segment above, unemployment levels and inflation are directly linked. In turn, interest rates are linked to inflation. Thus, the interconnected nature of these various factors can be seen and are kept

in mind while performing any regression analysis.

Methodology

An econometric method of multiple linear regression was used in order to use the input variables to try and explain as much of the volatility of exchange rates as possible. The specific input variables for the currency pairs examined were:

- The inflation differential between the two countries were examined.
- The yield of a 10 year government bond of the two countries.
- The annual GDP (gross domestic product) growth of the two countries.
- The annual growth in public(government) debt levels of the two countries.
- The annual growth in the current account balance of the two countries.
- The annual performance of the major stock market index in the two countries.
- The change in the unemployment rate of the two countries.
- The level of political stability of each country. Based on the World Bank's Political Stability and Absence of Violence/Terrorism index. The scale ranges from -2.5 (high degree of instability) to 2.5 (high degree of stability).

We assessed a group of emerging and developed market currencies. These were the: ZAR(South African Rand), USD(United States Dollar), GBP(British Pound), CNY(Chinese Yuan), INR(Indian Rupee) and JPY(Japanese Yen).

Thus, in a hypothetical scenario where a currency pair (A/B)'s volatility(% movement) is explained by all of the input variables mentioned, the regression equation would look as follows:

$$\%\Delta A/B = \beta_0 + \beta_1 * e.diff + \beta_2 * 10yYieldA$$

$$+ \beta_3 * 10yYieldB + \beta_4 * \%gGDPA$$

$$+ \beta_5 * \%gGDPB + \beta_6 * \%gDebtA$$

$$+ \beta_7 * \%gDebtB + \beta_8 * \%gCAA + \beta_9 * \%gCAB$$

$$+ \beta_{10} * \%gASX + \beta_{11} * \%gBSX + \beta_{12} * \Delta uA$$

$$+ \beta_{13} * \Delta uB + \beta_{14} * \Delta PSA + \beta_{15} * \Delta PSB$$

Where:

- *%ΔA/B* = the % annual change in the exchange rate of currency pair A/B, where A is the base currency and B is the counter-currency.
- β_0 = the y-intercept of the regression equation
- β_n = the coefficient of the specific variable
- *e.diff* = the inflation differential between country A and country B
- 10*yYieldA(B)* = the yield on a 10 year government bond in country A(B)
- *%gGDPA(B)* = the percentage annual growth rate of the GDP of country A(B)
- *%gDebtA(B)* = the percentage annual growth rate of the government debt levels of country A(B)
- *%gCAA(B)* = the percentage annual growth rate of the current account balance of country A(B)

- *%gA(B)SX* = the percentage annual growth rate of the stock exchange of country A(B)
- *ΔuA(B)* = the annual change in the unemployment rate of country A(B)
- *ΔPSA(B)* = the annual change in the political stability and absence of violence/terrorism index for country A(B)

The regression analysis was done with a 95% confidence level, which means that if it was found that any of the input variables had a statistical significance of less than 5% it was excluded from the regression equation. This leads to the fact that not all of the input variables were statistically significant in explaining the movements in the exchange rate.

Results

Results as to which input variables affect the exchange rate movements for differing currency pairs in this study vary substantially.

Below are the results found and some explanations thereof.

1. ZAR/INR:

The ZAR/INR multiple regression analysis gave the following regression equation:

$$\%\Delta ZAR/INR = -0.21 + 3.01 * ediff$$

$$+ 1.14 * \%gDebtSA + 0.23 * \%gNSE$$

Explainer:

- The largest individual factor affecting the ZAR/INR exchange rate is the inflation differential between India and South Africa. A 1% change in the difference in inflation will lead to a 3.01% move in the exchange rate, in the same direction, holding all other variables constant.
- A 1% movement in the government debt levels of South Africa will lead to a 1.14% move in the exchange rate, in the same direction, holding all other variables constant.
- A 1% movement in the value of the indian stock exchange(NSE) will lead to a 0.23% move in the exchange rate, in the same direction, holding all other variables constant.

The adjusted R-square of the regression analysis was 0.39, which means that a mere 39% of the variation in the exchange rate is explained by the combination of the variables above (thus, each individual variable would contribute even less than total 39%).

2. ZAR/CNY:

The ZAR/CNY multiple regression analysis gave the following regression equation:

$$\%\Delta ZAR/CNY = -2.05 * ediff$$

Explainer:

- The only factor, it seems, that seems to have any noticeable effect (however small) on the ZAR/CNY exchange rate is the inflation differential between South Africa and China. A 1% change in the difference in inflation will lead to a 2.05% move in the exchange rate, in the *opposite* direction (due

to the ZAR being the base currency), holding all other variables constant.

The R-square of the regression analysis was 0.41, which means that only 41% of the variation in the exchange rate is explained by the variable above.

3. GBP/CNY:

The GBP/CNY multiple regression analysis gave the following regression equation:

$$\%\Delta GBP/CNY = -0.14 + 4.44 * \%gGDPUK$$

$$- 0.12 * \Delta PSUK + 0.33 * \%gDebtUK$$

Explainer:

- In this currency pair, the largest individual factor affecting the GBP/CNY exchange rate is the GDP growth experienced by the United Kingdom (and not the inflation rate differential). A 1% move in the GDP growth rate experienced by the United Kingdom will lead to a 4.44% movement in the exchange rate, in the same direction, holding all other variables constant.
- Every 1.0 move on the political stability index for the United Kingdom will lead to a 0.12% move in the exchange rate, in the opposite direction, holding all other variables constant.
- Every 1% movement in the government debt levels of the United Kingdom will lead to a 0.33% movement in the exchange rate, in the same direction, holding all other variables constant.

The adjusted R-square of the regression analysis was 0.58, which means that 58% of the variation in the exchange rate is explained through the combination of the variables above.

4. GBP/ZAR:

The GBP/ZAR regression analysis gave the following regression equation:

$$\%\Delta GBP/ZAR = -0.12 - 6.12 * \Delta uUK$$

$$+ 2.59 * e.diff + 0.46 * \%gJSE - 0.44\%gFTSE$$

$$+ 0.12 * \%gCAUK$$

Explainer:

- The largest factor affecting the GBP/ZAR exchange rate is the change in the unemployment rate experienced by the UK. Every 1% movement in the unemployment rate of the United Kingdom will lead to a 6.12% move in the exchange rate, in the opposite direction, holding all other variables constant.
- Every 1% change in the difference in inflation between South Africa and the United Kingdom will lead to a 2.59% move in the exchange rate, in the same direction, holding all other variables constant.
- Every 1% movement in the growth experienced by the South African stock exchange(JSE) will lead to a 0.46% movement in the exchange rate in the same direction, holding all other variables constant.
- Every 1% movement in the growth experienced by the United Kingdom's stock exchange(FTSE)

will lead to a 0.44% move in the exchange rate, in the opposite direction, holding all other variables constant.
- Every 1% movement in the value of the current account of the United Kingdom will lead to a 0.12% movement in the exchange rate, in the same direction, holding all other variables constant.

The adjusted R-square of the regression analysis was 0.75, which means that 75% of the variation in the exchange rate can be explained by the variables above.

5. USD/CNY:

The USD/CNY regression analysis gave the following regression equation:

$$\%\Delta USD/CNY = 0.05 + 1.26 * \Delta uUS$$

$$- 0.79 * \%gDebtUS$$

Explainer:

- The largest factor affecting the USD/CNY exchange rate is the US unemployment rate. A 1% movement in the unemployment rate of the United States will lead to a 1.26% move in the exchange rate, in the same direction, holding all other variables constant.
- Every 1% movement in the government debt levels of the United States will lead to a 0.79% move in the exchange rate in the opposite direction, holding all other variables constant.

The adjusted R-square of the regression analysis was 0.47, which means that 47% of the variation in the exchange rate can be explained by the variables above.

6. USD/INR:

The USD/INR regression analysis gave the following regression equation:

$$\%\Delta USD/INR = 0.05 + 1.33 * e.diff$$

$$- 1.01 * \%gDebtUS - 0.1 * PSIndia$$

$$- 0.09 * \%gNSE$$

Explainer:

- The largest factor affecting the USD/INR exchange rate is the inflation differential between the United States and India. A 1% change in the difference in inflation will lead to a 1.33% movement in the exchange rate, in the same direction, holding all other variables constant.
- Every 1% movement in the government debt levels of the United States will lead to a 1.01% move in the exchange rate, in the opposite direction. Ceteris paribus.
- Every 1.0 movement in the political stability index of India will lead to a 0.1% move in the exchange rate, in the opposite direction, holding all other variables constant.
- Every 1% movement in the growth experienced by the Indian stock exchange(NSE) will lead to a 0.09% move in the exchange rate, in the opposite direction, holding all other variables constant.

The adjusted R-square of the regression analysis was 0.61, which means that 61%

of the movement in the exchange rate can be explained by the variables above.

7. USD/ZAR:

The USD/ZAR regression analysis gave the following regression equation:

$$\%\Delta USD/ZAR = -0.12 + 3.72 * e.diff$$

$$+ 0.44 * \%gJSE - 0.18 * \%gNASDAQ$$

Explainer:

- The largest factor affecting the USD/ZAR exchange rate is the inflation differential between the United States and South Africa. A 1% change in the difference in inflation will lead to a 3.72% move in the exchange rate, in the same direction, holding all other variables constant.
- Every 1% movement in the growth experienced by the South African stock exchange(JSE) will lead to a 0.44% move in the exchange rate, in the same direction, holding all other variables constant.
- Every 1% movement in the growth experienced by the United States' stock market(NASDAQ) will lead to a 0.18% move in the exchange rate, in the opposite direction, holding all other variables constant.

The adjusted R-square of the regression analysis was 0.64, which means that 64% of the movement in the exchange rate can be explained by the variables above.

8. ZAR/JPY:

The ZAR/JPY regression analysis gave the following regression equation:

$$\%\Delta ZAR/JPY = 0.13 - 3.21 * e.diff$$

Explainer:

- The only factor affecting the ZAR/JPY exchange rate is the inflation differential between South Africa and Japan. Every 1% change in the difference in inflation will lead to a 3.21% move in the exchange rate, in the opposite direction, holding all other variables constant.

The R-square of the regression analysis was 0.64, which means that 64% of the movement in the exchange rate can be explained by the variables above.

9. GBP/JPY:

The GBP/JPY regression analysis gave the following regression equation:

$$\%\Delta GBP/JPY = -0.09 + 3.93 * \%gGDPUK$$

$$- 0.54 * \%gFTSE + 0.45 * \%gNikkei$$

Explainer:

- The largest factor affecting the GBP/JPY exchange rate is the % growth in GDP experienced by the United Kingdom. Every 1% movement in the GDP growth rate will lead to a 3.93% move in the exchange rate, in the same direction, holding all other variables constant.
- Every 1% movement in the performance of the British(FTSE) stock exchange will lead to a 0.54% move in the exchange rate, in the opposite direction, holding all other variables constant.

- Every 1% movement in the performance of the Japanese(Nikkei) stock exchange will lead to a 0.45% move in the exchange rate, in the same direction, holding all other variables constant.

The adjusted R-square of the regression analysis was 0.59, which means that 59% of the movement in the exchange rate can be explained by the variables above.

The following currency pairs' regression analysis had a R-square (adjusted R-square) of less than 0.3. Meaning that less than 30% of the movement in the exchange rate could be explained by the input variables:

- GBP/INR: Only 29% of the variation in the exchange rate was explained by the regression analysis. The only factor that was statistically significant was the % growth of the current account levels of the UK. Every 1% movement in the current account level of the United Kingdom will lead to a 0.1% move in the exchange rate, in the same direction, holding all other variables constant.
- USD/GBP: Only 16% of the variation in the exchange rate was explained by the regression analysis. The only factor that was statistically significant was the % change in the current account balance of the United States. Every 1% movement in the current account balance will lead to a 0.15% movement in the exchange rate, in the opposite direction, holding all other variables constant.
- JPY/INR: Only 21% of the variation in the exchange rate was explained by the regression analysis. The only factor that was statistically significant was the % GDP growth experienced by Japan. Every 1% movement in the GDP growth of Japan will lead to a 2.55% move in the exchange rate, in the opposite direction, holding all other variables constant.
- CNY/JPY: None of the combinations of input factors gave a statistically significant regression model for the relationship between the CNY and JPY.
- USD/JPY: None of the combinations of input factors gave a statistically significant regression model for the relationship between the USD and JPY.

The highest adjusted R-square observed in the regression analyses above was 0.75. This does not bode well for the predictability of these currency pairs using the potential input variables chosen. Ultimately, this means that the causes of changes in these exchange rates is much more complex and relies on many more factors.

The following input factors were not included in any of the statistically significant regression equations obtained in this study:

- 10 Year government bond yields of either of the countries of a currency pair.
- The GDP growth rates of emerging market countries.

- The current account balance growth rates of emerging market countries.
- The unemployment rates of emerging market countries.

It is somewhat indicative therefore that when determining the exchange rates between a developed nation and an emerging market, that the developed nation's data is of greater importance than that of an emerging market.

The following input factors were most prevalent in the regression equations obtained in this study:

- Stock market performance of either country was observed in 8 of the regression equations.
- The inflation differential between the two countries was observed in 6 of the regression equations.
- Growth in government debt levels was observed in 4 of the regression equations.
- Current account levels of developed nations were observed in 3 of the regression equations.
- GDP growth rates of developed nations were observed in 3 of the regression equations.
- Unemployment rates of developed nations were observed in 2 of the regression equations.
- Political stability was observed in 2 of the regression equations.

Even though stock market performance was the most prevalent among the input variables looked at, on average, a 1% movement in the stock market would only lead to a 0.35% move in the relevant exchange rate. The change in inflation differentials however had a much larger effect. On average, for every 1% movement in the inflation differential between two countries, the exchange rate would move by 2.65%. The magnitude of this effect might be the reason that inflation rates get referenced so often.

Inflation Differential Analyses

So can inflation differentials be used to forecast exchange rate movements? All four of the regression models (GBP/ZAR, USD/ZAR, ZAR/JPY and USD/INR) that explained more than 60% of the variation in the exchange rate movements had the change of the inflation differential as a statistically significant input. When looking specifically at the ZAR, it does seem that it is an important individual variable, as all of the currency pairs tested, involving the ZAR had the movement in the inflation differential between the two currencies as a statistically significant input. This however is only indicative in showing that exchange rate movements are sensitive to changes in the inflation differentials and not the differentials themselves. Thus, this does not mean that anyone can accurately state that a currency with a higher inflation rate will deteriorate in value when compared to one with a lower inflation rate, or vice versa, no would you be able to reasonably predict the rate of change in the value of the currency.

In order to additionally test if the hypothesis has any merit to it, a simple test can be done. By looking at longer term historical currency pair movements and comparing that to the long-term inflation differentials between the

applicable countries, one should be able to deduce if they are related.

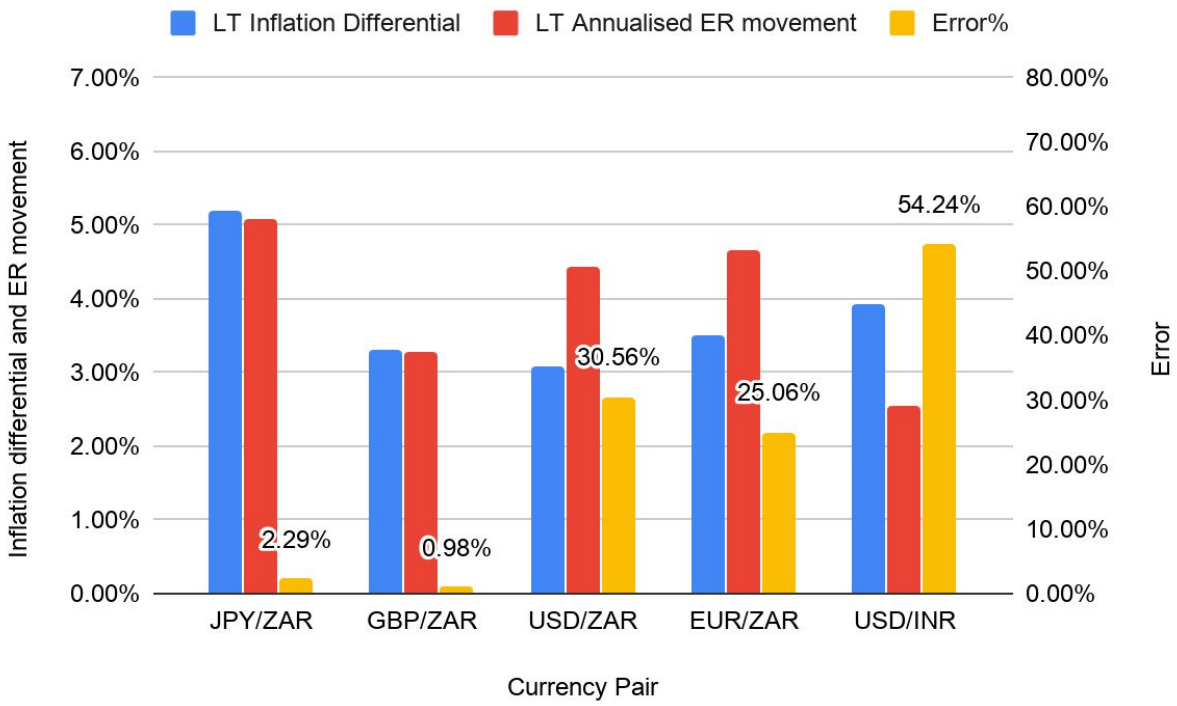
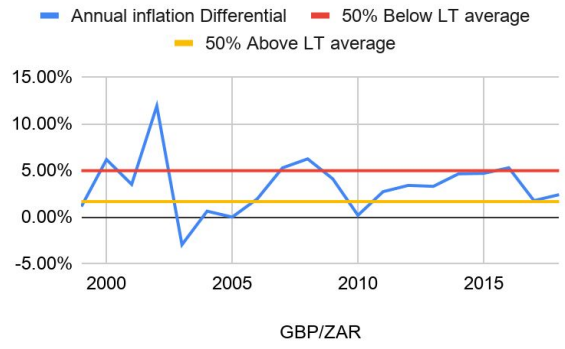


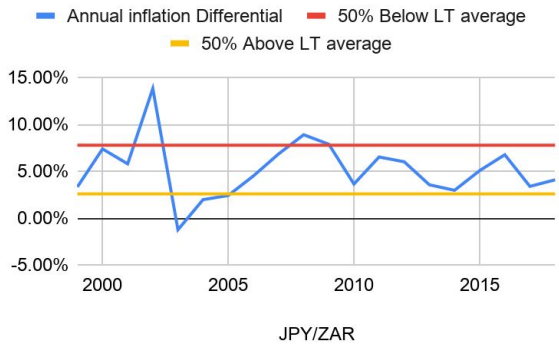
Figure 2: Inflation Differentials vs Actual Exchange rate movements

Figure 2 above shows the 20-year average inflation differential between the two countries for each currency pair, as well as the actual 20-year annualised exchange rate movement. The EUR/ZAR currency pair was added here in order to have more data points to work with. The yellow bars represent the magnitude of the error one would have made by forecasting the exchange rates using inflation differentials. Whilst the margin of error for the JPY/ZAR and GBP/ZAR pairs is low, in the case of the USD/ZAR and EUR/ZAR, error rates are high with USD/INR error rate being very high. One possible explanation for this could be the consistency/stability of the inflation differential, after all, we have seen what a large impact a change in the differential can have on exchange rate movements.

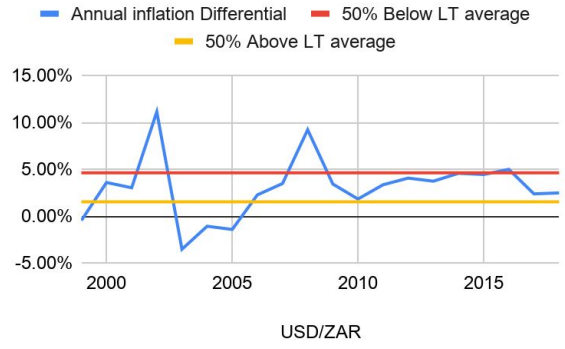
In order to measure the consistency/stability of the inflation differential, we observed how many annual inflation differentials of each currency pair was within 50% of the 20 year average inflation differential for each currency pair. The results of this can be seen in figures 3 - 7 below



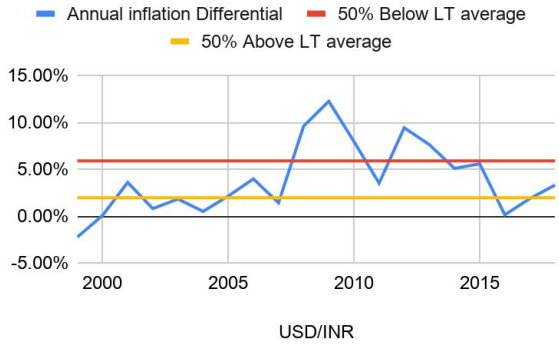
GBP/ZAR



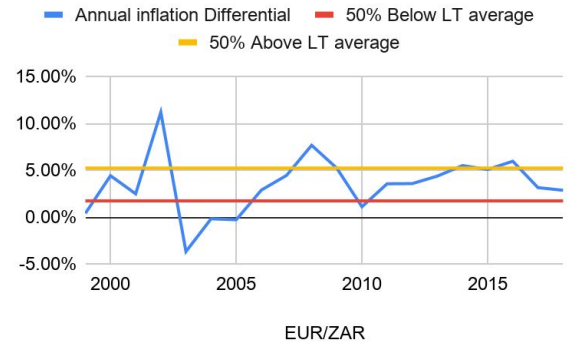
JPY/ZAR



USD/ZAR



USD/INR



EUR/ZAR

Figures 3 - 7: Annual inflation differentials deviation from average long term inflation differentials

As can be seen from the figures above, only the inflation differential between India and the United States (USD/INR) has moved significantly outside of the 50% ranges chosen. So it seems that consistent inflation differentials are a key element to consider when using the inflation differential as a proxy for future exchange rate movements. Inflation differentials remain consistent/stable in 2 main ways:

1. The inflation levels of the two countries move in a very similar way

2. The inflation levels of each individual country are fairly consistent.

For the countries represented in the currency pairs above, we believe that the 2nd option should be the one to focus on as expecting the inflation levels of two different countries to move in the same way is unrealistic due to the fact that countries have very different drivers of inflation.

So how can a country keep its inflation in check, or at least stabilise its price levels? This is usually the job of the central bank of the specific country as price stability is often included in their mandates. Below are the mandates of the central banks of the United States, the United Kingdom, South Africa, Japan, India and the European Union..

- US Federal Reserve: Long-term price stability and sustainable growth. They do not have an explicit inflation target, but regularly announce a desired target range for inflation between 1.7% and 2%.
- Bank of England: To maintain monetary and financial stability. They have an inflation target of 2%.
- South African Reserve Bank: To achieve and maintain price stability in the interest of balanced and sustainable economic growth in South Africa. Inflation target range is from 3% to 6%.
- Bank of Japan: The central bank of Japan decides and implements monetary policy with the aim of maintaining price stability. They have an inflation target of 2%.
- The Reserve Bank of India: Securing monetary stability, maintaining price stability while keeping the objective of growth in mind. They have an inflation target of 4%.
- The European Central Bank: To maintain price stability. They have an inflation target of 2%.

So it can be seen that all these central banks have price stability as an objective and use monetary policy to manipulate interest rates and ultimately the rate of inflation experienced by their country/region. But how effective have they been in reaching their inflation targets?

When calculating how far off the actual inflation observed in a country was from the inflation target of that country's central bank the following was found:

- On average, the US Federal Reserve was off by 37%.
- On average, the Bank of England was off by 34%.
- On average, the South African Reserve Bank was off by 25%.
- On average, the Bank of Japan was off by 99%.
- On average, the Reserve Bank of India was off by 70%.
- On average, the European Central Bank was off by 32%.

Thus, the central banks of the US, the UK, South Africa and the Eurozone were the most capable at achieving their inflation targets and maintaining the inflation differentials between any combination of these 4 geographies. It must be stressed

however that a 25% error is still very large and allows for a lot of unpredictability.

Conclusion

So is it possible to accurately forecast how an exchange rate will move using the inflation differential between two countries? In some cases, such as the JPY/ZAR and GBP/ZAR, when the long-term inflation differential is used to forecast the movement in the exchange rate you would have been fairly accurate. In cases such as the USD/ZAR and EUR/ZAR, you would see a significantly lower degree of accuracy and the actual move in the exchange rate was actually ~1.4 times greater than the inflation differential.

Furthermore, this method only worked for a select few currency pairs and is thus is a long shot from being a universal tool for forecasting future exchange rate movements. For these reasons we reject our hypothesis that inflation differentials can be used as an accurate method for making exchange rate movement forecasts.

Why is it then that it is referenced so much by the finance community? We theorize that it boils down to predictability. Movements in exchange rates are extremely volatile and notoriously difficult to correctly predict. This is due to the large amount of quantitative and qualitative information that drives these movements. Naturally then, when looking for something to explain exchange rate movements one would focus on something that is a lot more predictable. This is where inflation differentials come in.

If it is found that a highly influential entity, such as a reserve bank of a country, targets inflation and has a proven track record of successfully achieving its targets, you end up with a somewhat predictable indicator. This then gives you a predictable tool that can be used to forecast the very unpredictable exchange rate movement. As this study has shown however, using this methodology is very flawed and by no means a viable method to make forecasts regarding exchange rate movements.

Using this method requires the user to assume that the relationship between an exchange rate movement and an inflation differential to continue, and that central banks will be able to continue to achieve their inflation targets. These are material assumptions that cause the reliance on layers of potential errors. Any individual/institution that makes use of this method is using a highly inaccurate forecasting tool, and it is for this reason that we do not condone its use.