

# Research on the Implementation of Purchasing Power Parity Strategy in Chinese Market

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**Abstract.** Purchasing Power Parity, a calculation or a strategy that could be used in measuring and comparing the different exchange rates between two countries, and in order to go more indepth on deciding whether to trade to make profits in each time period. Our research is based on the last twenty years' changes in exchange rates, inflation rates, and interest rates, to compare G10 countries' different purchasing power to the Chinese market to obtain the forecasting on this strategy whether it makes a positive return or not with further future details and recommendations within this strategy. First, we collect all the data needed for this research by going through different authoritative websites to download the data records that are sufficiently provided. Then, we apply the specific formulas that were used to measure the exact purchasing power parity values among countries to have an overview of cumulative Profits and Loss graphs; to interpret the ups and downs over twenty years in different samples from the past. The actual research is developed into two samples, in the sample and out of the sample, to ensure the correct direction we are focusing on. Overall, we conclude a few main points to be careful within PPP, a brief comparison between advantages and disadvantages, and other considerations throughout the whole trading process.

**Keywords:** Purchasing Power Parity, Exchange Rates, Inflation Rates, Currency, Basket of Goods.

## 1. Introduction

Purchasing power parity (PPP) is a theory that determines exchange rates and a way of comparing the average cost of goods and services between countries. The theory assumes that the behavior of importers and exporters causes changes in spot rates. PPP calculations tell you how much it would cost if all

countries used the same currency. In other words, it is the exchange rate at which one currency needs to be exchanged to obtain the same purchasing power as another currency[1]. We can find out which countries are "cheaper" and which, on the other hand, are "more expensive". PPP theory says that price differences between countries should be reduced over time by changes in exchange rates or different rates of inflation[2].

## 2. The Construction of the portfolio

### 2.1. Economic Intuition

PPP strategy requires concentrating on the FX market in the long run, currencies tend to move towards their "fair value". Consequently, systematically buying "undervalued" currencies and selling "overvalued" currencies leads to a profitable trading strategy in the medium term. According to the law of one price, the same item should have the same value despite the fact that they are in different areas [1]. Normally, between two countries, the price of that item won't be adjusted too frequently, while the exchange rate as a transactional financial product, the price will fluctuate between time, therefore when the exchange rate is changing rapidly, by trading with PPP, before the exchange rate goes back to normal, profit could be made [1] [3] [2].

### 2.2. Data Setting

We chose G10 as the universe and the sector is trading bloc, that is to say, our planned handling is G10 FX, including United States Dollar (USD), Euro (EUR), Japanese Yen (JPY), Canadian Dollar (CAD), Swiss Franc (CHF), British Pound (GBP), Australian Dollar (AUD), New Zealand Dollar (NZD), Norwegian Krone (NOK) and Swedish Krona (SEK). It is worth mentioning that there are some shorting restrictions in the Chinese market. For example, banks are allowed to short foreign exchange and take negative FX positions. For individuals, however, investors must hold a full amount of foreign currency to be sold before trading, compared with the popular margin trading in the international short selling mechanism and financing leverage mechanism.

In this paper, we used a lot of data. To be specific, the G10 countries' daily data of exchange rates are taken from the OFX website [4] and monthly data from Investing.com [5]. The monthly inflation rates and interest rates of each G10 country and China were collected from the website of OECD [6] [7], details would be shown in the reference. The annual PPP exchange rates are also downloaded from OECD [8], which is directly related to the signal of the whole strategy, and was collected from the date 2002 to 2021. In addition, our total time period is 2002.02-2022.01.

### 2.3. Strategy

**2.3.1. Signal Generation.** We use the Annual PPP Exchange Rate that was obtained from the OECD database to generate the monthly signal according to the formula below:

Signal in Year  $t$  = Foreign PPP Exchange Rate in Year  $(t-1) \times (1 + \text{Domestic Inflation rate in Year } t - \text{Foreign Inflation rate in Year } t)$

Due to the asymmetry of time, we chose to infer the formulas of the signal depending on the absolute purchasing power parity [9], and finally get the 12 months' data for each year. By comparing each year's data to the PPP exchange rates, we concluded that the results of the comparison are very close. Therefore, it is efficient and reliable to run the signal generation above.

**2.3.2. Portfolio Construction.** To decide which one to long or short, we calculated the variable  $d$  with  $d = \text{signal} - \text{Actual Exchange Rate}$ , and then we chose to buy domestic currency and short foreign currency if  $d$  is positive, and to short domestic currency and long foreign currency if  $d$  is negative. In this case, we used equal weighting to be our sizing method because the signal is biased by some factors and events that happened around. As to the trading execution, the Forward Foreign Exchange Transaction Costs =  $\frac{1}{2}$  Bid-ask Spread = 1.0 bps and Fee Cost is 0.1 bps.

### 3. Implementation and Analysis

#### 3.1. Analysis for In-Sample Period



**Figure 1.** In-Sample Cumulative PnL.

The data within the sample of currency changes for the G-10 countries are taken from February 2002 to January 2018, with a total of 192 months of daily profits, calculated based on 5844 days. Overall, as shown in Figure 1, the cumulative PnL of monthly profit and loss, the currency of the G-10 countries fluctuates between 300,000 and 1,000,000 against the Chinese Yuan, with two relatively obvious ups and downs in the middle, and the exchange rate changes are quite stable in other time periods. There was a downward trend in 2002-2003, which may have been a continuation of the turmoil brought about by the 1997 Asian financial crisis. In addition, the emergence of the euro, the consolidation of the banking sector, and the increase in e-economy business also had an impact. The upward trend after 2004 was due to the higher volatility of the overall foreign exchange market, which supported more currency transactions by investing in currencies that continued to appreciate [10]. Exchange rate changes were then more stable until the 2008 financial crisis brought instability in currency supply and demand, showing a downward trend. However, the foreign exchange market was more resilient to the crisis than many other financial markets, and the rapid growth of foreign exchange transactions slowed; the volume of transactions was also driven by the continued development of market segments and new technologies [11].

**Table 1.** Important Statistics for Analyzing the Result.

Annualized return	-1.420055%
Annualized Volatility	10.38915%
Information ratio	-13.66864%
Normal Kurtosis	4.650667
99% VAR(Monthly)	-9.187283%

In general, the strategy performance was ordinary. Looking at it from an income perspective, the annual rate of return between the years 2002 and 2018 was negative being -1.420055%, which means that the implementation of this strategy over this period has brought negative returns.

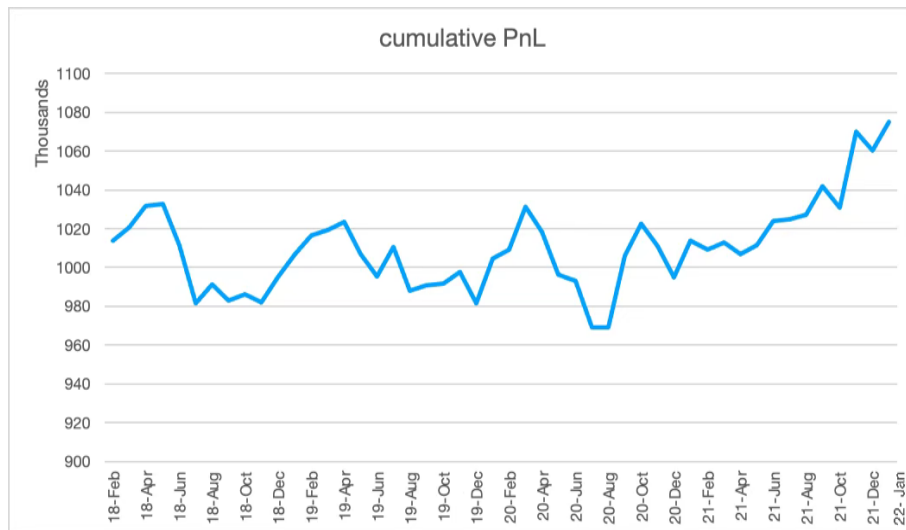
When looking at it from a risk perspective, the volatility as a measurement of the frequency and degree of change in the value of a currency in forex trading was 10.38915% being relatively high, this also led to our information ratio being negative. For the information ratio, it is generally the higher the better, in this case, our information ratio is -13.66864%, meaning that there is more benchmark return than our portfolio return[12]. The kurtosis of the income was 4.650667, meaning that the rate of return was a fat-tailed distribution[13]. This means that it has either an extreme gain or an extreme loss. The monthly VaR was -9.187283%, which means that at a 99% confidence level, a possible large loss that may occur would be -9.187283%[14].

A few reasons that may lead to a loss of money is that it has a high transaction cost, which would lower the profits made in trading. Another one would be that it is highly influenced by foreign exchange factors, for example, government policies on exchange rate controls, which can lead to the exchange rate deviating from the theory.

### 3.2. Difference In Expectations

The results of the strategy based on the data are similar to our expectations, but there are also differences. The similarity is that the overall strategy is relatively stable, there is no particularly prominent loss, and the long-term exchange rate changes are relatively stable. This strategy is related to the law of one price, based on a common currency, the price of internationally traded goods should be the same everywhere, and the goal of arbitrage profitability is achieved by shipping goods from where the price is low to where the price is high for a risk-free profit [15]. However, the difference with our expectations is that the performance of the in-sample derived from the data is not very good, getting a negative return, and the risk of implementing the strategy is a bit high, with the maximum possible loss suffered during the one-month holding period being -9.18%. This is just an in-sample test to create and optimize a strategy, an out-of-sample test is also needed to determine if the strategy works and if it will work in the future market.

### 3.3. Analysis for Out of Sample Period



**Figure 2.** OOS Cumulative PnL.

Out of Sample for the G10 countries' currency changes was taken in the last four years' data from our whole research data periods, which is from February 2018 to January 2022. There were a total of 48 months and calculated in 1461 days. Overall, looking at the cumulative PnL graph based on monthly profits and losses, the G10 countries' currency rates to the Chinese Yuan were moving between 960000 to 1080000, which presents relatively stable changes for the currency rates. The lowest point on the

cumulative PnL graph was in May 2020, which may be reflected by the outbreak of worldwide pandemics in recent years. However, as we can see that as countries obtain more control of the virus, the economic growth tends to go up, and vice versa. In the Out of Sample data, in May 2020, most countries were still discovering the resolution of the pandemics, and thus, the currency was comparatively lower than in other time periods and seemingly going up since then from the whole point of view.

**Table 2.** Important Statistics for Analyzing the Result.

Annualized return	1.880501%
Annualized Volatility	5.231816%
Information ratio	35.94356%
Normal Kurtosis	2.934312
99% VAR(Monthly)	-2.709931%

Through looking at the statistics above from OOS, the annualized return for this strategy over the most recent four years has only been about 2% of the entire investment amount, and it seems not a good percentage of profits even though there is a positive return from the investment average in each year, the annualized return was not obtaining high income profits. The annualized volatility seems very neutral at this point by moving the international prices not too high or too low, and usually while the neutral volatility wouldn't obtain too much risk in the trade. The related information ratios in this case are also neutrally good in the performance of the strategy by giving a near to 36% result that may be considered as a tendency to a good investment. By giving the result statistics of normal kurtosis of nearly 3 in the analysis, the overall trade for the exchange rates of G10 countries to CNY presents a high peak and may contain the extreme values of tails but still could be normal looking specifically at this strategy. The value at risk as seen in the above statistical table is around -2.7%, which implies that there would be a -2.7% loss that may occur in the 99% confidence level of the whole investment.

#### 4. Conclusion

According to the study, the Purchasing Power Parity strategy is closely related to the international situation and policies and requires the study and analysis of the global situation at the time of trading to better analyze the profitability of the overall strategy. In addition, this strategy assumes the premise that goods can be traded freely without the influence of transaction costs such as tariffs, quotas, and taxes. However, these factors cannot be ignored in real life and always need to be considered. In conclusion, the Purchasing Power Parity strategy is a relatively robust strategy.

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