COVID-19: WHAT HAS BEEN THE IMPACT ON THE FOREX?

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View full codebook from https://colab.research.google.com/drive/1JuVrCFj5vFuQ9obNVlh9Yb17akc42E61?usp=sharing

TABLE OF CONTENTS

INTRODUCTION

A once-in-a-century pandemic and unprecedented volatility in the forex markets

The coronavirus pandemic has led to the turmoil of the world economies. The COVID-19 pandemic continues to wreak havoc in global markets. In addition to the economic impacts of national lockdowns, travel restrictions, rampant unemployment, slack demand for consumer goods, and sharply reduced business activity, the volatility of the currency exchange rates has reached unprecedented levels. The negative impact one country suffers from the virus compared to that of another country is relative and so are the exchange rates between their sovereign currencies. Countries seeing sharp daily rises in new COVID-19 cases typically saw their currencies weaken, while countries successfully making progress containing the spread of the virus often saw their currencies strengthen. Also, currency prices are impacted by factors including inflation, international trade, political stability, among other macroeconomic factors. The interplay of the spread of the virus across the world with the dynamics of exchange rates has been fascinating to observe.

About this report:

This report adopts a retrospective view in the analysis of the currency exchange rate fluctuations during this period of the ongoing pandemic and conducts a case study focus on the Chinese Yuan. Specifically, it attempts to answer which one has been the most volatile currency and how did Yuan perform relative to USD? From the view of an investor, how to design and use a trading strategy to make a fortune out of the current situation?

There are four sections in the following report: motivation and background, dataset, analyses, and discussion.

- **Motivation and Background:** The reasons and contexts why we focus on the impacts of COVID-19 on the Forex market.

- **Dataset:** The approaches used to make API calls and the structures of the final datasets used in the analysis.
- **Analyses**
  - Subtask 1: Data processing——API calls

    Make Fixer API queries and create two data frames for the following subtasks.
  - Subtask 2: All currency suffered, which currency is most volatile and how about Yuan?

    Present the fluctuations of 7 foreign currencies against EUR with a line chart and a world colorbar map to identify the most fluctuating currency and see how volatile is Yuan compared to others.
  - Subtask 3: How has CNY/ USD been like?

    Use a line chart, pie charts and a box plot to visualize the overall, daily and monthly fluctuations of CNY/USD from 2019.12 to 2020.11.
  - Subtask 4: Capture the oscillation using Bollinger Bands

    Using CNY/USD, construct a Bollinger bands chart to capture the price variation. Add a 20-day moving average line and a pair of boundary lines of the upper and lower bands (two standard deviation above and below the MA line).
  - Subtask 5: An investor who got lucky

    Determine "buy"/ "sell" signal using a simple Bollinger Bands strategy, and calculate the aggregated profit for simulated Forex trading during the whole 12-month time period.
- **Conclusion:** Conclusions on the results of the analysis.

This report draws on the historical foreign exchange (Forex) rate data from Fixer.io. All the programming work and non-technical work are completed in pairs (Xinyuan Hu & Yutong Yang).

MOTIVATION AND BACKGROUND

It is undeniable that COVID-19 is having a profound impact on the Forex market, and will continue to do so for a long period of time. Since the 2008 financial crisis, volatility in the forex markets has been on the wane. However, COVID-19 is making the forex markets re-energize with volatility not seen in years. Just as Sun Tzu said in "The Art of War", in the midst of chaos, there is opportunity. When there is plenty of uncertainty around, we want to measure this market volatility for us to take advantage of.

We cast our eyes mainly at the situations of Chinese Yuan. This is not just because both the two authors of this report are from China. The first outbreak of the epidemic occurred in Wuhan, China, which should be where our research begins. After determining the timeline, we can visualize the CNY / USD fluctuations from different dimensions and explain the possible causes of the market volatility underlying the curves. Last but not least, we assume there is an investor backtesting our selected trading strategy and judgment about the Forex change.

This project is meaningful as it combines our undergraduate knowledge with programming. And learning from the huge and broad repercussions of the COVID-19 has become a compulsory course for everyone. We hope this report can help our readers understand how the Forex market reflected and responded to this virus during the past year.

DATASET

This report uses API to retrieve the historical foreign exchange (Forex) rate data from Fixer.io, which is an open-source service providing current and historical foreign exchange rates for 170 world currencies. Fixer API is available at: https://fixer.io/documentation. Our analysis needs the historical exchange rates between the chosen currencies from 2019-12-01 to 2020-11-30. The research idea is to use the panel and time series data of exchange rates,

analyzing the global overview of the Forex fluctuations, and then perform more analysis on CNY/USD.

ANALYSES

Subtask 1: Data processing——API calls

The data processing part requires us to query Fixer APIs and assemble two original data frames: one is for subtask 2, the other is for subtask 3-5. For both datasets, we use the time of each day as the row index. The tables below show the structures of the two data frames.

For subtask 2, we take Euro as the base currency. A panel data is needed to cover the exchange rates of seven currencies (chosen according to Bank for International Settlements, BIS1), including USD, CNY, JPY, GBP, CAD, CHF and AUD, from January, 2020 to November, 2020. Finally, we got a dataset of 7 columns and 335 rows, where each cell is the exchange rate of a given currency against Euro on that day.

Date	USD	CNY	JPY	GBP	CAD	CHF	AUD
2020-01-01	1.121830	7.811525	121.963096	0.846759	1.455630	1.085595	1.598259
…	…	…	…	…	…	…	…
2020-11-30	1.193780	7.853762	124.516032	0.895150	1.551001	1.084329	1.622734

Data Source: Fixer.io

For subtask 3-5 paying close attention to Chinese Yuan, we created a time series of CNY/USD with 366 rows. The research timeline is extended to include December 2019 that is the month when the first case was identified in Wuhan, China. Notably, our data of CNY/USD is converted from (CNY/EUR) / (USD/EUR).

Date	Rate
2019-12-01	7.032601
…	…
2020-11-30	6.578902

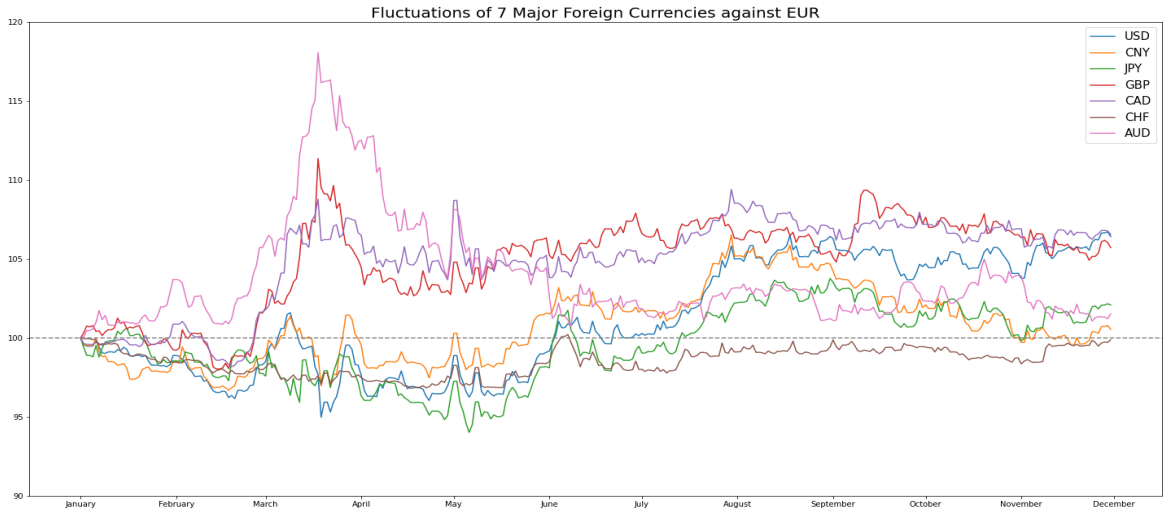
Data Source: Fixer.io

[1] https://www.visualcapitalist.com/forex-market-opportunities-for-investors/

Subtask 2: All currency suffered, which currency is most volatile and how about Yuan?

Major currencies for our analysis are chosen based on the most highly-traded currency pairs in the global foreign currency markets (FOREX) according to BIS. 68% of global forex trading falls into seven currency pairs, including USD vs Euro (24%), Yen vs USD (17.8%), GBP vs USD (9.3%), AUD vs USD (5.2%), CAD vs USD (4.3%), Chinese yuan vs USD (3.8%), and Swiss Franc vs USD (3.6%). Values of the following currencies are measured all in Euro, and we hope to compare their relative volatility by calculating certain straight-forward descriptive statistics.

The line chart below shows the exchange rate fluctuations of the seven major foreign currencies against EUR. We set the exchange rate on January 1st, 2020 to 100% (see the gray dotted line) to make different currencies comparable, and then look at the percentage increase or decline for each currency from that date. The fluctuations are all between 95% and 120%, which show highly consistency in different currencies for many times, especially in March. It is in March that accelerating COVID-19 infections were on the global scale and WHO made the assessment that COVID-19 can be characterized as a pandemic. We can also see in the graph, CHF/EUR (see the brown line) maintains the most moderate volatility. Compared with other currencies, Yuan behaves relatively "normally" against EUR while it is still in two-way fluctuations.



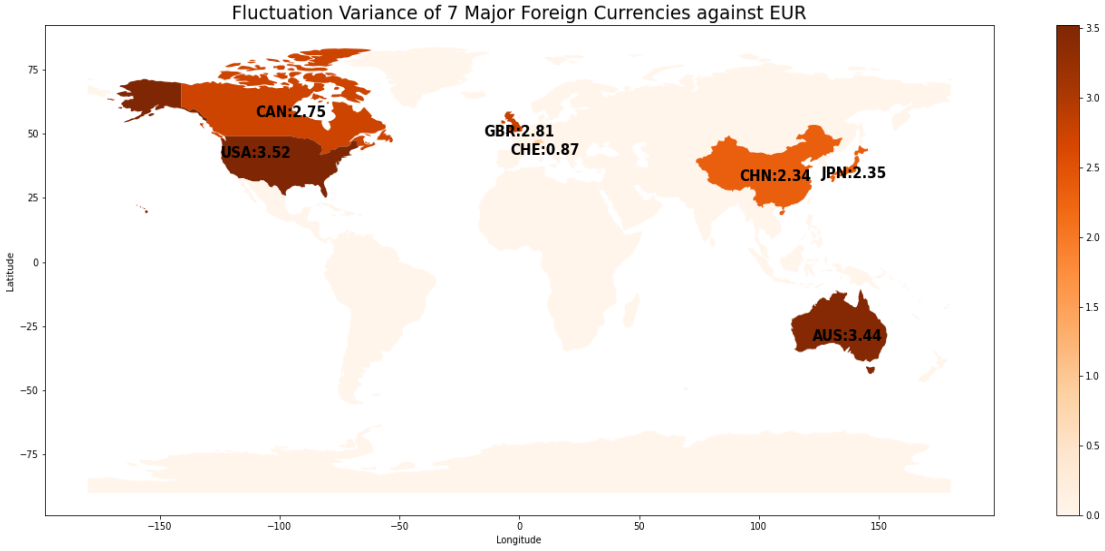
Data Source: Fixer.io

We identify the most fluctuating currency by two ways. The first is to measure which one has the largest total range of fluctuation (highest value- lowest value). The following table tells us it is AUD/EUR. The Australian dollar plummeted in March 2020 (the largest daily percentage increase in AUD/EUR reaches 118.05%), indicating the global panic surrounding the COVID-19 pandemic. Investors have fled the AUD in droves and flocked to other safe haven assets. On March 20th, the Reserve Bank of Australia (RBA) and the Federal Reserve of the United States announced an emergency currency swap arrangement, holding the runaway AUD exchange rate back from further downturns.

Currency	Highest value (largest daily percentage increase)	Lowest value (largest daily percentage decline)	Range
AUD/EUR	118.05%	100.00%	18.05%
GBP/EUR	111.36%	98.04%	13.32%
USD/EUR	106.71%	94.99%	11.72%
CAD/EUR	109.40%	98.19%	11.21%
CNY/EUR	106.52%	96.70%	9.82%
JPY/EUR	103.77%	94.03%	9.74%
CHF/EUR	100.22%	96.81%	3.41%

Data Source: Fixer.io

The variance of the Forex fluctuations is the second measure to find out the most fluctuating currency. This time, USA/EUR came to the front with the largest variance 3.52. We can look back at the blue line in the line chart, it goes through the dotted index line from below to above at the beginning of June. From then on, the U.S. dollar seems to move from periods of persistent strength to persistent weakness. Although it played the role of a safe-haven asset during the first few months of the outbreak, the strength in USD proved temporary.



Data Source: Fixer.io

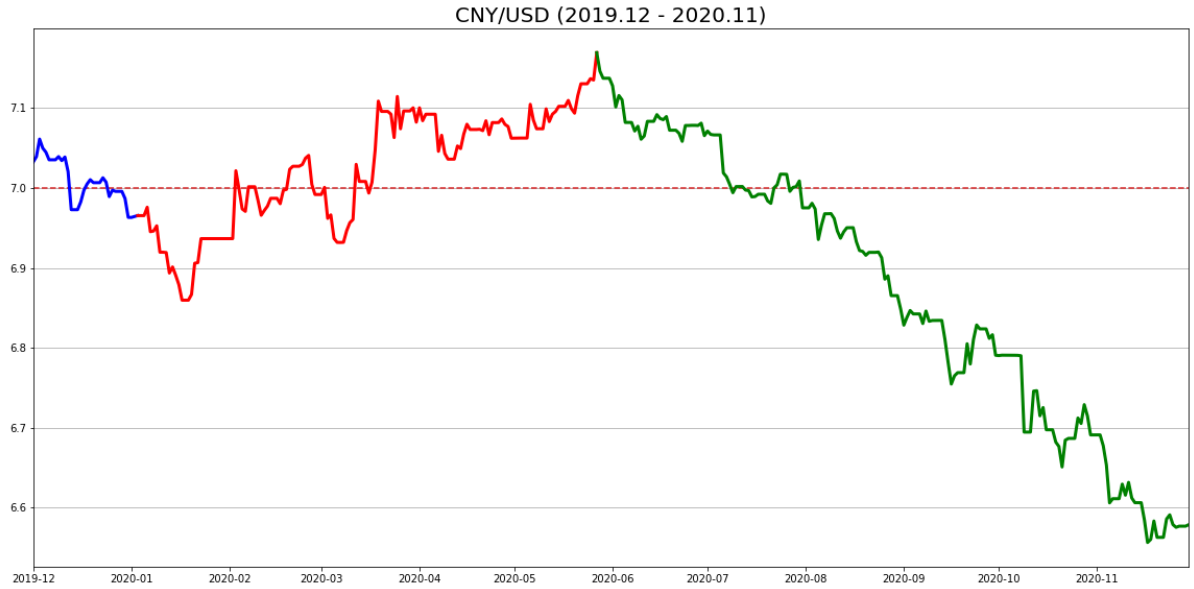
Subtask 3: How has CNY/ USD been like?

Overall Fluctuations in CNY/USD

The first Covid-19 outbreak was in Wuhan, China. On January 3rd, Chinese officials provided information to WHO on the cluster of cases of 'viral pneumonia of unknown cause' identified in Wuhan. Wuhan city officials prohibited all transport in and out of the city of 9 million residents Starting at 10 a.m. on 23 January 2020. This was the first complete lockdown of the population worldwide.

In response to the painful news of the virus outbreak, Yuan depreciated against the Dollar since January, 2020, and the overall upward trend continued into May, 2020. In May, 2020, China's offshore yuan tested the weakest level on record on speculation the government would be willing to permit a weaker currency in response to fresh punitive measures from the U.S. The offshore rate dropped as much as 0.7% to 7.1965 per dollar on Wednesday, the lowest since Sept. 3 2019, when it reached an all-time low. The upside of Yuan's devaluing is obvious. As one of the largest export-oriented nation, a weaker yuan makes Chinese goods cheaper abroad, giving it a competitive advantage that could help boost overseas demand.

Then since June, China's yuan has been rallying sharply against the dollar. Possibly due to China's economic recovery after the worst of the coronavirus hit, as well as a weakening dollar, which has slumped significantly this year. However, whether the rise in value will continue into 2021 remains opaque, as Beijing might step in to stop an excessive rise that would endanger the economy and its policy priority to promote home-grown innovation.



Data Source: Fixer.io

Daily Fluctuations in CNY/USD

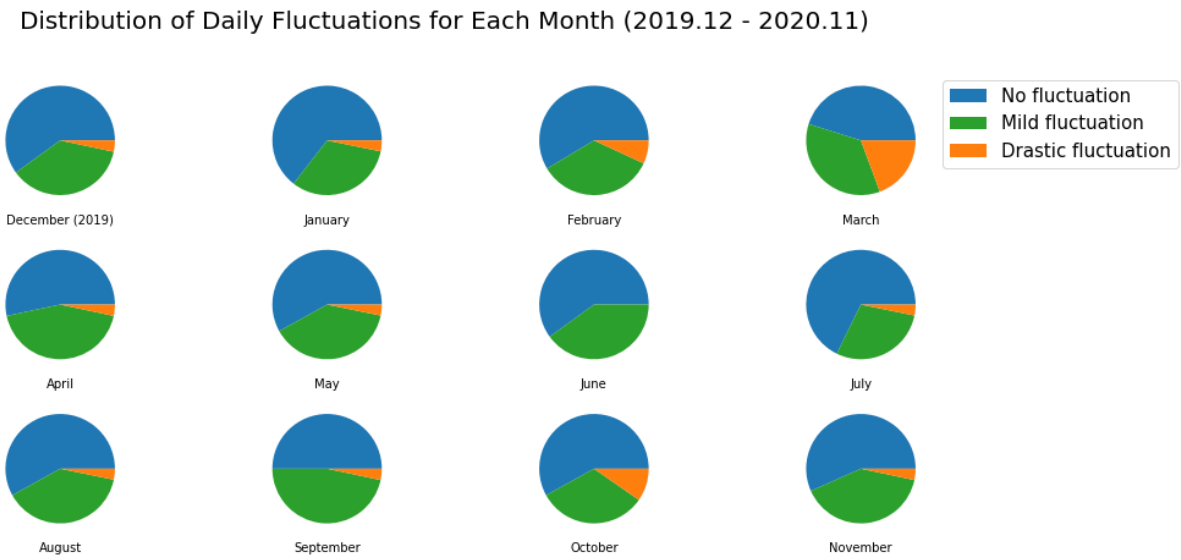
Using CNY/USD, we categorize each day's exchange rate fluctuation into "no fluctuation", "mild fluctuation" or "drastic fluctuation". The thresholds used to determine categories are as follows (pct = percentage change of exchange rate between each day and the day before):

"No fluctuation": -0.1% < pct <0.1%

"Mild fluctuation": 0.1% < = pct <0.5% or -0.5% < pct <= -0.1%

"Drastic fluctuation": pct > = 0.5% or pct < = -0.5%

Through the pie charts, we can find that March has the most "drastic fluctuation" days, then followed by October and February. In March, there are 6 "drastic fluctuation" days, which takes up 19.3% of a month.

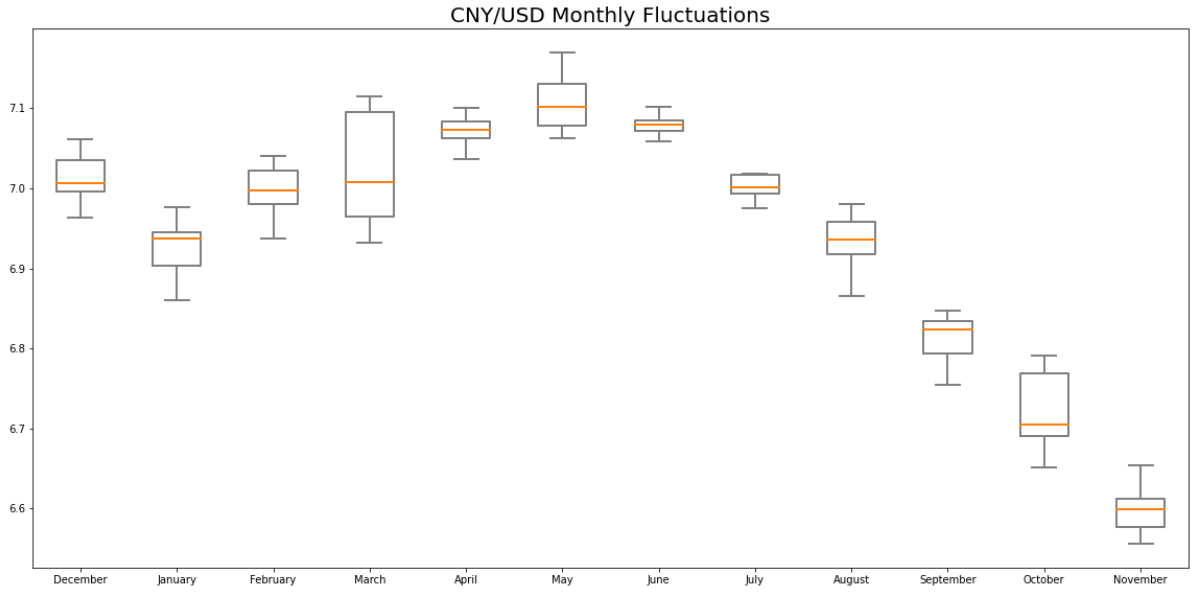


Data Source: Fixer.io

Monthly Fluctuations in CNY/USD

Consistent with the previous finding, the most drastic detrended fluctuation within a month also happened in March. A noticeable appreciation was witnessed in March, the time when China's surge in daily confirmed cases was contained from more than 500 to lower than 100. Besides the successful centralized effort that wrested control of its pandemic, another influential event is the Coronavirus Aid, Relief and Economic Security (CARES) Act signed into law on March 27, 2020 in the United States, which boosted the confidence in the fundamentals of the dollar and drove the exchange rate up.

The most peaceful period was June, the CNY/USD maintained slightly above 7. There were also some signs of relief about the "trade war" between the United States and China, as the former president Trump signed the China Trade Deal and putting economic conflict on pause amid saying "decoupling" with China was still a policy option.



Data Source: Fixer.io

Subtask 4: Capture the oscillation using Bollinger Bands

Bollinger Bands are a type of chart indicator for technical analysis and have become widely used by traders in many markets, including stocks, futures, and currencies.

Moving average (MA) is an indicator that is commonly used as the middle band in Bollinger strategy. Moving average helps smooth out the price data by creating a constantly updated average price, and the impacts of random, short-term fluctuations on the price of a stock over a specified time-frame are mitigated. In strong trending markets, it acts as an "area-of-value", which means the markets pull back towards MA.

We subsequently constructed a price channel that captures most of the oscillation of the CNY / USD exchange rate, also called the Band in the Bollinger Strategy specifically. The Price Channel consists of two parallel lines, called the Lower Price Channel and Upper Price Channel, which provide an indication of potential areas of support and resistance. When prices pass through and stay through a trendline representing support or resistance, the trend is said to be broken and there is a "breakout". A typical trader would sell when price approaches the price channel's upper trendline and buy when it tests the lower trendline. The formulas and parameters that we use are:

The middle band = 20-day Moving Average line (MA20)

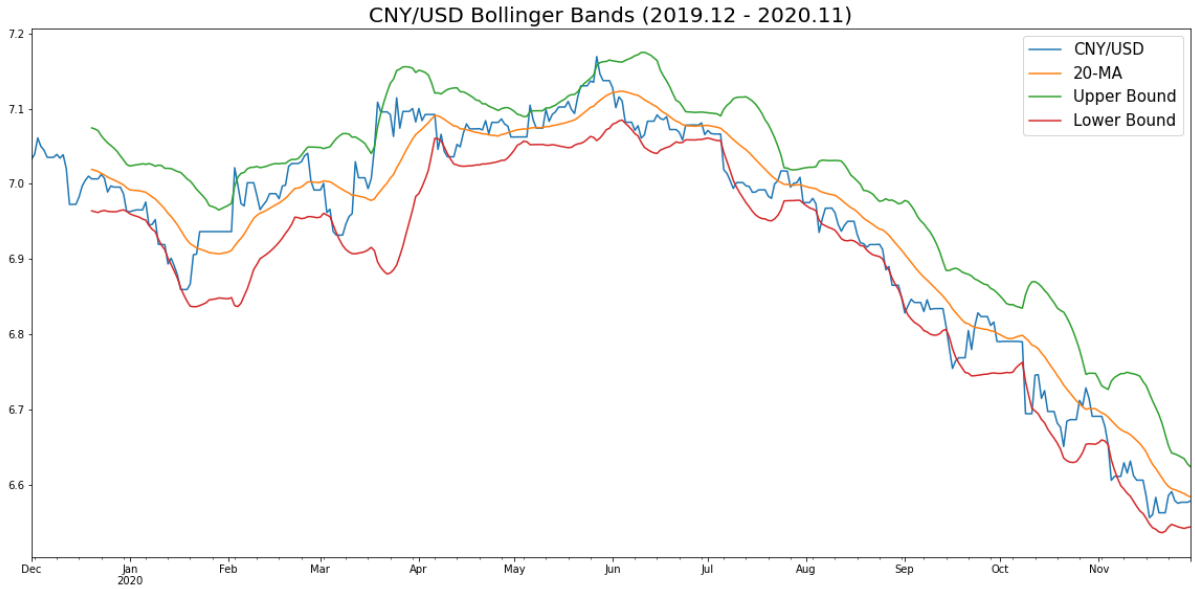
STD = Corresponding 20-day Standard deviation

The upper bound = MA20 + 2* STD

The lower bound = MA20 + 2* STD

We therefore identified clusters of "break-out" outside the defined support level in early January and late August, several "break-out" of defined resistance level in May.

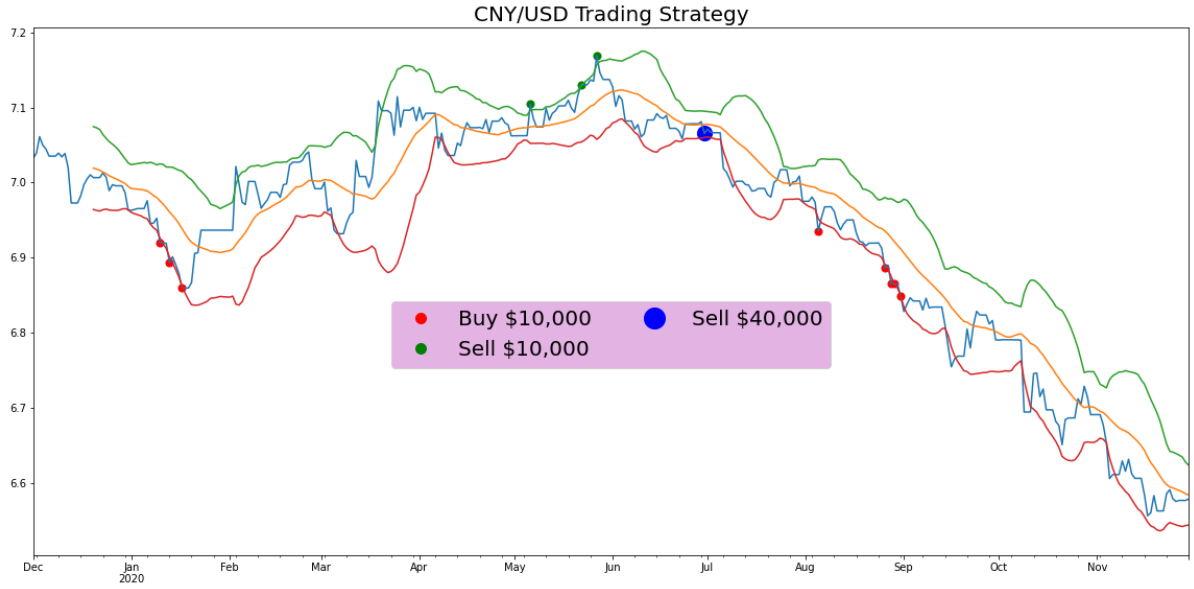
In June, there was an obvious contract in the width of the price channel, technically called Bollinger Squeeze, implying that the market was in a low volatility environment and volatility tends to expand after contraction, which indeed happened afterwards in July.



Data Source: Fixer.io

Subtask 5: An investor who got lucky

Imagine a person whose domestic currency is Chinese Yuan decided to participate in Forex trading since the beginning of the pandemic but only had limited knowledge about technical indicators or quantitative strategies. He decided to use the exact same Bollinger Bands strategy we discussed in the forward section. In January, he discovered three "break-out" of the lower band, therefore he bought $10,000 each time the breach happened. He owned $30,000 at the end of January and sold $10,000 each time he identified the "break out" signal of the upper band in May. That left him nothing by the end of May. Subsequently in June, he realized the so-called Bollinger Squeeze phenomenon and decided to take a big short position, $40,000 and waited in hopes of seeing explosive volatility in the future. And it indeed happened. In August, he felt uncertain whether the yuan will continue to appreciate against the dollar, so he bought back $10,000 from the fair market each time the "break out" of the lower band happens and completely closed out his short position by the end of August. By doing this, he walked away with a profit of 16,577 yuan in total.



Data Source: Fixer.io

CONCLUSION

Our analysis has revealed that the spread of the virus and the countermeasures of different countries are highly consistent with the dynamics of exchange rates. In general, the U.S. dollar is most volatile from the beginning of this year along with the AUD collapsing in March. Since June, the persistent appreciation of the Chinese Yuan against the US dollar is mainly supported by the sound fundamentals of China's economy. But CNY/USD exchange rate is still in two-way fluctuations. Enterprises and investors should be cautious when dealing with the risk of exchange rate fluctuations, as the offshore yuan is more sensitive to the international macroeconomic environment.

Looking back on the past year, we found some clusters of "break-out" and "Bollinger Squeeze" through the designed price channel that captures the CNY / USD oscillations. Using the Bollinger Bands strategy discussed in the report, we simulated Forex trading at these points in time. Finally, it is proved that our strategy is effective with a profit of 16,577 yuan. This could be served as investment advice for beginner investors.