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论文题目：The Effect of the inclusion of  
bitcoins in a portfolio typical to Chinese  
investors

# The Effect of the inclusion of bitcoins in a portfolio typical to Chinese investors

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**Abstract:** Given the deficiency of the current situation of Chinese households' asset allocation and the popularity of bitcoins among investors and speculators, this essay aims to explore the effect of inclusion of bitcoins in a portfolio consisting of Gold, Heng Seng Stock, and U.S. dollars by employing the Markowitz modern portfolio theory. The result shows that the efficient frontier shifts to the northwestern side the of coordinate when bitcoins are included and suggests that bitcoins can be included in such a portfolio to diverse risks.

**Key terms:** Asset allocation of Chinese Households; Modern Portfolio theory; Bitcoins

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## Contents:

I. Introduction	4
II. Analysis of the current situation of Chinese household's asset allocation	4
III. A brief introduction to Bitcoin	8
IV. Research method	9
V. Assumptions	10
VI. Body	10
VII. Conclusion	12
VIII. Bibliography	13

## I. Introduction

In modern society, the asset allocation of households is almost a process of which every person would have some experience of in their life regardless of whether they are aware of its importance. Crucial to the financial well-being of families and even societies, the asset allocation of households is a topic worth exploring quantitatively. Since the proposal of Modern Portfolio Theory in the 1950s, many other theories building on the mean-variance model are developed to create a more accurate model of real markets and to find a better way to maximize returns through asset allocation. Even so, the current situation of Chinese household's asset allocation has several obvious deficiencies which could have been caused by the lack of financial knowledge and the inaccessibility of certain financial products (Tang 41-42). Now, with the revolutionizing invention of bitcoin and the blockchain technology, many investors are hesitating about whether to include bitcoin in their investment portfolio. To order to better inform readers of their decisions, this paper statistically analyzes the effect of risk-diversification of bitcoin on a portfolio with an asset combination typical to a Chinese investor in the framework of the mean-variance model.

## II. Analysis of the current situation of Chinese household's asset allocation

Based on the statistics released by Southwestern University of Finance and Economics in the Chinese Household Financial Survey (CHFS), there are generally three patterns of asset allocation of Chinese households, as listed below.

First, Chinese households participate in financial asset allocation less frequently than developed countries including Japan, America, Britain and etc. According to ChunYue Du and LiYan Han, while on average only 11.5% money of asset of a Chinese family is invested in financial products in 2016, an American family on average invests 68.8% of all their money in financial products in 2016, a Japanese family investing 61.1% on average. Though other countries including Britain, Switzerland, Canada, and Singapore has a lower ratio, theirs on average are all higher than 50%, way higher than that of China (Tang 1; Du and Han).

Moreover, as evidenced in Figure 1 below, 18.25% of all Chinese households invest their money in time deposit in banks, and 7.89% of all Chinese households invest in stocks. Besides these financial products that are most popular among Chinese households, only 4.06% of all invests in funds, 0.75% investing bonds and 0.17% invests in securities and futures. These data reveal that investment frequency of all Chinese households is relatively low in 2013 for all financial products.

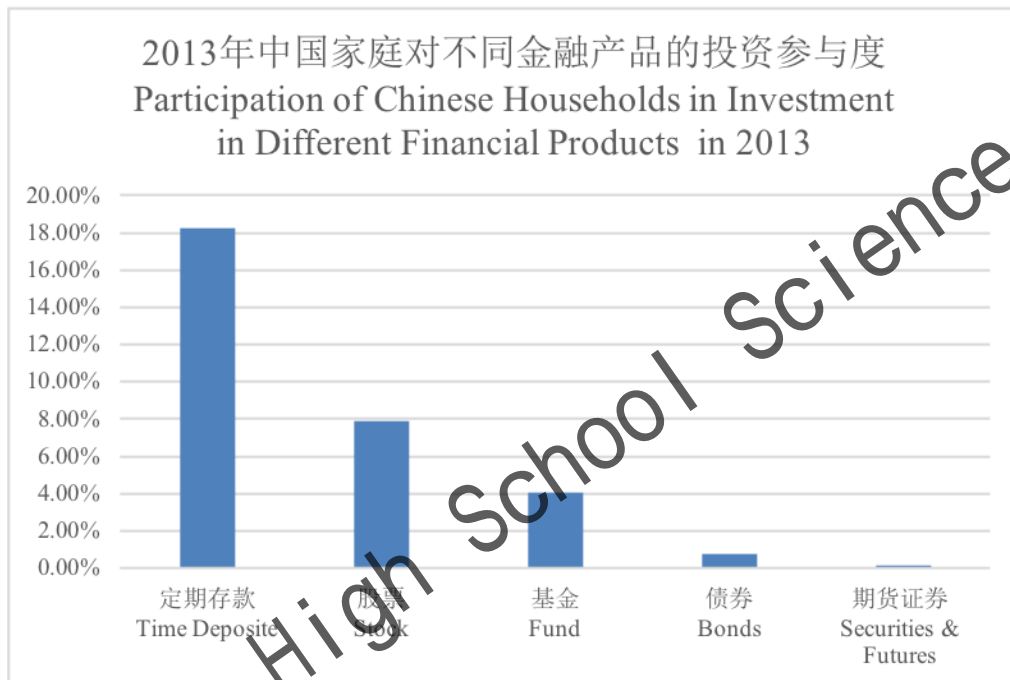


Figure 1

Second of all, the investment of Chinese households in housing is significantly higher than that in other kinds of financial assets. The comparison between figure 2 and figure 3 clearly shows that while 13,238 households surveyed have a house with housing valuation approximately close to 500,000 yuan, only 262 households of all surveyed invest in time deposit more than 500,000 yuan when the money they invested in other kinds of financial assets are only lower than that of time deposit.

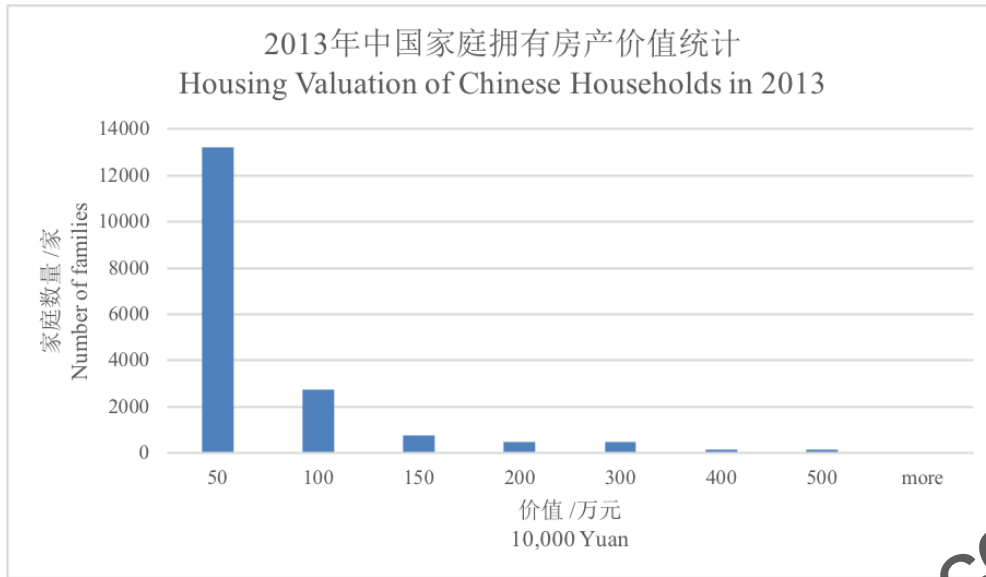


Figure 2

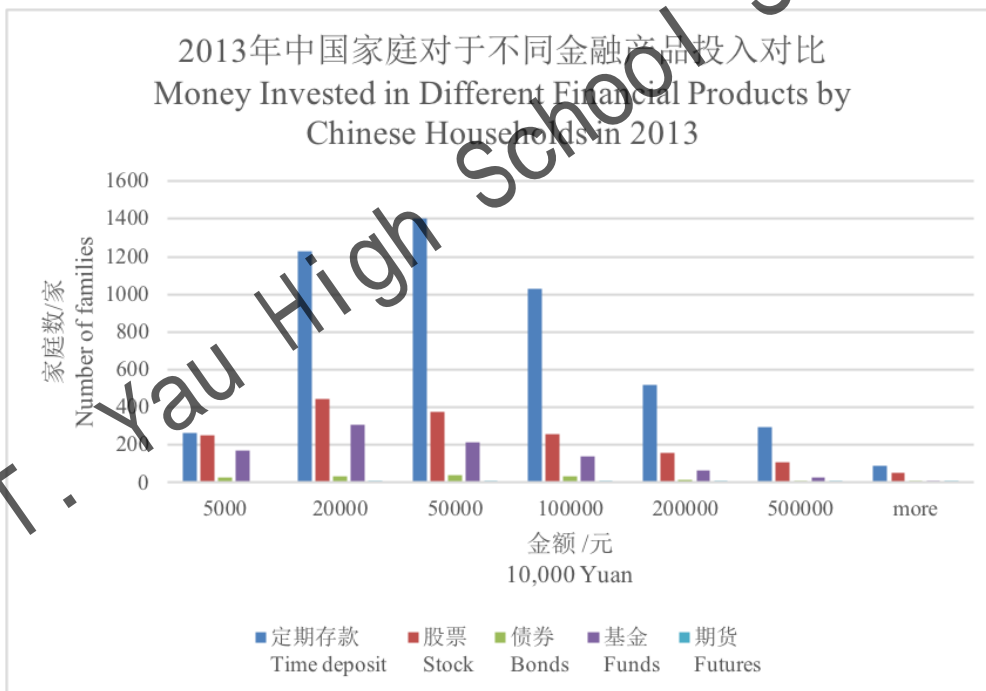


Figure 3

Third of all, Chinese households prefer investment in time deposit and stock more than other choices. Figure 1 illustrates that 18.25% of all households choose to invest their money in time deposits while 7.89% of all households choose to invest their money in stock, with only a few households investing in

other classes of financial assets. Figure 3 and Figure 4 below both demonstrate that Chinese households mostly invest in and gain from time deposit and then investments in stocks. These statistics altogether support the conclusion that time deposit and stock are two both popular choices for Chinese households in terms of the number of families investing in them and the amount of money invested in them.

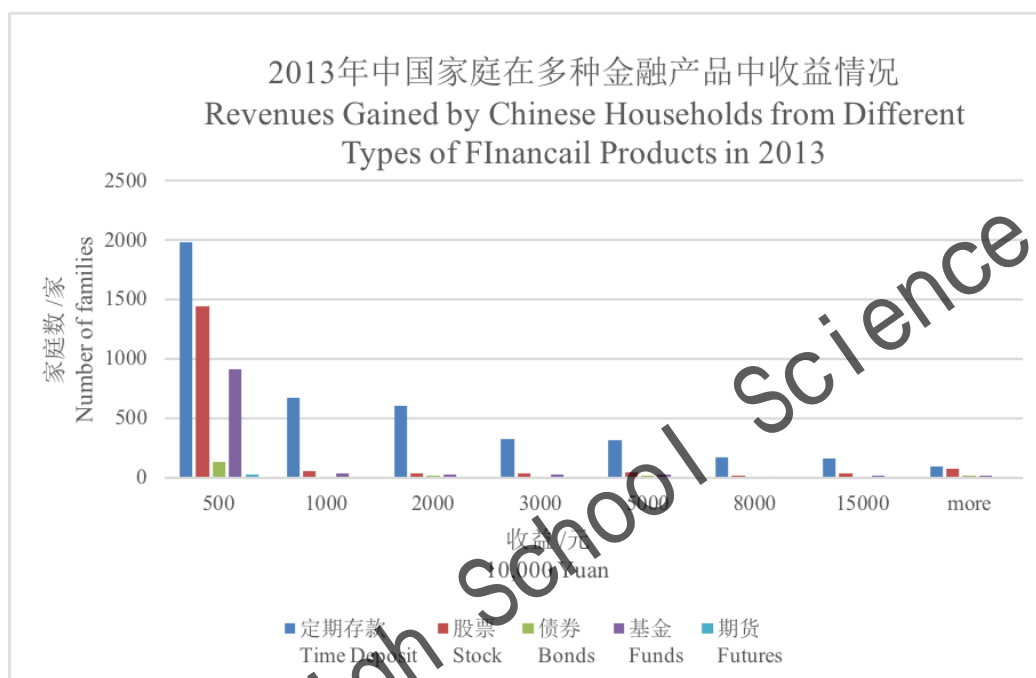


Figure 4

However, such patterns in asset allocation are deficient. Historically speaking, time deposit is a financial asset with low risk and low return while stocks are usually a financial product with high risk and high return. When mostly invested in time deposit and stocks, the financial allocation of a family tends to be biased towards two extremes. If inclined to either deposit or stocks, a financial asset tends to be either ineffective or overly risky. Thus, this paper aims to provide Chinese households with more information on whether investments in bitcoin is wise or not.

### III. A Brief introduction to Bitcoin

Oftentimes regarded as the most disruptive innovation since the invention of the Internet, Bitcoin is a decentralized virtual currency that can be used for the

online transaction between parties (Middlebrook 1). Bitcoin is built on an idea that if there is an efficient and fast way to distribute records of the online transaction to all private computers, then a central clearinghouse would not be needed to maintain the functioning of an online transaction system. The blockchain technology invented by Satoshi Nakamoto provides a cheap and fast enough way to realize this idea and solve the “double spending problem” without a center controlling all transactions (Wallace).

Because of its decentralized nature, the price of bitcoin is not fully or largely regulated by any central authority. Since Satoshi Nakamoto published his paper describing his design on a new virtual currency on November 1, 2008, and mined the first fifty bitcoins on January 3, 2009, the value of bitcoin has changed dramatically from almost worthless to 6783.3 USD on September 28, 2018 (Wallance 1; BlochChain 1). Such a dramatic change in its price naturally draws the attention of many people, including some investors and many speculators. However, the rapid fall in the value of bitcoin from 195,000 USD to 6700 USD today makes many wealth managers exclude bitcoins from their portfolios and advise their clients against investments in bitcoins since it is overly risky (Love 1). In order to explore the probability of bitcoins as a financial asset for investment decisions and the risk diversification effect they have on a portfolio typical for Chinese investors, this paper approaches this issue in a quantitative way using the underlying theories of Capital Asset Pricing Model. Using data from the January 1<sup>st</sup>, 2013 to September 1<sup>st</sup>, 2018, this essay explores the effects of the inclusion of bitcoins for a portfolio typical to Chinese investors over relatively long periods of time (years).

#### **IV. Research method**

According to Modern Portfolio Theory, we assume that there are  $N$  financial assets combined into a portfolio and each financial asset has a weight. Then we



define the expected return of the whole portfolio as the weighted average of returns of each financial asset in this portfolio. Thus, if a financial asset  $i$  has a return of  $R_i$  and a weight of  $W_i$ , then the return of the whole portfolio is  $R_p$ :

$$R_p = \sum_{i=1}^N R_i W_i$$

and

$$\sum_{i=1}^N W_i = 1$$

Then, we assume the risk of the whole portfolio as the standard deviation of its returns. If there are  $T$  time periods in total,  $R_t$  means the return at the end of  $t$  period and  $\mu$  is the mean of  $T$  returns, then the risk of the whole portfolio is  $\sigma$ ,

$$\sigma = \sqrt{\frac{\sum_{t=1}^T (R_t - \mu)^2}{T}}$$

Thus, by calculating the expected return and risk in this way, we can establish a coordinate with expected returns on the y-axis and risk on the x-axis.

Then, we generally assume there are three types of people: risk-seeking, risk-neutral, and risk-averse. Risk-seeking people are those who try to maximize both their returns and risks. Risk-neutral people are those who try to maximize their returns regardless of the risk. Risk-averse people are those who try to maximize their returns at a fixed level of risks. In this paper, we assume that all people are risk-averse people.

In a mean-variance framework, every point in this coordinate represents a portfolio of unique risk and return. Thus, when the financial assets are fixed, we can find all possible portfolios of different combinations of financial assets by changing the weights of each asset. Then, when the expected return is fixed, we can find the portfolio with the minimum risk by changing the weights of each

asset. The set of all the points above the global minimum variance point is the efficient frontier. Then, by drawing the capital market line and superimposing the indifferent curve on this graph can we find the optimal portfolio for a specific individual. Since we assume that all people are risk-averse, then the closer the efficient frontier is towards the northwestern side of the graph, the better this combination of financial assets are. We will try to find out whether bitcoins should be added to the combination of financial assets by comparing the positions of efficient frontiers with and without bitcoins.

## V. Assumptions

1. We regard  $R_p$  as the expected return of the whole portfolio;
2. We choose the simple moving average method instead of the weighted moving average method and the Generalized AutoRegressive Conditional Heteroskedasticity (Wang 125). That is, we regard  $\sigma$  as the risk of the whole portfolio;
3. We assume all people are risk-averse;
4. We assume all people are rational and seek to maximize their utility;
5. We assume there is no transaction costs and no taxes;
6. We use historical risk and returns as the actual risk and returns;

## VI. Body

The following calculation is based on statistics downloaded from investing.com. Due to the fact that Bitcoin did not enter the mainstream market during its early days, we only chose data on the price change of bitcoin from 2013/01/01, the approximate date when bitcoin price start to change on a regular basis. In order to obtain consistent results for comparison and calculation, data of all the other assets in the portfolio model, namely stock (Hang Seng Index), gold and U.S. dollar, are also from 2013/01/01 to 2018/09/01. Considering five years present relatively few data for such an analysis, we analyzed these data weekly instead of annually. In order to show the final results as an annual return according to

tradition, we defined the return like this:  $\ln\left(\frac{P(d_1)}{P(d_2)}\right)$

The ratio of two different prices are processed through an  $\ln$  function, and the date 1 and date 2 in the algorithm are always exactly 52 weeks apart (approximately a year). According to the definition, the mean value of all the return would be the expected return for this asset over a year. Utilizing the standard deviation function in Excel, we are able to calculate the  $\sigma$ , which would be the risk of an asset.

Then, by using the correlation function in Excel, we calculated the correlation between every possible combination of assets, which in turn gives us the covariance of two assets when the correlation is multiplied to the standard deviations related to the assets.

Therefore, the risk and the expected return of the whole portfolio can both be obtained by using formulas mentioned above.

We assigned specific values for the expected return and minimized the risk by varying proportions of different assets to obtain data for the efficient frontier. During this process, we wrote a macro with Visual Basics so that excel can solve minimized risk associated with different returns repeatedly with an increment of 1% (0.2% for the first 3 percents) The above procedures are practiced one time with three assets (stock, gold, and dollar) and another time with 4 assets which included bitcoin. Eventually, the graph was generated with two sets of data (one included bitcoin and one did not include bitcoin). The Final result is shown in Figure 5.

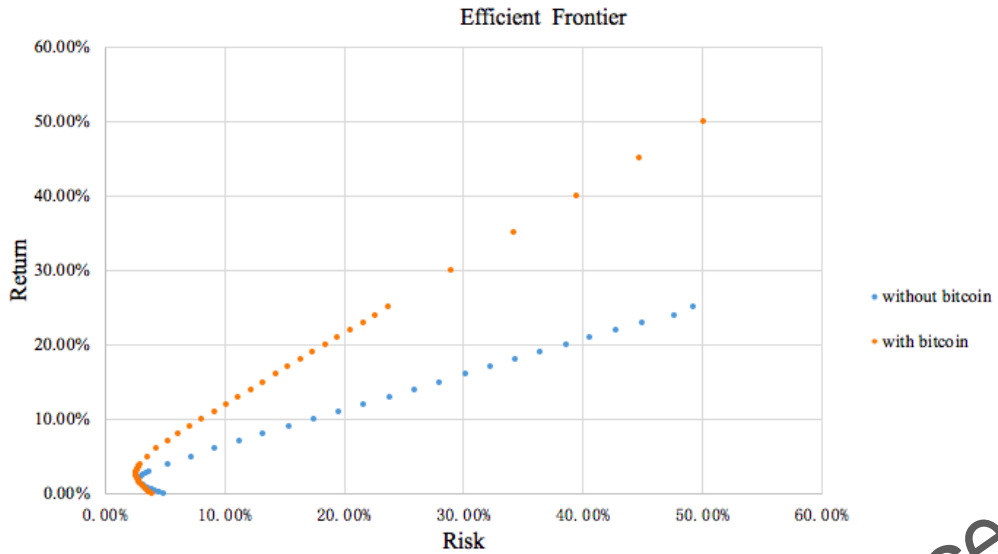


Figure 5

## VII. Conclusion

As evidenced in Figure 5, the efficient frontier of the portfolio shifted significantly rightward after we added bitcoin into the portfolio, which suggests the addition of Bitcoin made the portfolio more rewarding given a specific risk. Therefore, financially capable people in China should be encouraged to invest bitcoins as a new approach to improve the current portfolio within the limits of the legal framework. Given the current financial situation in China, where traditional investments seem rather less profitable, bitcoin surely seems like a promising investment to try. Moreover, since the majority of Chinese investors believe faithfully in real asset and banks, bitcoin offers them a great opportunity to explore other and newer investments. It is suggested that investors buy the appropriate amount of bitcoin according to their own indifferent curve and CML. Notably, the price of bitcoin has shown a more capricious trend than traditional

investments. Thus, bitcoin doesn't always necessarily qualify a worthy and stable investment in the traditional sense. Investors should include bitcoins into their typical combination of investments.

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