Impacts of Covid-19 on U.S. Financial-related Industries Based on Fama-French Five-factor Model

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Abstract – As a global pandemic, Covid-19 has brought significant impacts on various sectors. The emphasis of this paper lies in its influence on the four financial-related industries of banking, insurance, real estate, and trading under the U.S. stock market. Based on the Fama-French five-factor model, multiple linear regression was conducted on daily portfolio returns with periods of both before and after the outbreak of Covid-19, and coefficients of the five factors were obtained to be evaluated and compared. The results indicate that the banking industry was less affected since fewer changes occurred in terms of its p-value. All analyzed stocks had become relatively more aggressive and sensitive to market volatility. Value stocks with small market-scale and high book-to-market ratio can be regarded as more dominant under the circumstance of Covid-19, and speculative stocks are preferred over stocks from robust companies, especially in the trading industry.

Keywords – Fama-French five-factor model; Covid-19; financial industry; U.S. stock market

1. INTRODUCTION

Covid-19 has been spread globally since January 2020 and caused a severe crisis for the global financial markets and economy to a varying degree. On March 11, 2020, the WHO officially confirmed Covid-19 as a global pandemic. With the pandemic announcement, the NYSE announced a trigger fuse mechanism after the main index dropped more than 7% and the stock price dropped sharply during March and April in 2020, and the unemployment rate rose to 10.1%. Dealing with the crisis, on March 23, the Federal Reserve announced that it would continue to buy U.S Treasury bonds and mortgage-backed securities to maintain the stability of the financial market and to keep the market running smoothly without a quota cap. This policy is also known as quantitative easing. During this period, U.S. stock prices very intuitively reflected the impact of Covid-19 on financial markets and the effectiveness of quantitative easing. Through asset pricing theory, it is very convenient to analyze the impact of the pandemic on the financial sector.

Asset pricing theory is used in many areas, and it is also one of the most important fields in financial research. The theory attempts to explain the value of assets to be paid in the future under uncertain conditions. In general, lower asset values contain higher yields, so people began to use the theory to justify how some assets were paid more than the average return on others. In

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1993, Fama and French believed that the excess returns of stocks are not only affected by market risk and presented the famous three-factor model. Many scholars have carried on further research and discussion based on the three-factor model. Hamid et al. evaluated the effectiveness of the Fama-French Three-factor Model for financial stocks in Pakistan [1]. In 2013, Fama and French discovered new risks that could impact excess returns and proposed a five-factor model this year. The model explains the excess returns of individual stocks more fully. The risk factors in the five-factors model are market risk, market value risk, book value ratio risk, profit level risk, investment level risk, and other unexplained factors (denoted by "α"). If the five-factor model perfectly explains the excess benefits of different risks, then α should be zero.

1.1 Impact of Covid-19

Covid-19 is a sudden global pandemic that not only has an impact on the global economy but also has a significant and enormous impact on financial-related industries. Sunder discussed how the U.S. stock market recovers from the pandemic in 2020 by analyzing the US FRS assets and Wilshire 5000 stock price index and Price levels under high and low liquidity. The result is surprising that despite the negative economic growth, the U.S. stock prices had rebound during May and June in 2020. This is due to the quantitative easing adopted by the FRS in the face of the Covid-19 pandemic. In recent two decades, QE is the main method to dealing with the financial crisis. This leads to a not-so-unreasonable expectation that the central bank will increase liquidity dramatically when facing such problems [2]. Wójcik and Ioannou commented on the actual and potential impact of Covid-19 on financial markets, sectors, and centers. Based on their prediction, new financial regulation will slow down, corporate-level integration will continue, and financial-related business services will continually increase. The retail banking business will face greater challenges, so will the local and regional financial centers. The panic and partial recovery of the global financial market around Mar-2020 emphasized the importance of the US$-leading international monetary system, which implies an impossibility of the Asia-oriented shift of the financial power [3]. Albulescu empirically investigated the impact of Covid-19 on U.S. financial market volatility by analyzing new cases of infection and fatality ratios worldwide and in the U.S. The realized volatility (RV) of the S&P 500 index was used as a proxy for the U.S. financial market volatility, and the robust results indicated that the persistence and uncertainty of the Covid-19 crisis magnified the volatility of the U.S. financial market, thus affecting the global financial cycle [4]. Nuredini employed the data from the trend of real estate cycles in plenty of countries worldwide to investigate the impact of Covid-19 on the global real estate market. They plotted the growth and decline in the real estate market in the U.S from January 2019 to April 2020 and found the sales have dropped by 45%, which is the worst in the recent decade. The paper compared the Covid-19 with the financial crisis from 2008 to 2010, the impact of Covid-19 on real estate is much greater, and restrictions in traveling and many other sectors induce a fall in investment in the real estate [5]. Ling et al. used asset-level data from the CRE market (the exposure of commercial real estate) and construct a measure of geographically weighted measure to Covid-19 growth (GeoCovid) by using a sample of equity REITs from January 21, 2020, to April 15, 2020, to examine how the impact of the pandemic transferred from the asset market to equity markets. The result of a consistent negative relationship between abnormal returns and GeoCovid and reducing the negative influence of GeoCovid by exposing to NPIs indicates the investors expected lifting policies to be effective to stock performance strengthens the importance of asset-level attributes in explaining investors'

reactions to the pandemic [6]. Li et al. calibrated how Covid-19 and government capital injection impacted banks' optimal interest margin and efficiency gains and losses in the shadow banking industry. They developed a down-and-out option model of the bank equity and presenting a numerical analysis. The result showed that the negative impact on bank stability was due to the pandemic during 2020, making it easier for banks to take loan risk-taking. Meanwhile, government capital injections would improve banking stability. Both Covid-19 and government capital injection harmed the efficiency of gains in shadow banking [7].

1.2 Fama-French Factor Model

The model used by Fama-French is a multi-regression model, and a three-factor model theory is put forward. Hamid et al. empirically evaluated the effectiveness of the Fama-French Three-factor Model for financial stocks listed on the Karachi Stock Exchange (KSE) in Pakistan in terms of asset pricing and expected portfolio returns. Using monthly data of 20 banks during the five years from Jan-2006 to Dec-2010, six portfolios were subjected to multiple regression analysis. The results showed that most portfolios conformed to the Fama-French Three-factor Model, denying the existence of market risk premiums and providing empirical evidence for the scale and value premium of the financial industry [1]. In 2013, Fama and French refined the three-factor model and expanded the risk factors in the model to five. Racicot and Rentz attempted to use an improved GMM-based instrumental variables technique in a fixed-effects panel data approach for estimating the new parameters of the Fama-French (2015) five-factor model and augmented FF six-factor model. The paper found for both two models, whether using OLS, GMMd, or Hausde approach, the excess market return factor of all 12 Fama-French sectors is significant at the 1% level, and the significance of each factor in the Fama-French Five-factor model is highly variable [8]. Yanjun et al. conducted ordinary least square estimations using the Fama and French Three-factor and Five-factor models on thirty US-based industry portfolios. The parameters (the impacts of the Covid-19 pandemic on the markets and the Fama and French models) are significant by comparing the significant rate of all the variables. During the Covid-19 pandemic, the significance level of all the independent variables has increased. The Five-factor model fares a more substantial increase in efficiency during the pandemic, and some variables, such as HML and CMA, see tremendous changes. The market becomes less sophisticated during the pandemic, and the Fama-French Five-factor Model may be more suitable for estimation under certain market environments, contrary to many previous studies [9]. Horváth and Wang used the monthly excess returns and a parameter of the R^2 coefficient rolling over time in selected events to examine the ability of the Fama-French model. The result that only one of the five-factor models rose during the outbreak of Covid-19 and experienced the highest level of R^2 during the period indicates that the influence of the Dotcom bubble on the R^2 of the growth model is statistically significant and drops dramatically during the Covid-19 outbreak [10]. Sun performed validation of the Fama-French Five-factor Model in the U.S. market before and after the outbreak of Covid-19. By applying the OLS method to 49 Fama-French industry portfolio returns from Mar-2019 to Dec-2020, the goodness of fit had been improved after the outbreak for all industries. By mainly implementing the ARCH-test, residual anomalies existed in most industries. Thus the influence of unexplained factors can be regarded as enhanced. The pandemic also brought significant changes to beta and factor exposure of most industries [11].

The purpose of this paper is to study the impact of Covid-19 on banking, insurance, real estate, and trading using the Fama-French Five-factor Model. Based on the theory of the model, we analyzed the stocks of the four industries, with the time period ranging from 188 trading days from the beginning of June 2019 to the end of February 2020 to the 191 trading days from March 2020 to November 2021. The regression result reveals the coefficient and the significance level of the four factors in the industries before and after the outbreak of Covid-19 so that those risks that impact the industry could be distinguished. Through the discussion part, possible reasons are listed, and the impact of the coronavirus is demonstrated among industries.

2. METHOD

CPAM had been proved ineffective when applied to the stock market. Thus a more complicated and accurate model was necessary to describe investors' behaviour. Fama and French (1993) proposed the Fama-French Three-factor Model based on the theory of CPAM by adding SMB (size of the portfolio) and HML (book-to-market value ratio) into the model to better explain the cross-sectional excess return of the portfolio. The model is expressed as follows:

$$E(r_{it}) - r_{ft} = \alpha_i + \beta_{im}\big(E(r_{mt}) - r_{ft}\big) + \beta_{is}E(SMB_t) + \beta_{ih}E(HMI_t) + \varepsilon_{it} \quad (1)$$

where r_{ft} is the risk-free rate of return; r_{mt} is the market rate of return; r_{it} is the rate of return of asset i; $E(r_{mt}) - r_{ft}$ is the market risk premium; ε_{it} is the regression residual.

Fama-French Three-factor Model can be used as factor analysis of the return or risk of any fund to explain the source of the return and risk of the fund thoroughly. If the three factors can completely explain the excess return brought by various risks, then the number of α_i should be 0 for any portfolio. However, it turns out that α_i is significantly different from 0, which means the factors cannot give a good explanation of all excess returns. As a result, Fama and French put another two factors into the model in 2015. Compared with the three-factor model, the five-factor model can be a better explanation of the problem above. The basic form is very similar:

$$E(r_{it}) - r_{ft} = \alpha_i + \beta_{im}\big(E(r_{mt}) - r_{ft}\big) + \beta_{is}E(SMB_t) + \beta_{ih}E(HML_t) + \beta_{ir}E(RMW_t) + \beta_{ic}CMA_t + \varepsilon_{it} \quad (2)$$

where RMW is the profitability factor and CMA is the investment style factor.

The five-factor model can be used to choose portfolios: α_i should be 0 if the five factors can perfectly simulate the excess return of the portfolio. But when $\alpha_i < 0$, the return rate is relatively low during this period, so the stock price is also relatively lower. However, it will grow higher in the future till it reaches the average return. Thus, choosing a portfolio needs the following steps: the first step is to set a frequency, like every T days reallocating the portfolio, then set the length of the sample as S days. If we do a regression of the past S days' data, the number of α_i in the past S days can be calculated. The stocks of lowest α_i can be put into the portfolio.

3. RESULTS

From Kenneth R. French's data library, daily data of four value-weighted financial-related industry portfolio returns (banking, insurance, real estate, trading) and Fama-French five factors of $Mkt - R_f$, SMB, HML, RMW, and CMA were adopted to be analyzed. To apply the Fama-French five-factor Model, they were used respectively as the dependent variable R_i (y-value) and the five independent variables (x-value) for the multiple linear regression with a 95% confidence level.

Since the Covid-19 was officially confirmed by WHO on March 2020 and its vaccine was launched in the U.S. around December 2020, two equal-length periods of 'Fore' and 'Aft' its outbreak were constructed for comparison, with the former one of 188 trading days from the beginning of June 2019 to the end of February 2020 and the latter one of 191 trading days from March 2020 to November 2021 [12].

TABLE 1. DESCRIPTIVE REGRESSION STATISTICS IN FOUR FINANCIAL-RELATED INDUSTRIES 'FORE' AND 'AFT' THE OUTBREAK

Industry	Item	Period	**Mkt-RF**	**SMB**	**HML**	**RMW**	**CMA**
Banking	Coefficients	Fore	0.7766	0.4181	0.5495	-0.4567	0.0288
		Aft	0.8870	0.7123	0.8446	-0.2246	-0.0388
	P-value	Fore	0.0000	0.0000	0.0000	0.0000	**0.7610**
		Aft	0.0000	0.0000	0.0000	0.0272	**0.7599**
Insurance	Coefficients	Fore	0.8893	0.0123	0.2349	-0.5033	0.3945
		Aft	0.9477	0.3402	0.4733	-0.1470	0.0808
	P-value	Fore	0.0000	**0.8485**	0.0004	0.0000	0.0018
		Aft	0.0000	0.0000	0.0000	**0.1082**	**0.4810**
Real estate	Coefficients	Fore	0.8632	0.6938	0.1665	-0.1911	0.0277
		Aft	0.9477	0.3402	0.4733	-0.1470	0.0808
	P-value	Fore	0.0000	0.0000	**0.1438**	**0.3090**	**0.8983**
		Aft	0.0000	0.0000	0.0000	**0.1082**	**0.4810**
Trading	Coefficients	Fore	0.9273	0.2479	0.2975	-0.1186	0.0038
		Aft	0.9621	0.4673	0.4077	-0.2472	-0.2731
	P-value	Fore	0.0000	0.0020	0.0003	**0.3732**	**0.9802**
		Aft	0.0000	0.0000	0.0000	0.0239	0.0467

As shown in Table 1, among all the eight multiple linear regressions of the 95% significance level, all the bold numbers in the 'P-value' rows are less than 5%, which means that the factors corresponding to these values are statistically significant in the five-factor model. On the contrary, the remaining ones are relatively not significant, thus ineffective in terms of investing return's calculations. If comparing the p-value of the same industry in different periods, it is obvious that some factors had changed between significant and not significant after the outbreak. For instance, SMB in the insurance industry changed from not significant to significant, while its RMW and CMA changed conversely. Similarly, some factors in the real estate and trading industries also experienced conversion, but all the five factors in the

banking industry remained the same status of significance, which may imply that Covid-19 hardly affected the U.S. banking system.

4. DISCUSSION

In respect of factor coefficients, all β_{Mkt}<1 but all had increased to a higher value that closes to 1 after March 2020, which means all those financial-related stocks became relatively more aggressive and more sensitive to the market volatility. Since all the β_{SMB} and β_{HML} are positive, value stocks with small market value and high book-to-market ratio were dominant in all the four industries. Specifically, all coefficients for SMB and HML in the 'Aft' period had experienced a growth comparing to the 'Fore' period, except for the drop of β_{SMB} in the real estate industry. Moreover, β_{RMW} are negative for all industries and both periods, and all β_{CMA} had decreased apart from the real estate industry.

4.1 MKT

"Mkt-RF" is the market relative to risk-free investment expectations of excess return, this factor denotes the market risks which cannot be diversified. In general, the overall volatility of the market risk coefficient value is regarded as one, coefficient value is used to quantify the volatility of individual investment vehicles relative to the market as a whole. This separates changes in stock prices caused by non-systemic risks from systemic risk, i.e., the price changes caused by market risks. The higher the coefficient value of a stock, the greater the potential risk and the higher the return on investment.

According to the regression results shown in Table 1, the impact of market risk factors on the financial sector has been significant before and after the outbreak of Covid-19, indicating that the impact of the outbreak on market risk is not obvious. This means market risk has always had a significant impact on stock prices. In addition, the coefficients of market risks of the banking industry, insurance industry, and real estate industry have increased about 0.1 after the outbreak, as for the trading sector, the increase is not so obvious. However, the coefficient of the trading industry is the biggest among the four industries, which implies that the trading factor has the greatest return on investment.

4.2 SMB

$E(SMB_t)$ is the simulated portfolio return of the size factor at time t, namely, the risk premium generated by different company sizes. All the four industries analyzed have positive β_{SMB}, which means that the sample portfolio may prefer to allocate small-cap stocks, and the returns of small-cap stocks more influence its excess return. Thus the U.S. financial-related stock market is generally more inclined to small enterprises. This is easy to comprehend, because typically when a company falls into the 'Big Company Disease', its management and operating costs will gradually increase, and its efficiency will gradually decline, resulting in higher systematic and operating risks. In contrast, small companies have higher efficiency and growth potential. Otherwise, it is difficult to survive. This is especially true during the epidemic period, when excessive company size may bring more unbearable cash flow pressure than in the past. Under this battered and shrinking market, more financial companies will choose to reduce their market capitalization and market share to maintain the normal operation

of essential business. It is also helpful to focus on the interests and preferences of their target customers and seek some more specialized market supply or service. The pursuit of 'small but refined' often provides them better opportunities to change the direction of development and find a new way out of the pandemic dilemma. Therefore, affected by the Covid-19, the return of investing in companies with small market value is relatively high, since the return compensation is large, regardless of the relatively high risk.

Furthermore, by comparing the data before and after the pandemic outbreak, it can be found that only the β_{SMB} in the real estate industry decreased from 0.69 to 0.34, while the other three industries all showed significant increases. Due to the particularity of the real estate industry, large-scale real estate companies are less likely to be destroyed by the epidemic than small-scale ones because their strong market competitiveness could be advantageous to reduce or even offset the negative impact of the Covid-19, such as the pressure on personnel flow and credit pressure.

4.3 HML

HML equals the high book-to-market ratios minus low B/M ratios, so $E(HML_t)$ is the simulated portfolio return of the B/M factor at time t. According to the data in Table 1, all the β_{SMB} are greater than 0, which is consistent with the B/M effect (the average rate of return of the companies with higher B/M value is higher than that of the companies with lower B/M value). It can be seen those sample portfolios tend to allocate value stocks, and enterprises with higher P/E ratios have more dominant positions in the financial market. Generally, when a company has a high book-to-market ratio, the fundamentals of the company can be regarded as 'undervalued' compared with the share price on the secondary market. After the outbreak, the return of investing on the risk is commonly lowering. Yet, those relatively mature companies may have some more stable revenue sources than startups, which enable them to better solve problems like strikes fundamentally, to obtain a better performance of return rates. The comparison between the 'Fore' and 'Aft' periods clearly confirms this point.

Meanwhile, the essence of HML is to find the difference between "underestimated" and "overestimated", whereas SMB is looking for the difference between "maximum efficiency and potential" and "diseconomy of scale". If compare horizontally, the "maximum efficiency and potential" is equivalent to "underestimated" in some cases, similarly to the "diseconomy of scale" and "overestimated". Hence, SMB and HML have certain overlaps and commonalities in terms of economic principles, just as the positive correlation of their data changes.

4.4 RMW

E(RMW) represents profit level risk, which means that industries with higher profitability are generally associated with higher risk. E(ROE) is used as a criterion for the ability to make a profit. Thus, a higher E(ROE) may well mean a higher profit level risk. E(RMW) calculation is the difference between the expected return of the high profit level stock and the low one.

Table 1 provides a clear demonstration of how E(RMW) affects the excess return of the individual stocks in the four different industries. The significance level of the factor merely changed in two industries: the insurance and the trading industry, though the direction of changing is opposite. One thing that deserves people's attention is that the coefficients are

negative in all four industries both before and after the pandemic outbreak, which means that there existed speculation. However, the factor remained significant in the banking industry and insignificant in the real estate industry.

To be more specific, for those two industries that maintained their significance level, they both underwent a small impact of the coronavirus. For the banking industry, the coefficient remained significant before and after the outbreak of Covid-19. Thus, profit level risk existed and influenced the excess return of the stocks in this industry. That was partly because the coronavirus did not strongly influence the banking industry. The policy of the Federal Reserve protected the interests of the banks. Stata showed that the non-performing loan ratio of American banks in 2020 did not see a great change. On the contrary, the coefficient was insignificant in the real estate industry, which meant that the factor had no strong correlation with the excess return of the stocks in the real estate industry.

For the remaining two industries, the factor in the insurance industry became insignificant and decreased after the outbreak of Covid-19, which meant that the risk of speculativeness lowered. Since the death rate increased significantly because of the pandemic, the pressure to compensate for life insurance was rather high. Other kinds of insurance like travel insurance also require high compensation. Thus insurance was no longer a good speculative choice because of the increasing compensation rate. The increasing unemployment rate and control measures also worsened since people's demand for insurance decreased continuously. For the trading industry, the annual reports of many shipping companies and other kinds of trading companies indicated a magnificent increase in the first half of 2021 because of the explosive growth of people's consumption. However, the increase might not be continuous, so speculativeness and uncertainty existed. That explains why the absolute value of the coefficient increased, which meant that speculative stocks are preferred.

4.5 CMA

CMA simulates the risk of the investment. A higher risk means a lower investment rate so that the investors demand a higher expected return, that is, a higher E(CMA). The calculation of E(CMA) is similar to that of E(SMB), E(HMI), and E(RMW). Focusing on the change of the coefficient and p-value can give us a brief view of the change of the expected return after and before the outbreak of Covid-19 to better understand the impact of the coronavirus on different industries.

When it comes to the significance level, the p-value changed significantly in the insurance and trading industry. There was no change in significance in the other two industries, but they saw different variations in the coefficient. According to Table 1, the coefficient turned from positive to negative in the banking industry while remaining positive in the real estate industry. All β_{CMA} had decreased apart from the real estate industry.

For the banking industry, the CMA factor remained insignificant in explaining the excess return of a certain stock, which implied that a strong link between the CMA factor and the excess return of a stock in the U.S. banking system did not exist. The unchanged status of the significance also suggested that the coronavirus might not have impacted the banking system. A similar result in the real estate industry indicated that the CMA factor was also inefficient in explaining the excess return of stocks in this industry.

However, the CMA factor changed its significance in the remaining two industries. The factor transformed into an insignificant factor in the insurance industry. Before the happening of the pandemic, the coefficient was positive, and the p-value was higher than 0.05, which implied that there existed the risk of investment in the insurance industry. The decrease of the coefficient after the pandemic meant a lower risk of investment, partly because many people had to stay at home to protect themselves from exposure to the virus, which lowered the possibility of the payment of health insurance. The number of patients in the hospital also decreased, the reimbursement for medical expenses afforded by the insurance company had decreased, either. Finally, for the trading industry, the coefficient turned into a negative one. The factor became significant after the coronavirus outbreak, which meant that the factor had a significant impact on the industry. The trading industry was influenced both by the pandemic and the trade war between China and America. Because of the pandemic, the consumption and the trade volume decreased much. However, since the beginning of the second half of the year, the consumption saw a retaliatory increase. The economy revived, and the virus was under better control. However, there existed uncertainty about the mutation of the virus, which still influenced people's choices about stocks and their confidence in this industry. For example, nearly all the shipping companies saw a rocketing increase in their orders and turnover in the first half of 2021. Due to a growing demand for commodities and an increasing price in staple commodities, some companies could cover their costs after several voyages and buy another ship. However, some of the public companies also posted risk warnings for investors, saying that the increasing turnover might not be continuous because of the pandemic. Thus, the trend was that despite an increasing turnover in trade companies, there existed uncertainty about business volume in the future due to the virus. Such a phenomenon gave a possible explanation for the result: the negative coefficient indicated that stocks with higher volatility were preferred in this industry. The higher the risk, the lower the excess return. Since people were not sure about whether the prosperity of the industry would continue, robust companies were not as preferred as before.

5. CONCLUSION

The stock price is a visual reflection of a company's value and fluctuates up and down around it, making it an important factor for investors to consider when evaluating whether a company is worth investing in. This paper adopted the Fama-French Five-factor model to evaluate the impact of Covid-19 on corporates' returns in the banking, insurance, real estate, and trading sectors. The results indicate that small-cap companies, except the real estate industry, had relatively higher returns before and after the pandemic. Companies with high B/M ratios outperformed those with low B/M ratios before and after the pandemic. Additionally, mature companies performed better, most likely due to their capital accumulation. The real estate industry is hardly affected by the risk of profit levels. The insurance industry is affected by the impact of the pandemic, and the pressure to compensate is so great that insurance is no longer a good speculative option. On the contrary, with the pandemic outbreak causing a surge in demand for daily necessities, the sudden increase in consumption makes the industry more speculative. Investment level risk primarily affects insurance and trading, with home quarantine reducing the risk of infection while making insurance payouts relatively less risky.

The trading boom was marked by uncertainty during the epidemic, making the sector's companies with less volatile less desirable to investors.

For investors, investing in industries with high B/M ratios and relatively small sizes can bring substantial returns. Meanwhile, the real estate industry is always a good investment choice, and its performance was relatively strong before and after the pandemic. The gradual recovery of the real estate market now also proves that the sector has good shock resistance. Still, unlike other industries, the performance of larger real estate companies will be relatively better.

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