A Study on Application in Quantitive Models of Financial Assets

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Abstract. This paper serves as an in-depth exploration of various financial instruments, including bonds, futures, and derivatives such as futures and options. It delves into the intricate process of asset valuation, encompassing different methods and techniques employed by financial experts to quantify the worth of these assets. Furthermore, the paper sheds light on the nuanced intricacies involved in pricing financial assets, drawing attention to the challenges and limitations faced by quantitative models in this context. The utilization of quantitative models, such as Hypothesis Testing, Multivariate statistical analysis, and Basic statistical analysis methods, is central to the valuation of financial assets, including bonds, stocks, and derivatives. These models offer a structured framework for pricing and assessing the value of these assets. However, this paper highlights the existence of limitations within these models, which may impede their ability to accurately forecast the trends in financial assets. Through a comprehensive analysis of contemporary research and empirical data, alongside specific case studies, this paper underscores the importance of understanding these limitations, ultimately contributing to a more informed approach to asset valuation in the financial industry.

Keywords: Financial Assets; Quantitive Models; Asset Pricing.

1. Introduction

Before people use quantitative model to evaluate, what do people use in order to measure the pricing and application. In the past, people have only few rough methods to help them measure the pricing and application. For examples, make marketing research, conducting focus groups, interviews, and surveys to learn more about the demands, preferences, and price expectations of consumers. This aids in determining the potential market size for a particular product, and in comprehending the dynamics of the market. For another instance, ancient people's decision was based on people's own opinion. In other words, they will be seeking for some industries skilled staff, consultants, or advisors who are well acknowledged on some certain aspects, by passing through some seminar and discussion to evaluate in the end. This paper will have a brief introduction of different kinds of model for bond, stock, futures and option of derivatives, as well as how people use a tool.

In an effort to demystify the intricacies of pricing assets, the Asset Pricing Program embarks on an exploration of the determining factors behind the valuation and returns associated with a spectrum of financial and tangible assets. This encompasses a wide array of assets, ranging from equities, bonds, foreign exchange, to real estate. It's essential to note that financial assets, such as cash, investments in stocks, bonds, mutual funds, and bank deposits, differ fundamentally from tangible assets like real estate and commodities due to their lack of inherent physical value or physical presence. The assessment of an asset's worth can be likened to the calculation of the present value of anticipated payoffs or cash flows, factoring in considerations of risk and the passage of time [1]. It is crucial to the decision-making process both at the macro and company levels. Stock prices come to mind frequently when think about "asset" pricing. Nonetheless, asset pricing generally also pertains to non-financial assets like gold and real estate as well as other financial assets like derivatives and bonds. When it examines a model that helps us forecast the future, it typically depends on the underlying presumptions. Positive tests can be used to determine whether the underlying assumptions are accurate if the normative tests' evaluation process yields positive results. But really, all need to do is combine everything into a single, streamlined arrangement.

2. Bond

Bonds serve as fixed-income instruments, embodying an investment that involves an investor lending funds to a borrower. The predictability of returns within the corporate bond market is underpinned by the intricate interplay of serial and cross-serial dependencies in the daily returns of investment-grade and high-yield bonds. Cross-serial dependencies manifest as a complex, non-linear structure, akin to lines crisscrossing in an upward curving fashion.

The historical returns from both in-sample and out-of-sample stock market data can be harnessed to forecast forthcoming returns in investment-grade and high-yield bonds. Conversely, the evidence supporting the use of previous bond returns for anticipating future stock market returns remains elusive. These findings retain their validity even when factoring in conditions of conditional heteroskedasticity, mean return fluctuations influenced by volatility, and the ever-evolving landscape of interest rates.

Relating to the understanding bond prices and bond yield, bond price is directly related to interest rate and the economic activity that government or firms may made in the future. Thus, the bond price and bond yield will fluctuate as change in interest rate. As bond price increases, bond yield will decrease. The stability of the bond's coupon rate leads to fluctuations in its secondary market price, which adjusts in response to prevailing market interest rates. To put it differently, as market interest rates increase, a plethora of new investment prospects emerges, allowing individuals to capture higher interest rates [2]. As interest rates rise, there is a corresponding reduction in the secondary market price of the bond to balance the coupon payments. Consequently, the diminished bond price translates into an enhanced yield for the investor, serving as compensation for the increased interest rates. For various types of bonds, there are actually a number of different yield calculations. For instance, it is challenging to determine the yield on a callable bond because it is unclear when the bond may be called. Unknown is the total coupon payout. For non-callable bonds, the yield can be computed with a high degree of precision and the exact maturity date is known. Treasury bonds are valued using a yield to maturity calculation. There are some limitations for every yield to maturity. In the computation of yield to maturity, an assumption is made that all coupon payments will be reinvested at the yield to maturity rate. However, it's important to acknowledge that the future remains uncertain, rendering it challenging to precisely gauge this rate.

Both inflation and discount rate should be considered when bond price are going to be measured. In terms of inflation, it is related to prevailing market. Inflation rate means a general and continuous rise in price level. The current lower interest rates are less appealing when interest rates rise. The discount rate employed in ascertaining the bond's valuation experiences an ascent. As the inflation rate diminishes, the Federal Reserve exhibits a greater inclination to reduce interest rates, with the objective of stimulating consumer spending and bolstering aggregate demand, thereby fostering an upturn in price levels. This action is called expansionary monetary policy in macroeconomics [3]. As interest rate become lower, it makes the current bond more attractive, so more people are willing to buy the bonds in secondary market, bond price will increase in the end. Furthermore, lower rates imply a lower discount rate, which lowers the price of the bond. Therefore, bond price will increase when the inflation rate decreases. When evaluating the discount rate, the key factor influencing the rate that investors employ to establish a bond's valuation lies in their outlook on inflation. Nevertheless, this is not a steadfast rule, particularly when comparing bonds with differing maturities, such as a five-year bond versus a ten-year one. This distinction signifies that, relative to longer-term bonds, the broader market perceives a greater level of interest rate risk within the shorter time frame. Additionally, the potential for defaults must be factored into the equation. In cases of lower credit quality, yields tend to be higher, correspondingly driving down the bond's price.

3. Stock

Stock represents the funding acquired by a company or corporation by issuing and selling shares to investors. The stock market stands out as a highly complex financial ecosystem, given its vast array

of diverse equities, the values of which undergo significant fluctuations over time. Identifying temporal market patterns is a fundamental aspect of predicting stock market trends. Each investor aims to maximize his own returns and to minimize the loss and risks during investment across the time period [4]. Stock market is highly sensible, so the prediction of the stock market should be measured on different range of aspect. One thing is being unchanged for every period is that investors' main aim is to gain profit by developing innovation for the society as well as build a statistical model in order to predict the price of stock in stock market in the future.

There are four steps in forecasting process [5]. Firstly, identifying problems, which means people should understand the reason why they are going to predict the price of stock and also master the some basic problems that they are going to research and analysis in the next stage of the exploring. Second is to gathering the information, data should be collected directly form the respondents which have to be really precise in order to make accurate decisions. Thirdly, preliminary analysis is the key stage of the process, this stage analyzes the data and makes recommendations regarding whether or not the information gathered is useful. Additionally, preliminary analysis is useful for identifying patterns or trends, which facilitates the selection of models that best suit the data. Ultimately, the selection and adaptation of models, along with the application and assessment of forecasting models, come into play. To provide greater clarity, precise validation of this model can only be conducted once the data for the forecasted timeframe becomes accessible.

The ARIMA Model can be used to make stock pricing prediction [6]. The ARIMA Model has some benefits but also has some drawbacks for measuring an accurate stock price. About the pros of ARIMA Model, it is interpretability, ARIMA Model can interpret some data and results, enabling traders to comprehend how past and future price movements are related and to make wise judgments based on the model's coefficients and statistical metrics. Moreover, it is also handle a non-stationarity, this helps to transform non-stationary data into stationary form. Regarded to the cons of ARIMA Model, it has limited Complexity, ARIMA models may have trouble capturing intricate or nonlinear trends in financial markets since they presume linear correlations. They might not properly account for rapid changes or uncommon occurrences that have a big impact on prices. Furthermore, it is limited incorporation of external factors, the primary focus of ARIMA models is past price data, and it may be difficult to easily include external factors that can affect price movements, such as news events, economic indicators, or market sentiment. And only focus on short-term, since they may struggle to capture longer-term trends or shifts in market dynamics. Overall, this method is use previous price trends to predict several future trends for stock pricing the prediction.

A facet of the value investing approach involves the selection of stocks that seem to be trading below their intrinsic or book value. Value investors actively seek out stocks they perceive as being underrated by the stock market. Value investors utilize financial analysis, avoid herd behavior which most of people would like to do, and make long-term investments in reputable businesses. The price of the stock may be undervalued in real life, there are several reasons why this might be happened. Firstly, there are unnoticed and unglamorous stocks, people may not likely to find other opportunities like some small stocks or some foreign stocks that might be underestimated by others. For instance, corporations like Proctor & Gamble or Johnson & Johnson are less likely to be impacted by herd-mentality investing than equities like Meta (previously Facebook), Apple, and Google. Moreover, cyclicality, the fluctuation that affected by business, people cannot measure the economic cycle whether goes up or down, or in downturn or boom, so this might influence consumers attitude on buying stock in stock market like consumer confidences and expectations, whereas, this factor only influenced in short run, so this may cause no impact in long run investment. Furthermore, market crashes are also a factor that cause an underestimation of stock price. Prices rise rapidly, creating a "bubble" as a result of investor euphoria. The bubble usually bursts when the market reaches an unfathomable level. Investors ultimately experience panic and sell off connected assets in large quantities since the price levels are unsustainable. A market crash is the effect of this. That's what happened during the dot-com bubble in the early 2000s, when the value of tech stocks skyrocketed

above what the underlying businesses were worth. When the housing bubble broke in 2006 and the market fell in the years that followed, it witnessed the same thing.

4. Derivatives

4.1. Futures

Futures represent a category of financial derivatives, binding parties to buy or sell an asset at a predetermined future date and price. The futures market stands out for its unique utility, offering valuable guidance to producers, distributors, and consumers of commodities.

Comparing futures to forward contracts, subtle distinctions emerge. Futures contracts are publicly traded on exchanges, rendering them standardized agreements. In contrast, forward contracts constitute private arrangements between two parties for the purchase and sale of assets at a predetermined future price, introducing a potential risk of default. Furthermore, futures contracts benefit from the involvement of clearinghouses that ensure transaction security, while forward contracts culminate in a single settlement date at the contract's conclusion. Futures contracts undergo daily mark-to-market valuation, their worth recalibrated daily until contract maturity, and they allow settlement across a range of dates. Speculators, those speculating on asset price movements, frequently employ futures, while hedges primarily employ forwards to mitigate price volatility, culminating in asset delivery and cash settlement. To summarized, the price of futures will fluctuate up and down with value rest to 0 daily, while forwards have a constant price with a fluctuation value.

To effectively mitigate the potential risks associated with the new low sulfur bunker spot prices in the three primary global bunker hub ports responsible for distributing such fuels, Kavussanos and Xiwen Bai undertake a novel assessment of the cross-hedging capabilities offered by various petroleum futures contracts [7]. Their study highlights that, in comparison to Rotterdam and Houston, Singapore's port emerges as the most effective hedge against price fluctuations in low sulfur marine gasoil, utilizing specific futures contracts. Moreover, their research demonstrates the superior performance of petroleum futures belonging to the middle distillates family in minimizing the variability of returns when contrasted with other petroleum products. These findings bear significant implications and can guide shipping companies in making informed decisions regarding their bunker risk management, including the selection of optimal hedging instruments, strategies, and bunkering ports.

4.2. Option

Options represent a type of derivative financial tool where two parties enter into a contractual agreement to execute a transaction involving an asset at a predetermined price on a future date. In more precise terms, the option purchaser possesses the flexibility to either acquire or offload the underlying asset at the agreed-upon price. The contract is null and void in the event that the buyer does not exercise the option. The investor will have to pay the seller the cost of the underlying item, though, if they want to buy or sell.

The Black-Scholes Model provides a valuable tool for assessing option pricing and, consequently, devising hedging strategies to mitigate risk. It was through the Black-Scholes model that the pivotal role of mathematics in the realm of finance was unmistakably underscored. This groundbreaking model not only revolutionized financial engineering but also fueled the emergence and subsequent prosperity of the mathematical finance discipline. The Black-Scholes model encompasses five essential variables: the option's strike price, the prevailing stock price, the time remaining until expiration, the risk-free interest rate, and the asset's volatility. Also, the Black-Scholes model, while generally accurate, is subject to specific assumptions that might cause forecasts to diverge from actual outcomes. Additionally, the conventional Black-Scholes-Merton (BSM) model, which discounts the possibility of early exercise for American options, is primarily employed for valuing European options. The Black-Scholes Model operates under a set of fundamental assumptions: no dividend disbursements throughout the option's lifespan, the market behaves randomly with unpredictable

price movements, there are no transaction costs associated with option acquisition, the risk-free rate and asset volatility remain constant and known, returns of the underlying asset adhere to a normal distribution, and the option in question is European in nature, restricted to exercise only at its expiry.

There are several differences between options and futures [8]. Firstly, underlying assets, commodities like wheat, gold, and oil as well as financial assets like stocks, bonds, and currencies are commonly traded using futures contracts. An even greater variety of assets, such as stocks, bonds, currencies, and commodities, can be traded using options contracts. Secondly, obligations of buyers and sellers, in a futures contract, the buyer and seller are both required to carry out their end of the bargain when the contract expires, but in options, buys has no responsibility only the right. Thirdly, pricing and costs, futures has different price compared with options. Futures contracts are valued in accordance with factors such as supply and demand, interest rates, and storage costs, in addition to the underlying item's current market value. The present market price of the underlying asset, the amount of time till expiration, and the volatility of the underlying asset are some of the elements that go into pricing options contracts.

Recently, most of derivatives are mixed with both futures and options [9]. The reason for that is because it gives traders and investors access to a wider variety of risk management tools and methods. People can customize their positions to certain market conditions and their personal risk tolerance by combining futures and options. Futures contracts present a uniform arrangement for buying or selling an underlying asset at a predetermined price and date. These contracts serve as a means to safeguard against potential losses while also presenting an opportunity to capitalize on fluctuations in the price of the underlying asset. The requirement to purchase or sell the item at the designated date is a drawback of futures contracts, thus it's not always ideal. Conversely, options grant the right, but not the responsibility, to purchase or sell an underlying asset at a fixed price and date. Because the buyer has the option to exercise or not, they provide flexibility and risk control. Options can be utilized for revenue generation, hedging, or speculating. Futures and options can be used by investors to develop complicated strategies tailored to their own requirements. For example, they can utilize futures to profit from market moves while utilizing options to reduce downside risk, or they can use options to hedge against possible losses in a futures contract.

For example, Russo-Ukrainian War influence the price of fuels and food significantly. Because wars have led to a decrease in food production, on the contrary, prices have been relatively stable when there is no sharp rise. Because Ukraine used to be a large food supplier in the world, oil prices and food prices have increased. All things considered, the use of futures and options in derivatives increases flexibility, reduces risk, and increases profit potential under different market circumstances [10].

5. Conclusion

In conclusion, this paper has analyzed the usefulness and limitation of quantitative models for assets pricing. As for bonds, this paper gives a comprehensive review of the relationship between bond price and bond yield, as well as, provides the weakness and limitations of the methods used for bond pricing. In terms of futures, the ARIMA Model is used to have a stock pricing, the paper discussed the steps in forecasting progress to make a specific explanation. As for derivatives, which can be divided by futures and options. This paper talked about the characteristics of them and made a comparison between futures and options. Furthermore, it's important to note that options contracts grant investors the privilege to buy or sell an underlying asset at a pre-determined price on a specific future date, whereas futures contracts entail commitments to either purchase or sell an underlying asset at an agreed-upon price on a designated future date. All in all, there are also any other factors that may influence the assets pricing that are not sure, so it required loads of quantitative data analysis and empirical study for a much more deep and comprehensive understanding.

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