# 摘要

# 引言

# 理论背景

## The Solution of Ornstein-Uhlenbeck Process

In the stochastic volatility models, the volatility follows the Ornstein-Uhlenbeck Process, which shows the existence of mean reversion about the volatility(Heston,1993). Under the physical measure ,on the trade date , the stock price and volatility evolves as[[1]](#footnote-1):

Where and represent the drift rate and volatility of the stock return, respectively. is a constant but not .is the speed of mean reversion, and is the long-term mean of volatility, is the volatility of volatility..and are the wiener process of stock and volatility under the physical measure , respectively, and their correlation is .

The option price is , thus the partial differential equation of value is:

Where is the compensation of volatility risk(Huang and Darien, 2018), thus is the drift of volatility under the risk-neutral measure .is the risk free rate, which is set to a constant. To get the risk-neutral SDE of volatility and stocks, we use the Cameron-Martin-Girsanov lemma set the wiener process of volatility under Q , in which .Thus we get the SDE of volatility under Q measure:

To get the solution of volatility SDE under Q ,we substitute and into Equation (3) so that it takes the form Ornstein-Uhlenbeck process[]:

The solution of Equation (4) is[]:

Where and represent long-term mean and the speed of mean reversion under Q measure, respectively. We can get the risk-neutral volatility from the option price, which is called the implied volatility. The implied volatility follows the mean reversion process, and .From the Equation(5), we can get the math process of , include its possible values and the corresponding probability.

## Response of Volatility to Distance

According to the volatility SDE under Q Equation, the implied volatility fluctuates around long-term mean of volatility . For researching the response of volatility to distance between the and ,we let , thus:

When the are higher than ,the will be more negative,

# 样本与变量

# 实证检验

# 稳健性检验

# 解释

# 结论

1. Heston(1993) set the SDE of volatility as , but we can change the with the to get the SDE in this paper easily. [↑](#footnote-ref-1)