



भारतीय प्रौद्योगिकी संस्थान गुवाहाटी  
INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

# MA 374: Financial Engineering Lab **Lab 08**

---

AB Satyaprakash (180123062)

**Note:** 

1. All the questions have been solved in a single python file, so kindly wait (~4 mins) while the program runs.
2. All plots are in the /Plots folder and the NSE and BSE data (stocks and indices are in the respective folders)
3. Please run python programs using python3, i.e., `python3 <filename>.py`

For this question we have used data of 10 stocks each of NSE (inside nsedata1.csv) and BSE. We have also used the data of NSE and BSE indices.

## Question 1, 2 and 3.

- Historical volatility was obtained by taking the data and then finding the standard deviation of returns, which are obtained as

$$\text{return}[i] = \frac{S[i+1] - S[i]}{S[i]}$$

- This was then scaled by a factor or  $\sqrt{252}$ , to express it in annualized terms. Here we are assuming that there are 252 trading days by convention.
- Now we take the final value of the stock price, i.e. on Dec 31, 2018 as  $S_0$ , and  $K = AS_0$ , where  $A = 0.5 : 0.1 : 1.5$ , with r=5% and compute European Call and Put option prices with an expiry period of 6 months.
- We have tabulated the data, displaying them as pandas Data frames, and the graphs have been attached below.
- We make the following observations:
  - The value of  $\sigma$  (volatility) is independent of the value of A. This is evident from the tables where we get the same volatility irrespective of the value of A

- As A increases from 0.5 to 1.5, the Strike Price K also increases. This is why the call option price decreases and the put option price increases.
- In case of most stocks, as we go backwards in time month by month, the option prices initially decrease and then start to increase again (look at the graphs). This is a general behavior and might differ from stock to stock.

## Question 4.

The data has been obtained and added as an excel sheet in the zip file of the report.

## Extras...

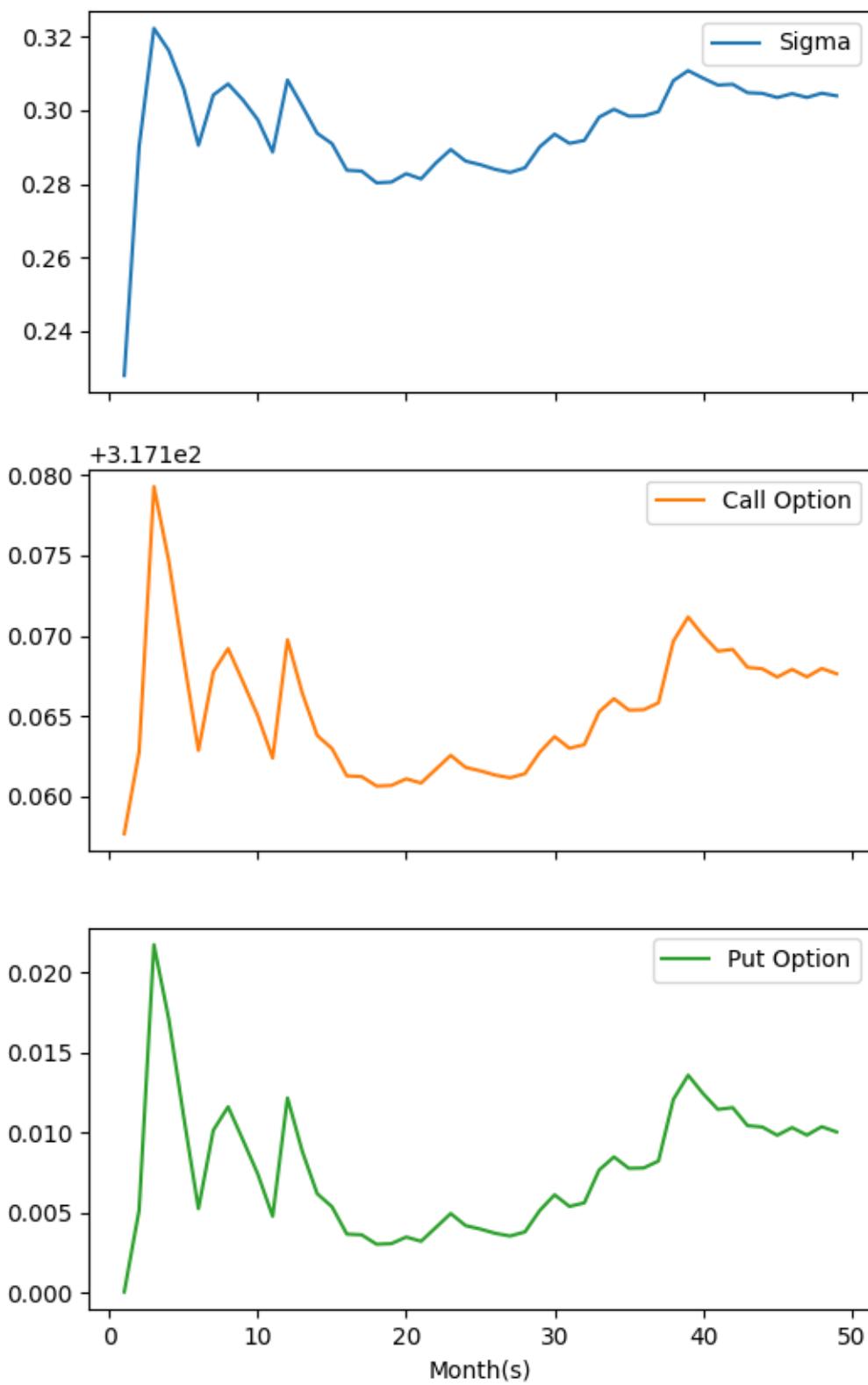
The following packages need to be installed for this lab.

*Kindly use pip3 since the code must be run in python 3 as mentioned previously.*

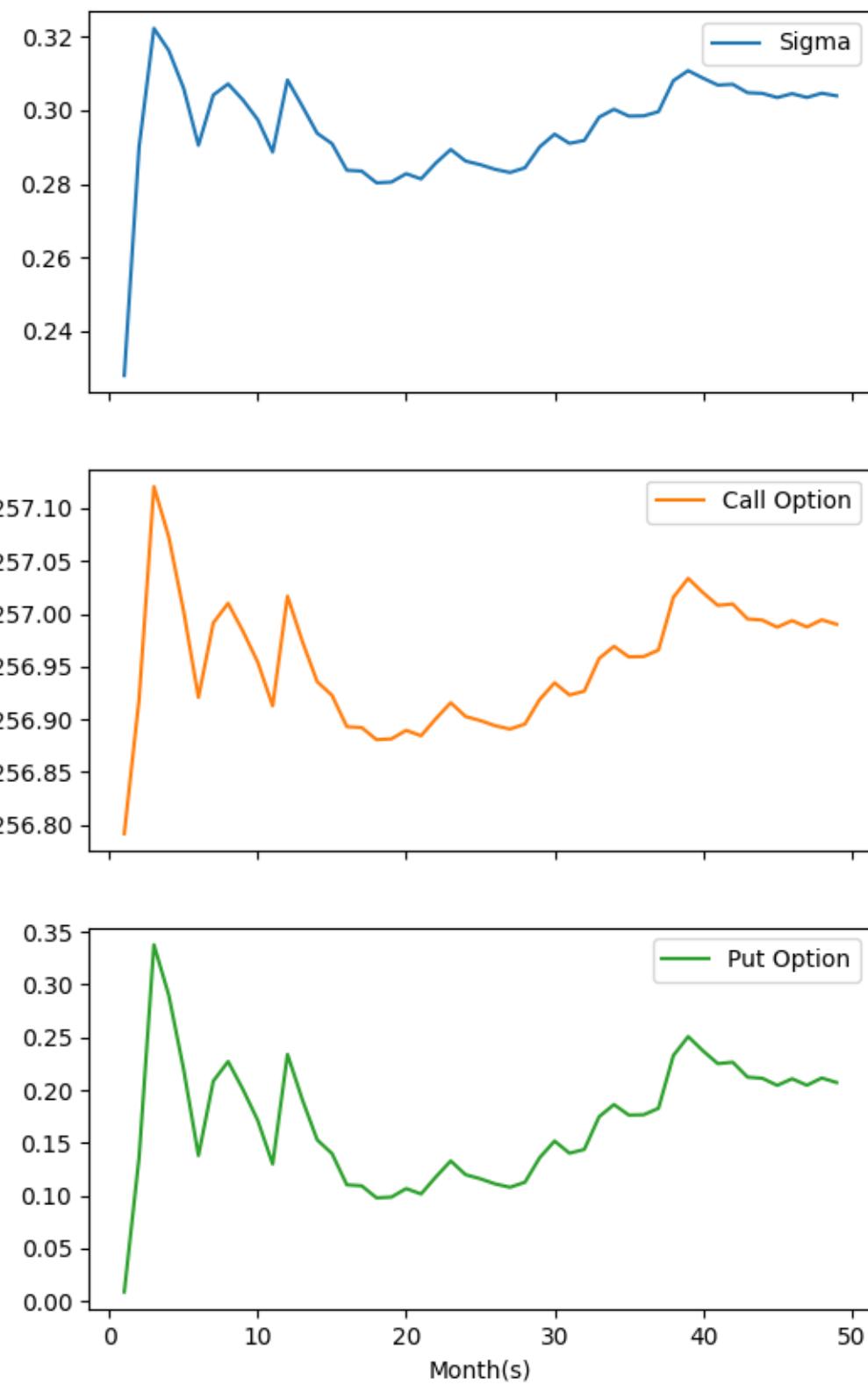
```
Numpy - pip3 install numpy  
Pandas - pip3 install pandas  
Matplotlib - pip3 install matplotlib  
Scipy - pip3 install scipy
```

# **BSE Stocks**

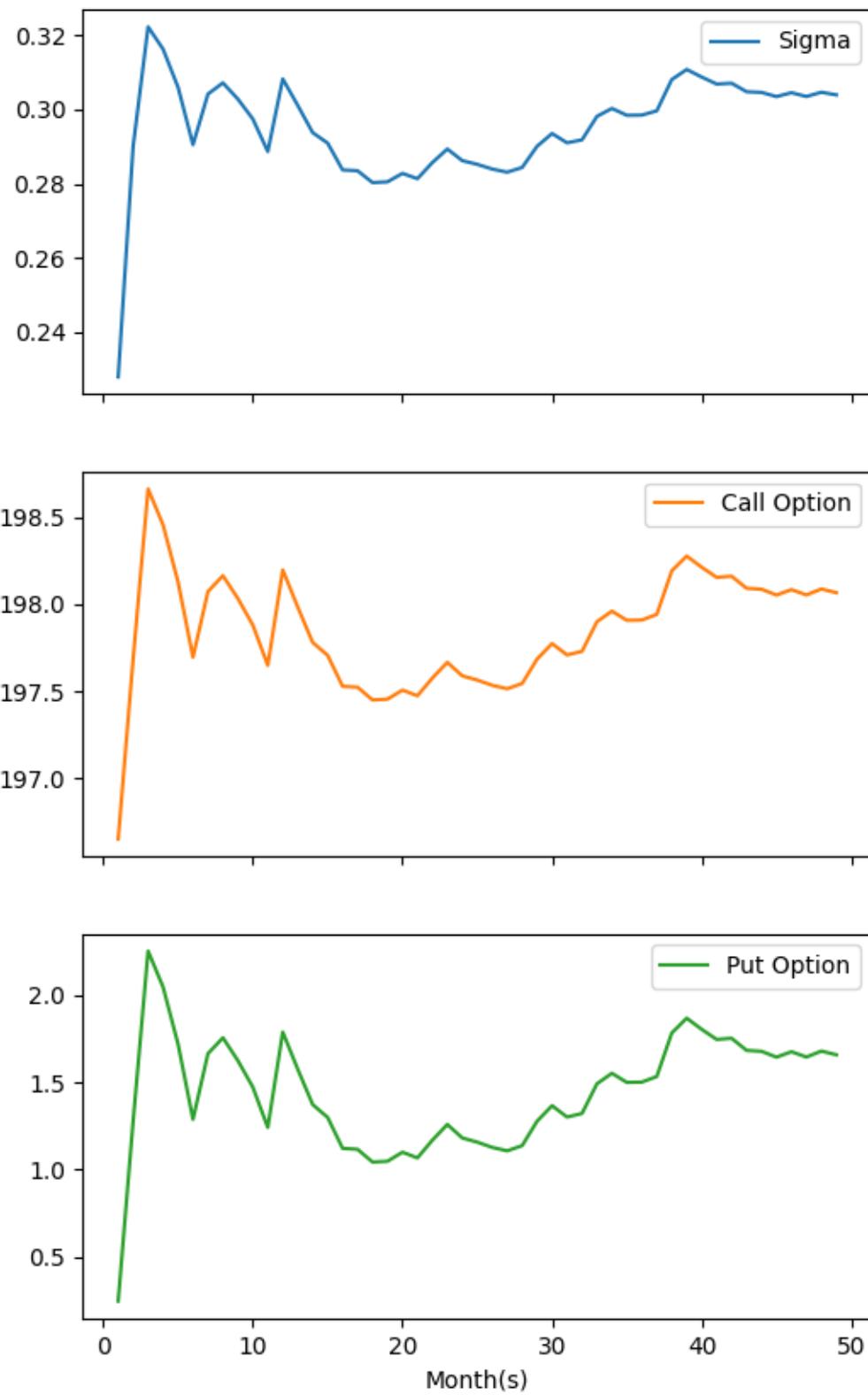
### Plot of AXISBANK (BSE) with A = 0.5



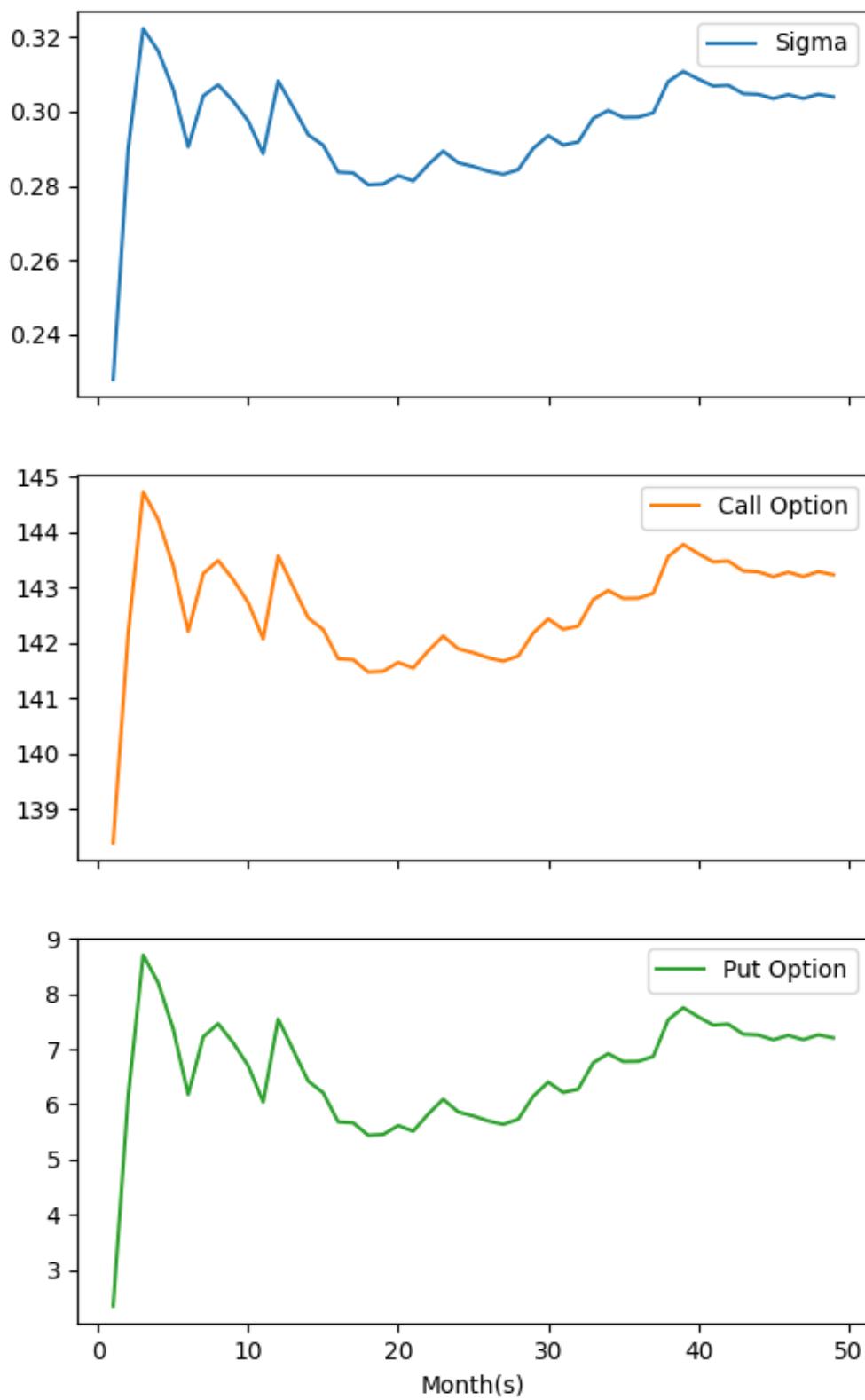
### Plot of AXISBANK (BSE) with $A = 0.6$



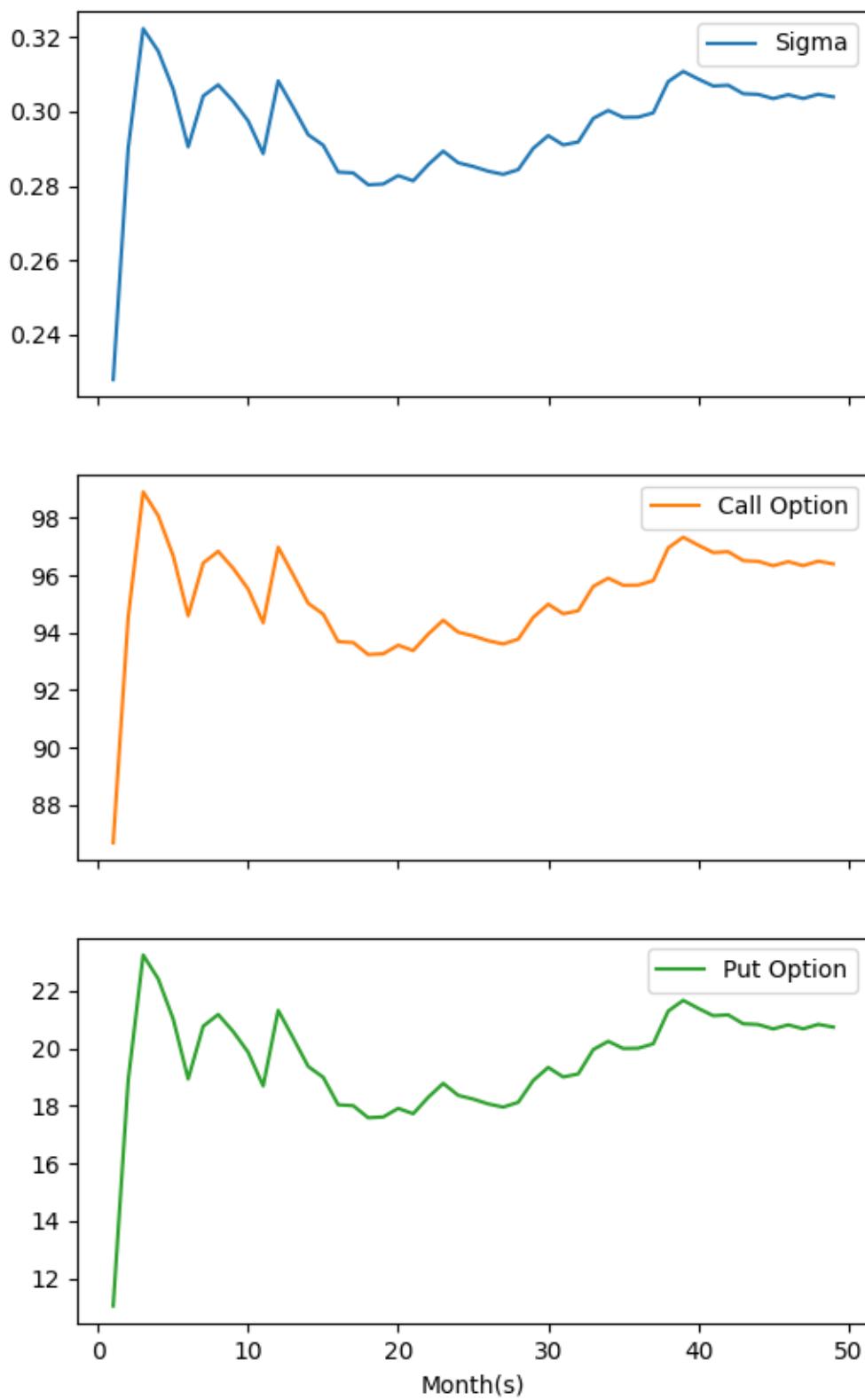
### Plot of AXISBANK (BSE) with $A = 0.7$



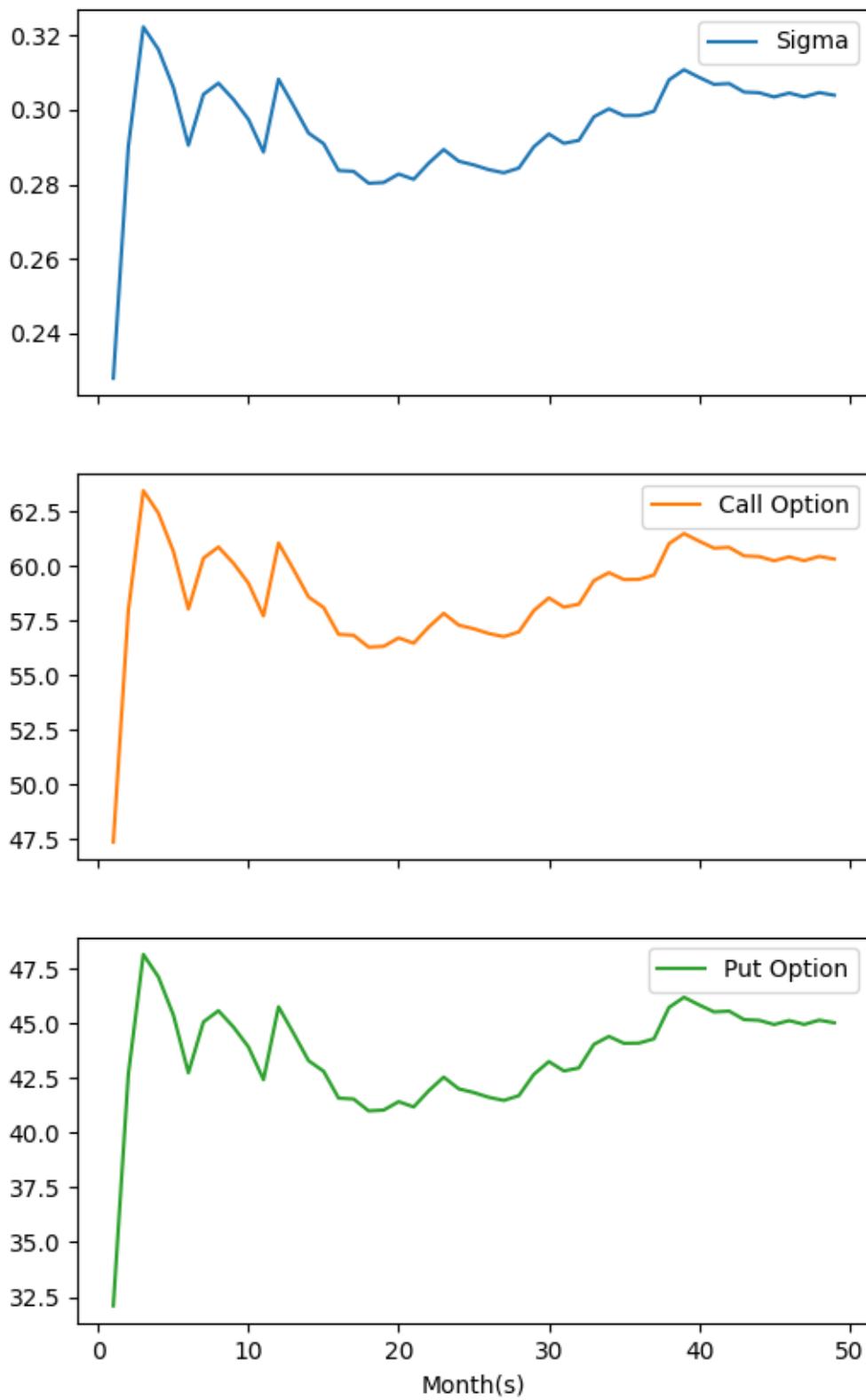
### Plot of AXISBANK (BSE) with $A = 0.8$



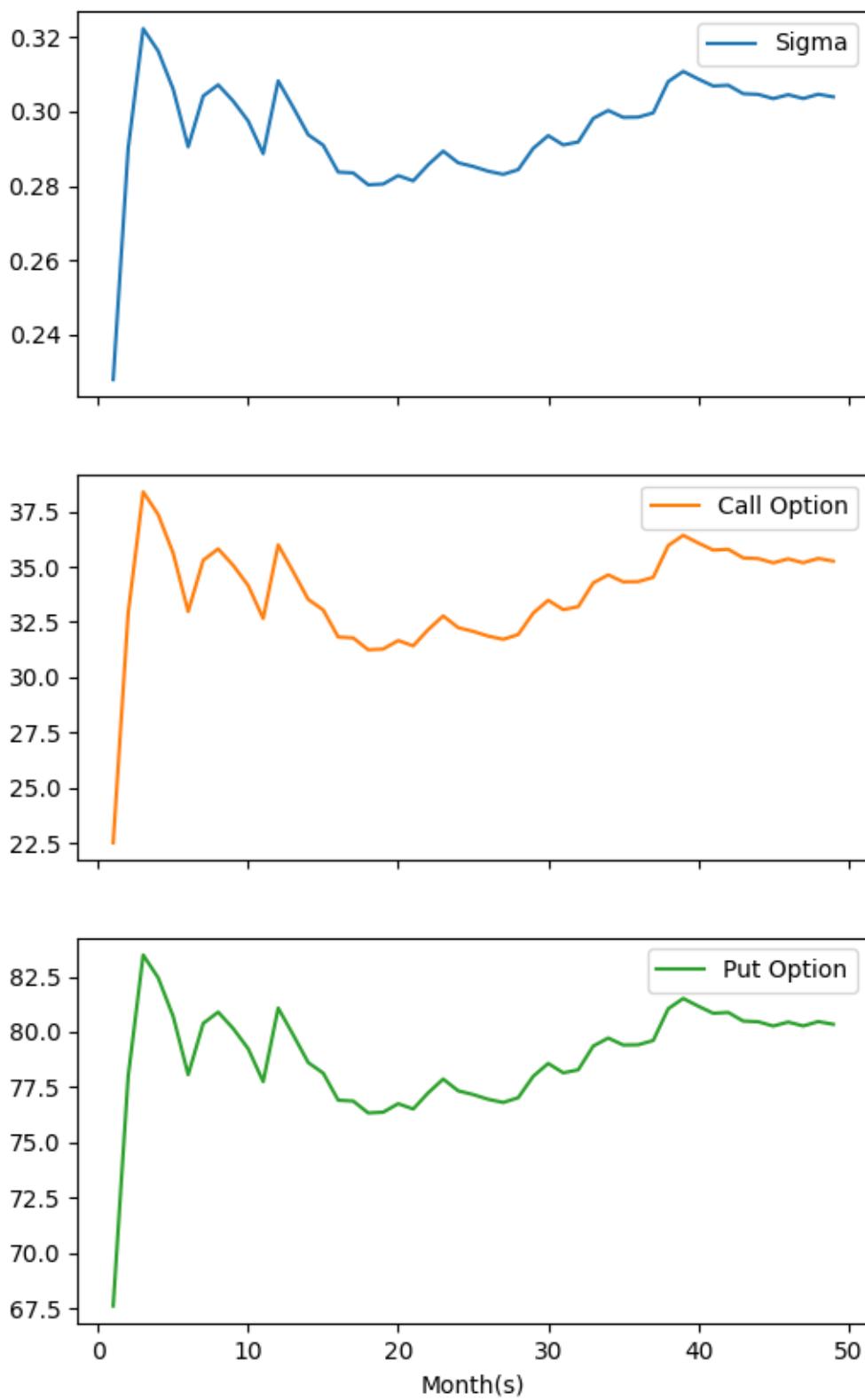
### Plot of AXISBANK (BSE) with $A = 0.9$



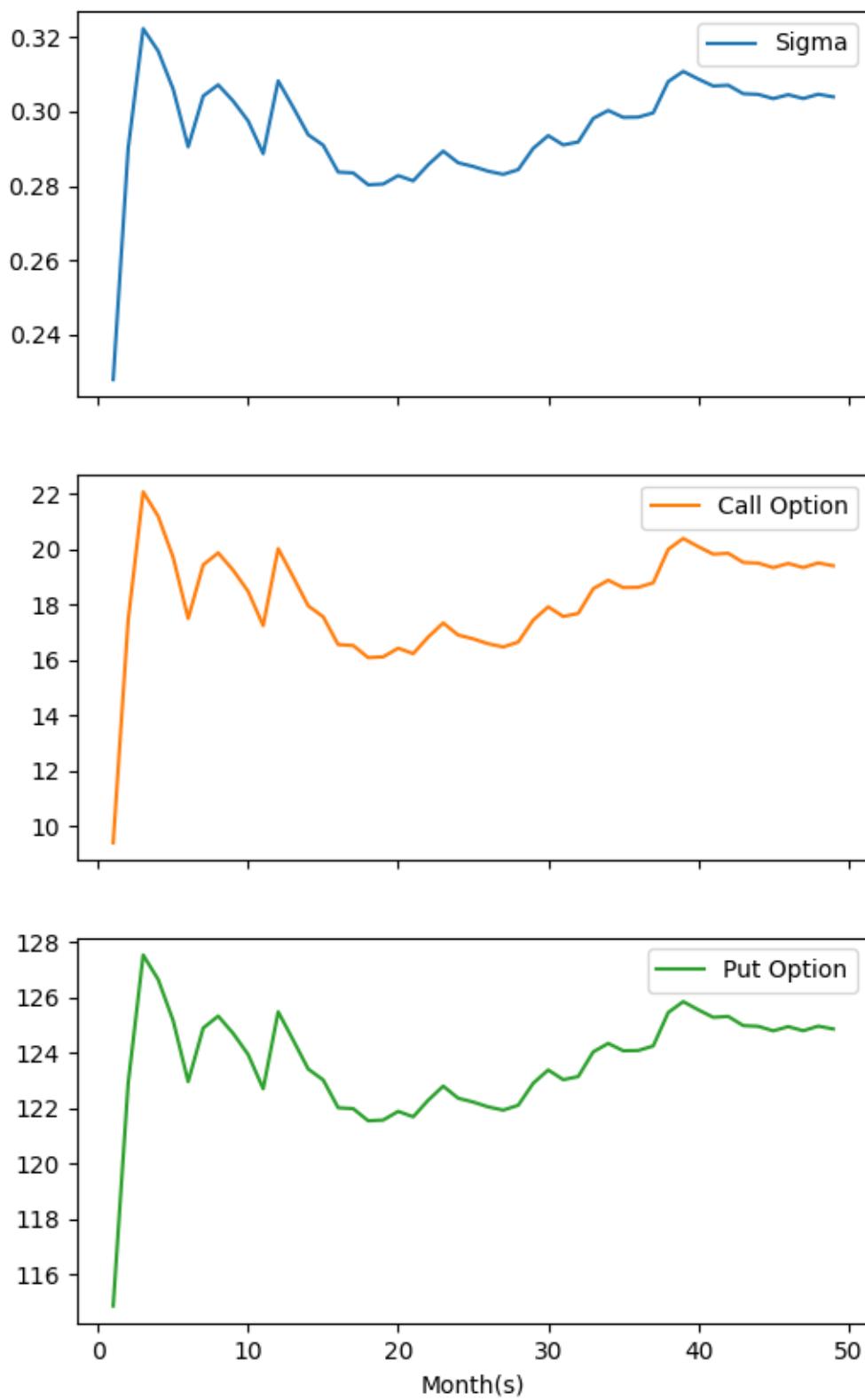
### Plot of AXISBANK (BSE) with A = 1.0



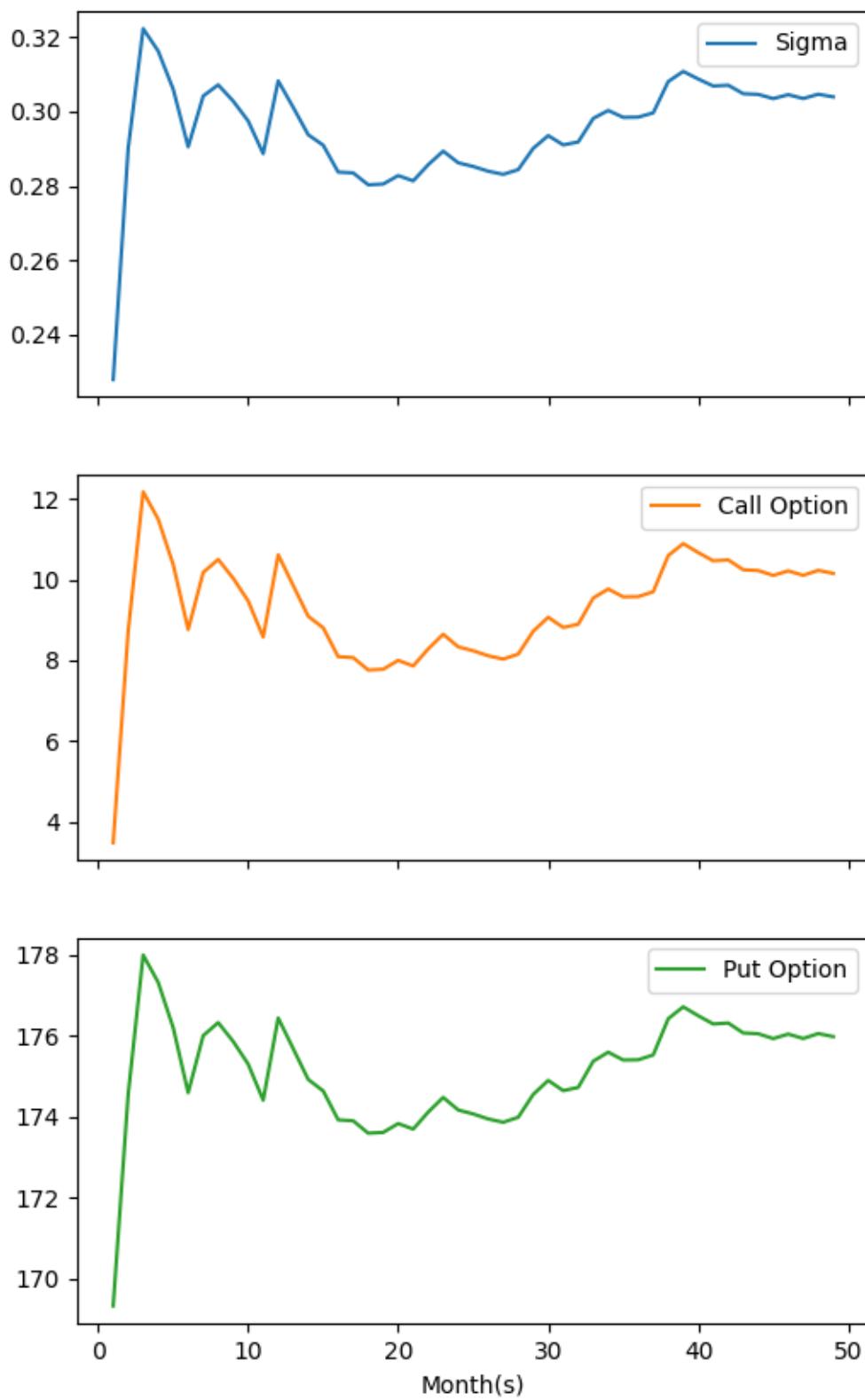
### Plot of AXISBANK (BSE) with A = 1.1



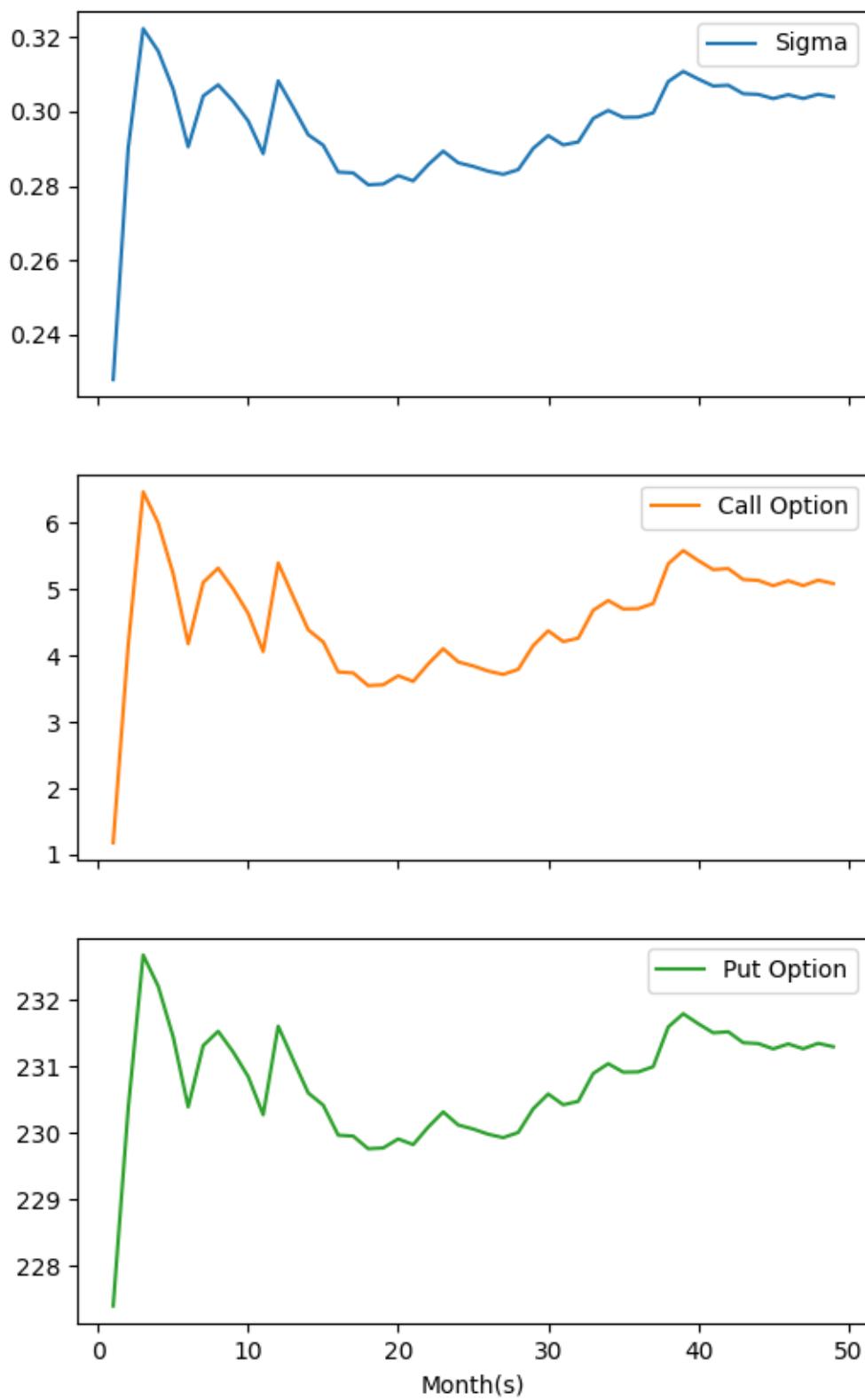
### Plot of AXISBANK (BSE) with A = 1.2



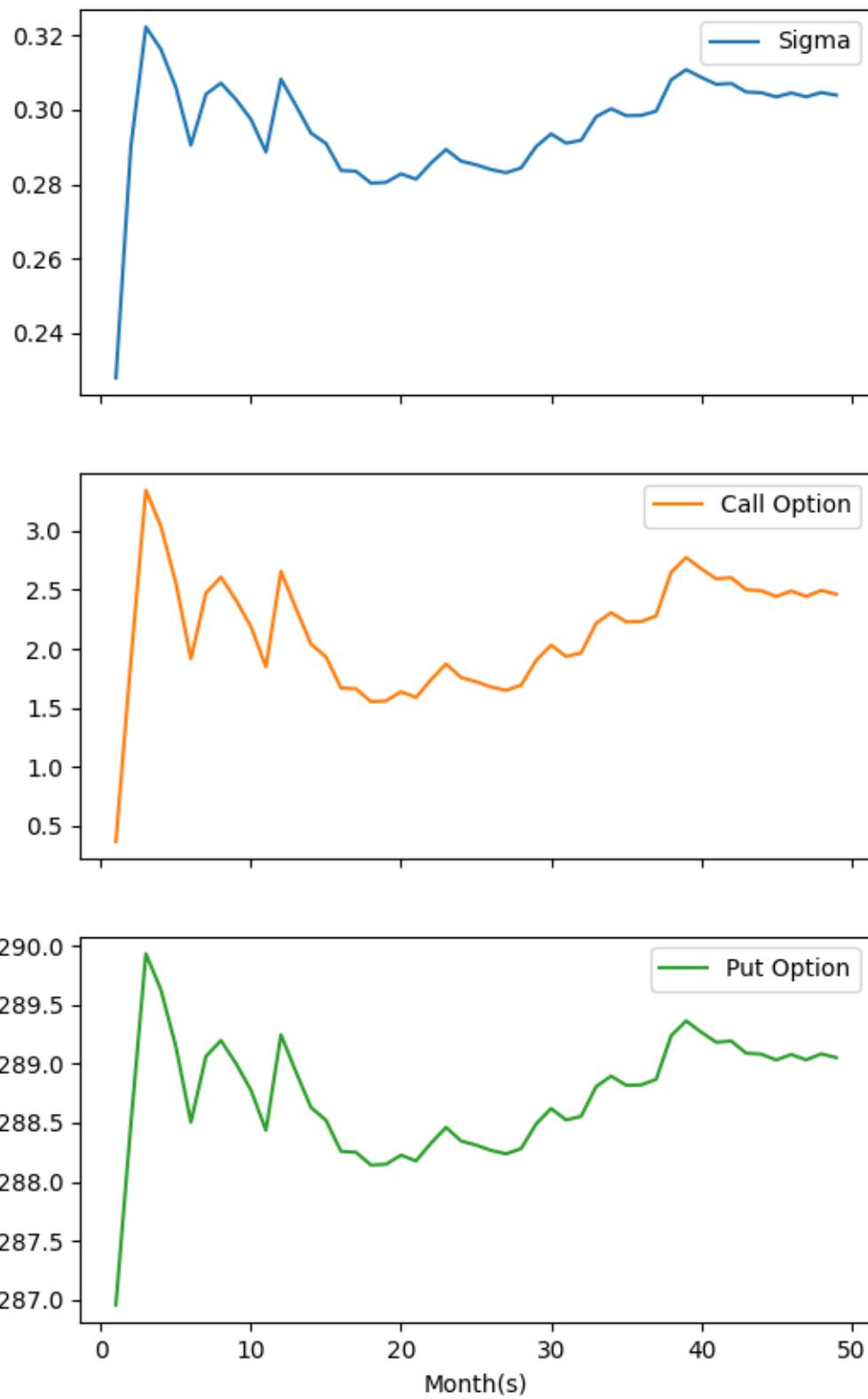
### Plot of AXISBANK (BSE) with $A = 1.3$



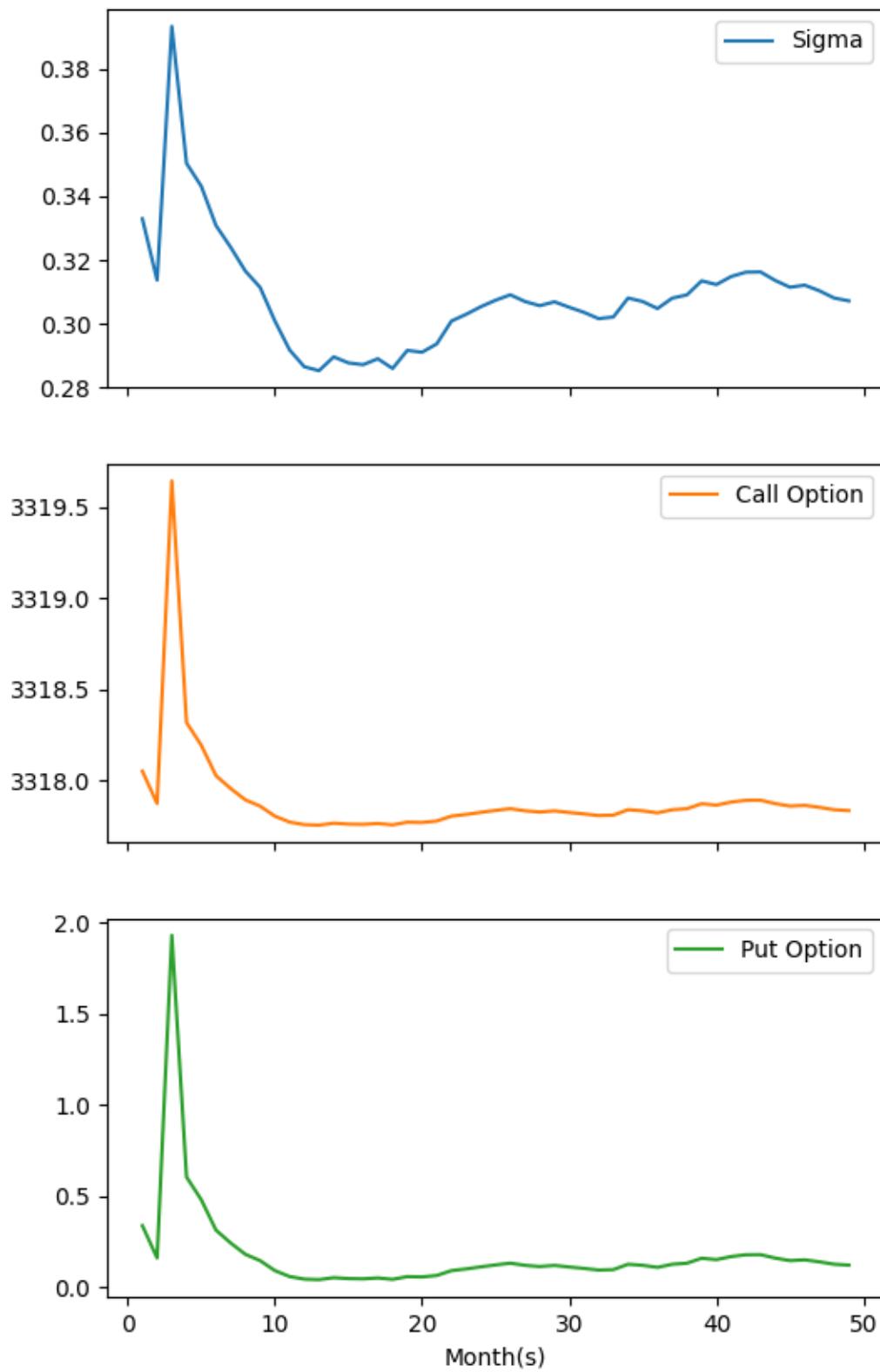
### Plot of AXISBANK (BSE) with $A = 1.4$



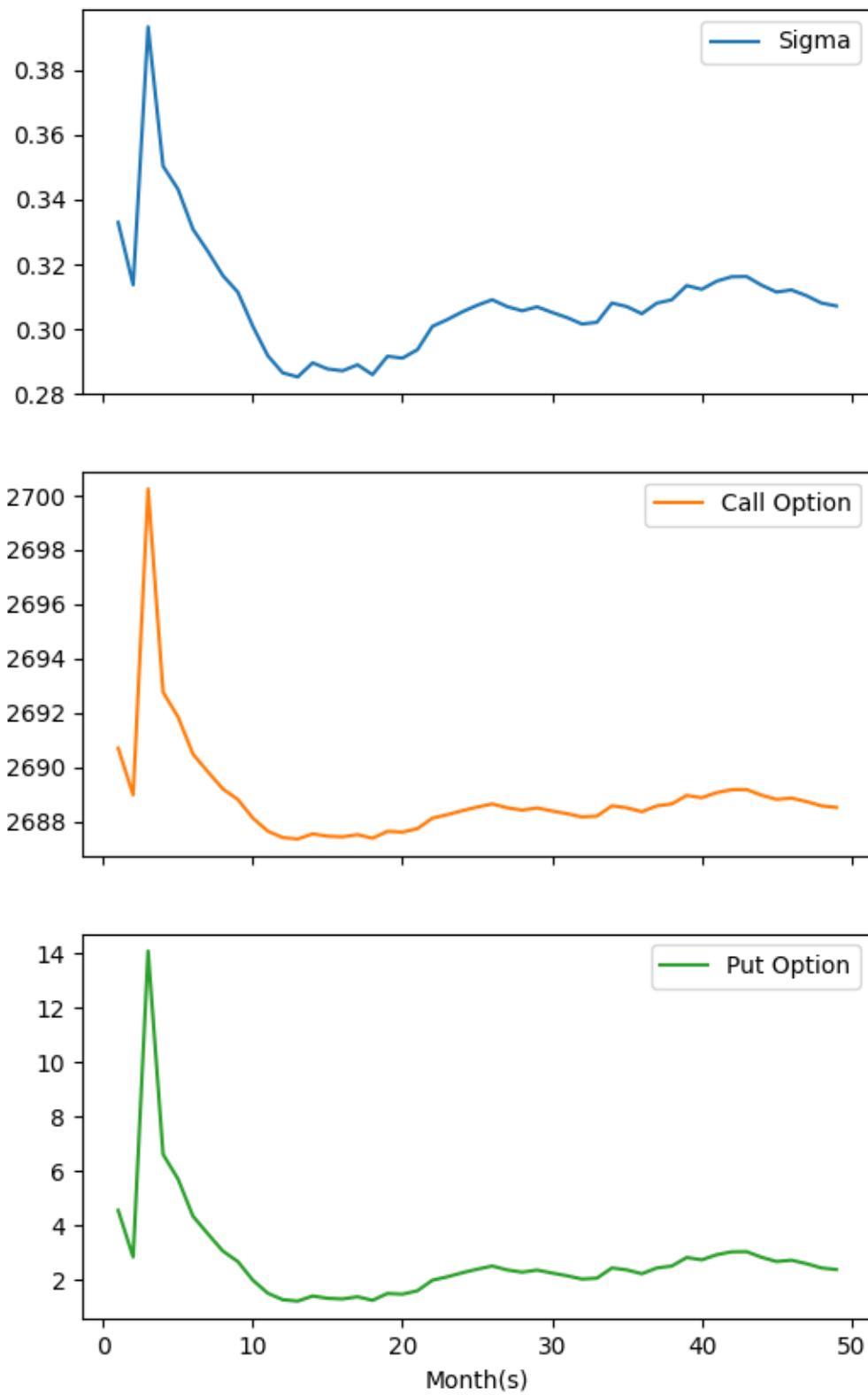
### Plot of AXISBANK (BSE) with $A = 1.5$



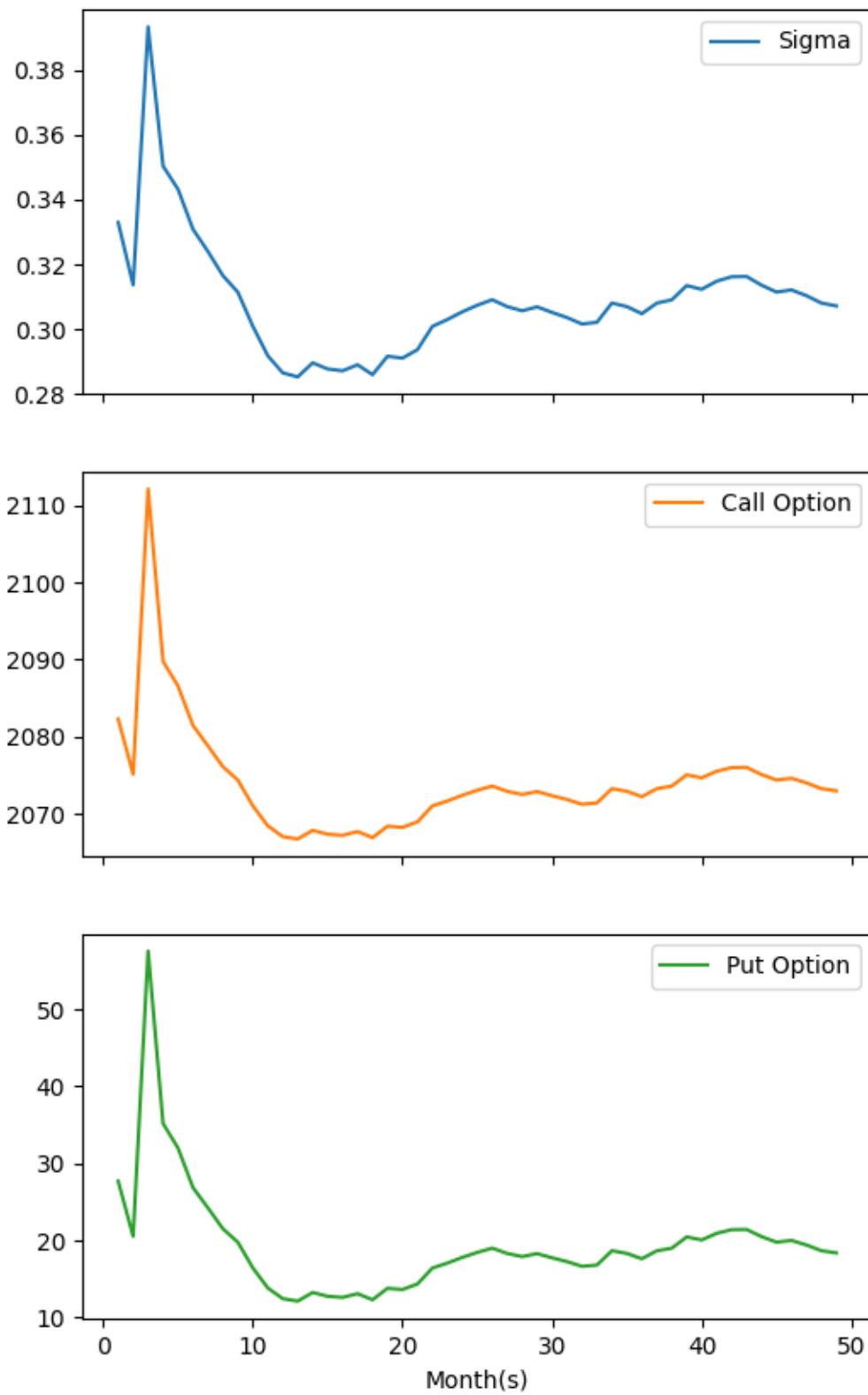
### Plot of BAJAJFINSV (BSE) with A = 0.5



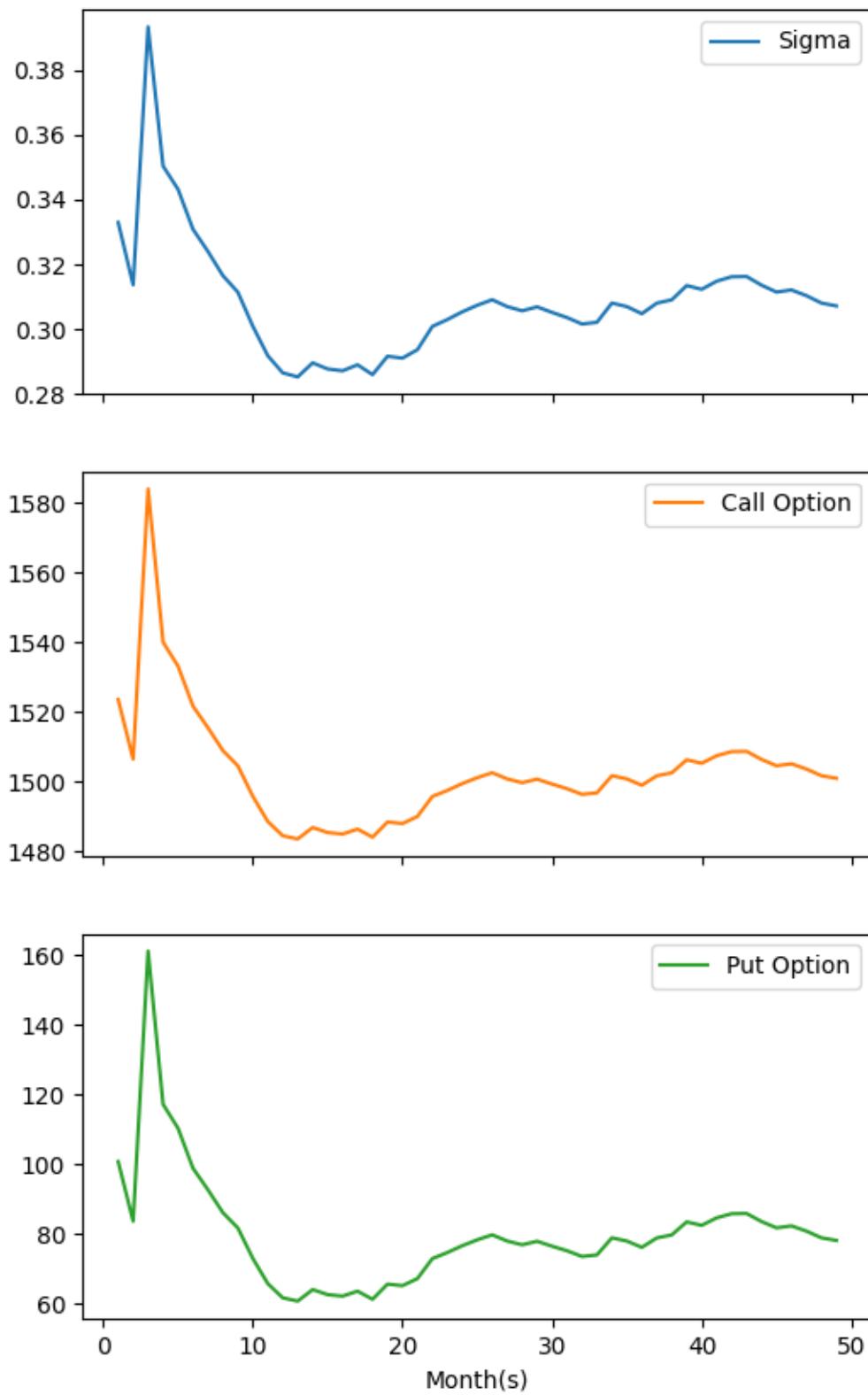
### Plot of BAJAJFINSV (BSE) with A = 0.6



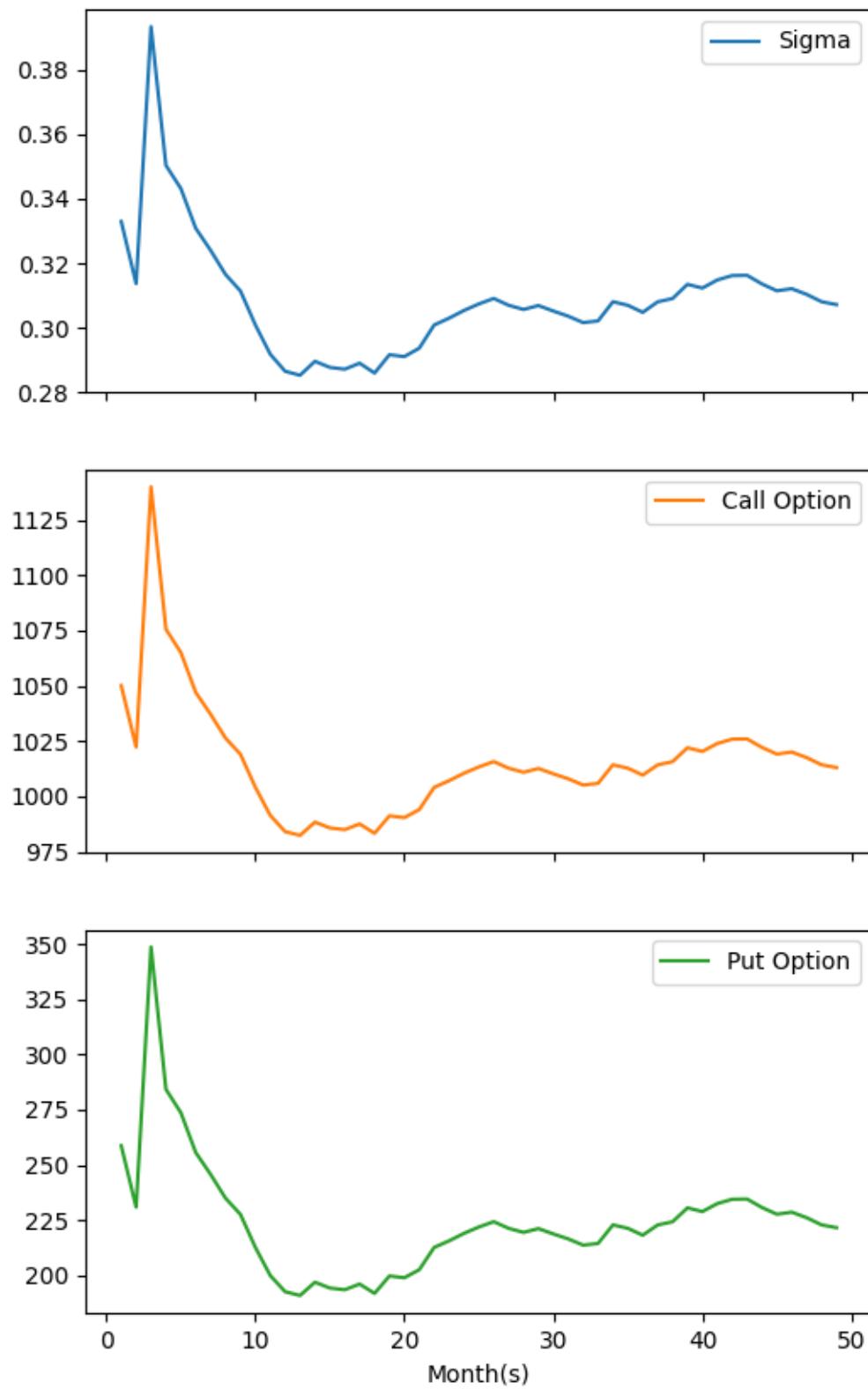
### Plot of BAJAJFINSV (BSE) with A = 0.7



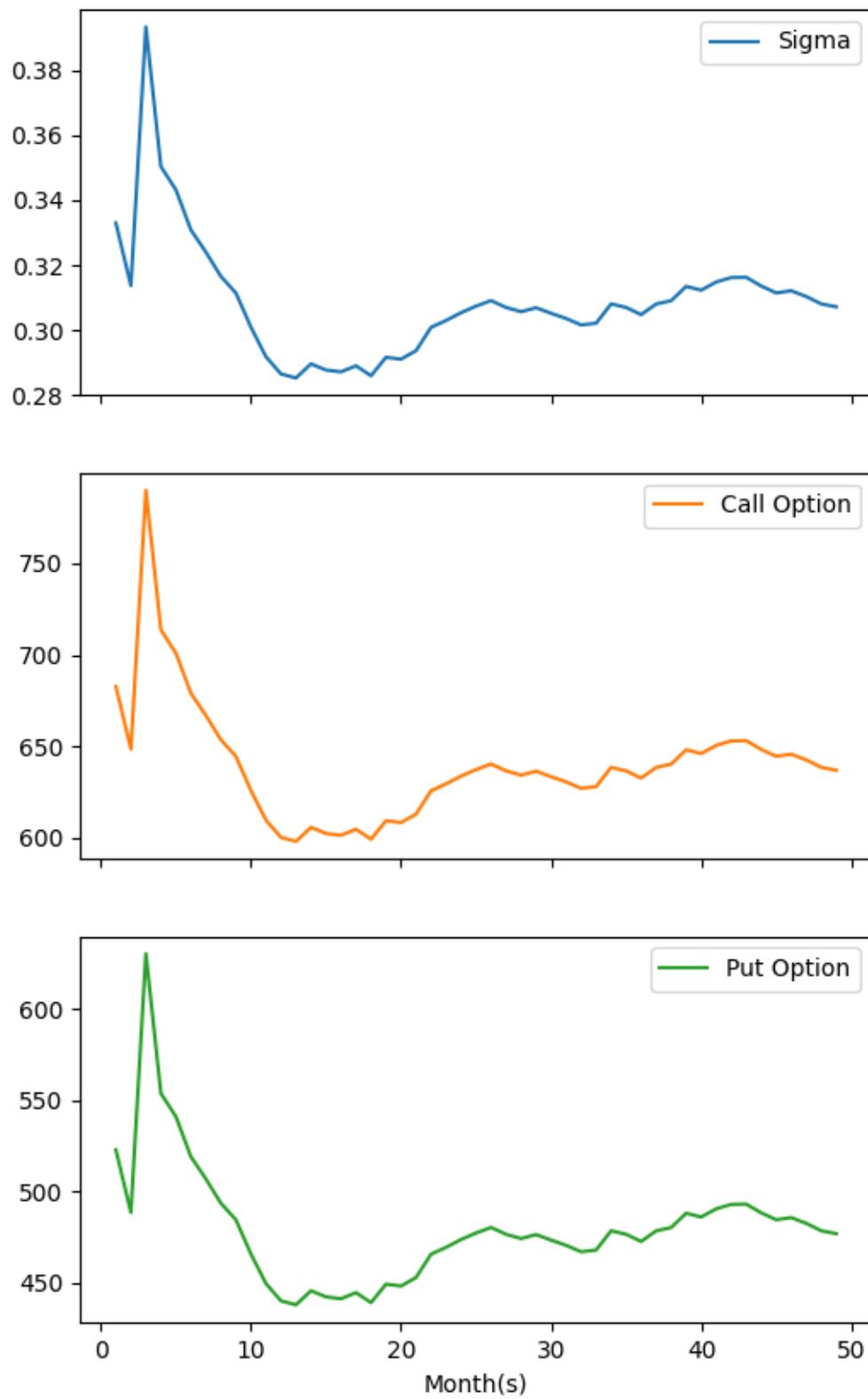
### Plot of BAJAJFINSV (BSE) with A = 0.8



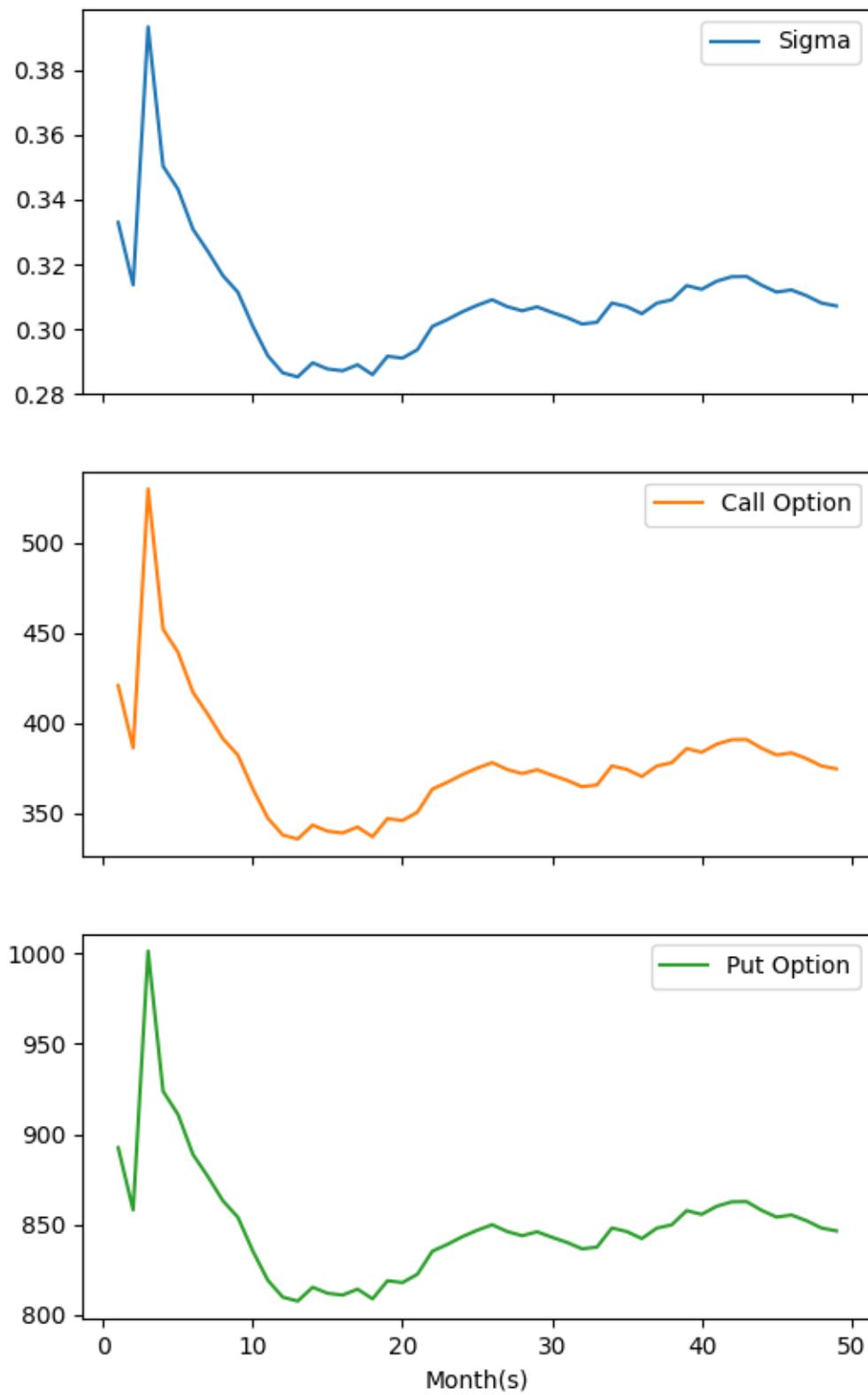
### Plot of BAJAJFINSV (BSE) with A = 0.9



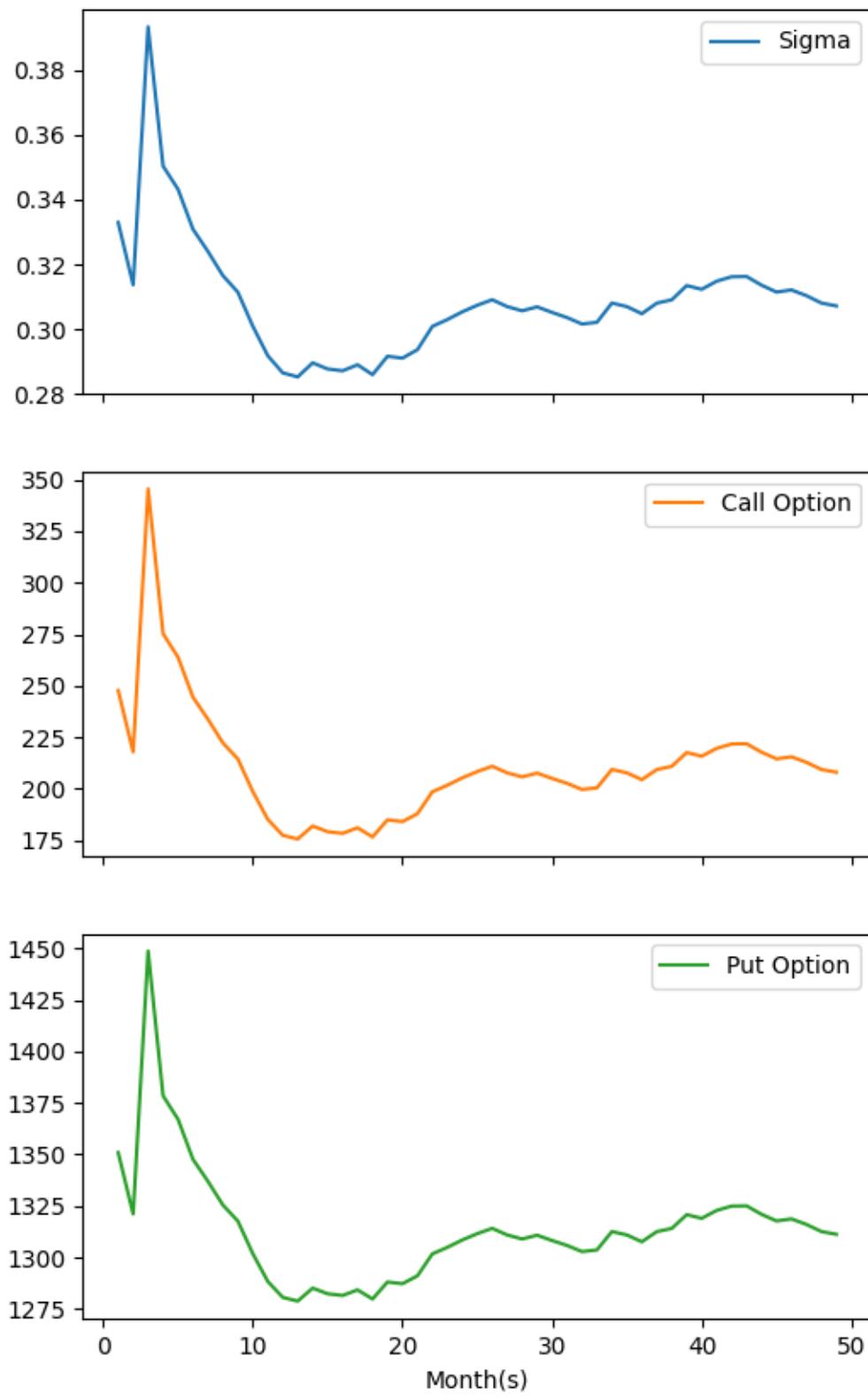
### Plot of BAJAJFINSV (BSE) with A = 1.0



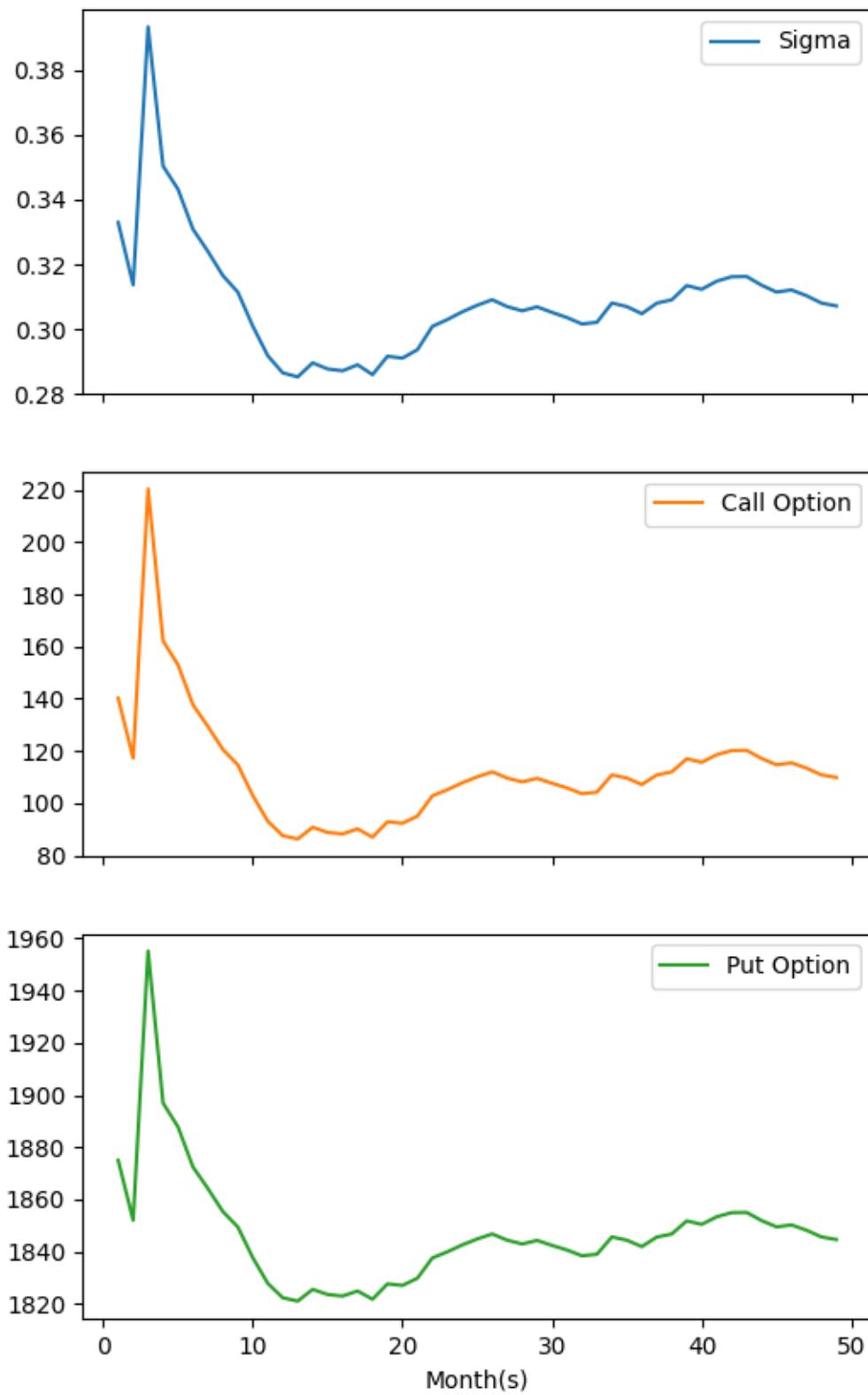
### Plot of BAJAJFINSV (BSE) with A = 1.1



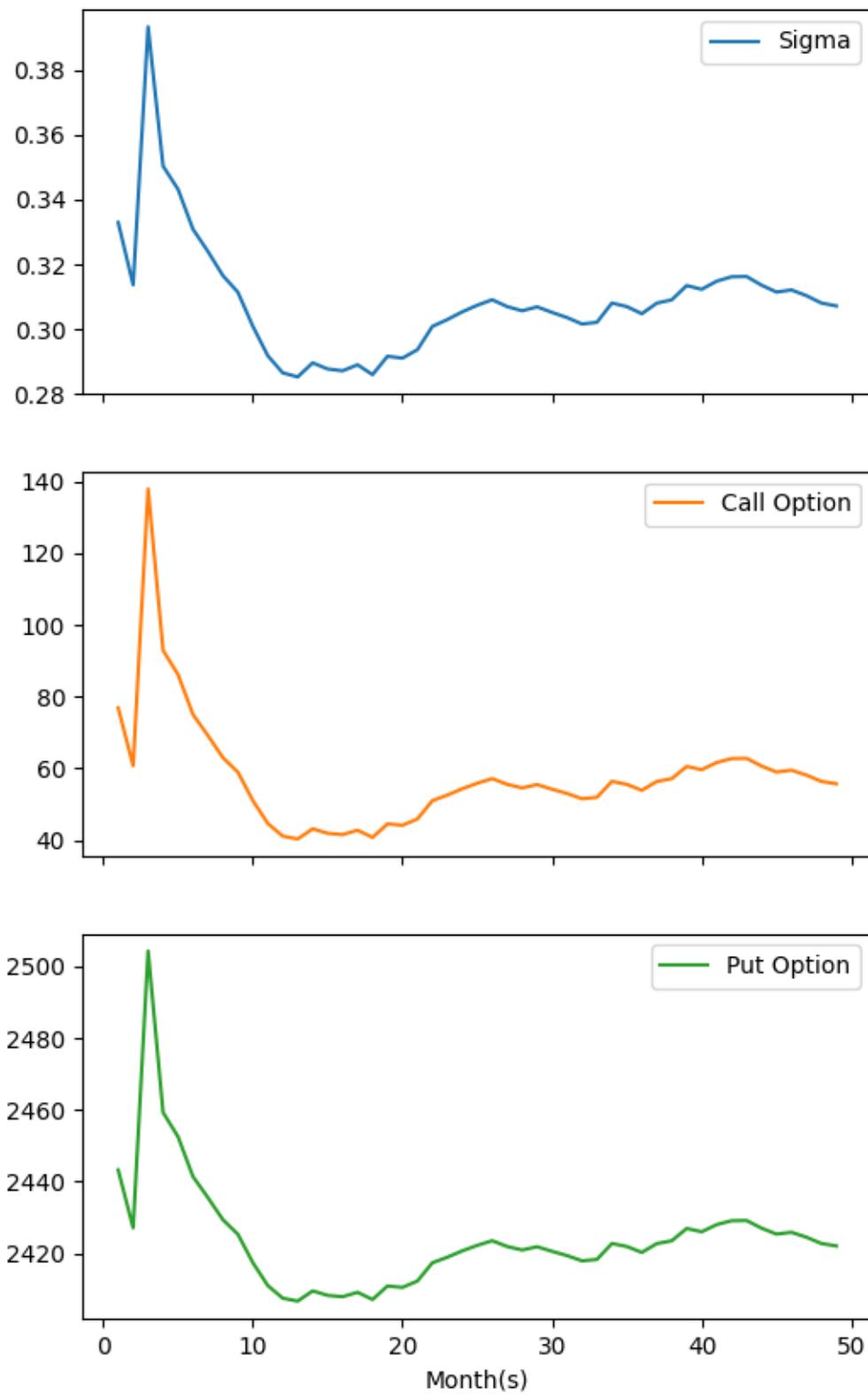
### Plot of BAJAJFINSV (BSE) with A = 1.2



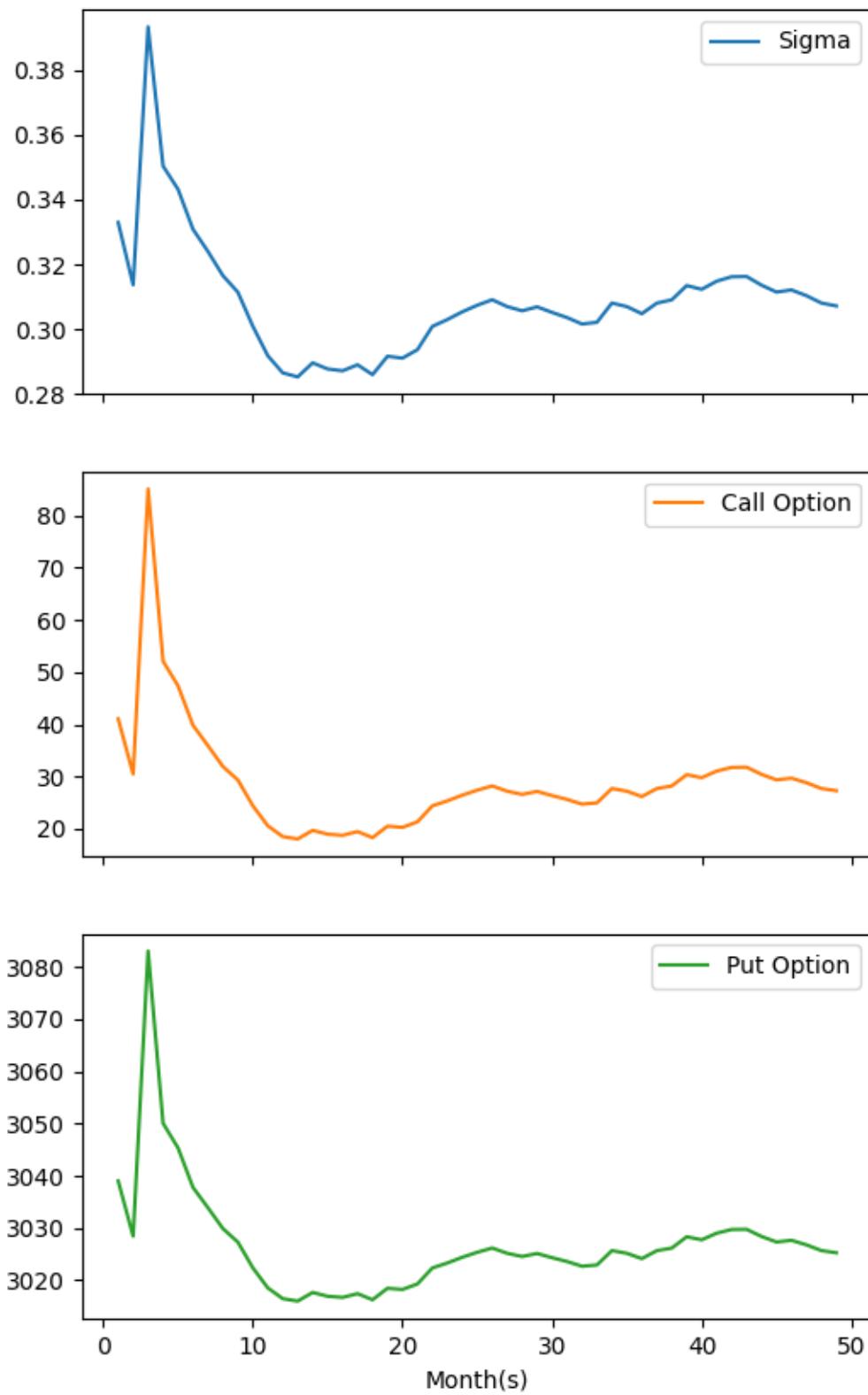
### Plot of BAJAJFINSV (BSE) with A = 1.3



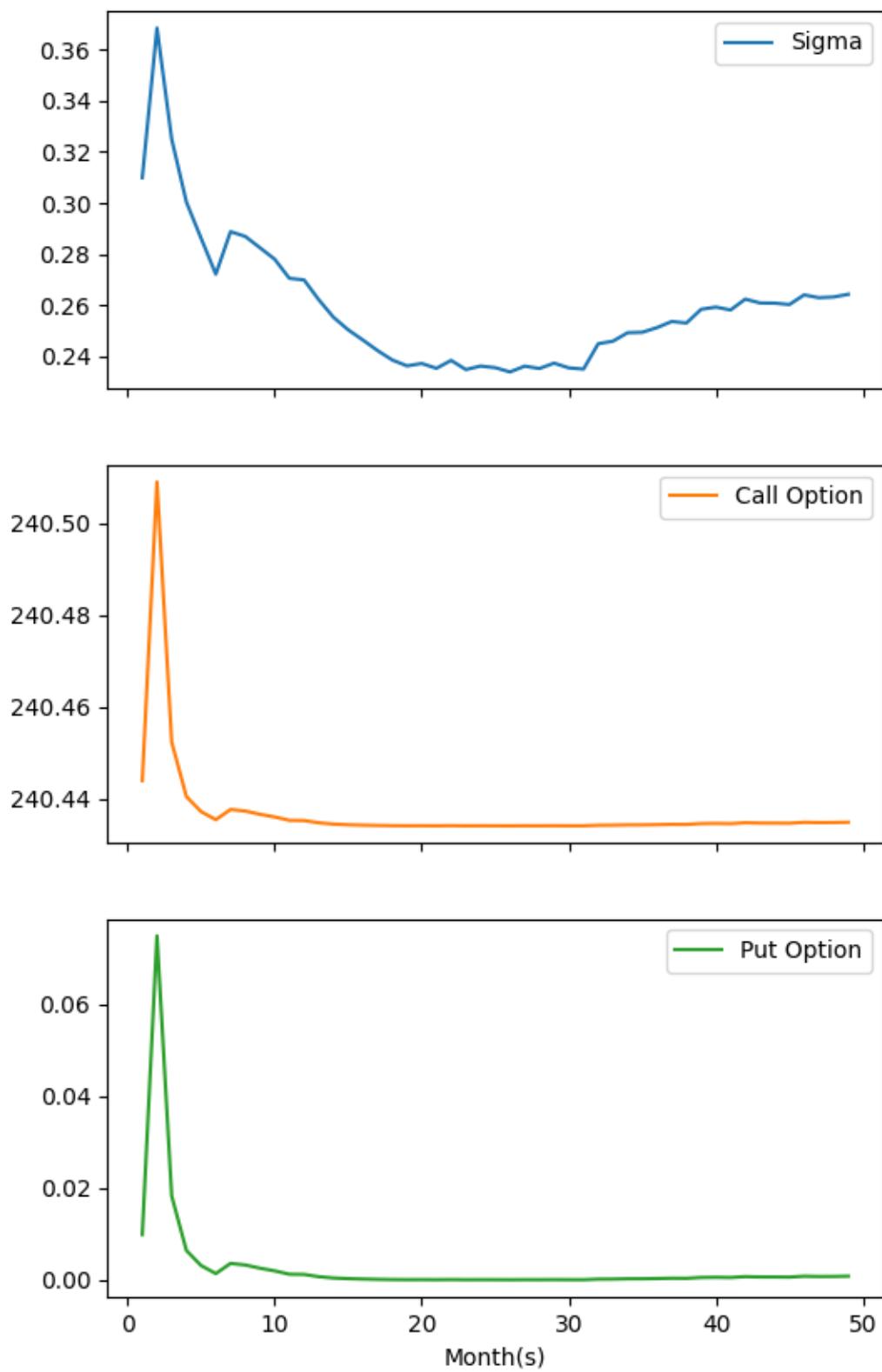
### Plot of BAJAJFINSV (BSE) with A = 1.4



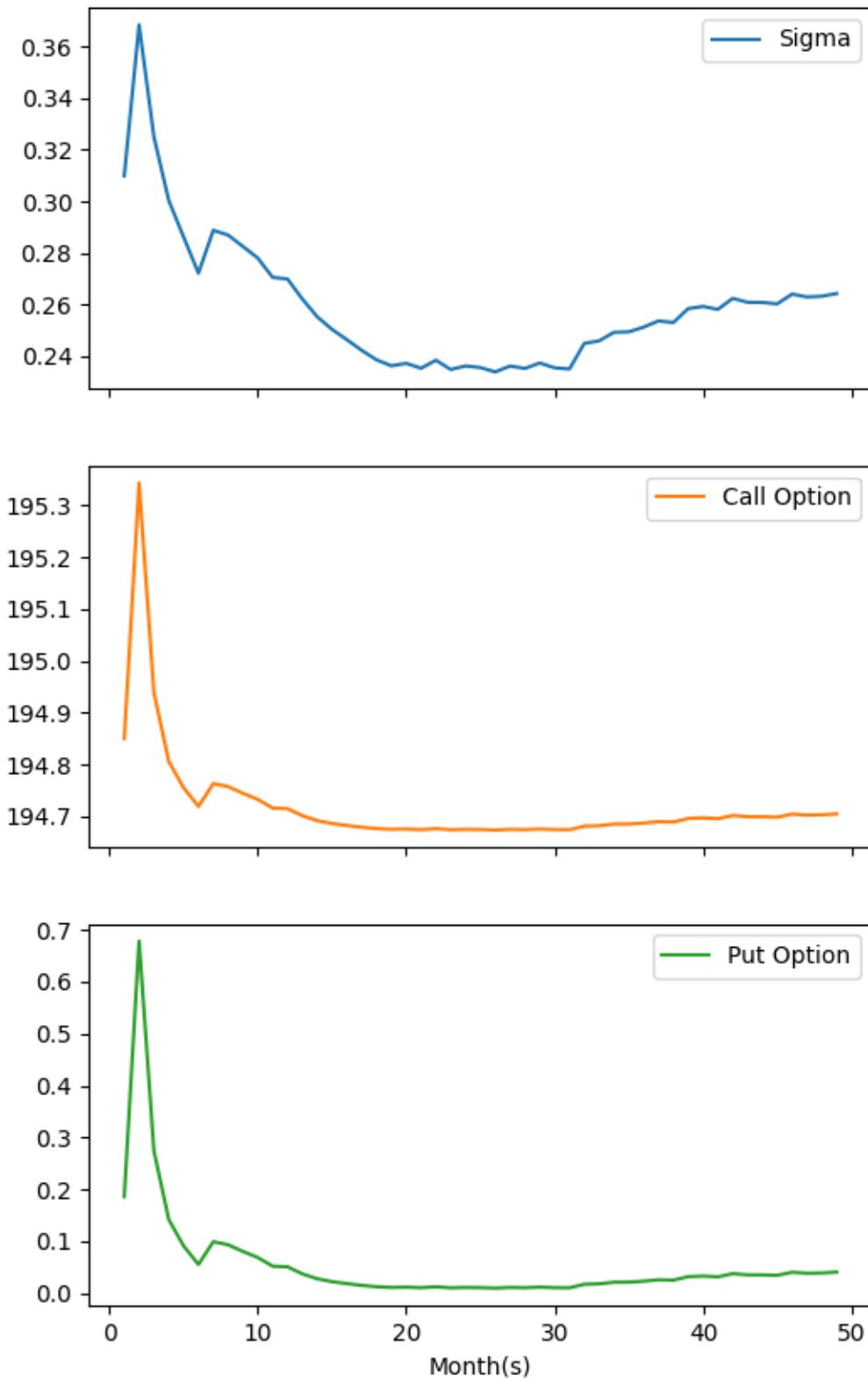
### Plot of BAJAJFINSV (BSE) with A = 1.5



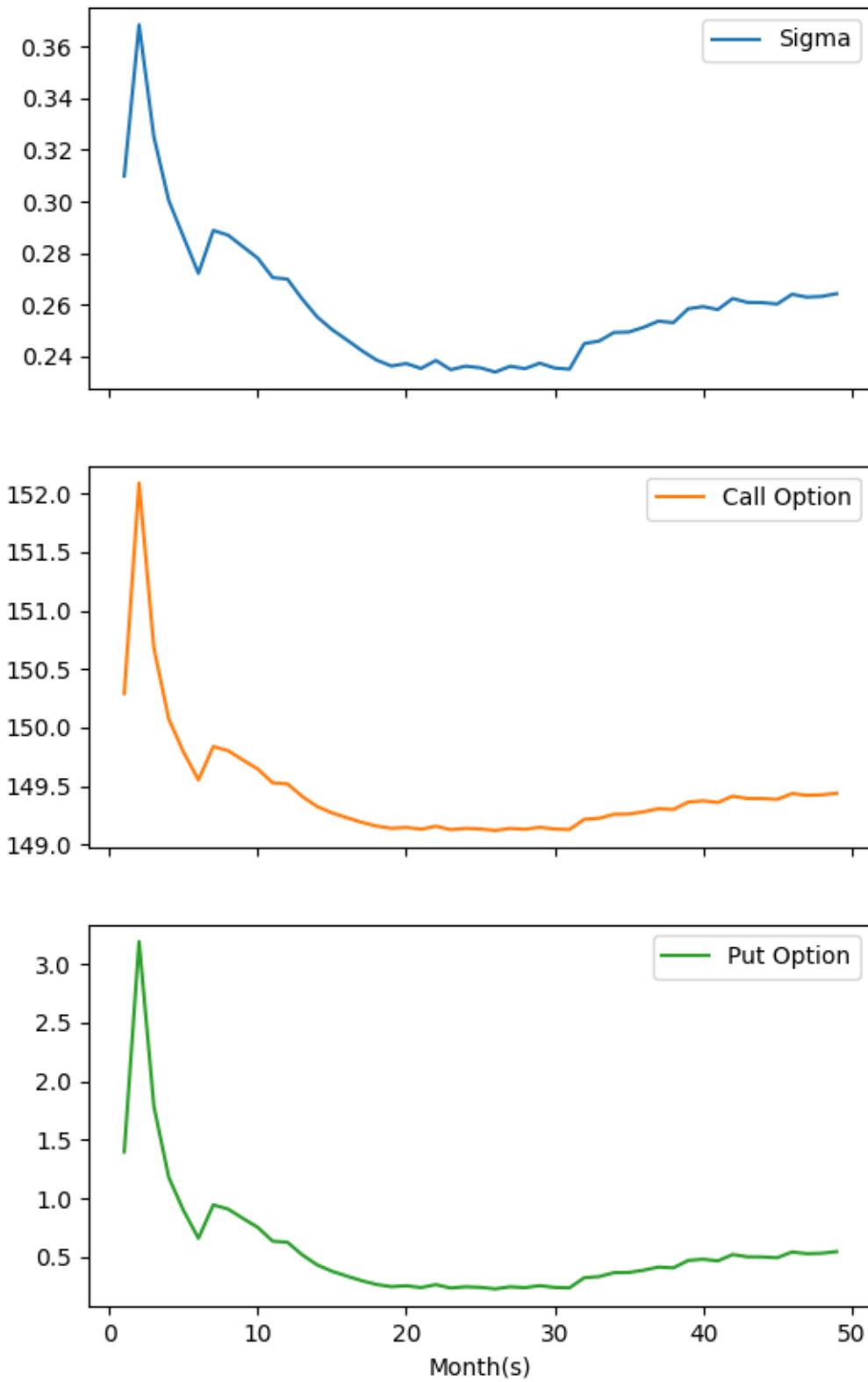
Plot of HCL (BSE) with  $A = 0.5$



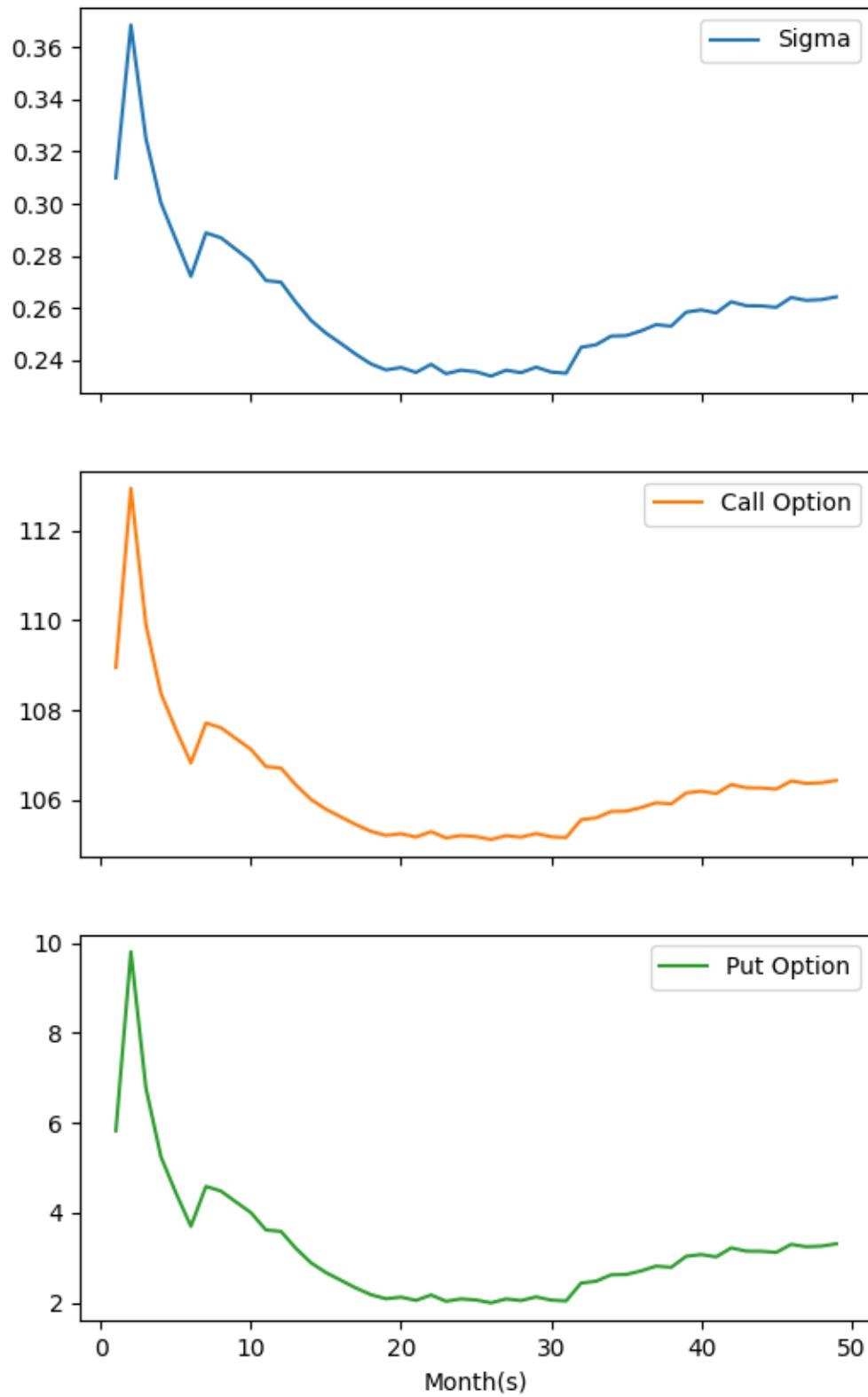
Plot of HCL (BSE) with  $A = 0.6$



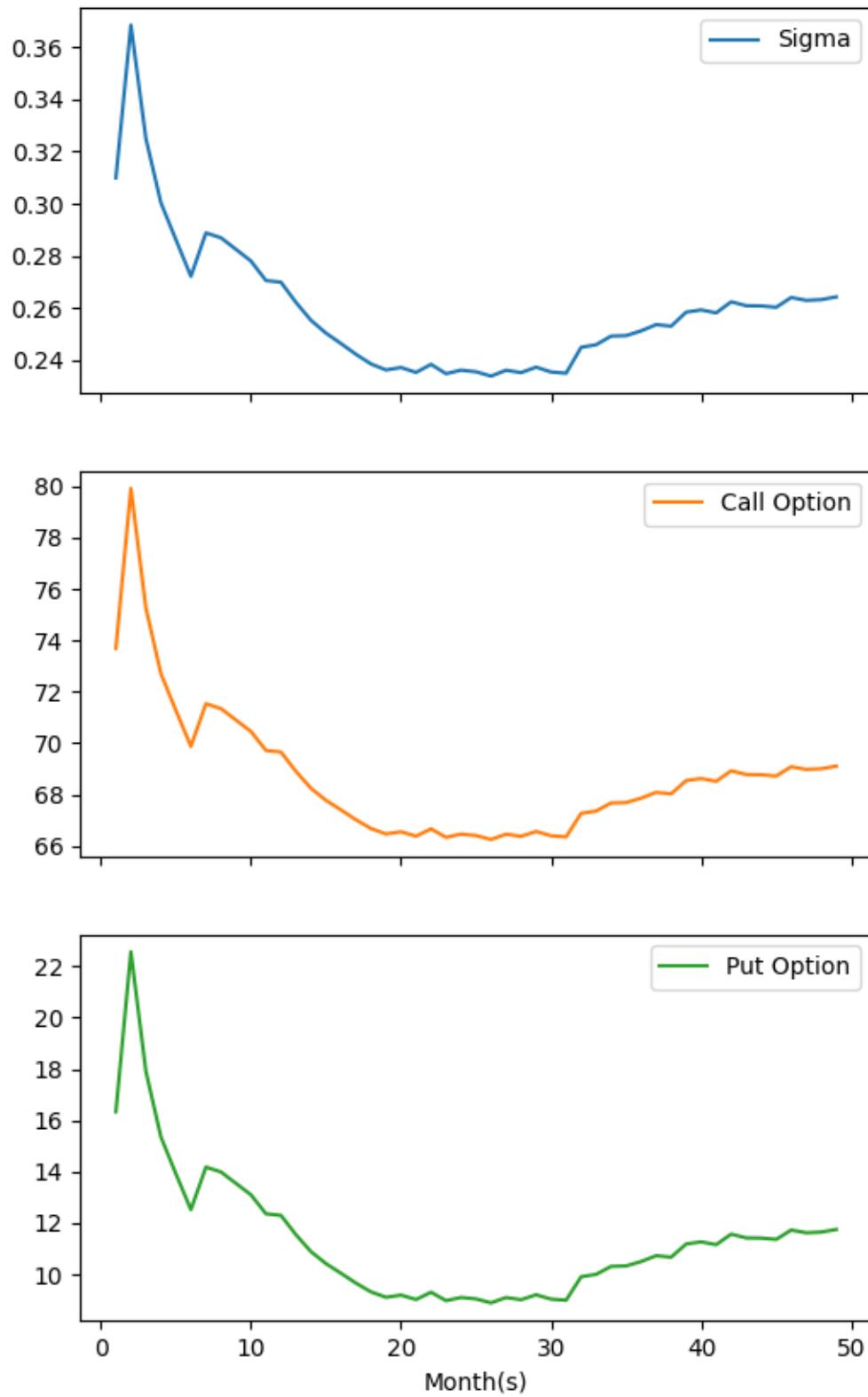
Plot of HCL (BSE) with A = 0.7



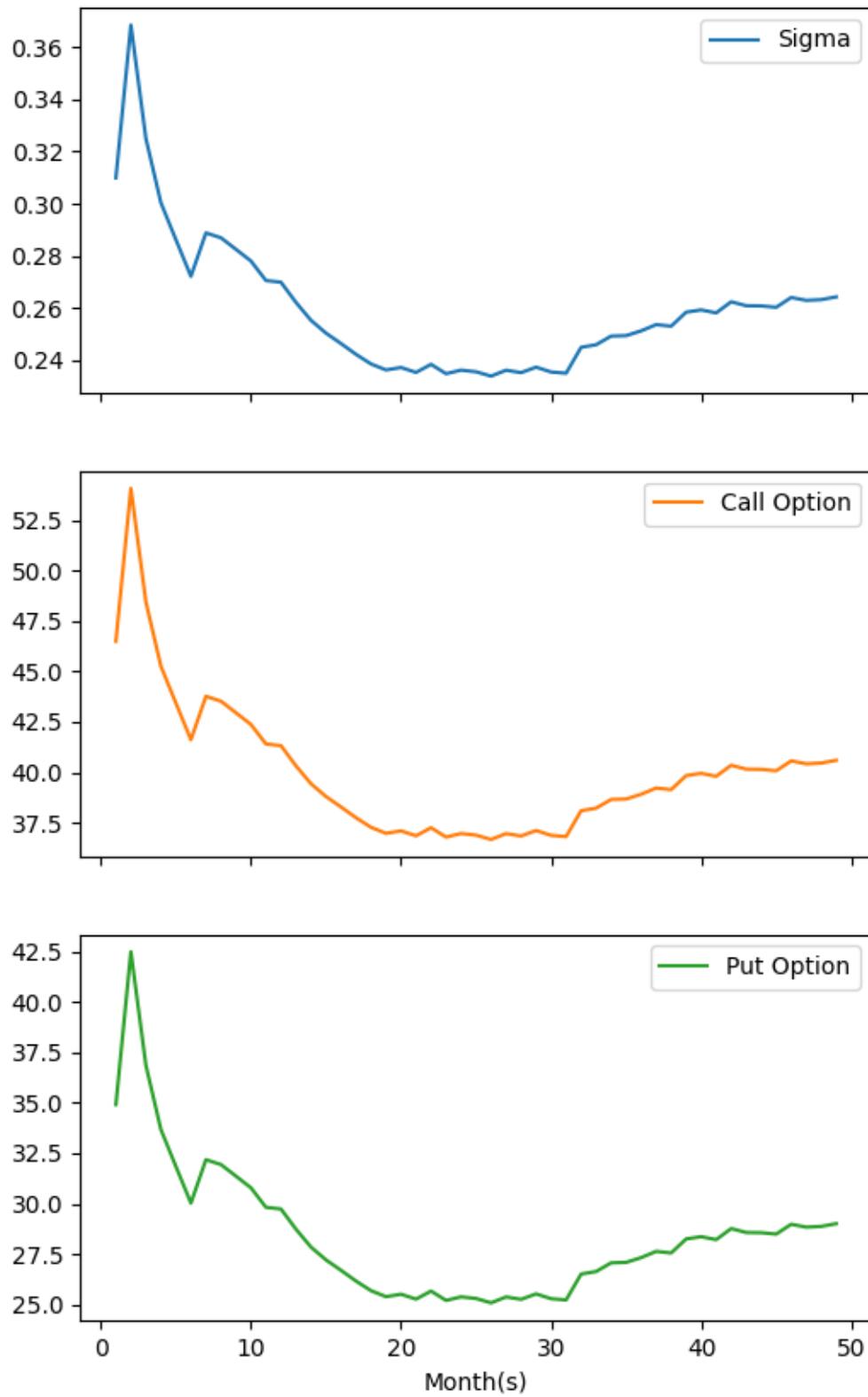
Plot of HCL (BSE) with  $A = 0.8$



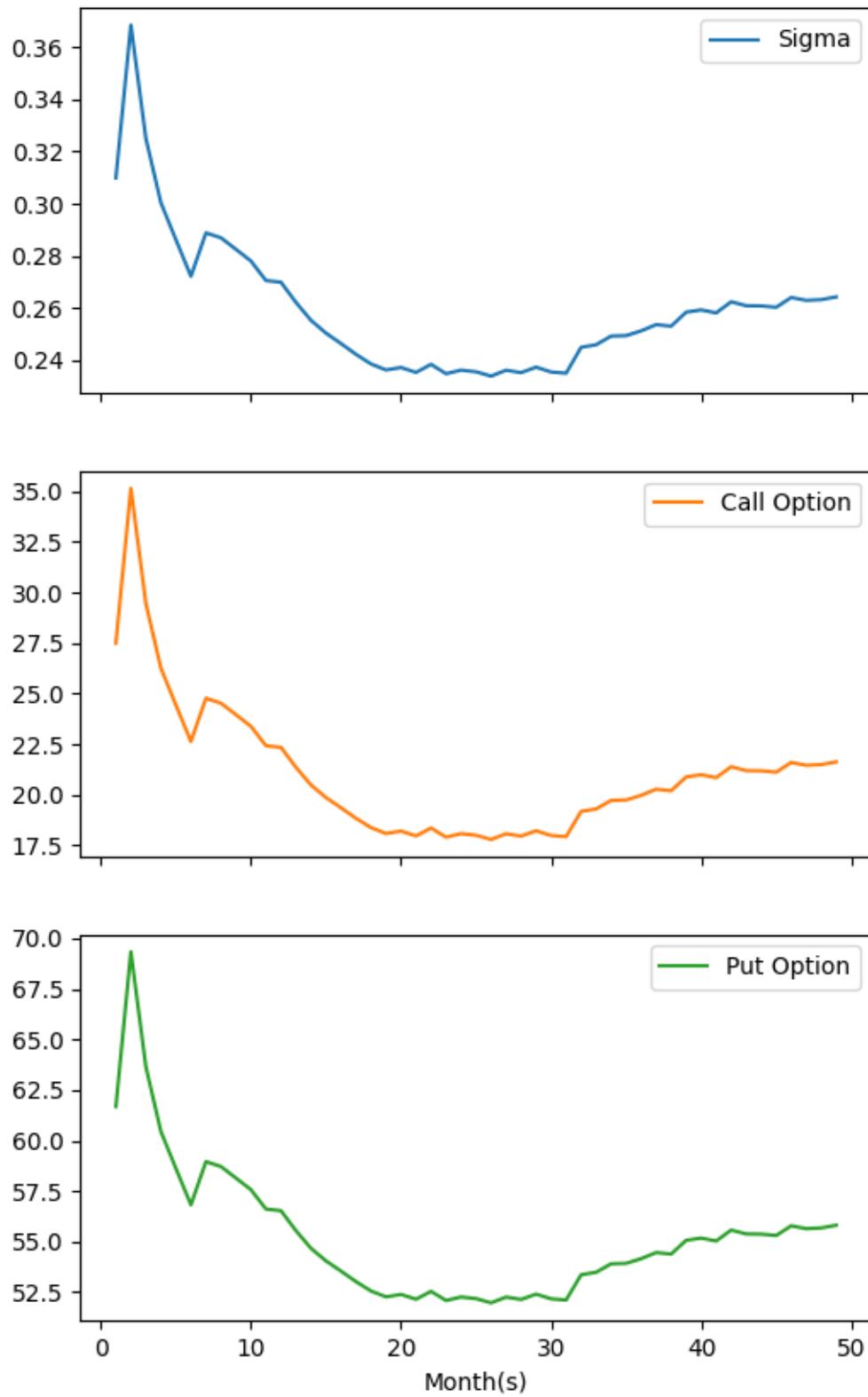
### Plot of HCL (BSE) with A = 0.9



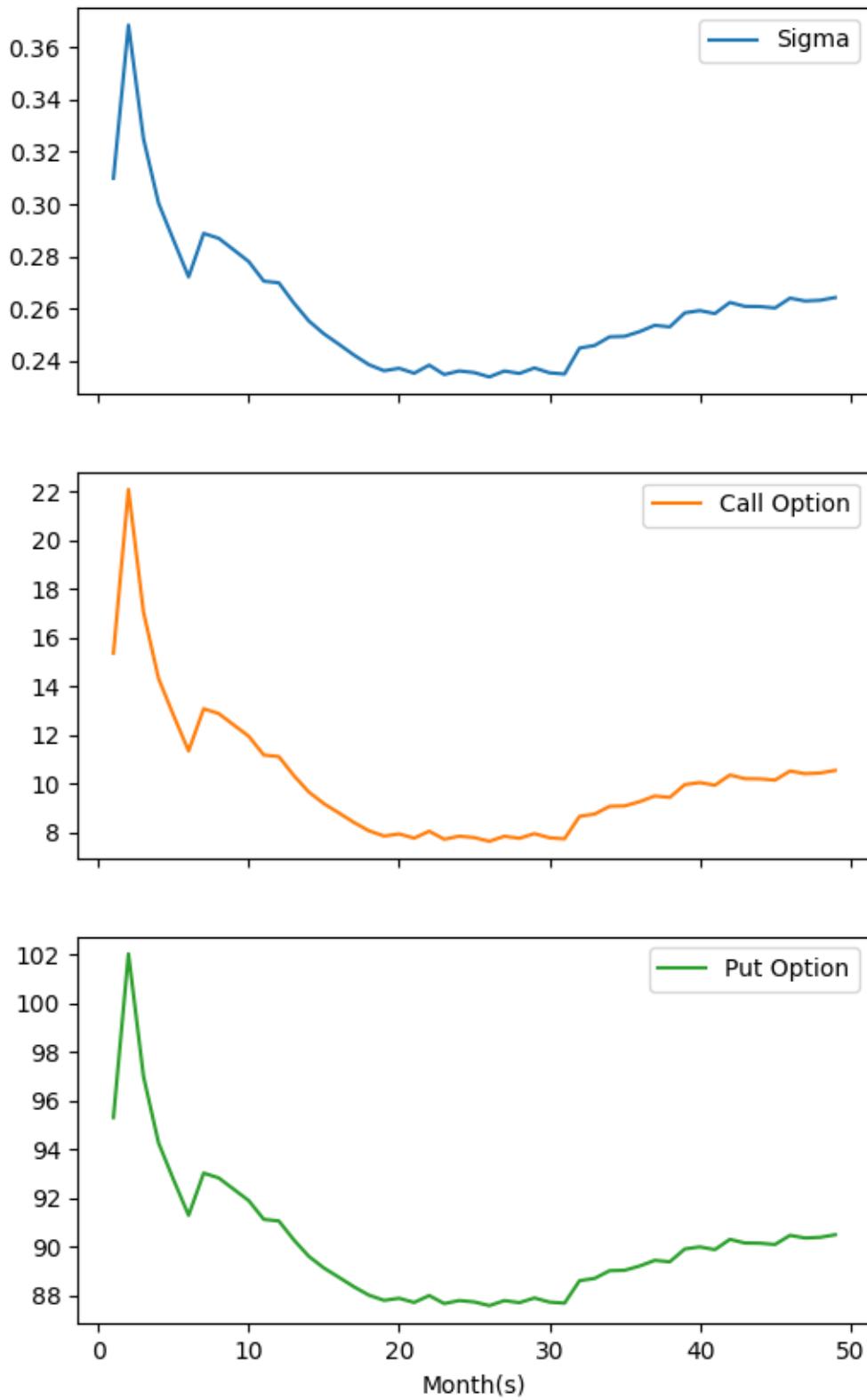
### Plot of HCL (BSE) with A = 1.0



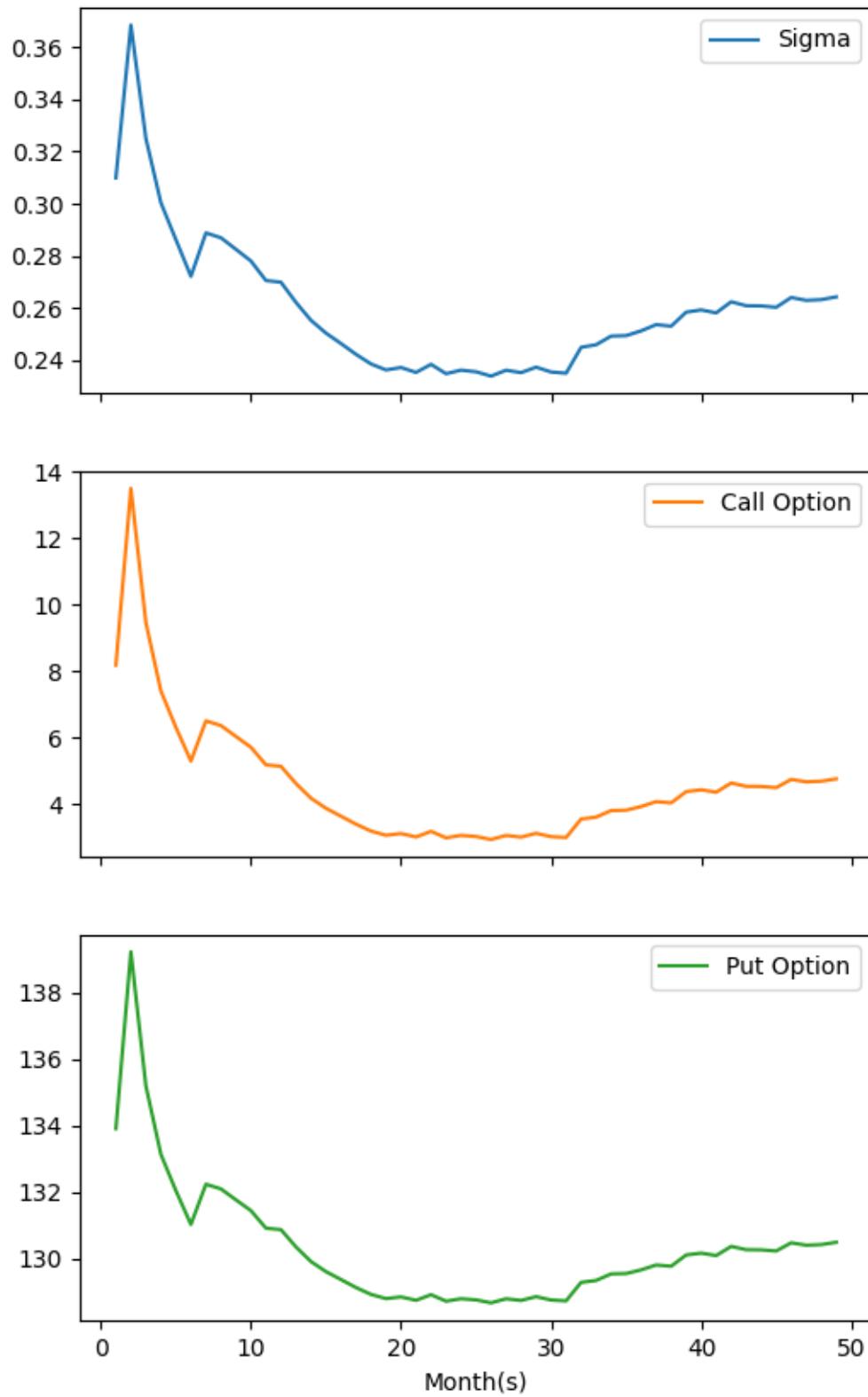
Plot of HCL (BSE) with  $A = 1.1$



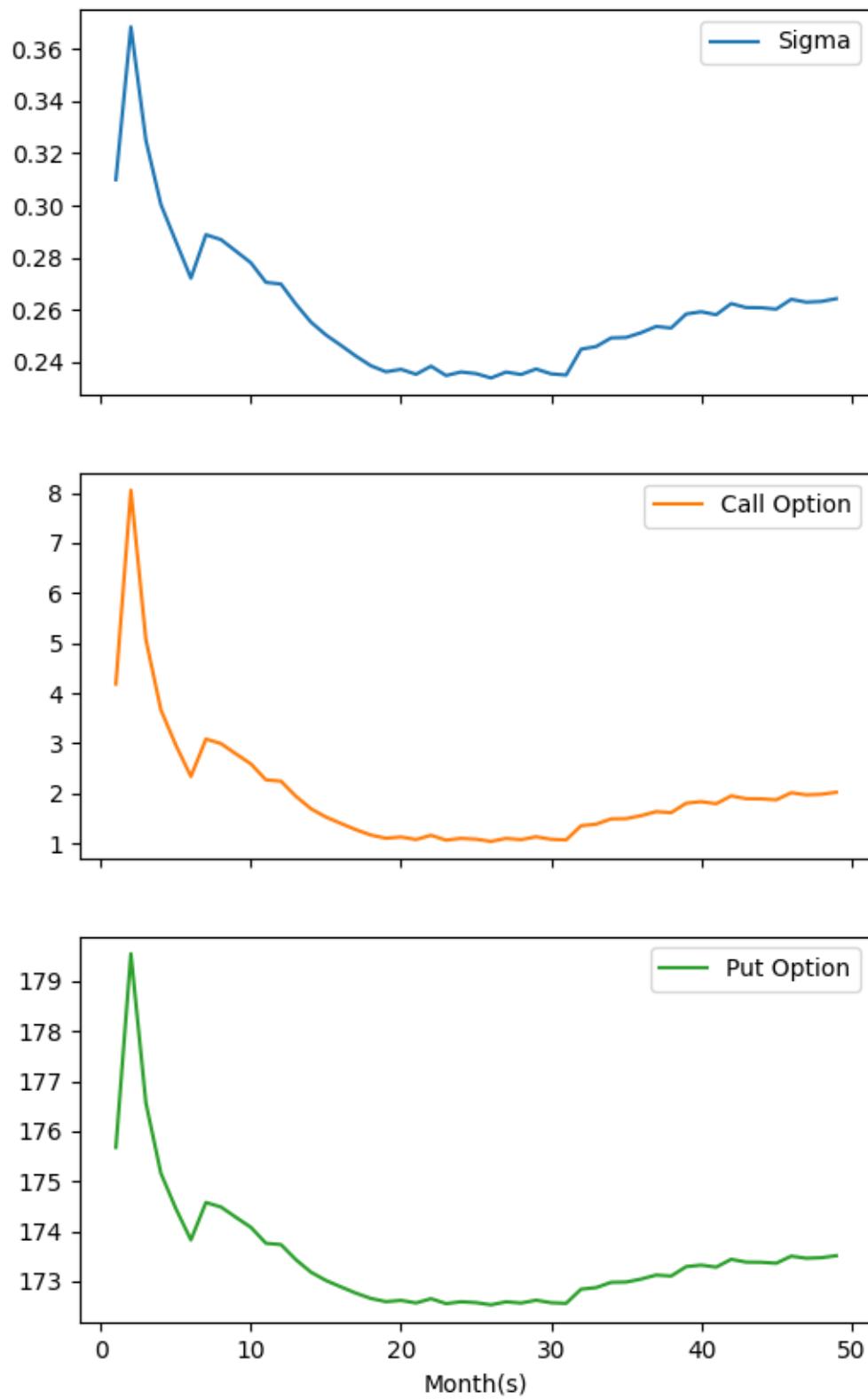
Plot of HCL (BSE) with  $A = 1.2$



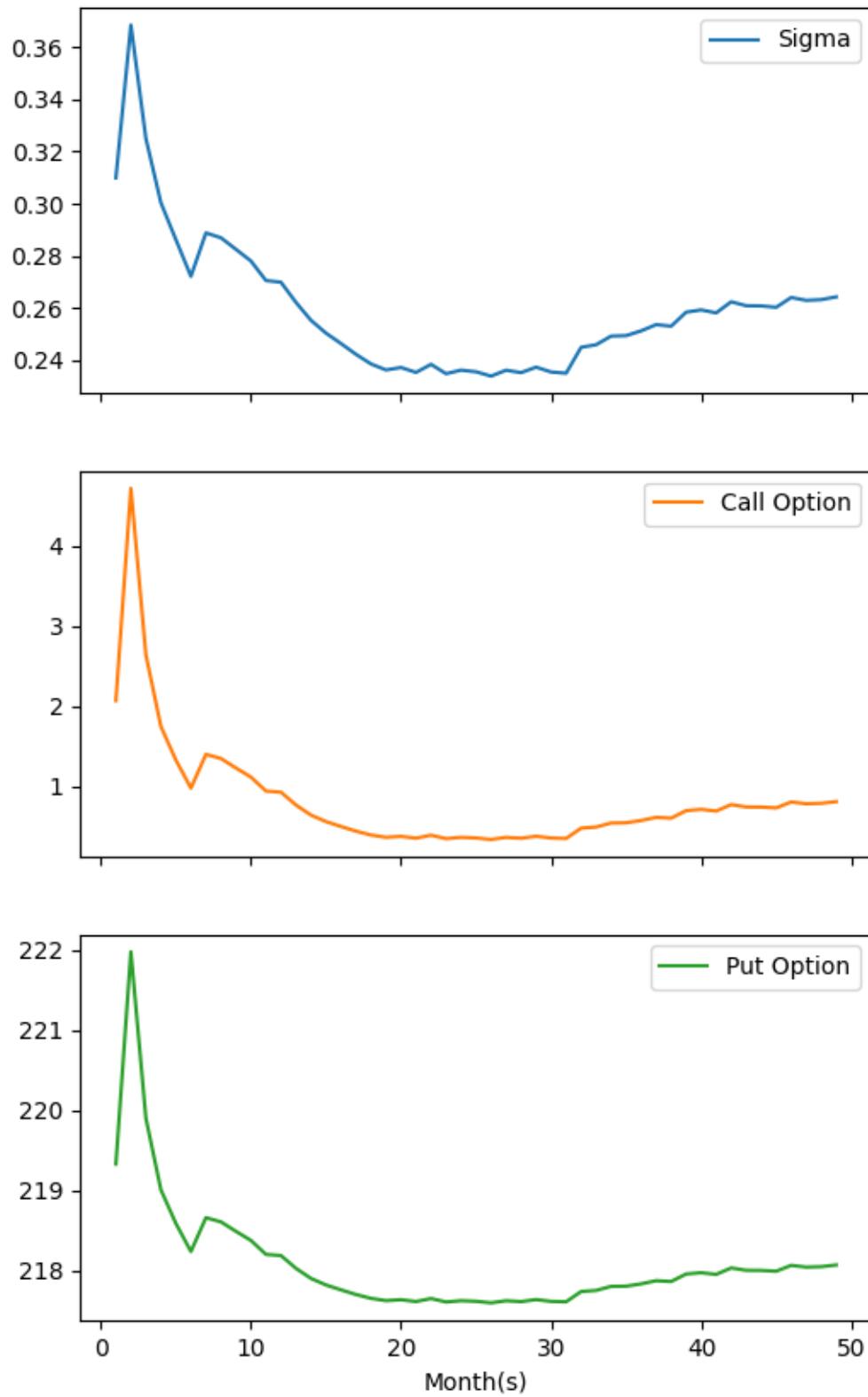
Plot of HCL (BSE) with  $A = 1.3$



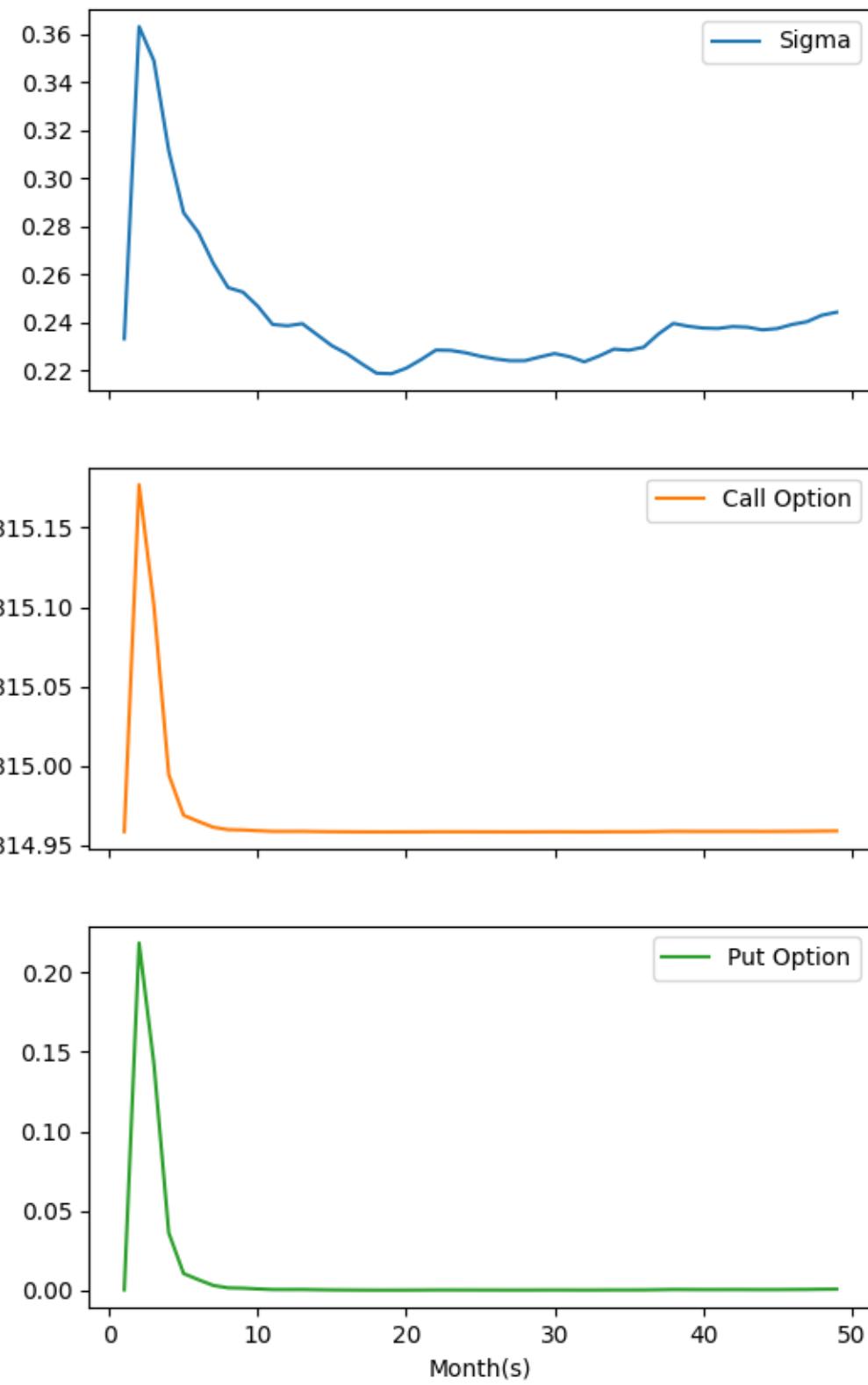
Plot of HCL (BSE) with  $A = 1.4$



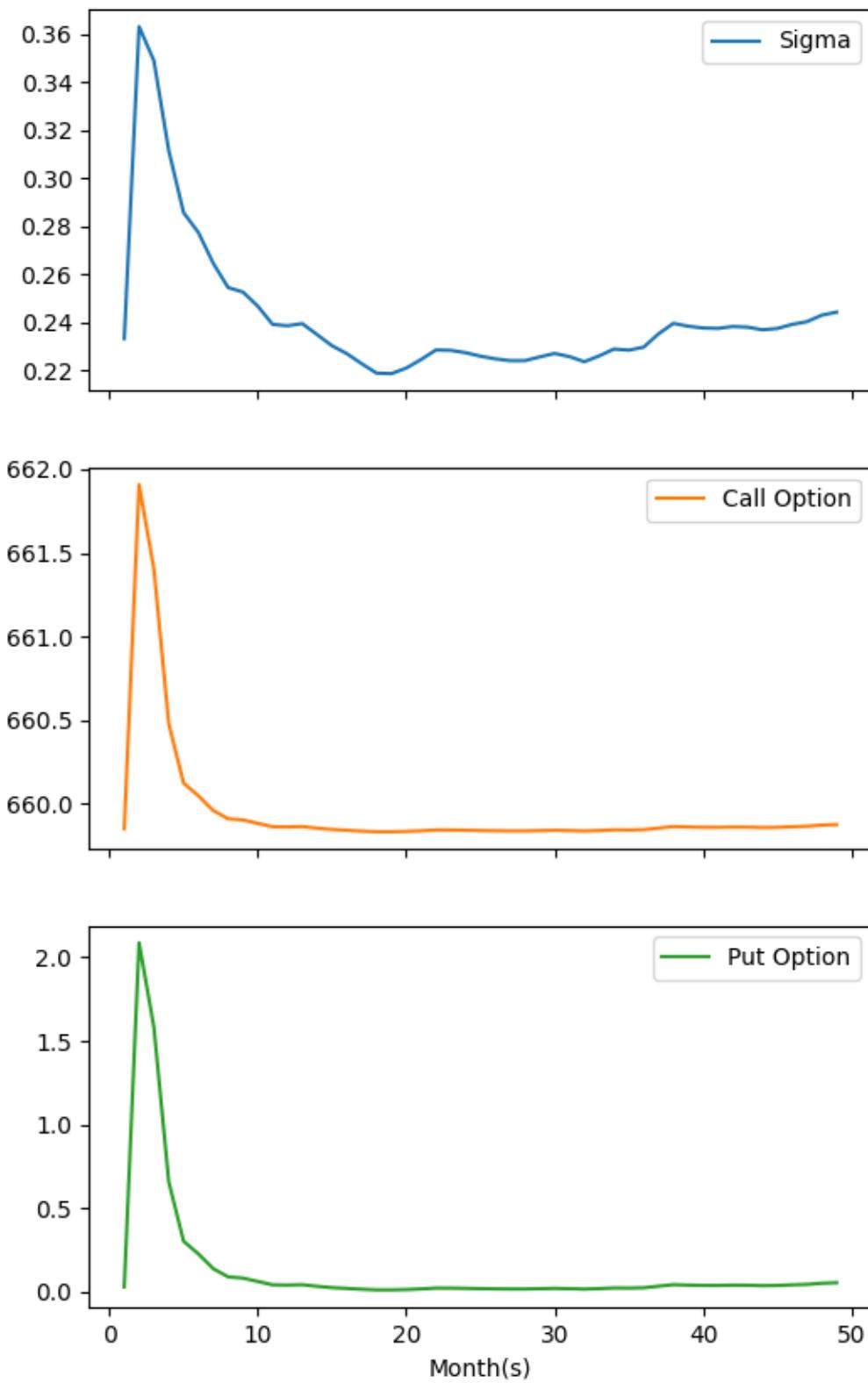
### Plot of HCL (BSE) with A = 1.5



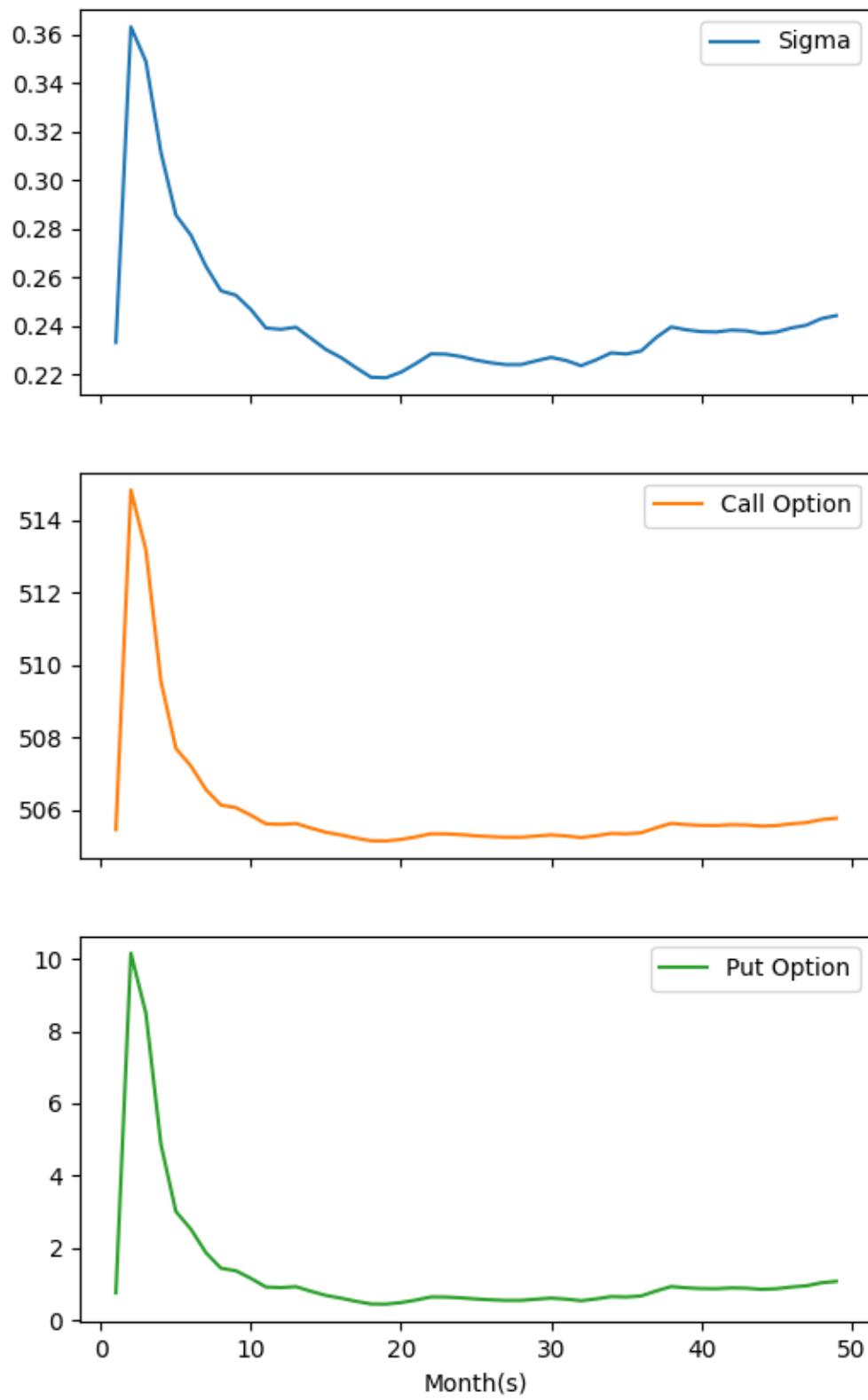
Plot of INDUS IND (BSE) with  $A = 0.5$



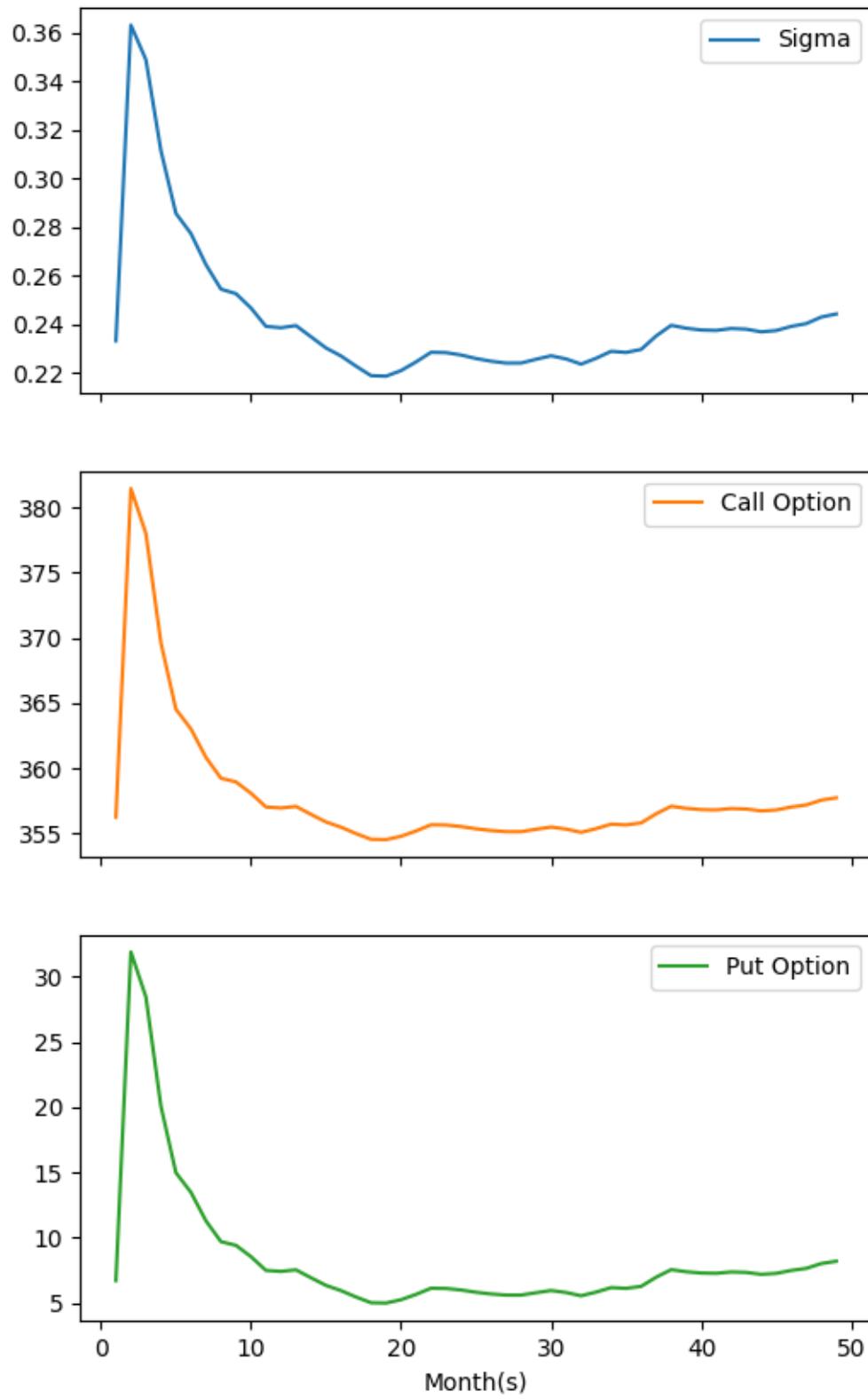
Plot of INDUS IND (BSE) with  $A = 0.6$



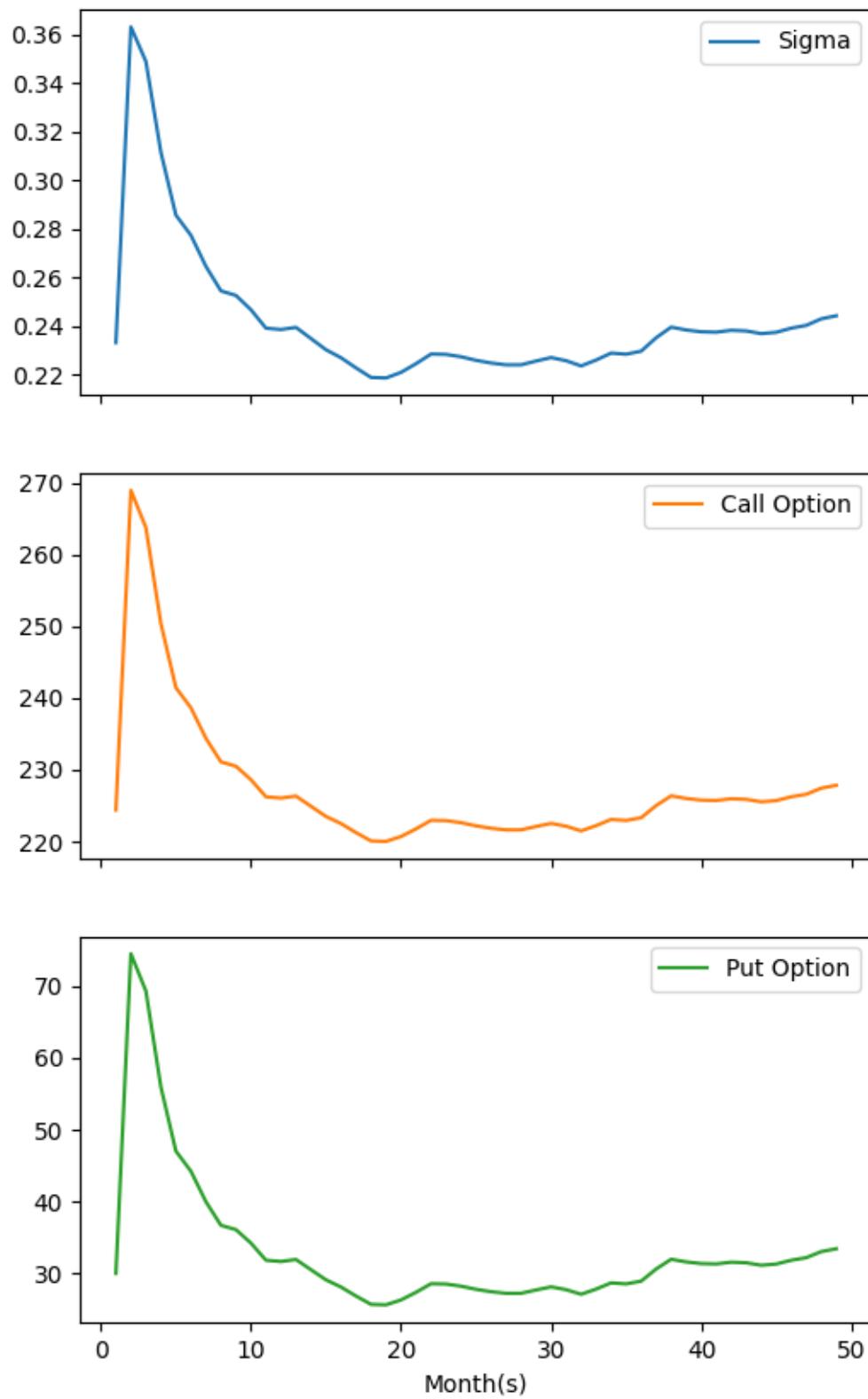
Plot of INDUS IND (BSE) with  $A = 0.7$



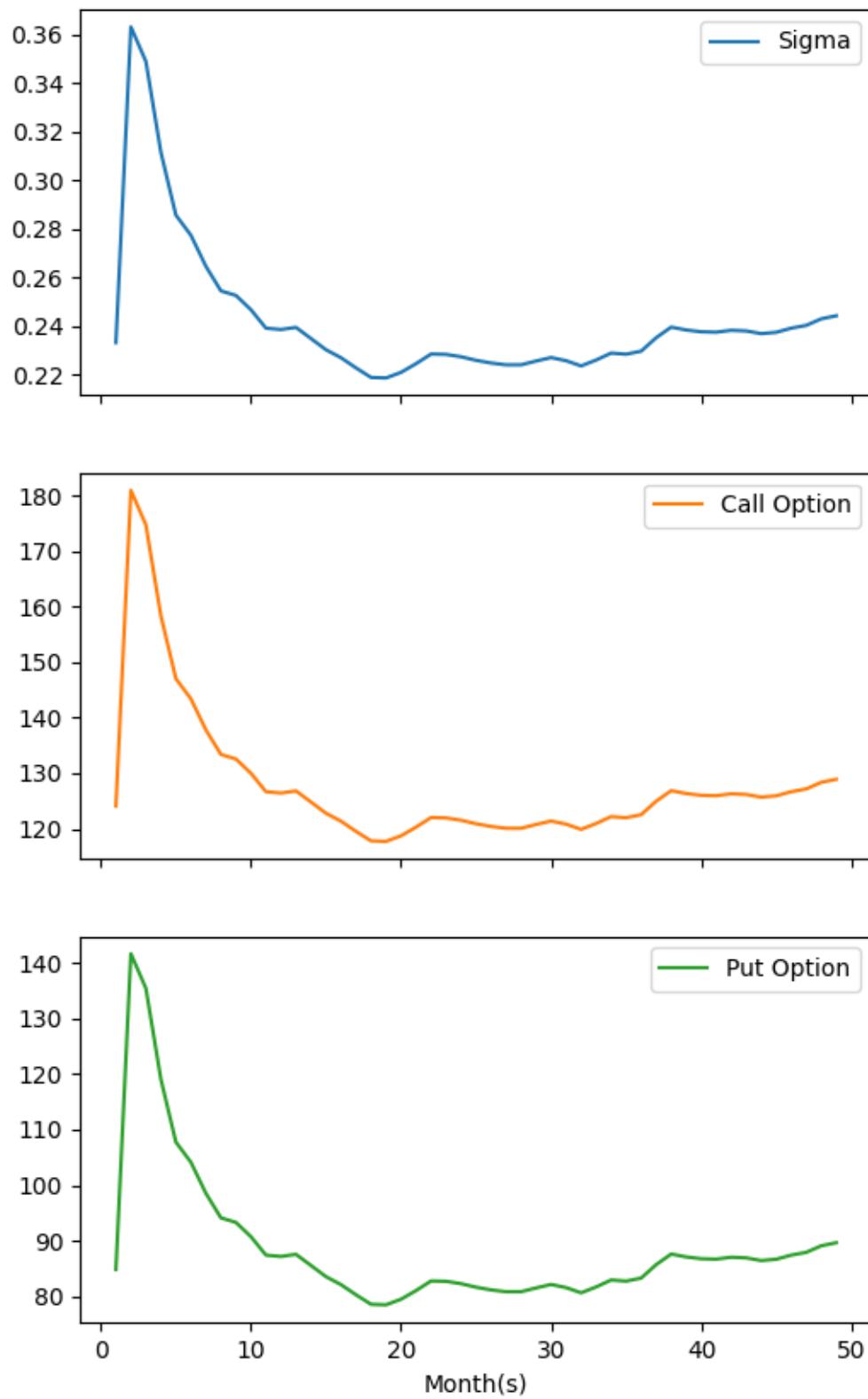
Plot of INDUS IND (BSE) with  $A = 0.8$



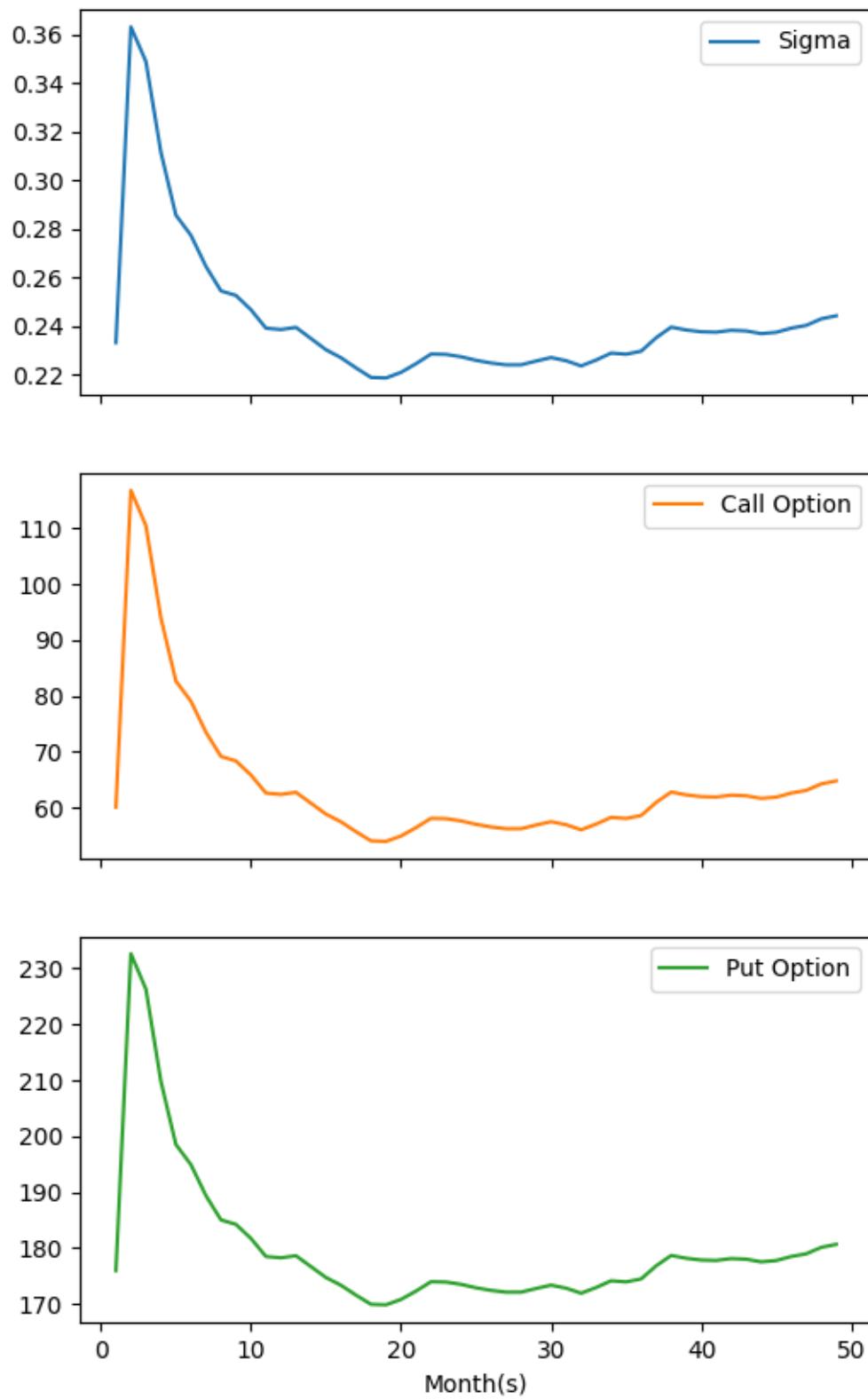
Plot of INDUS IND (BSE) with  $A = 0.9$



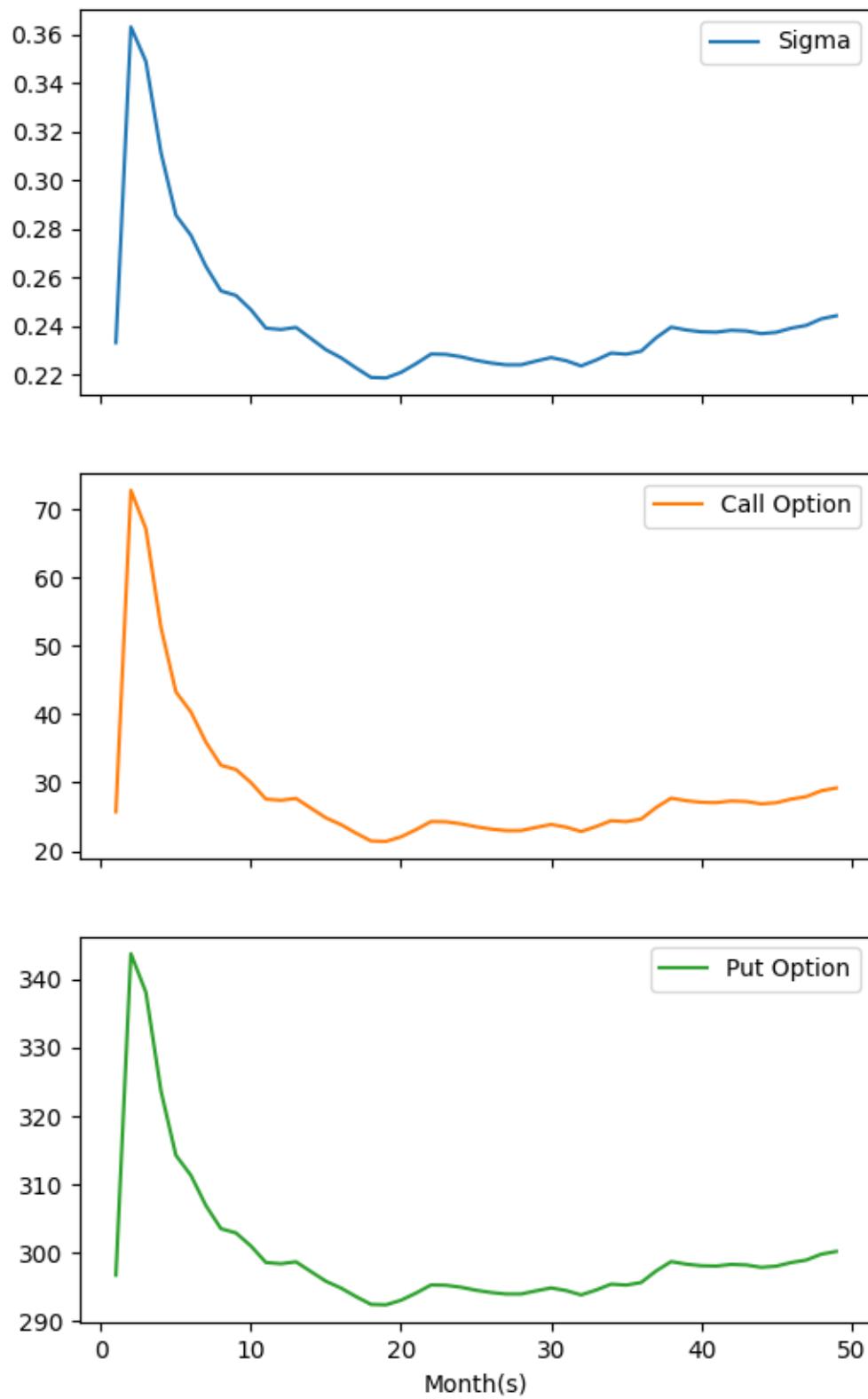
### Plot of INDUS IND (BSE) with A = 1.0



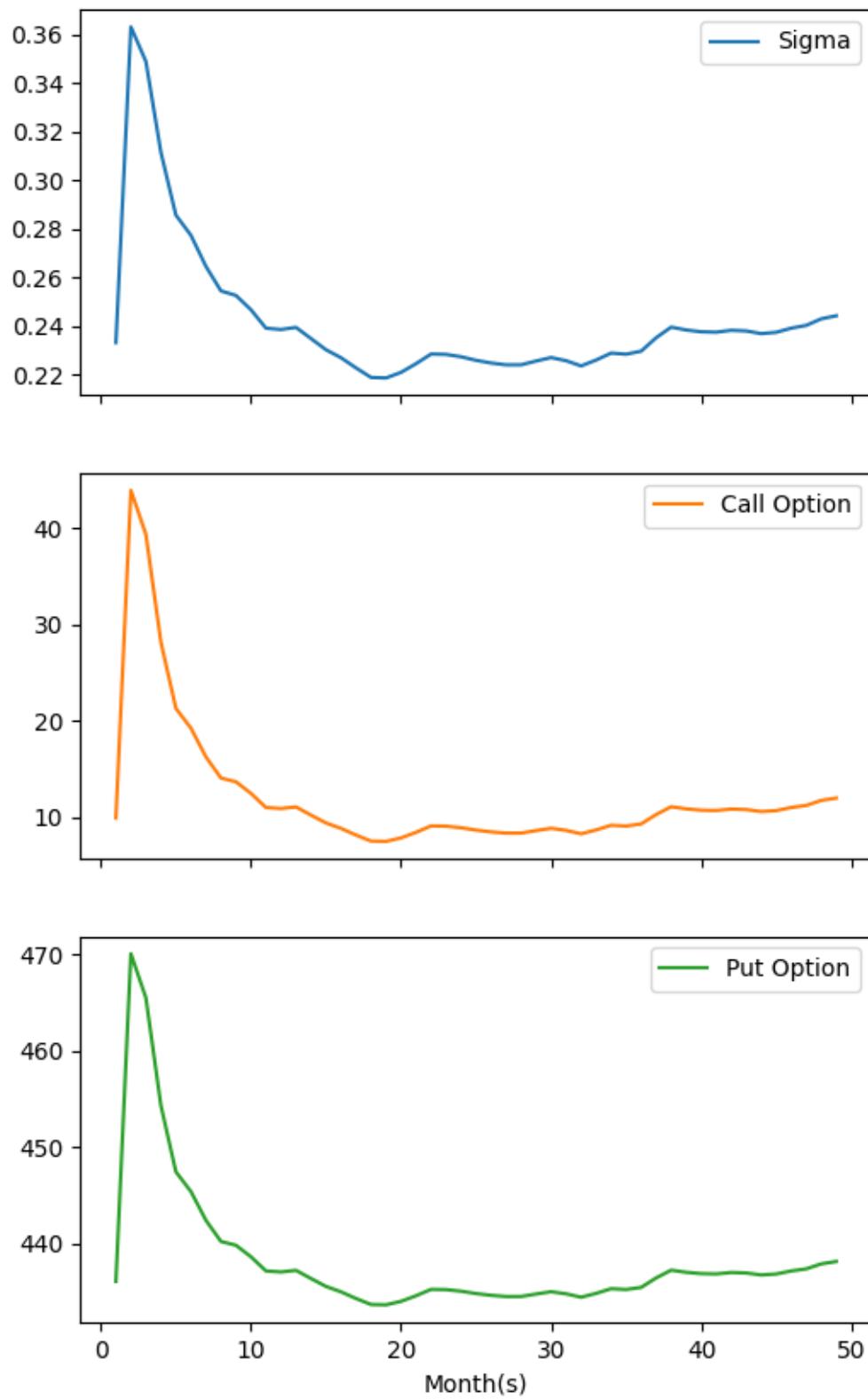
Plot of INDUS IND (BSE) with  $A = 1.1$



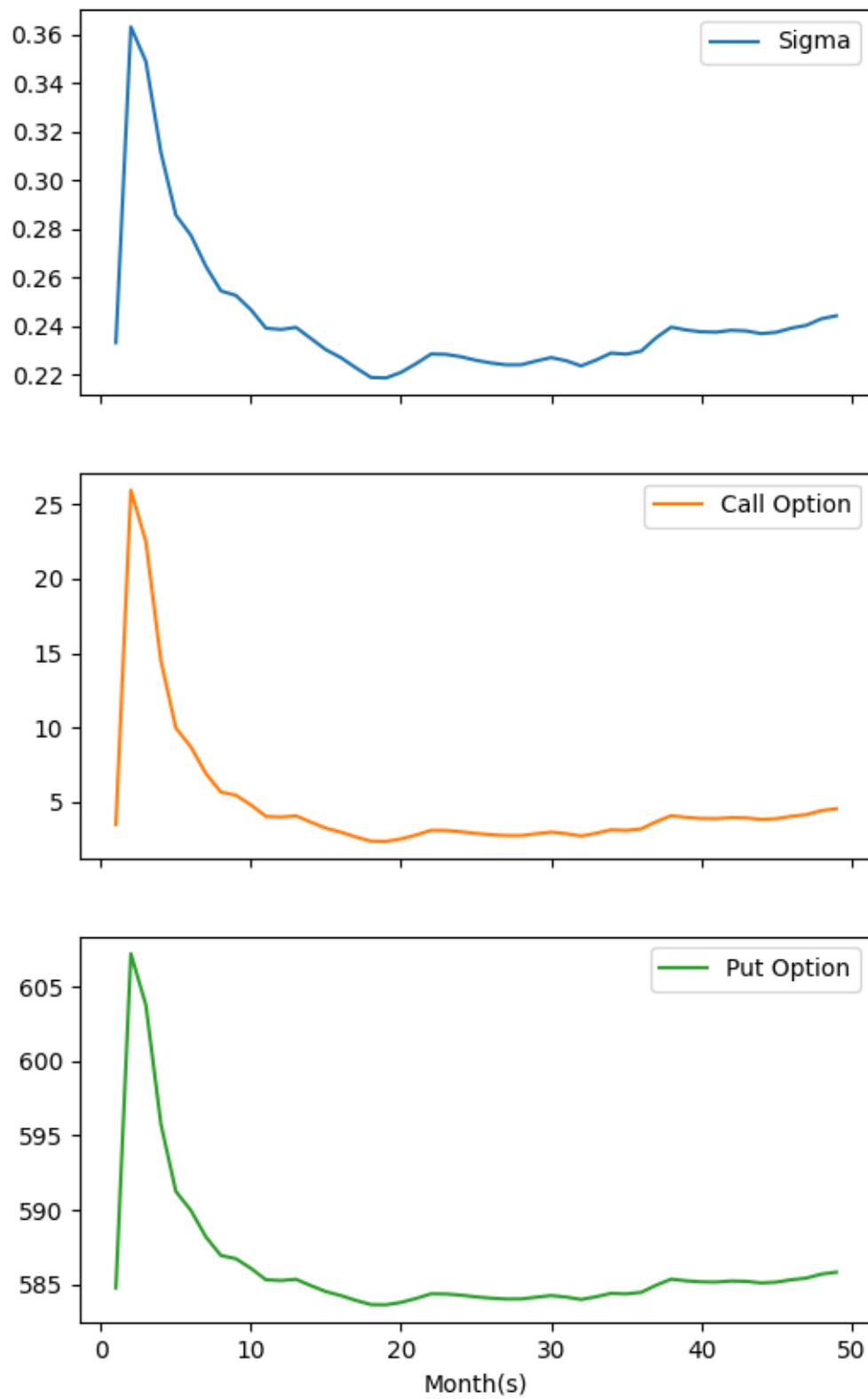
Plot of INDUS IND (BSE) with  $A = 1.2$



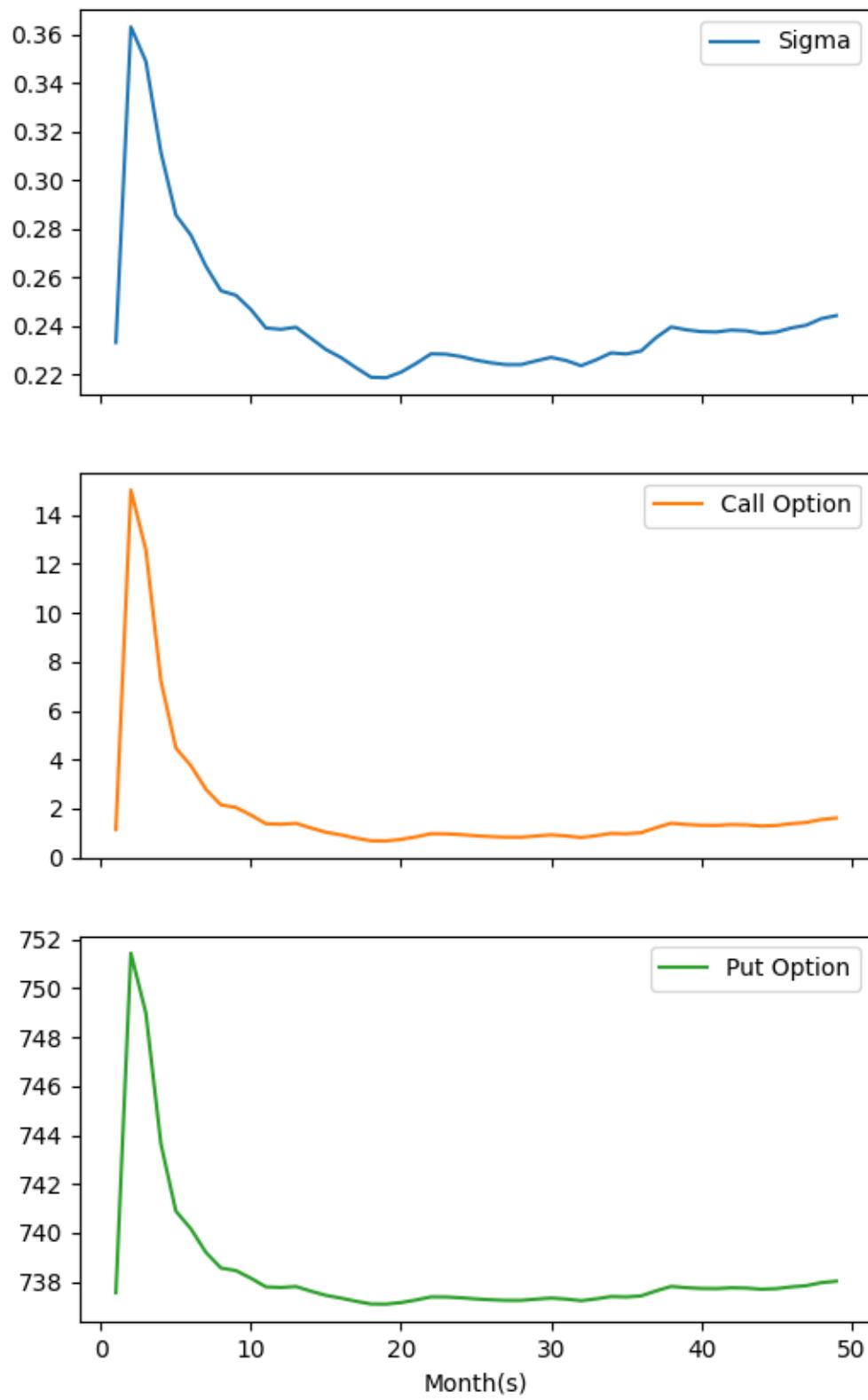
Plot of INDUS IND (BSE) with  $A = 1.3$



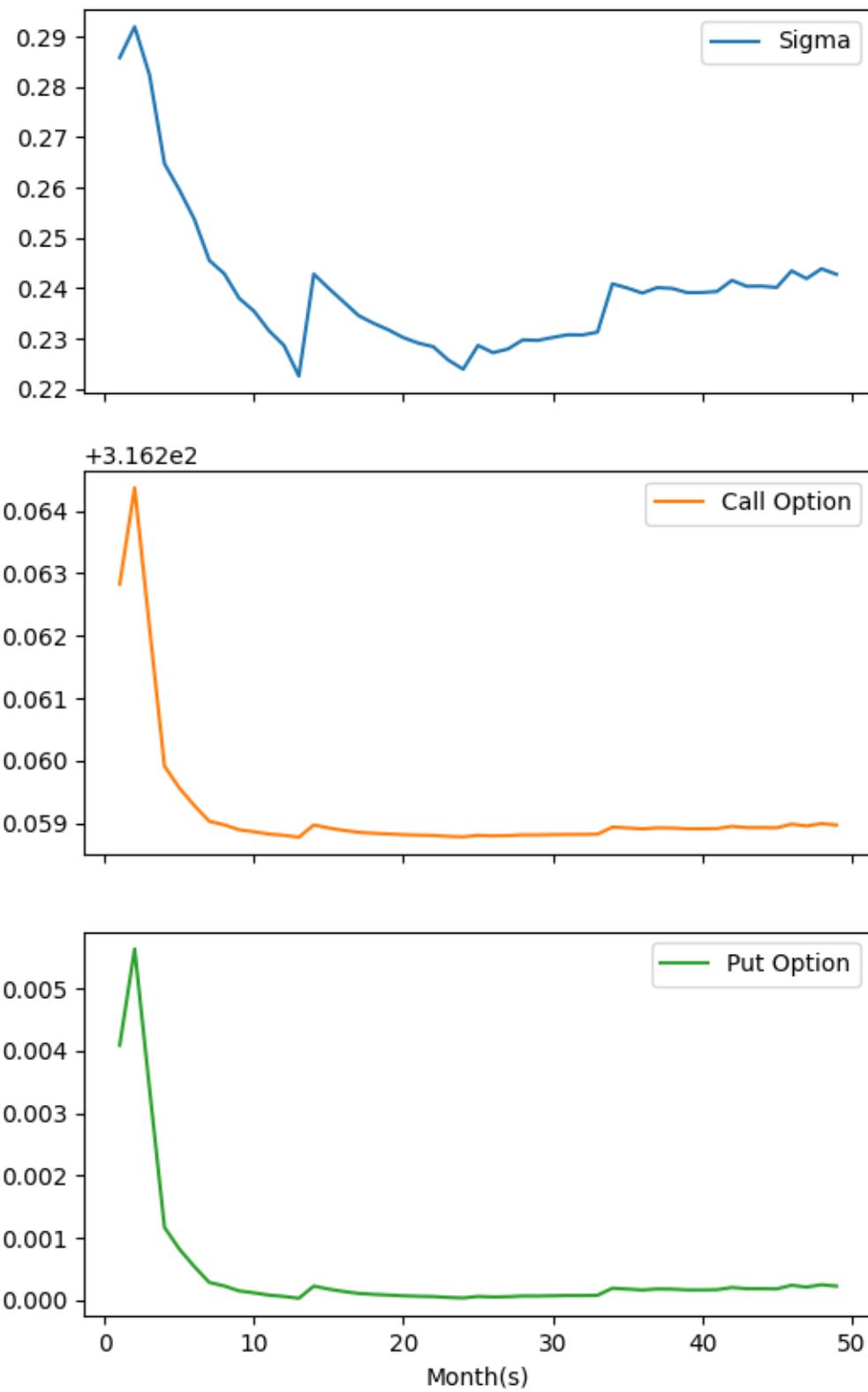
Plot of INDUS IND (BSE) with  $A = 1.4$



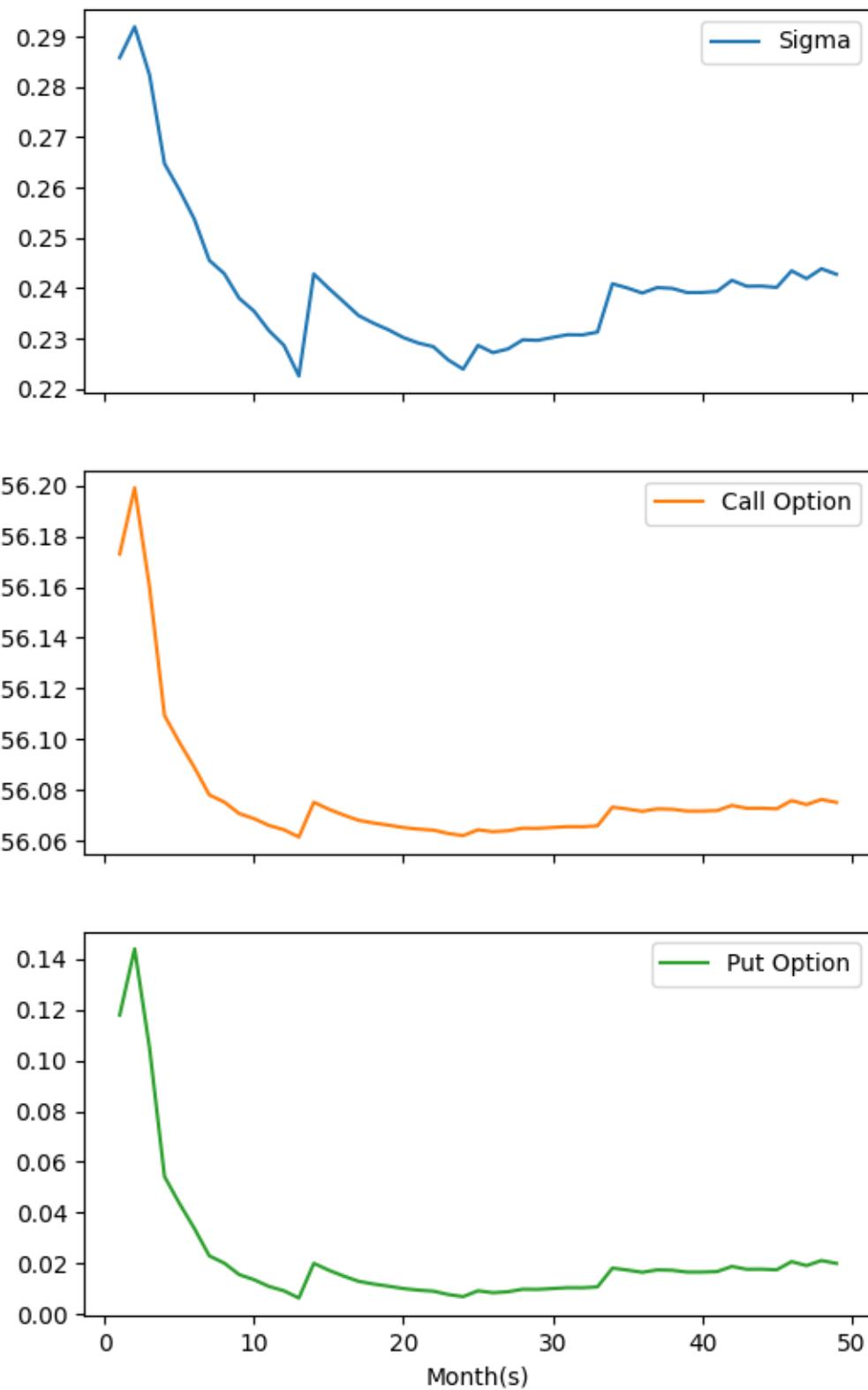
Plot of INDUS IND (BSE) with  $A = 1.5$



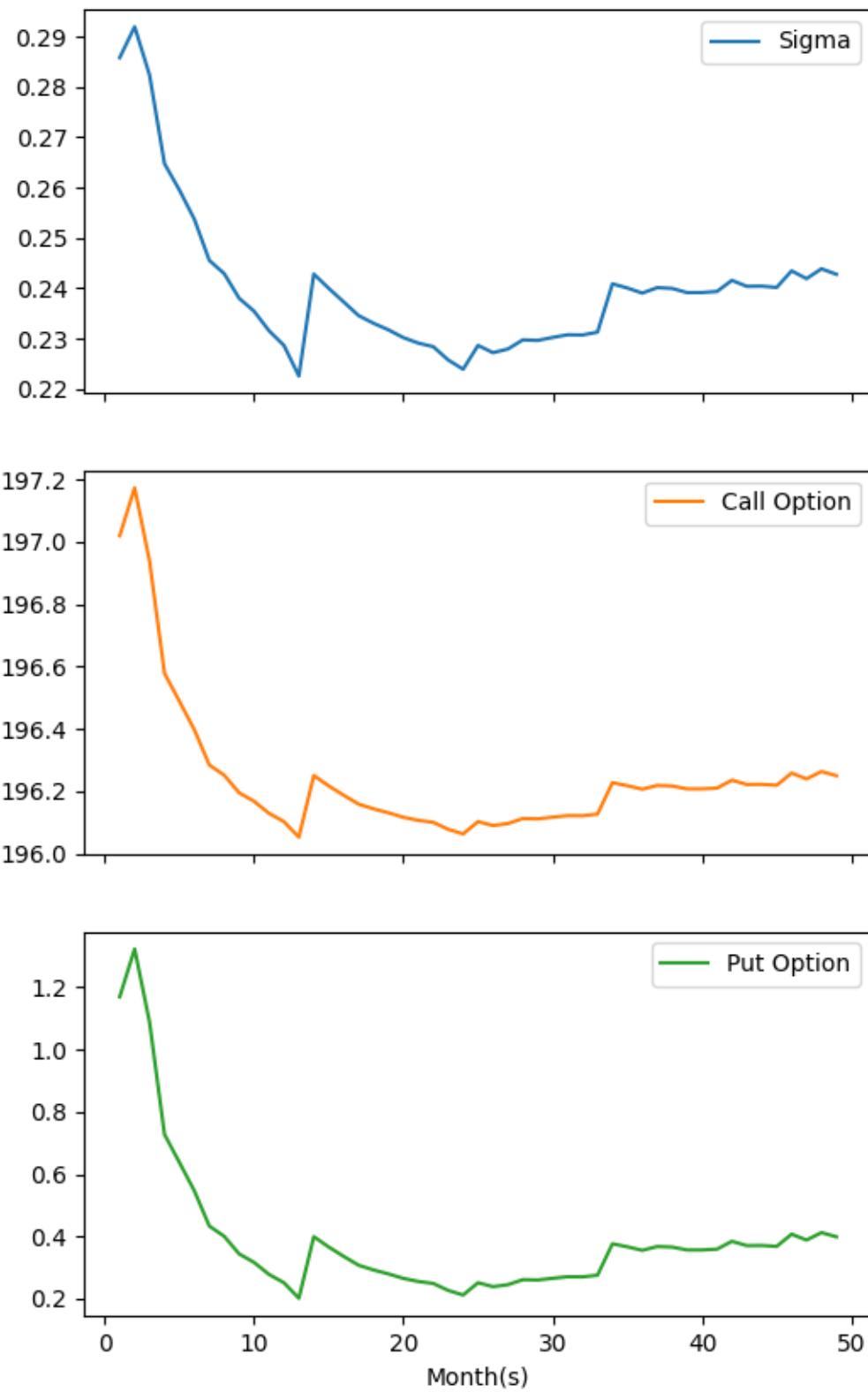
### Plot of INFY (BSE) with A = 0.5



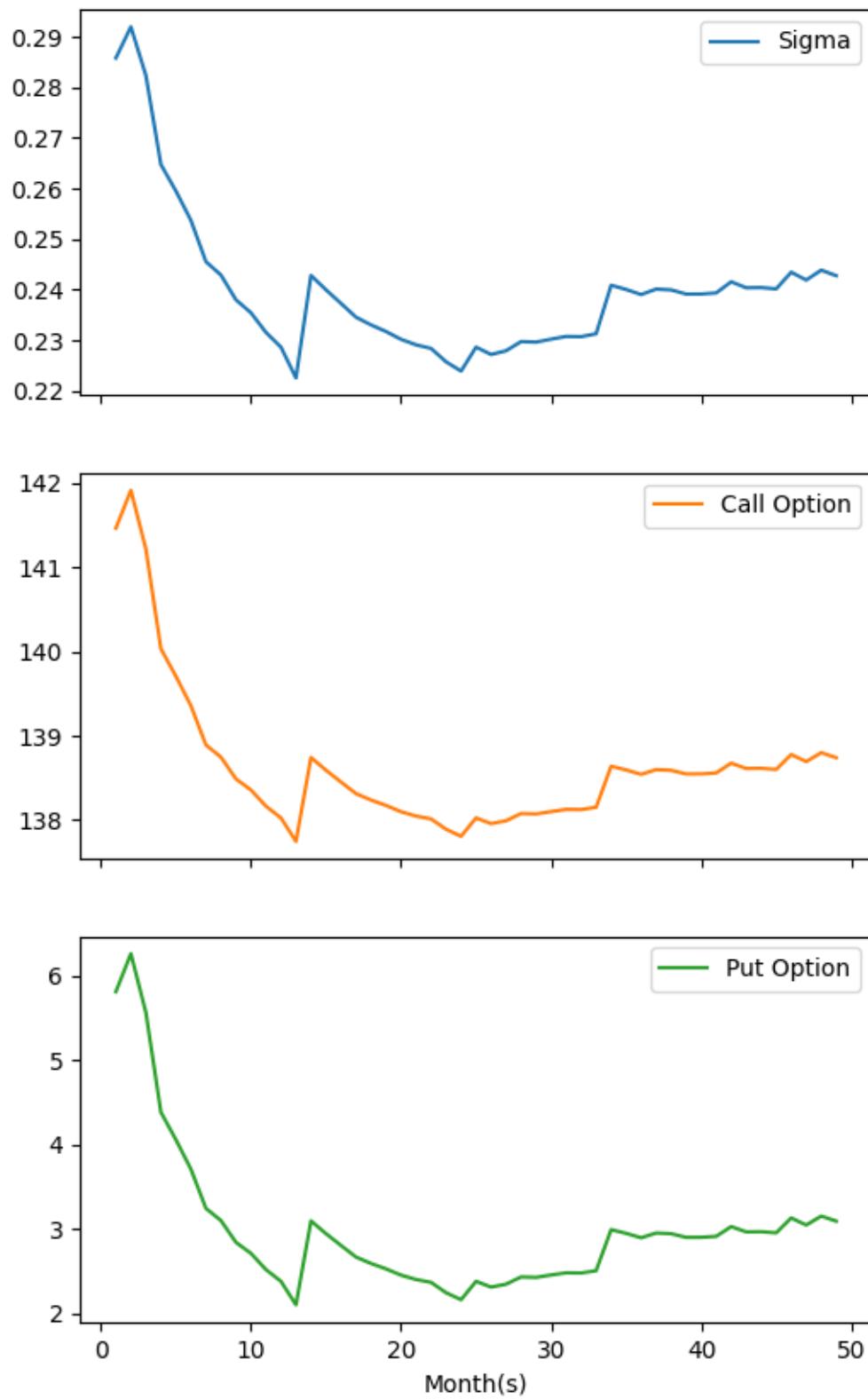
### Plot of INFY (BSE) with A = 0.6



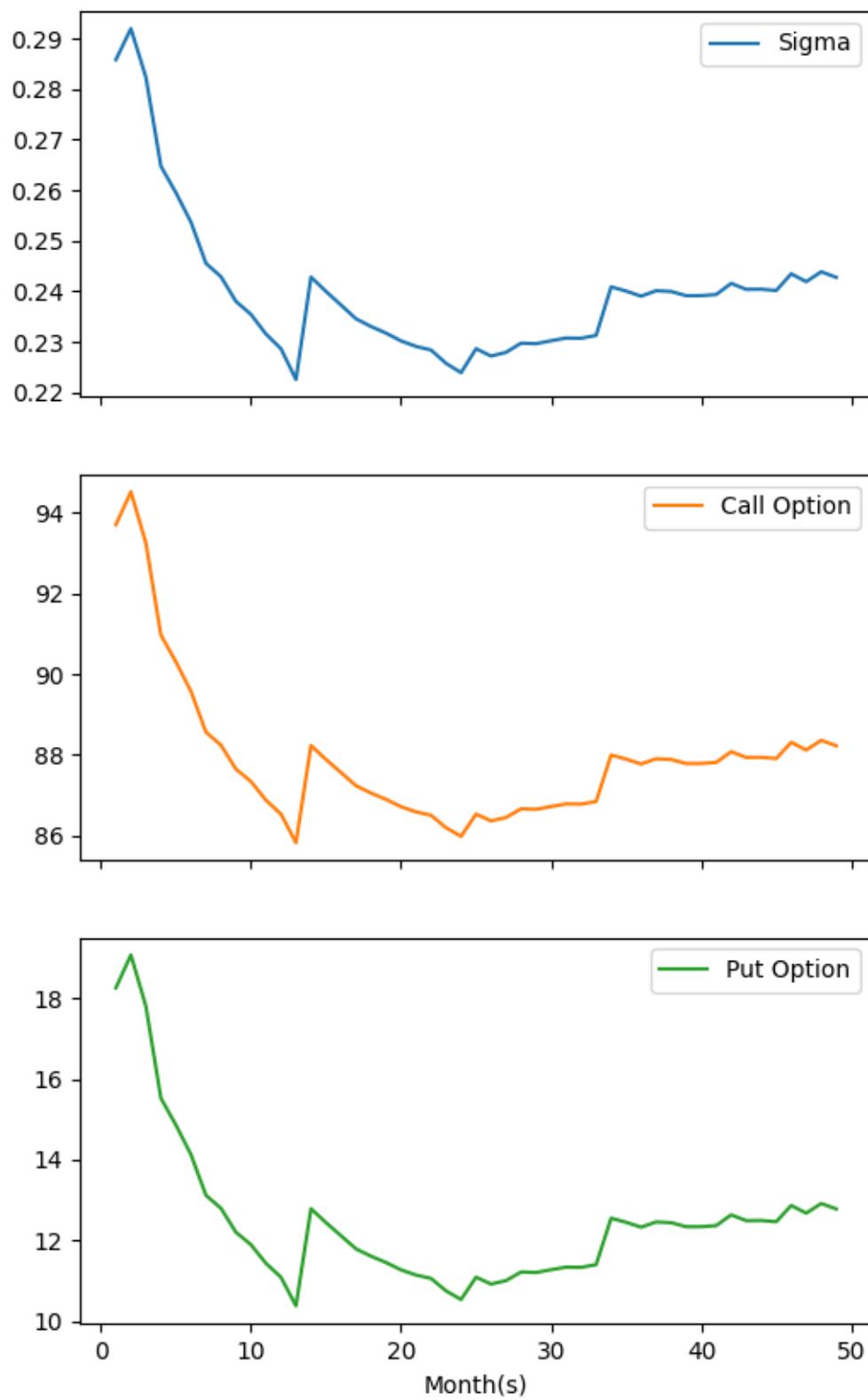
### Plot of INFY (BSE) with A = 0.7



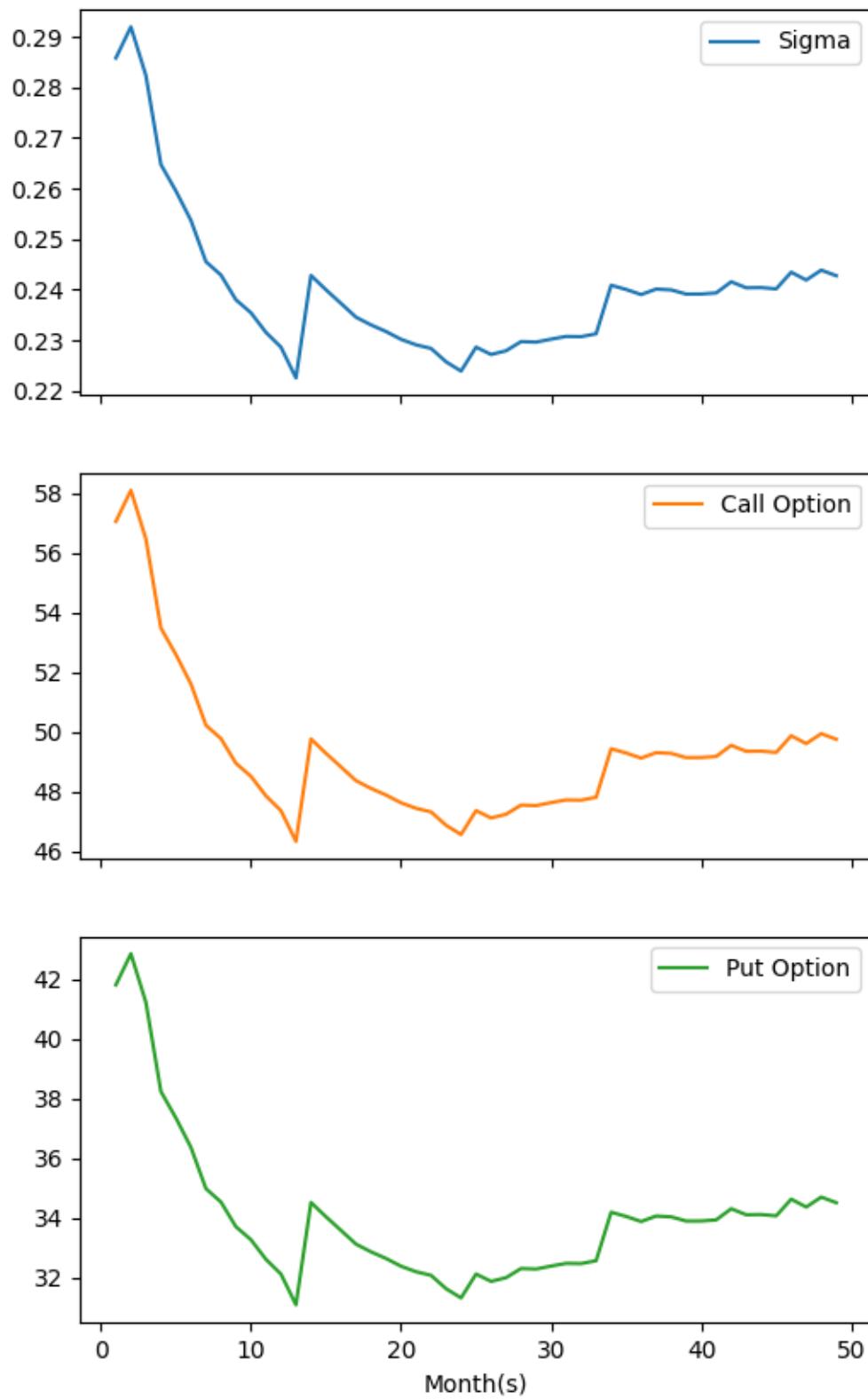
### Plot of INFY (BSE) with A = 0.8



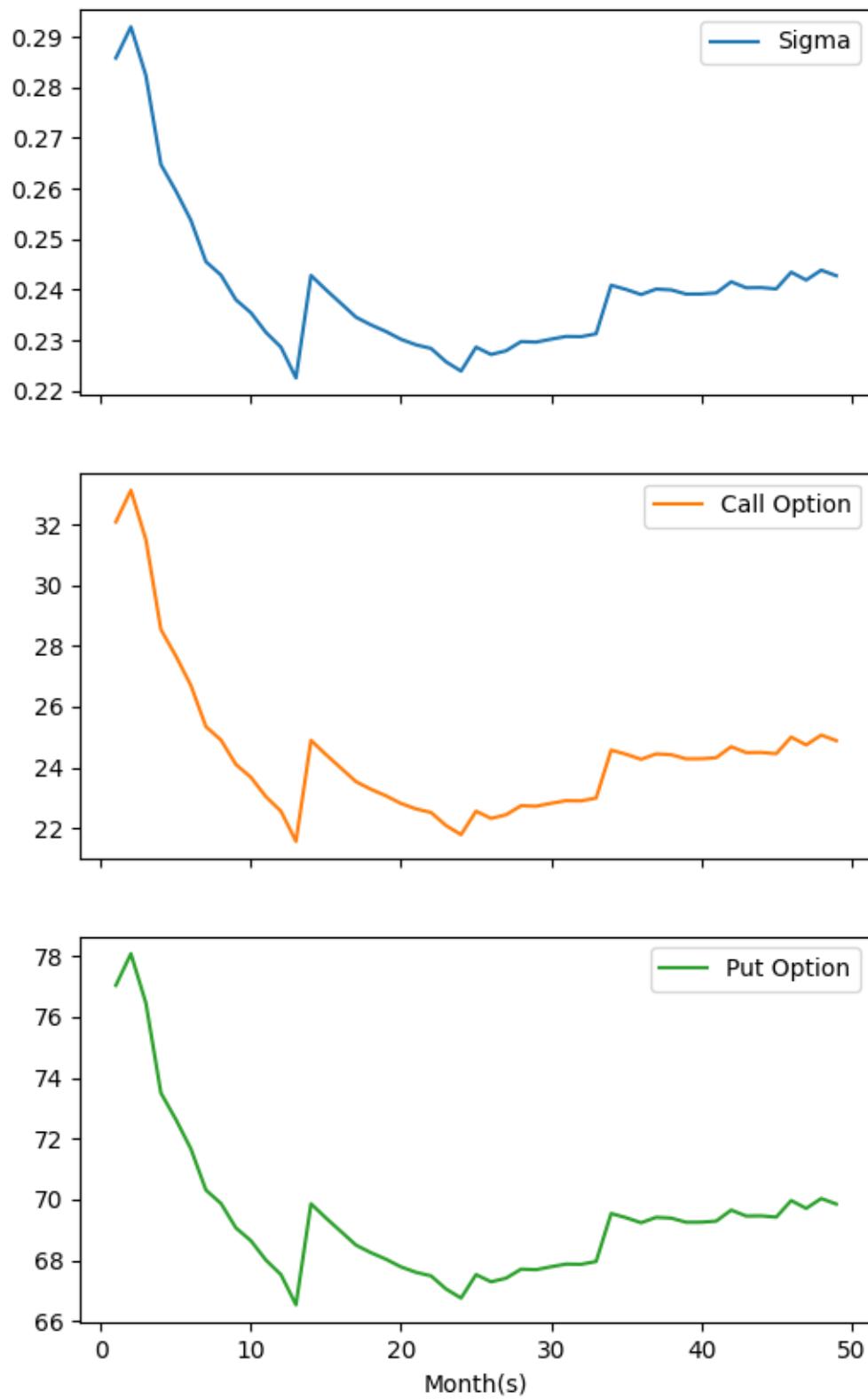
Plot of INFY (BSE) with  $A = 0.9$



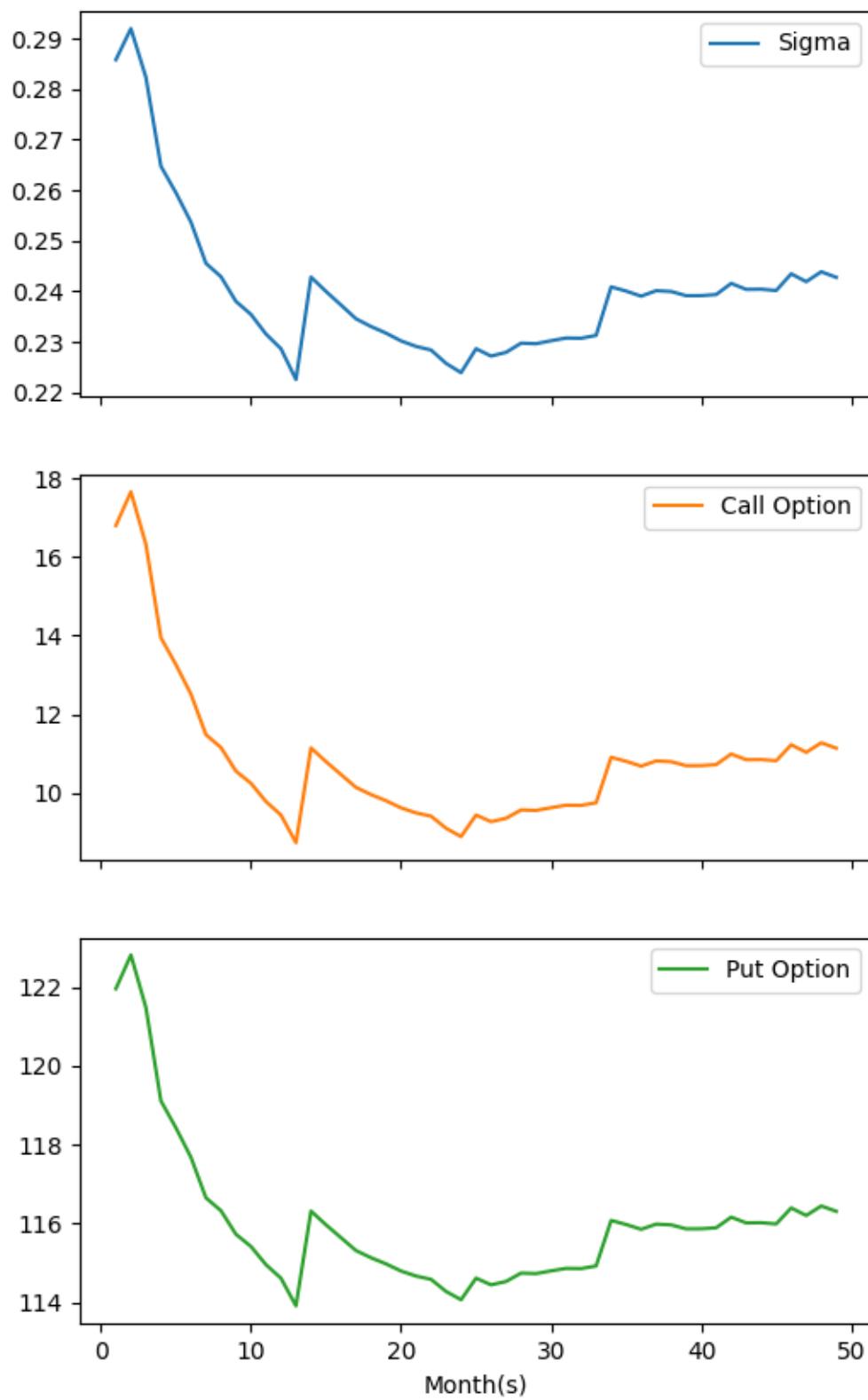
### Plot of INFY (BSE) with A = 1.0



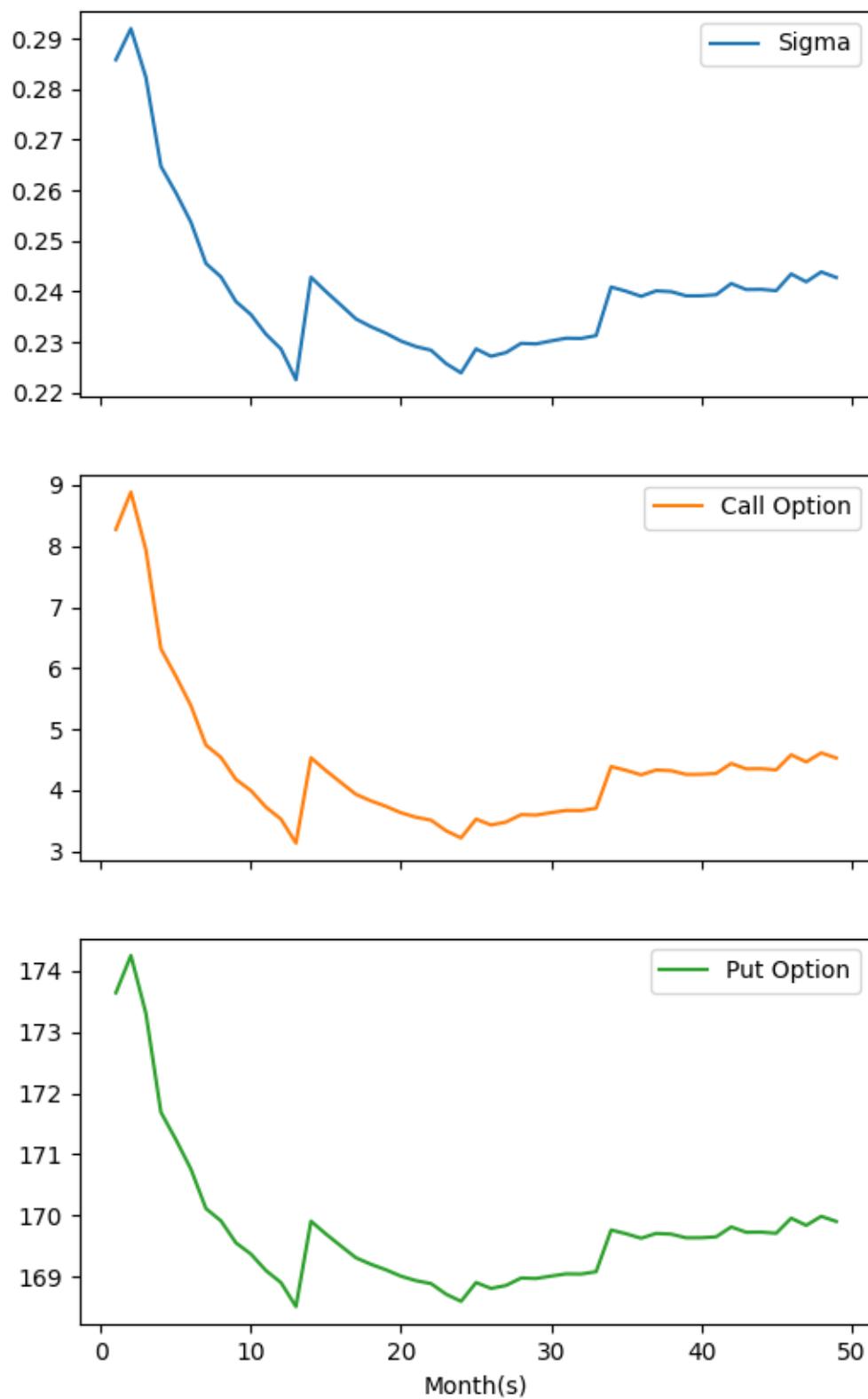
Plot of INFY (BSE) with  $A = 1.1$



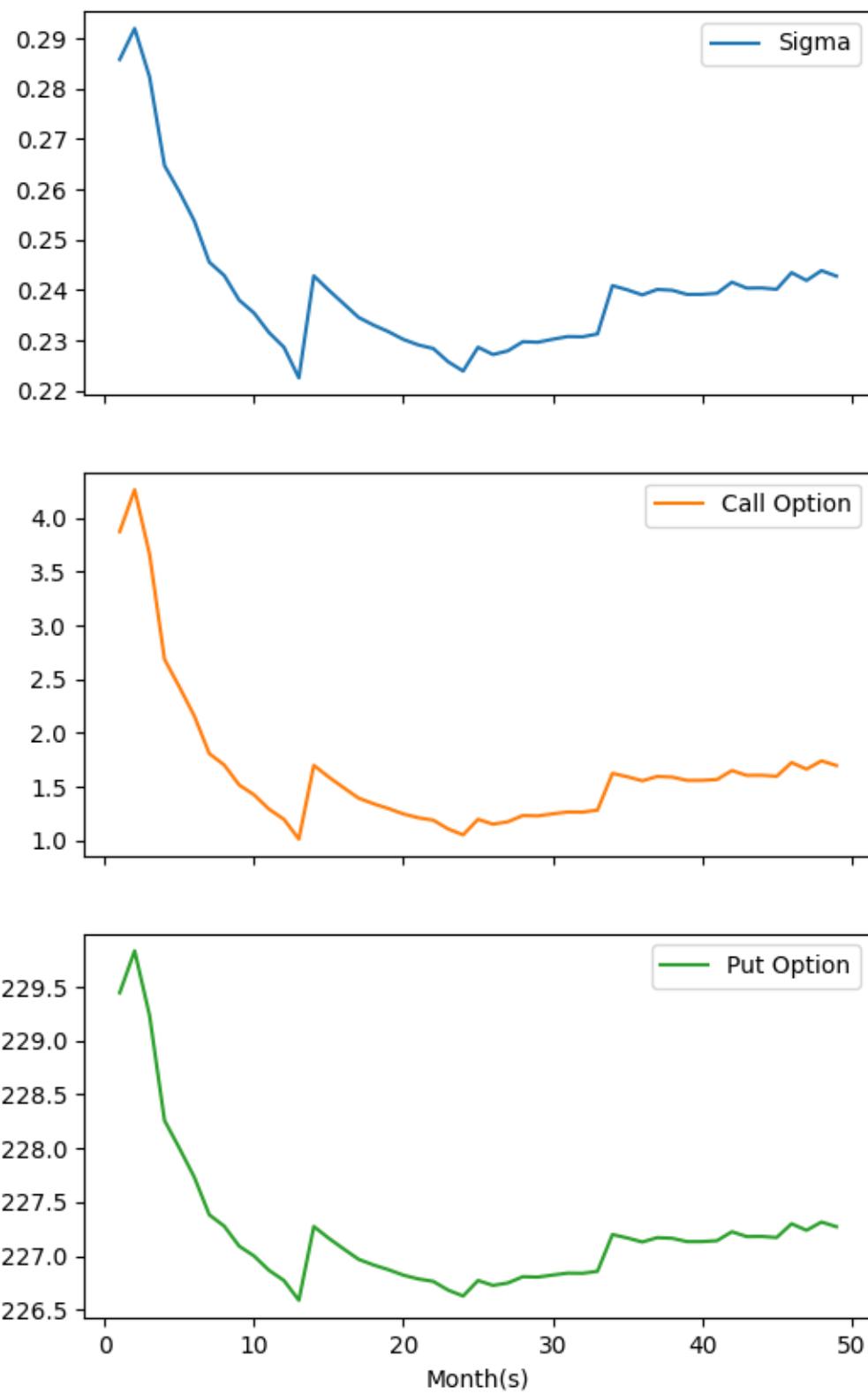
### Plot of INFY (BSE) with A = 1.2



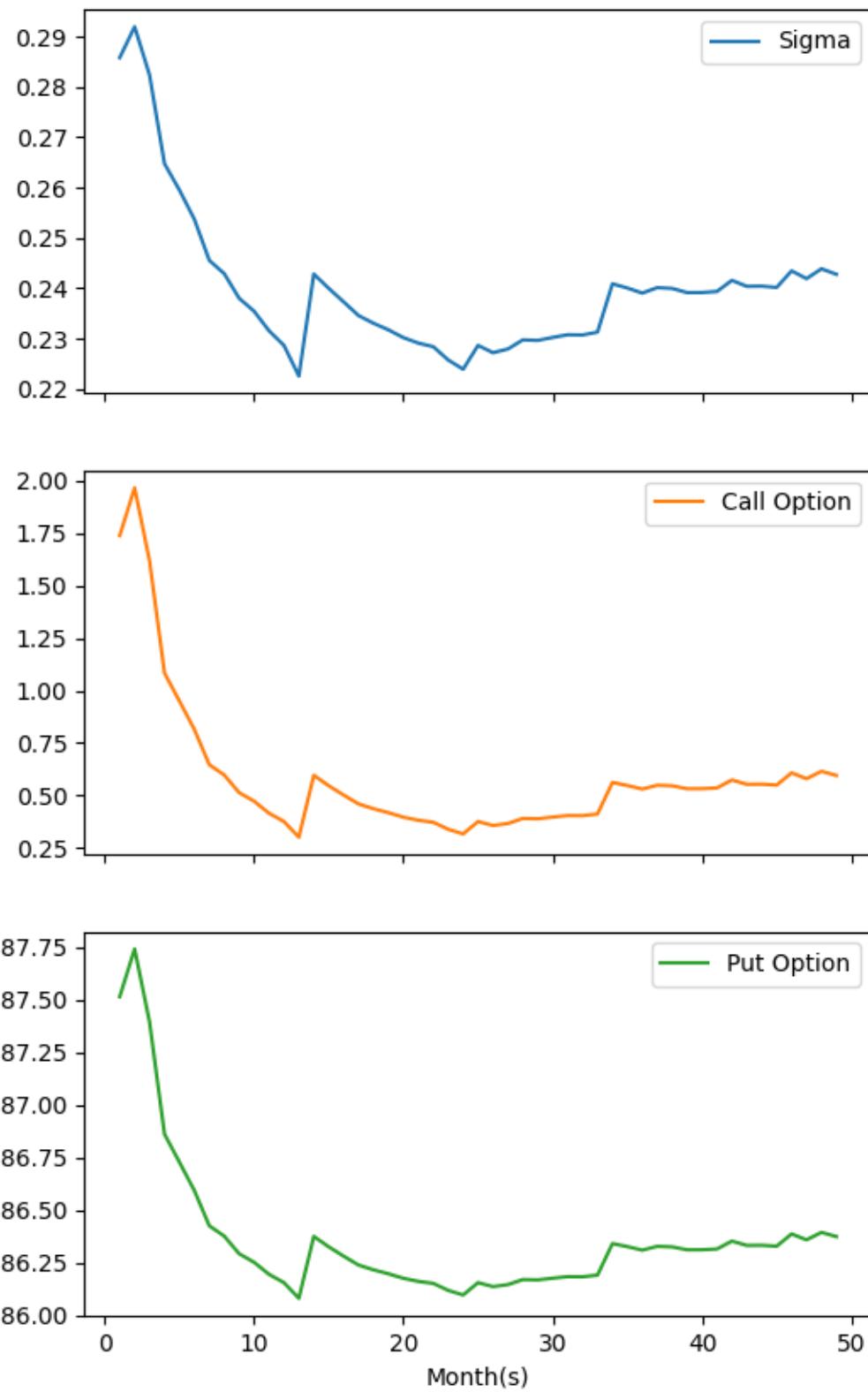
### Plot of INFY (BSE) with A = 1.3



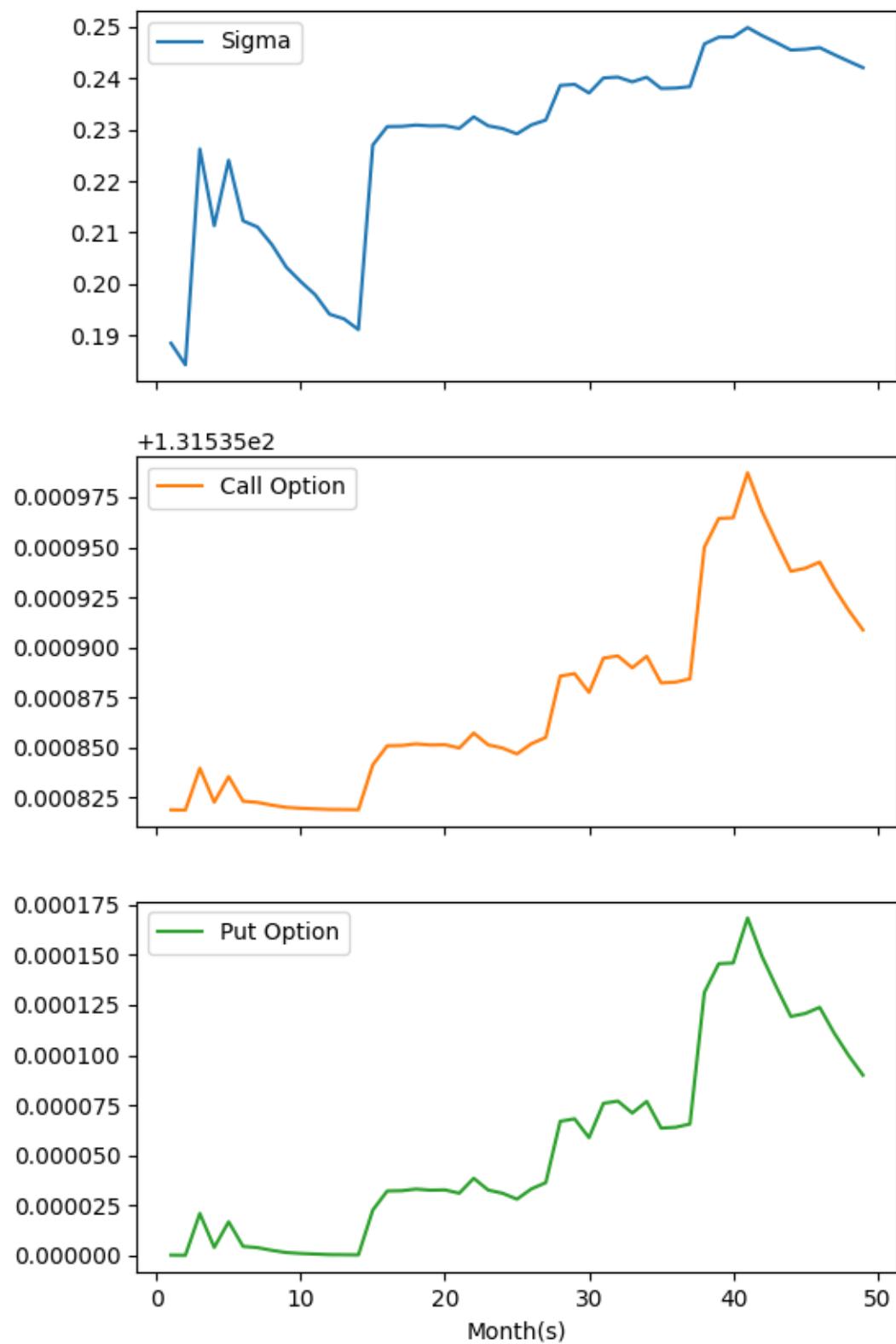
### Plot of INFY (BSE) with A = 1.4



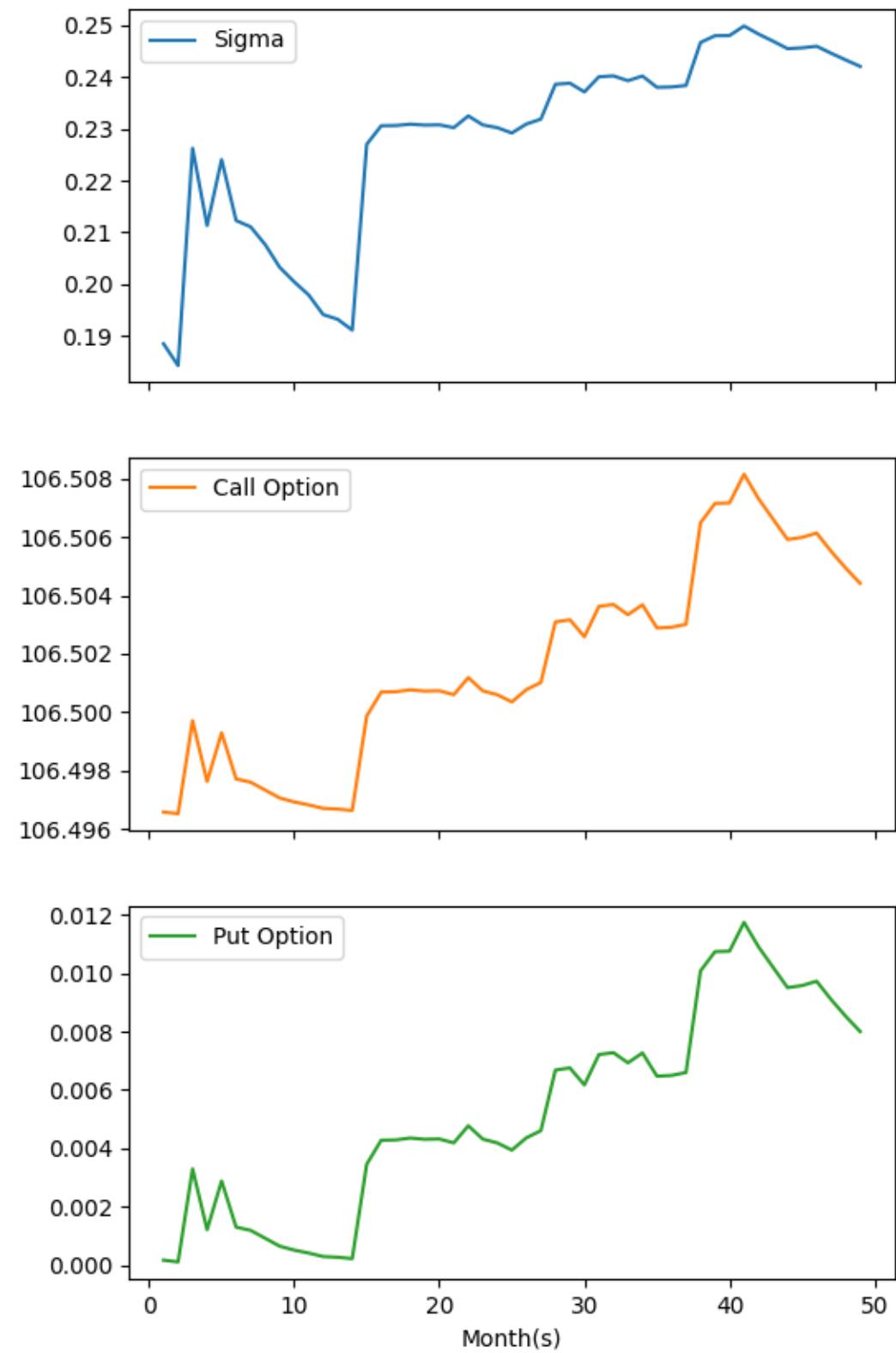
### Plot of INFY (BSE) with A = 1.5



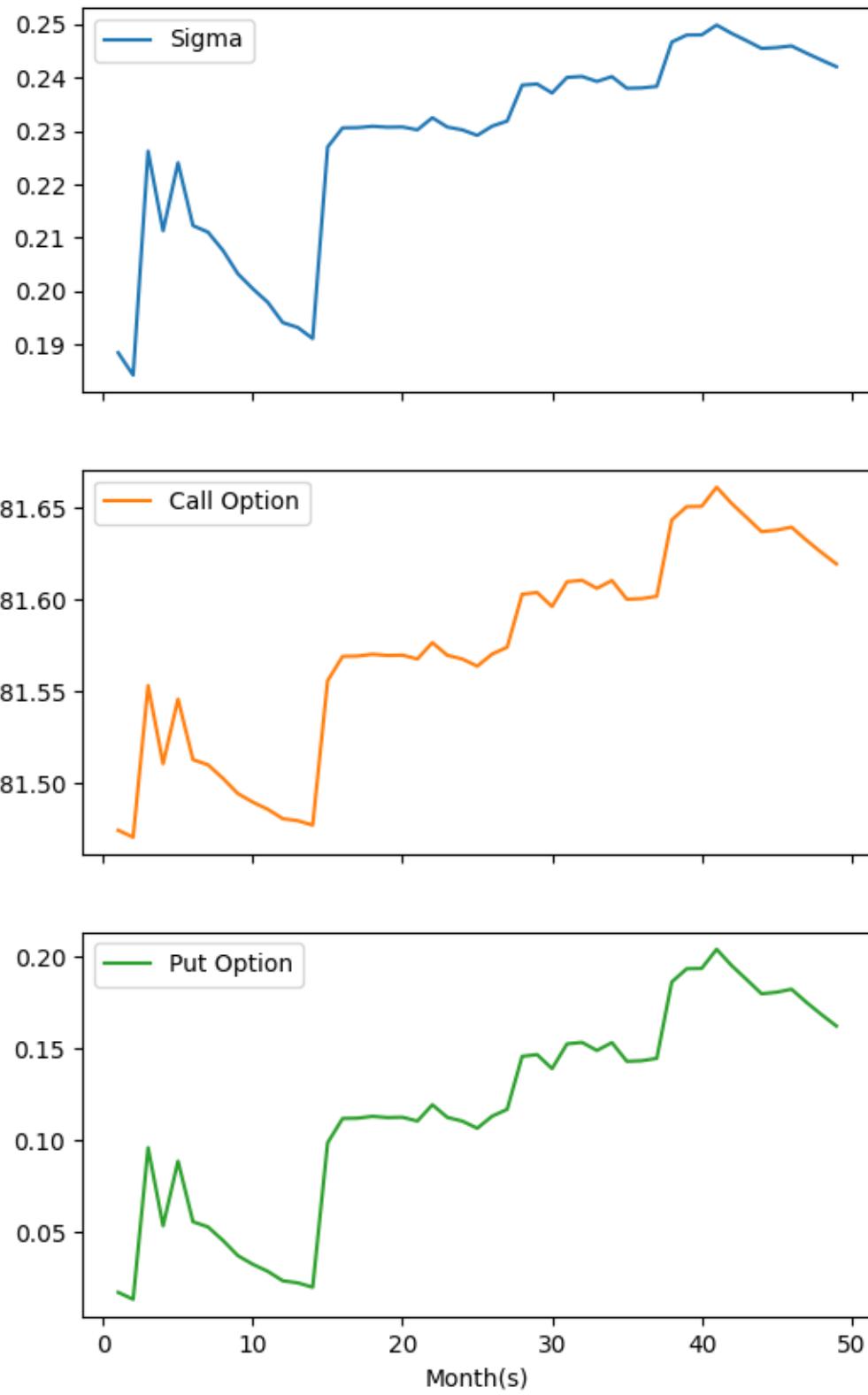
Plot of ITC (BSE) with  $A = 0.5$



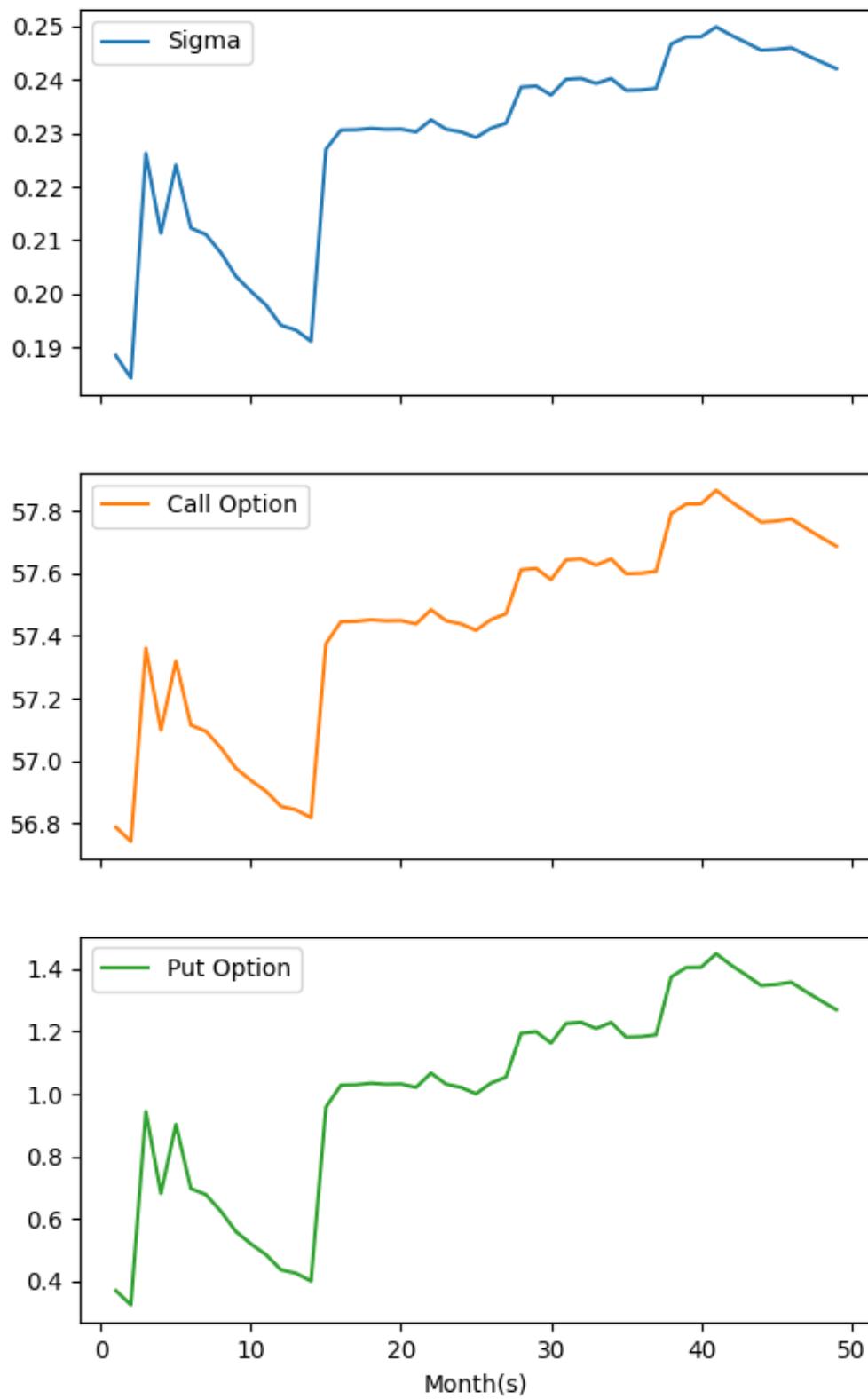
### Plot of ITC (BSE) with A = 0.6



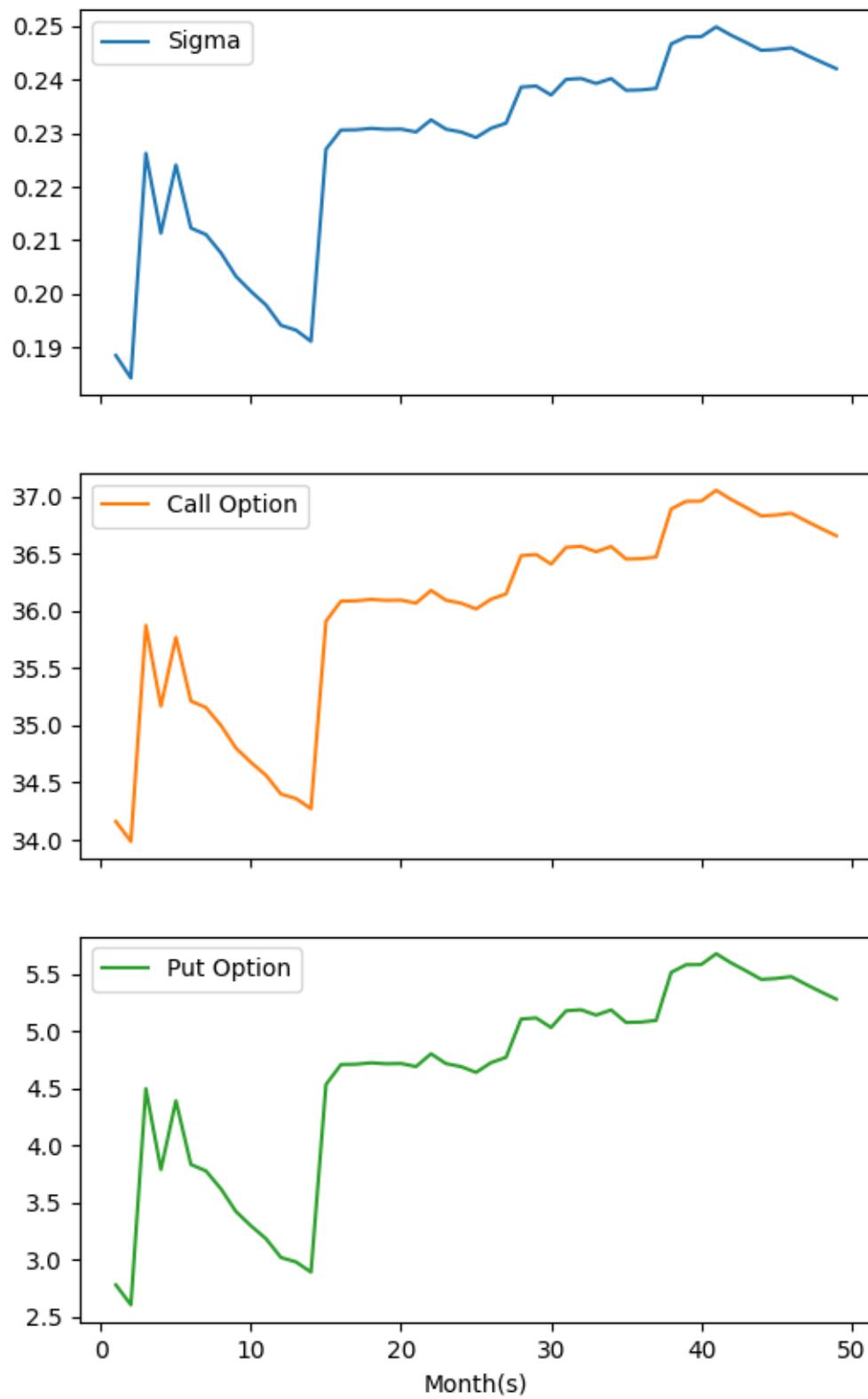
### Plot of ITC (BSE) with A = 0.7



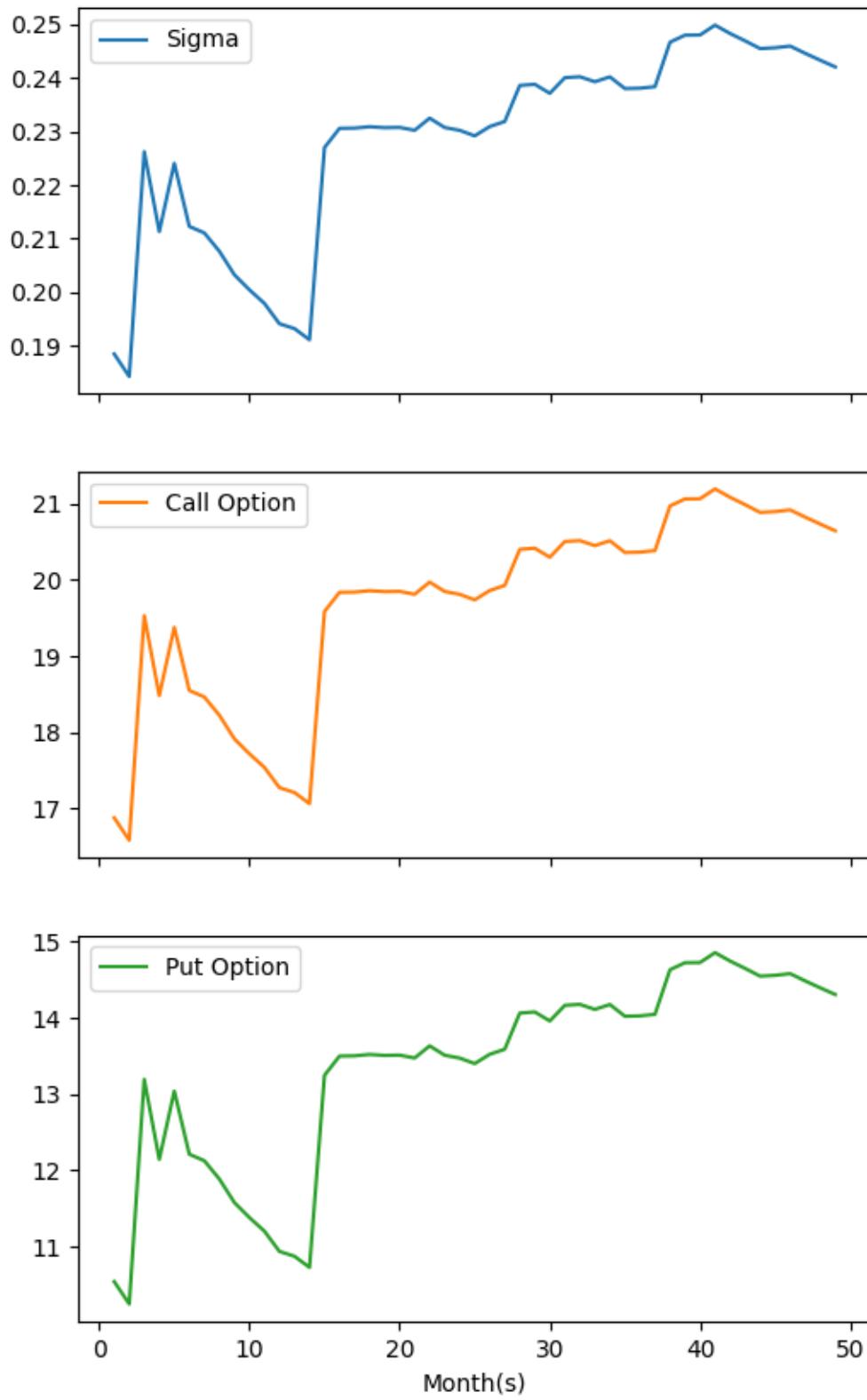
### Plot of ITC (BSE) with $A = 0.8$



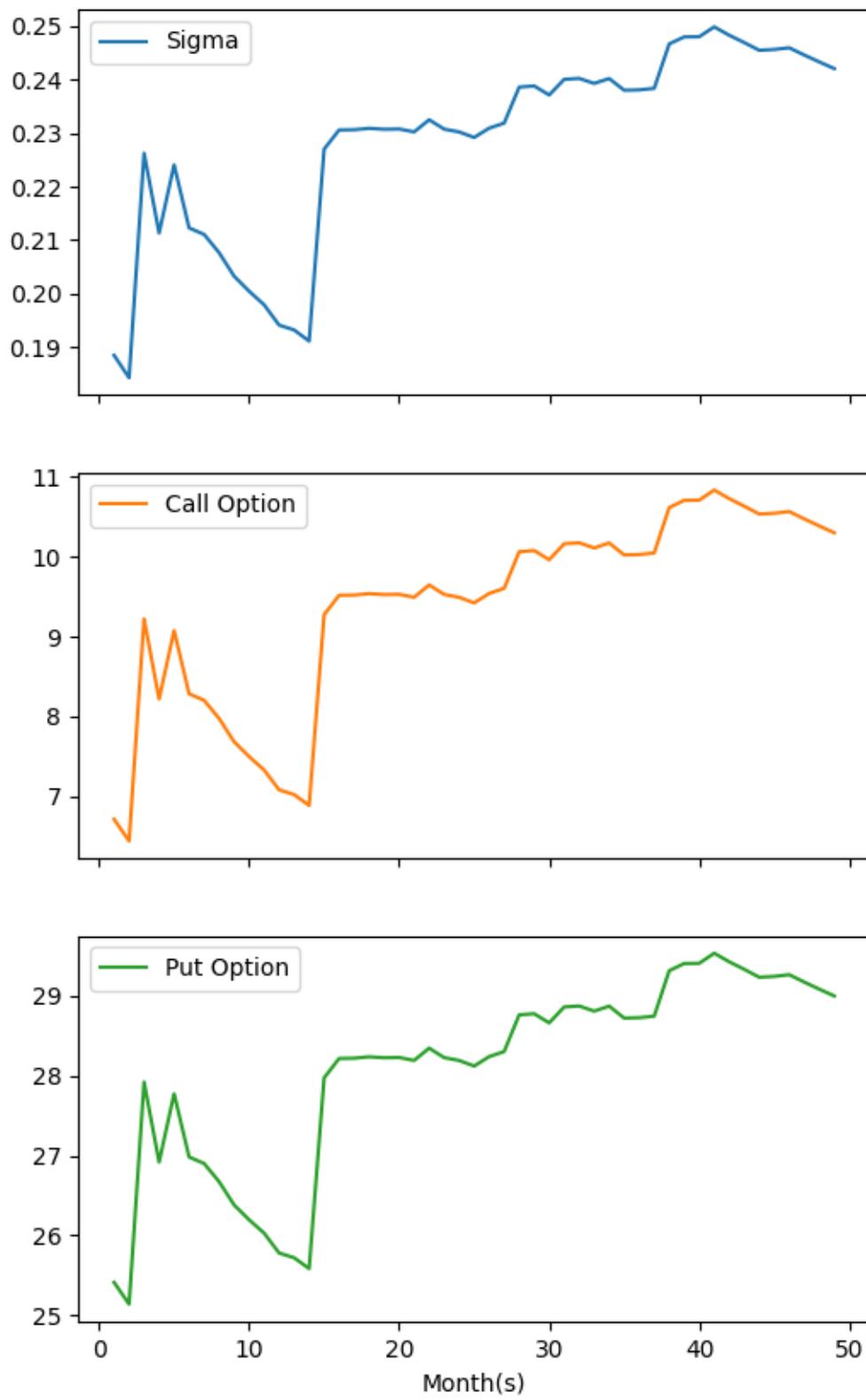
Plot of ITC (BSE) with  $A = 0.9$



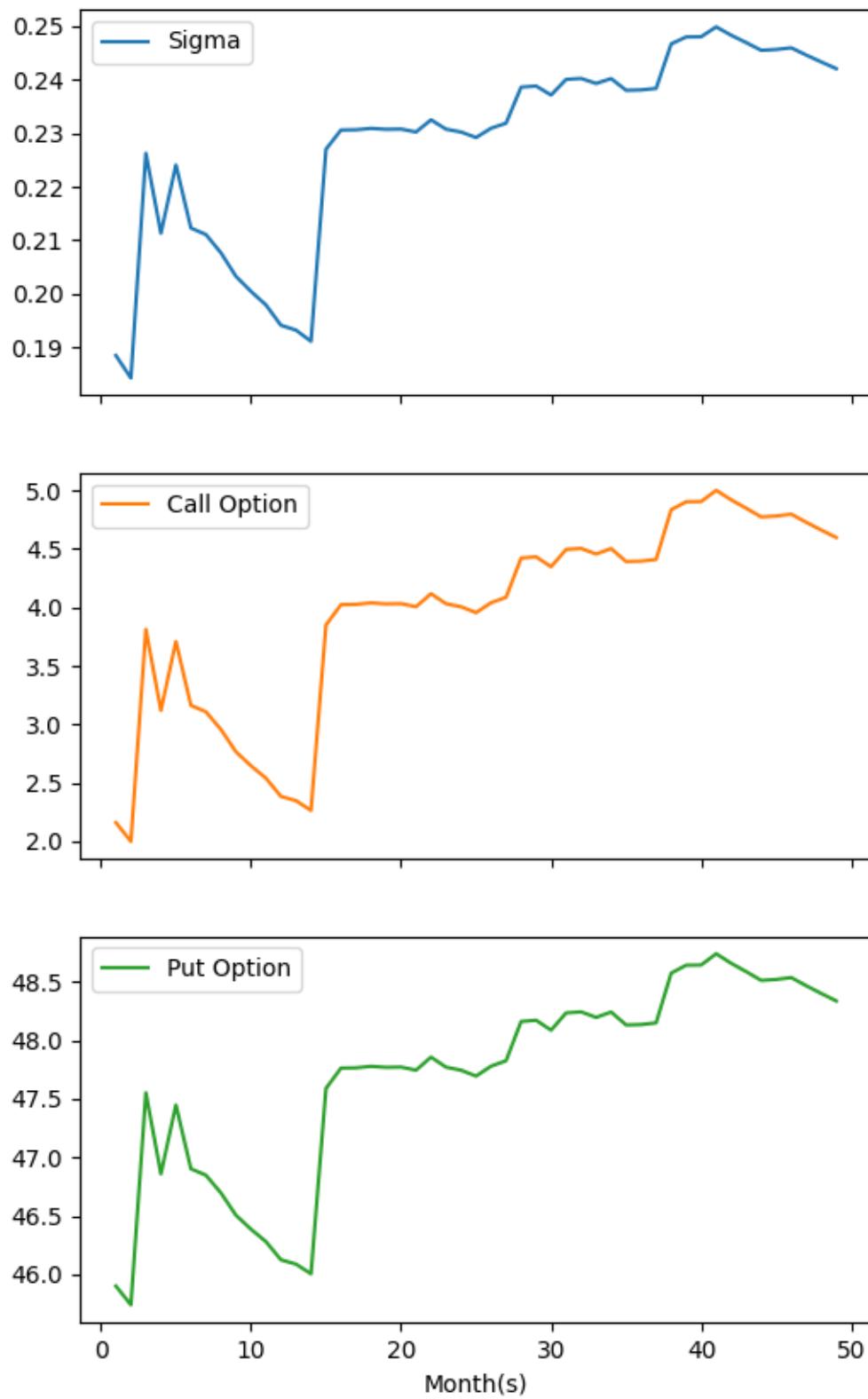
### Plot of ITC (BSE) with A = 1.0



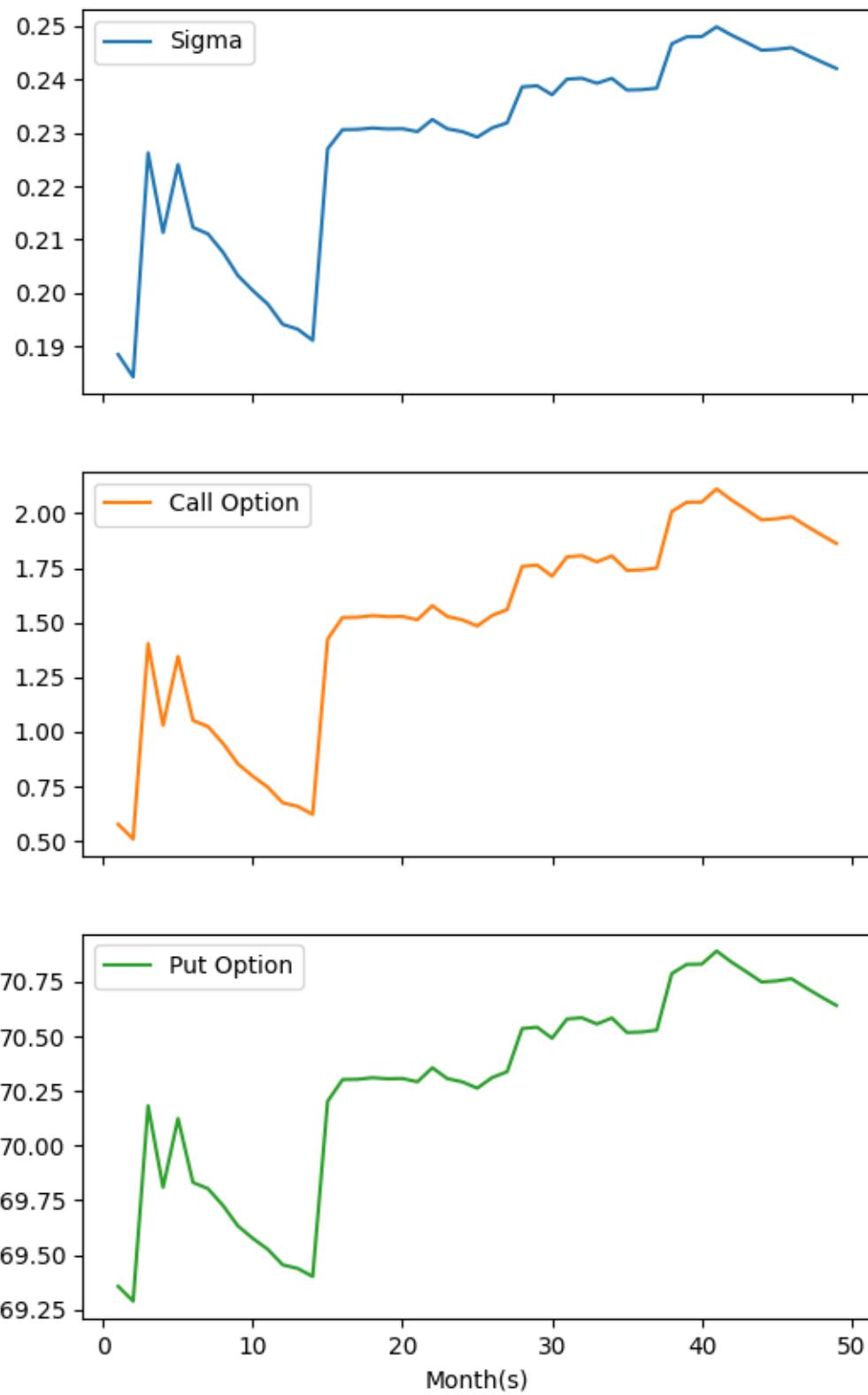
### Plot of ITC (BSE) with A = 1.1



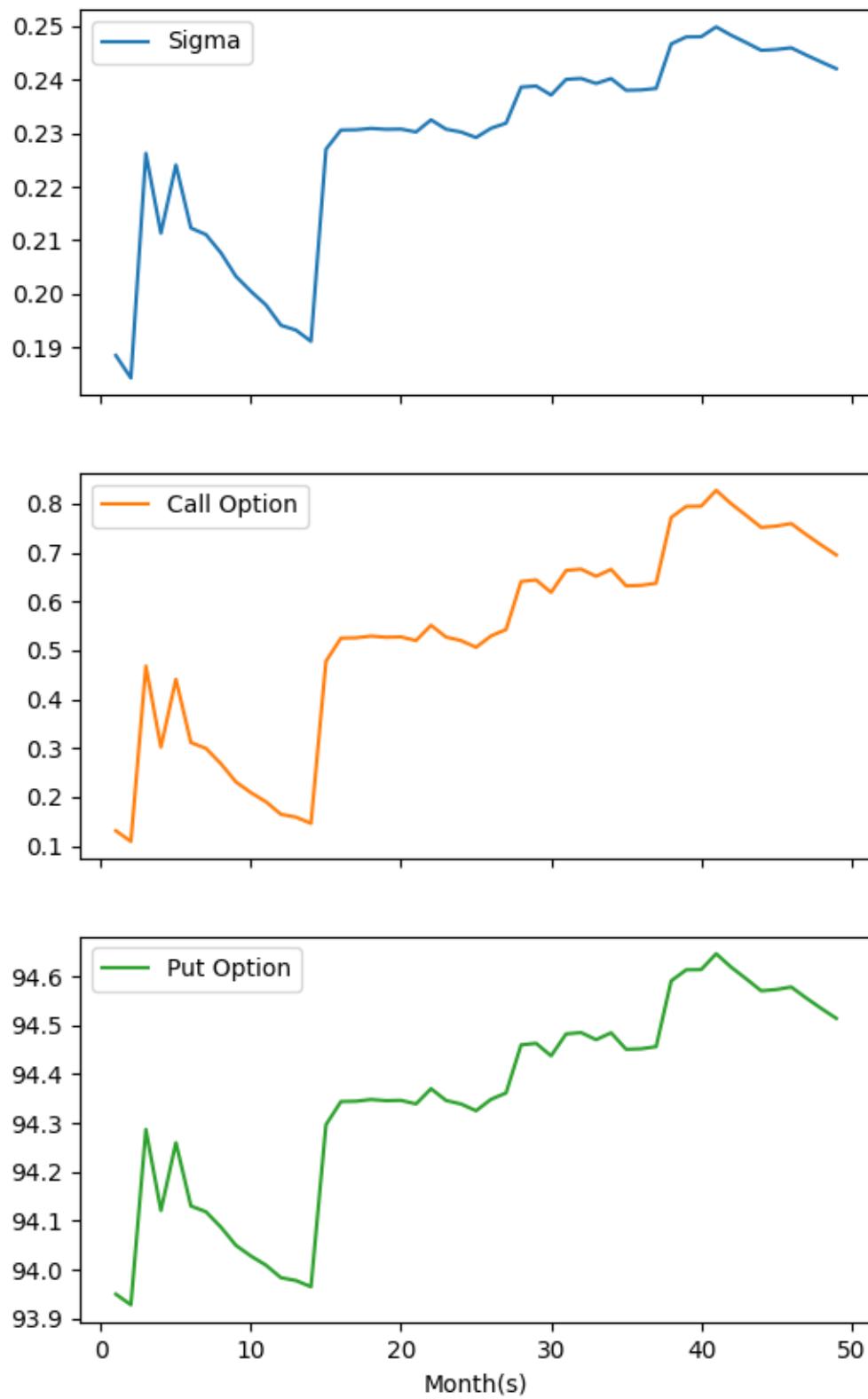
Plot of ITC (BSE) with  $A = 1.2$



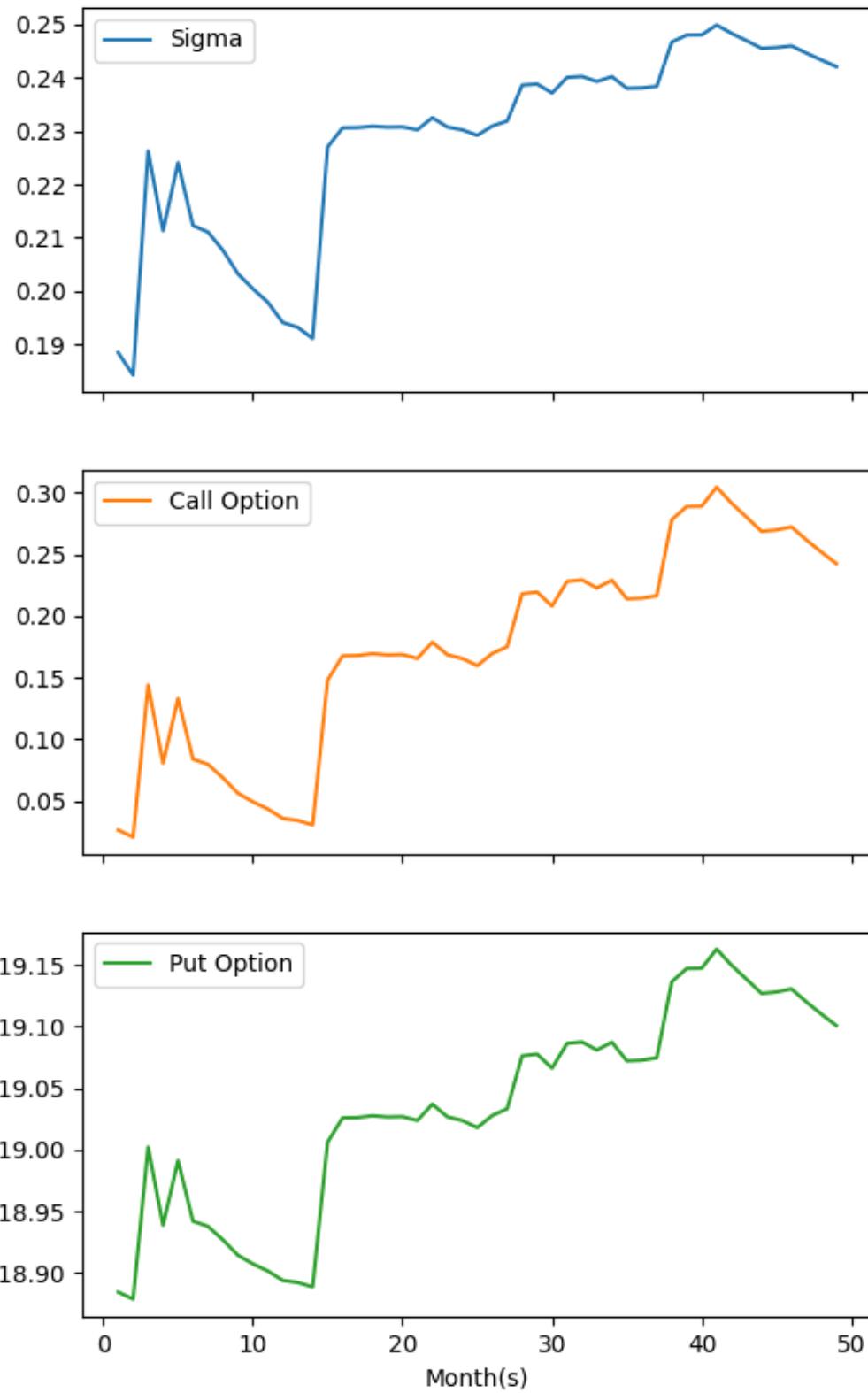
Plot of ITC (BSE) with  $A = 1.3$



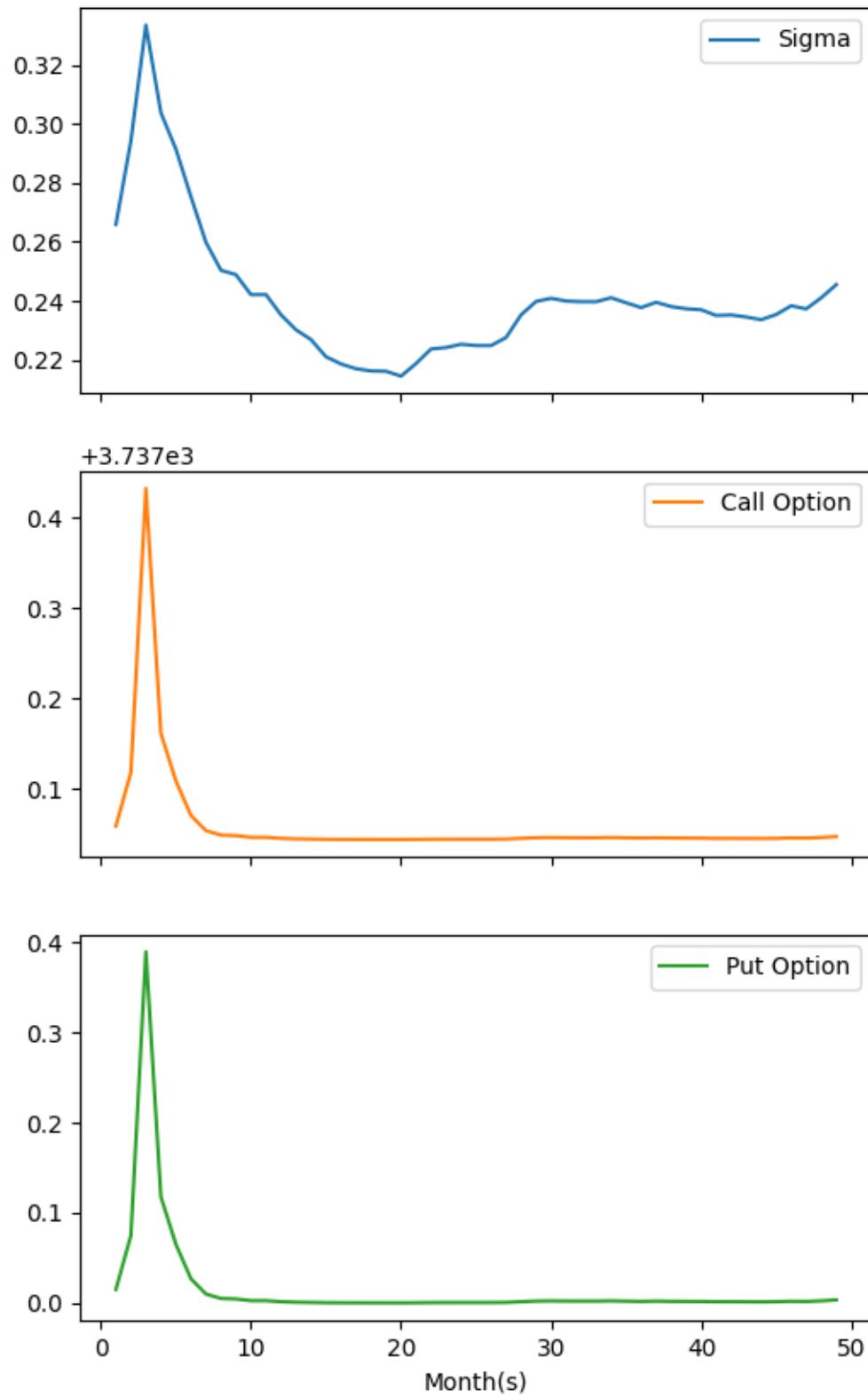
### Plot of ITC (BSE) with $A = 1.4$



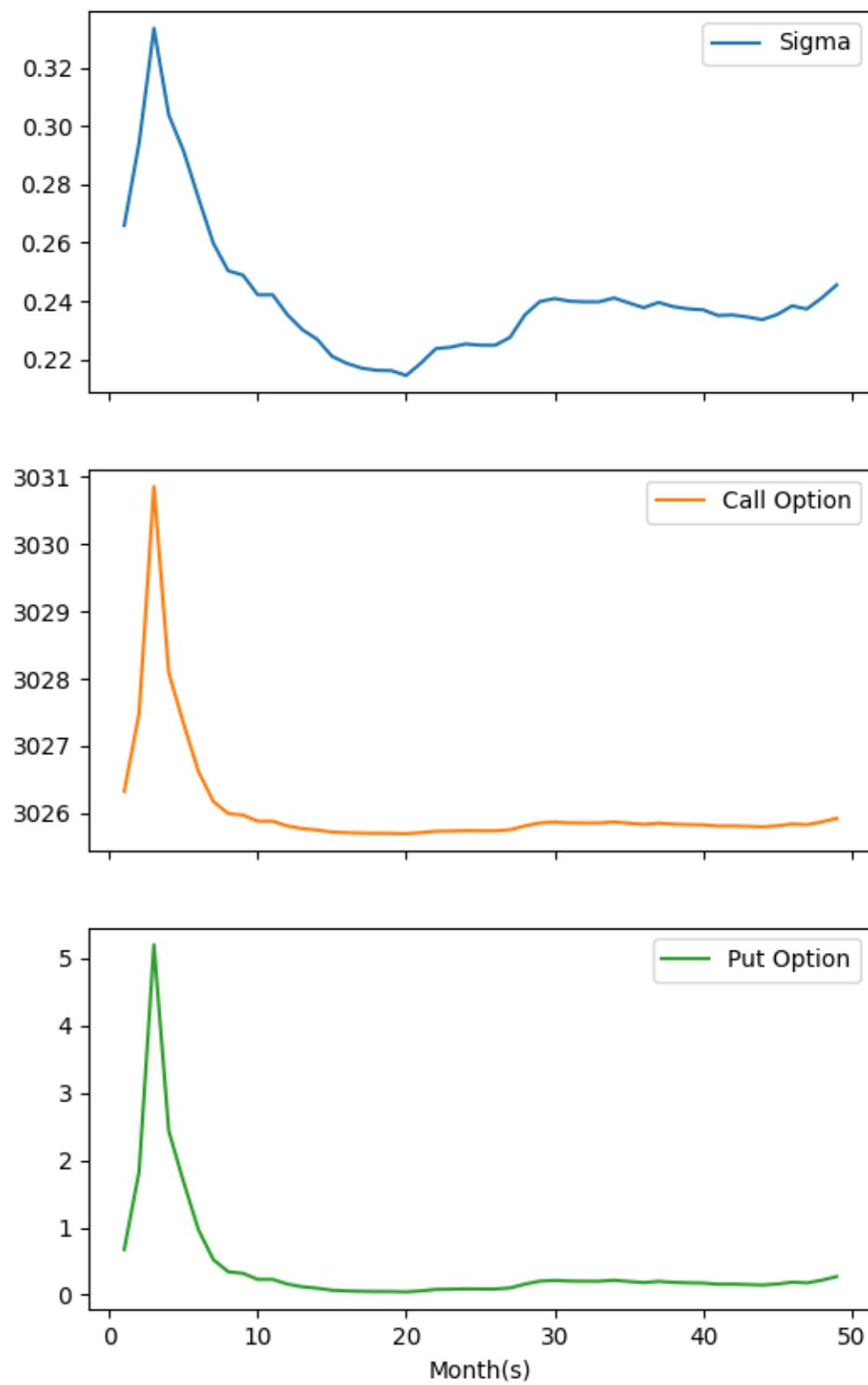
### Plot of ITC (BSE) with A = 1.5



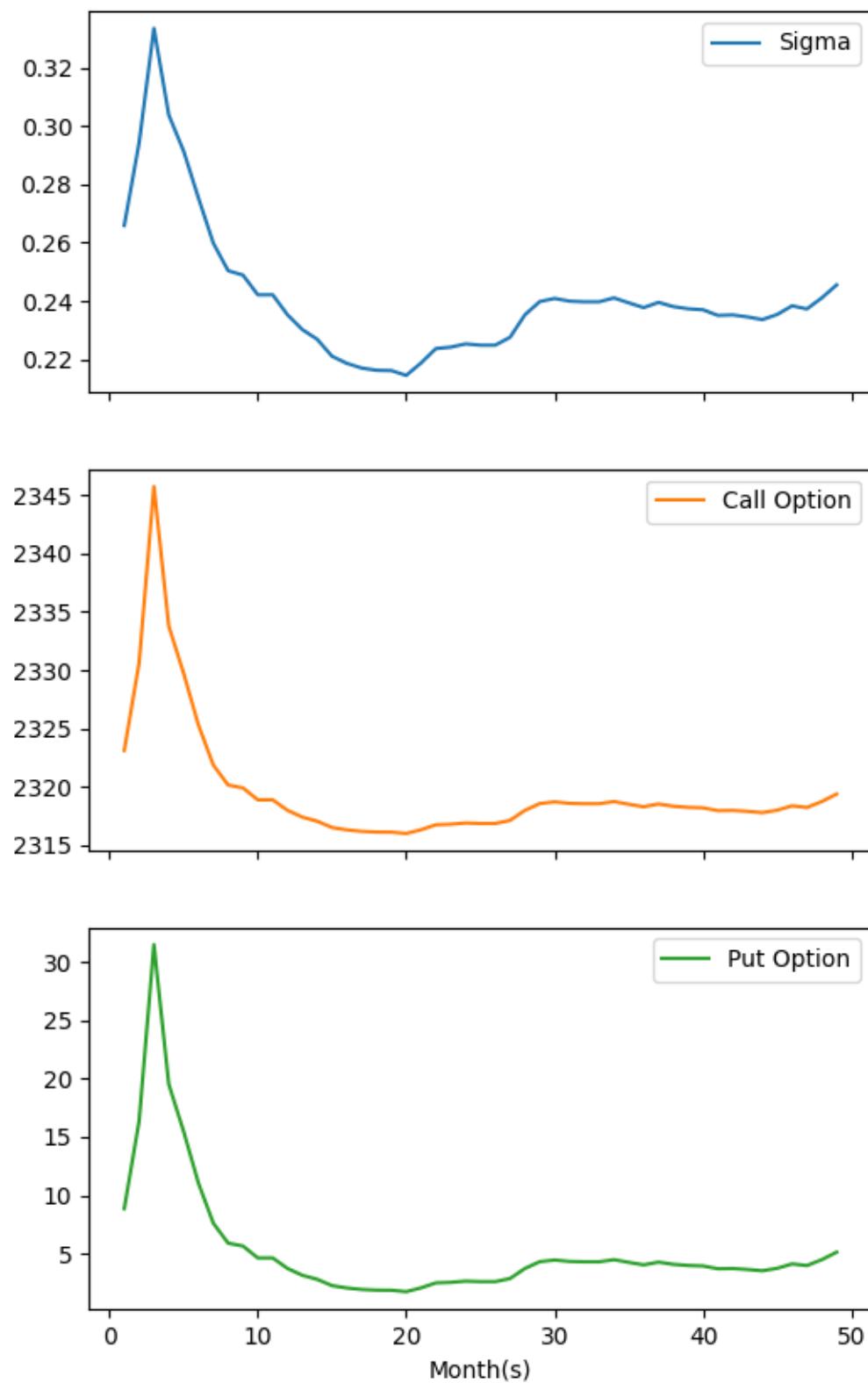
### Plot of MARUTI (BSE) with $A = 0.5$



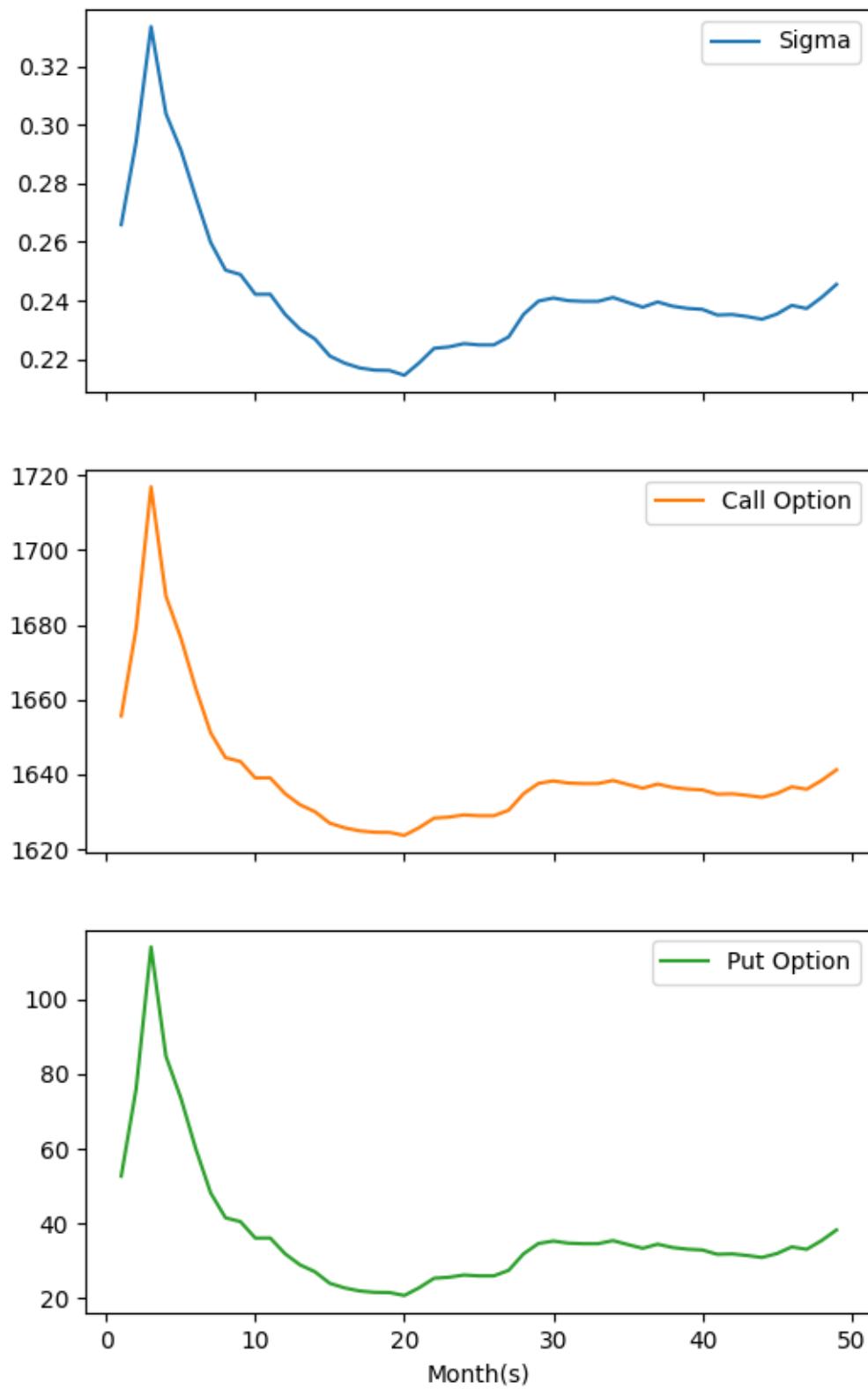
### Plot of MARUTI (BSE) with $A = 0.6$



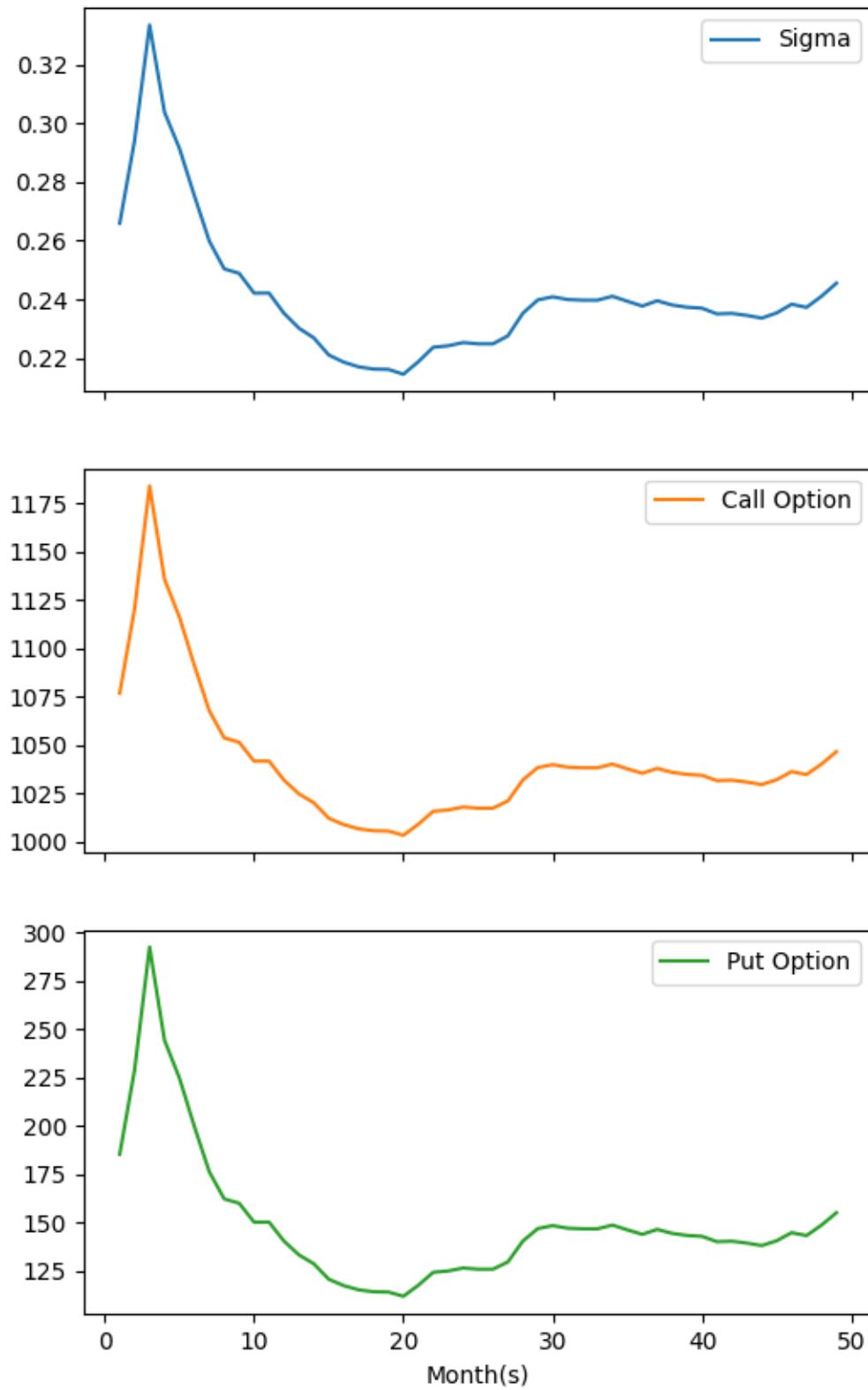
### Plot of MARUTI (BSE) with $A = 0.7$



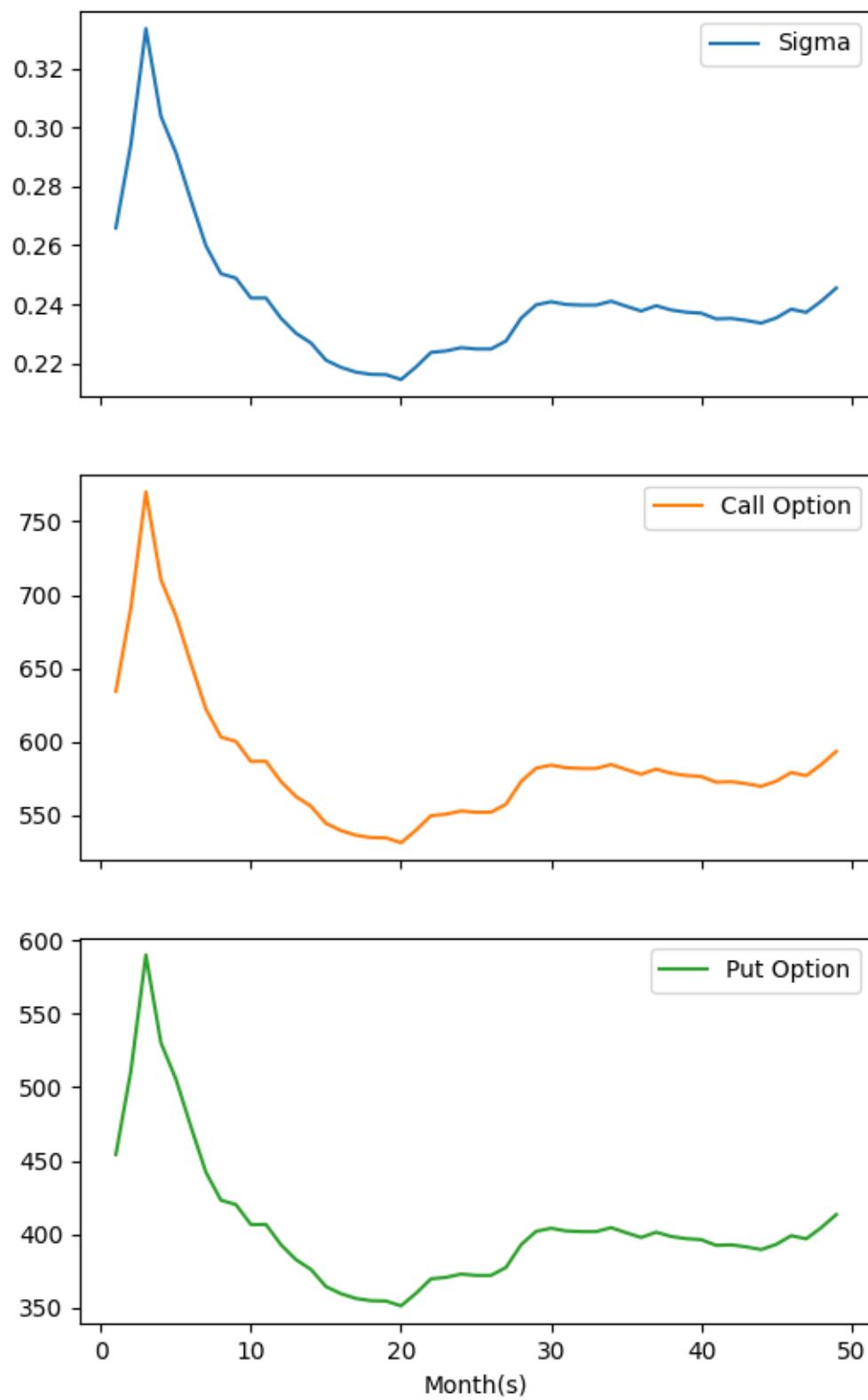
### Plot of MARUTI (BSE) with $A = 0.8$



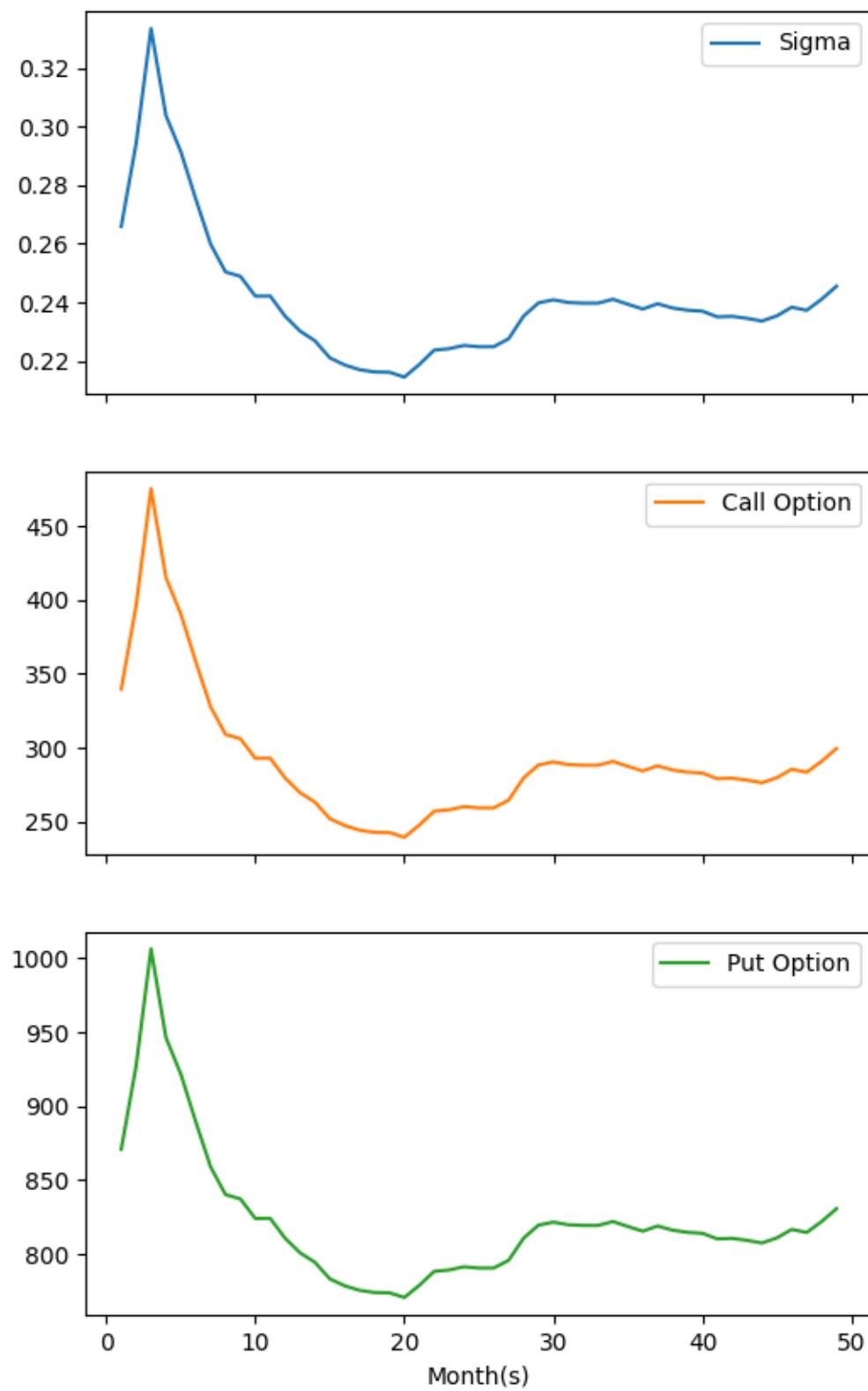
Plot of MARUTI (BSE) with  $A = 0.9$



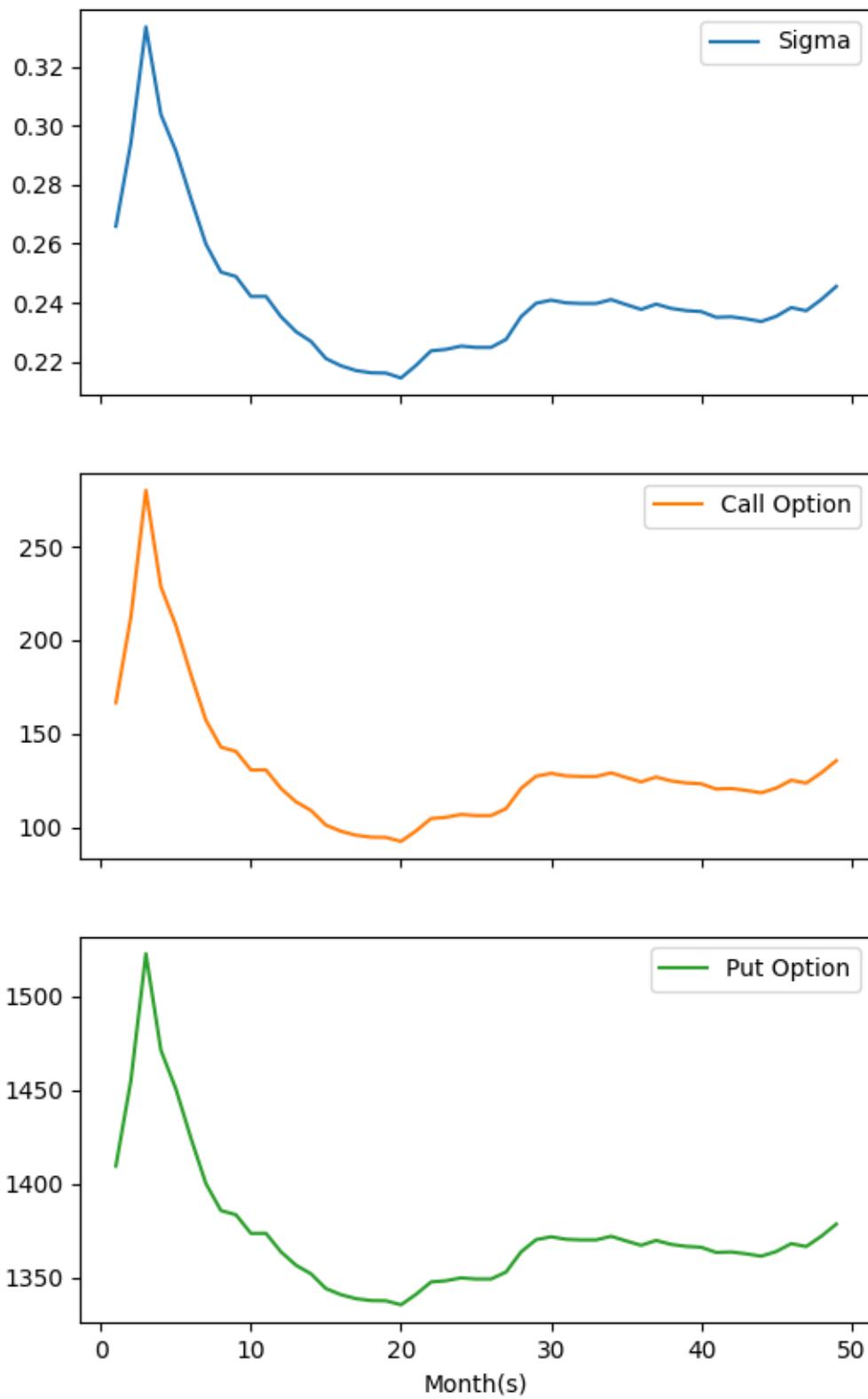
### Plot of MARUTI (BSE) with $A = 1.0$



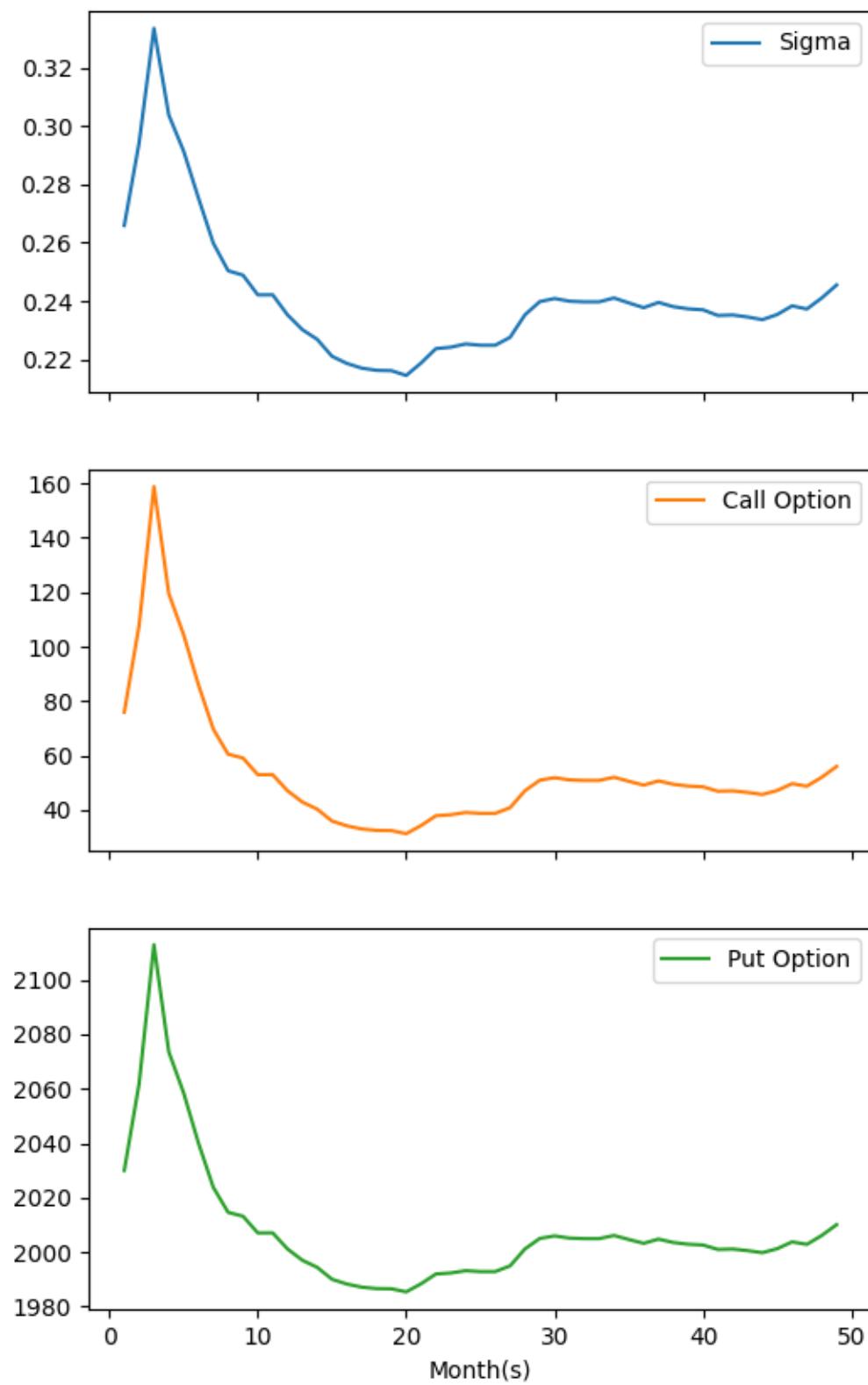
Plot of MARUTI (BSE) with  $A = 1.1$



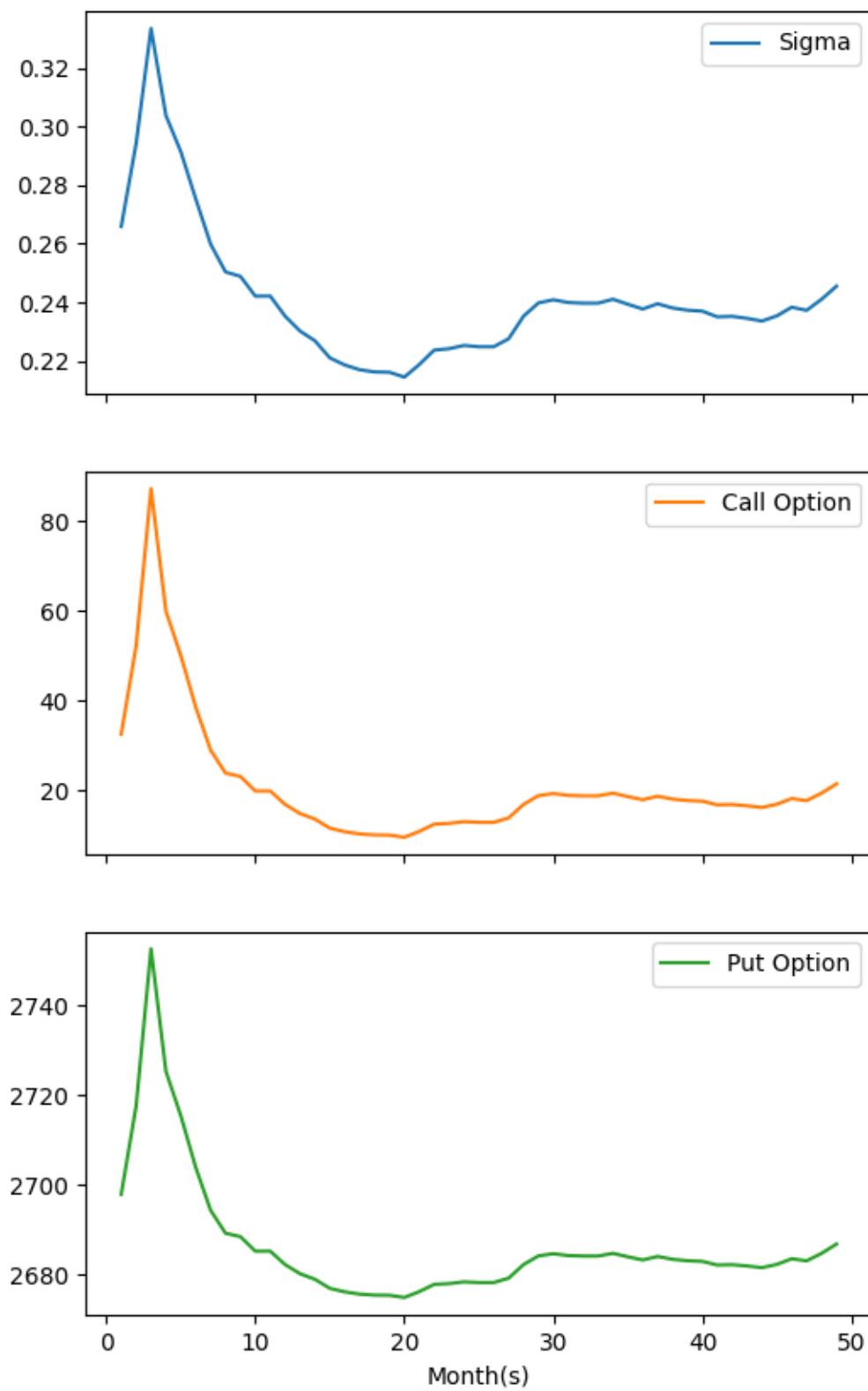
Plot of MARUTI (BSE) with  $A = 1.2$



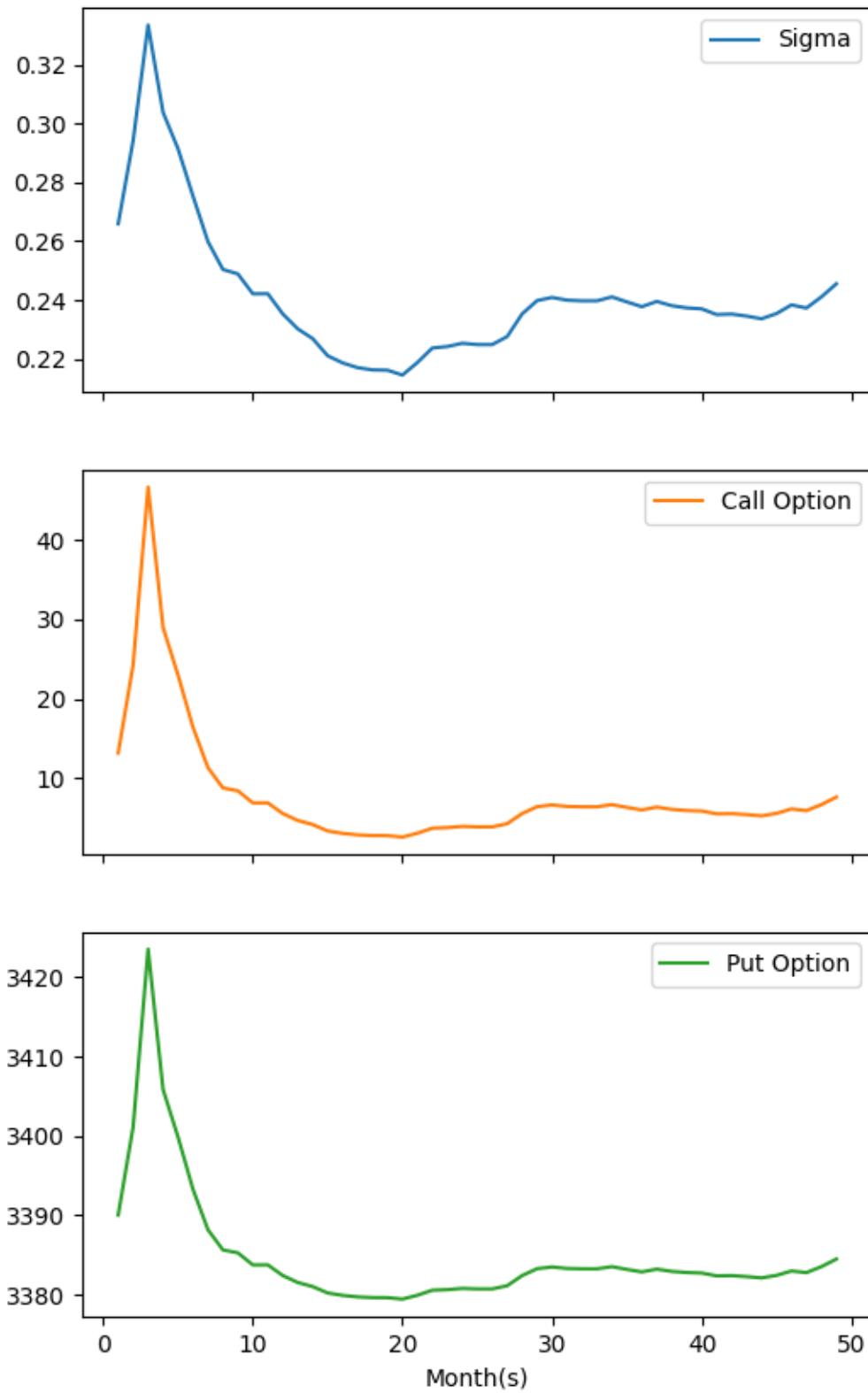
Plot of MARUTI (BSE) with  $A = 1.3$



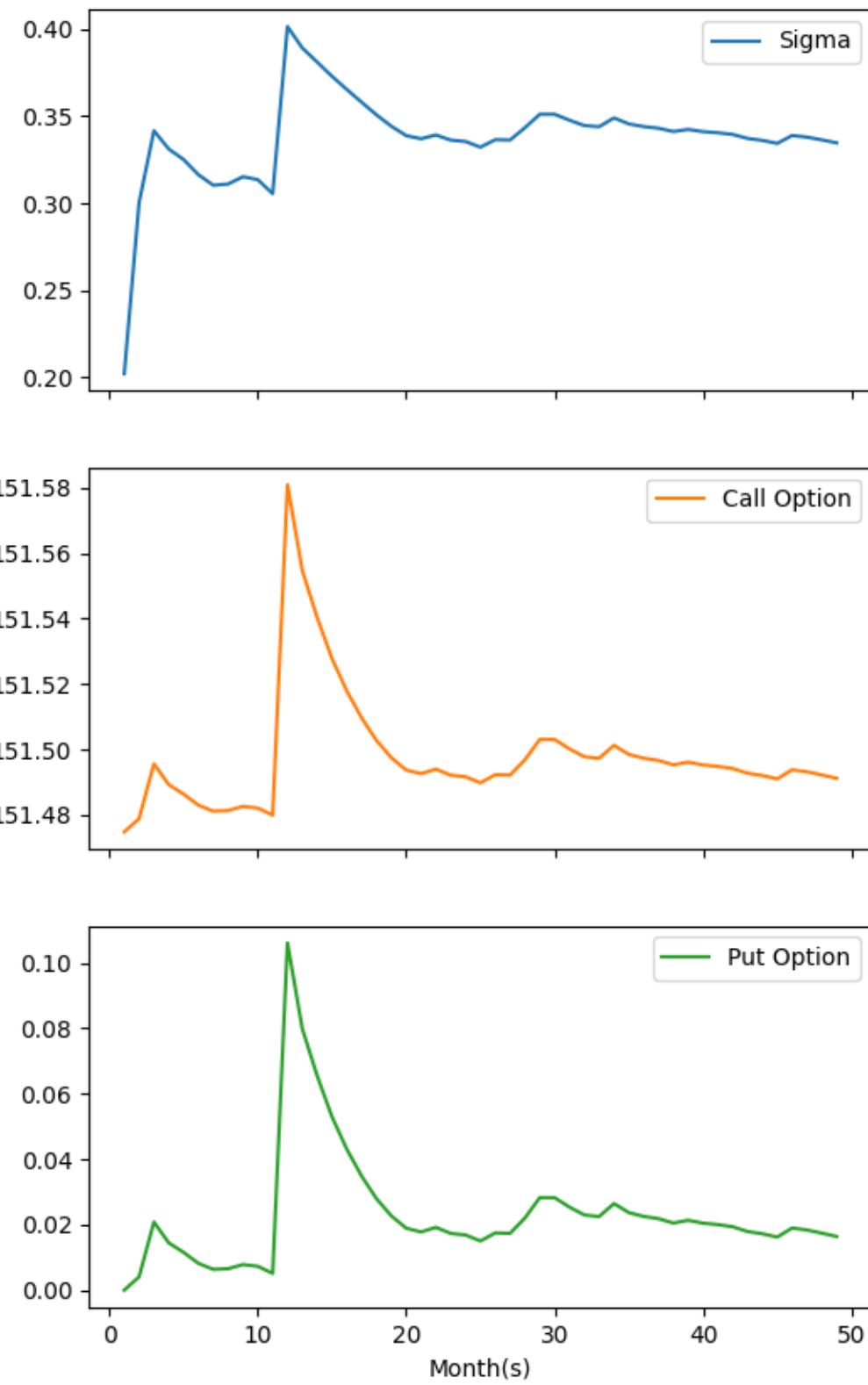
Plot of MARUTI (BSE) with  $A = 1.4$



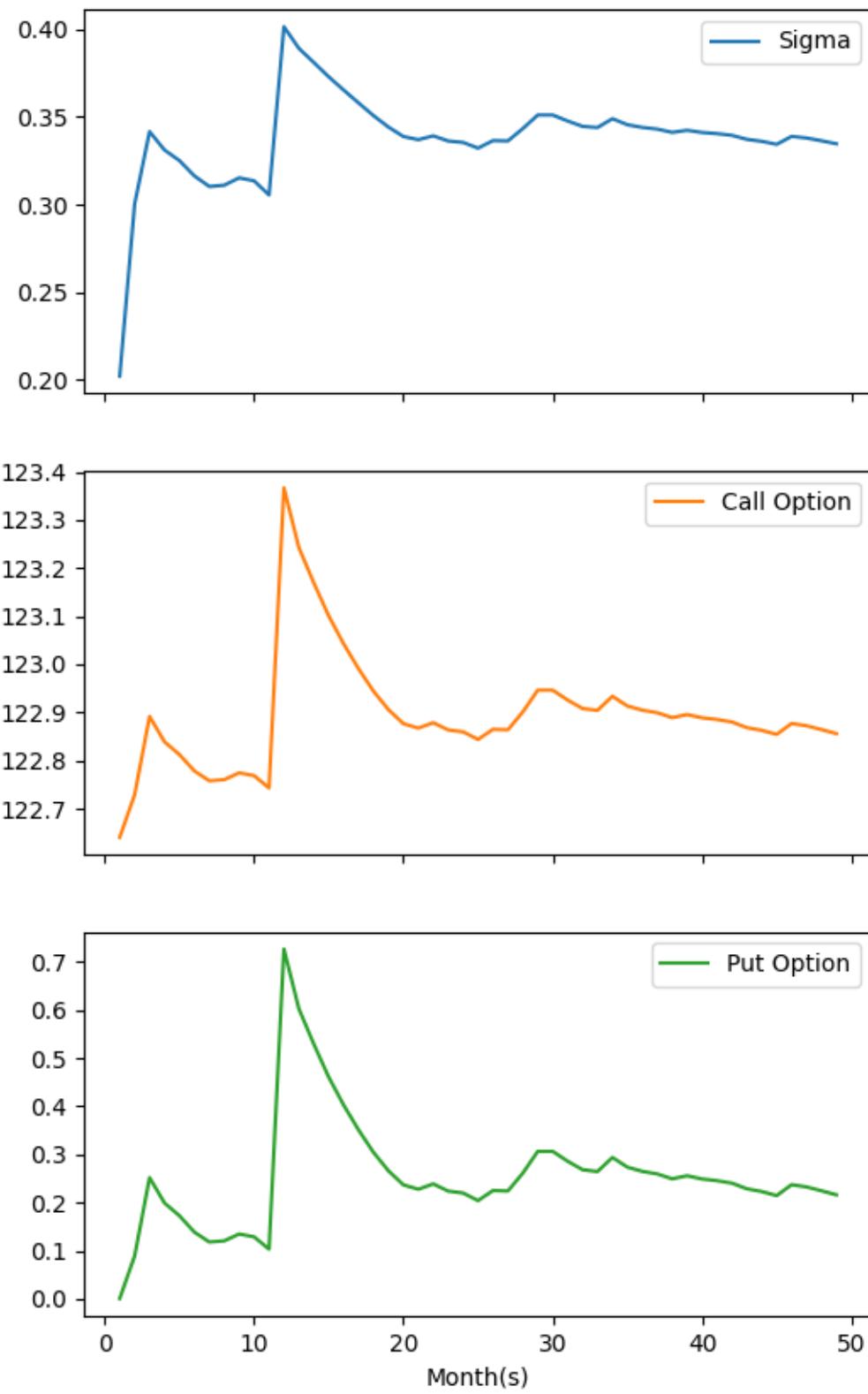
### Plot of MARUTI (BSE) with $A = 1.5$



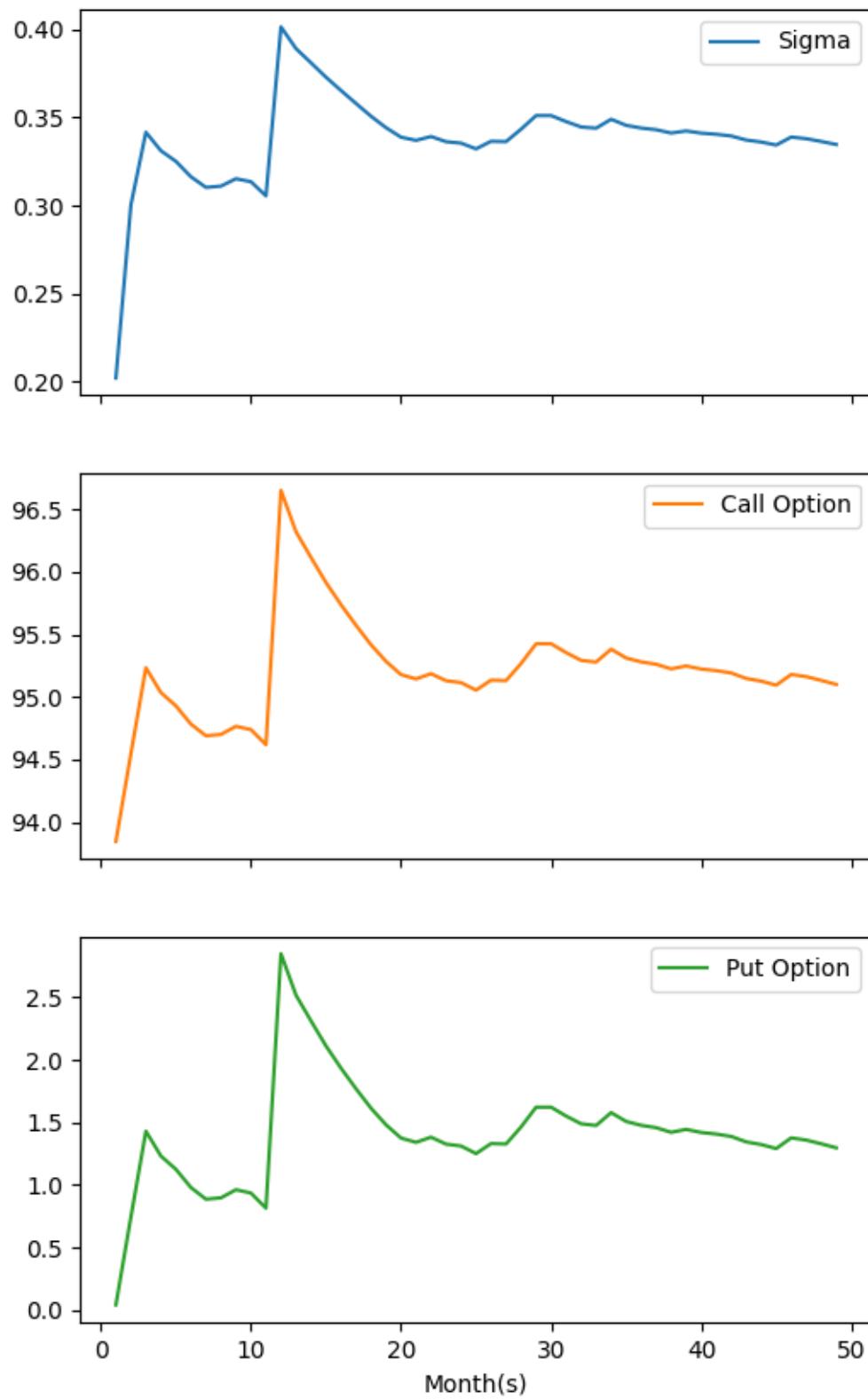
### Plot of SBIN (BSE) with A = 0.5



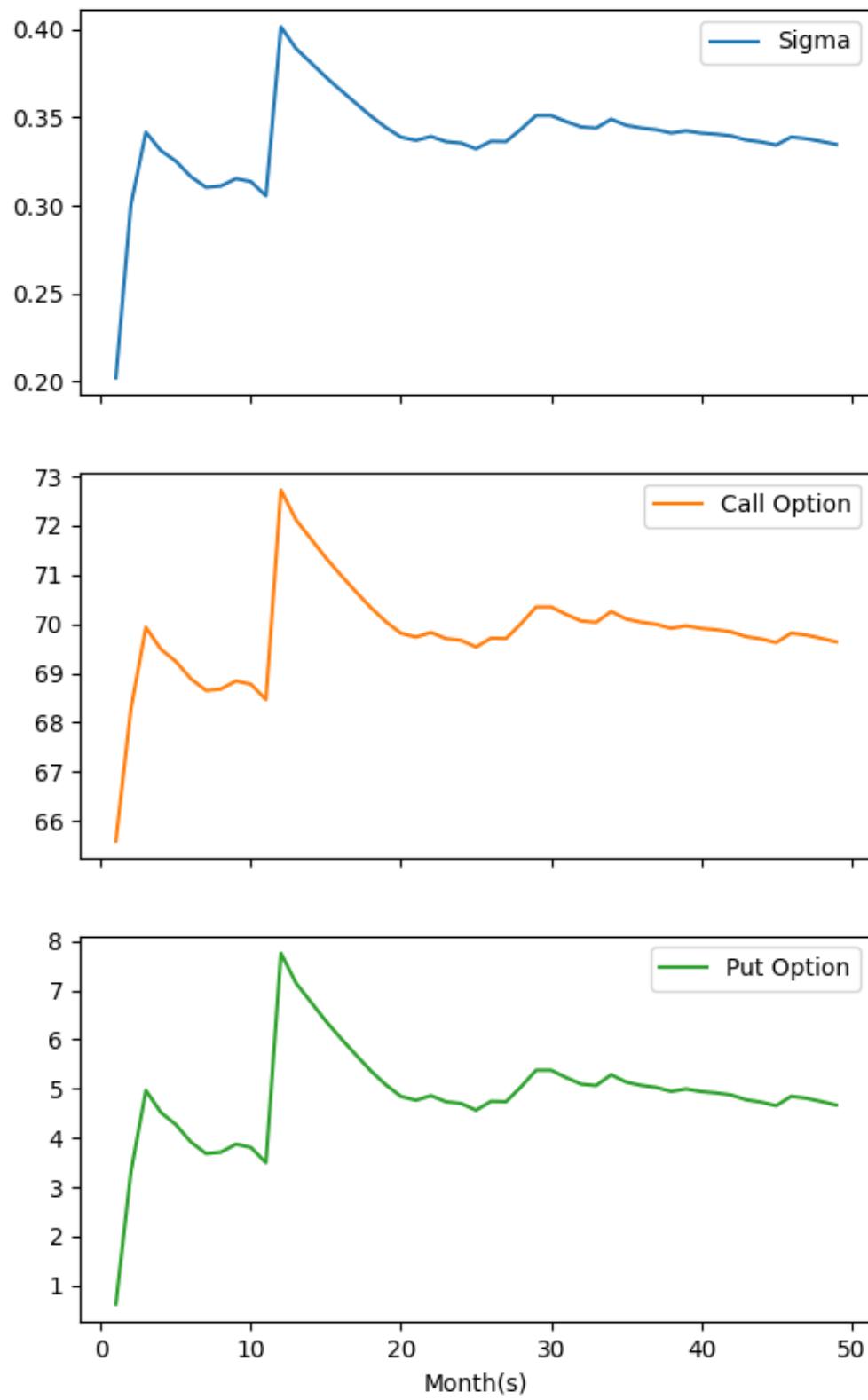
Plot of SBIN (BSE) with  $A = 0.6$



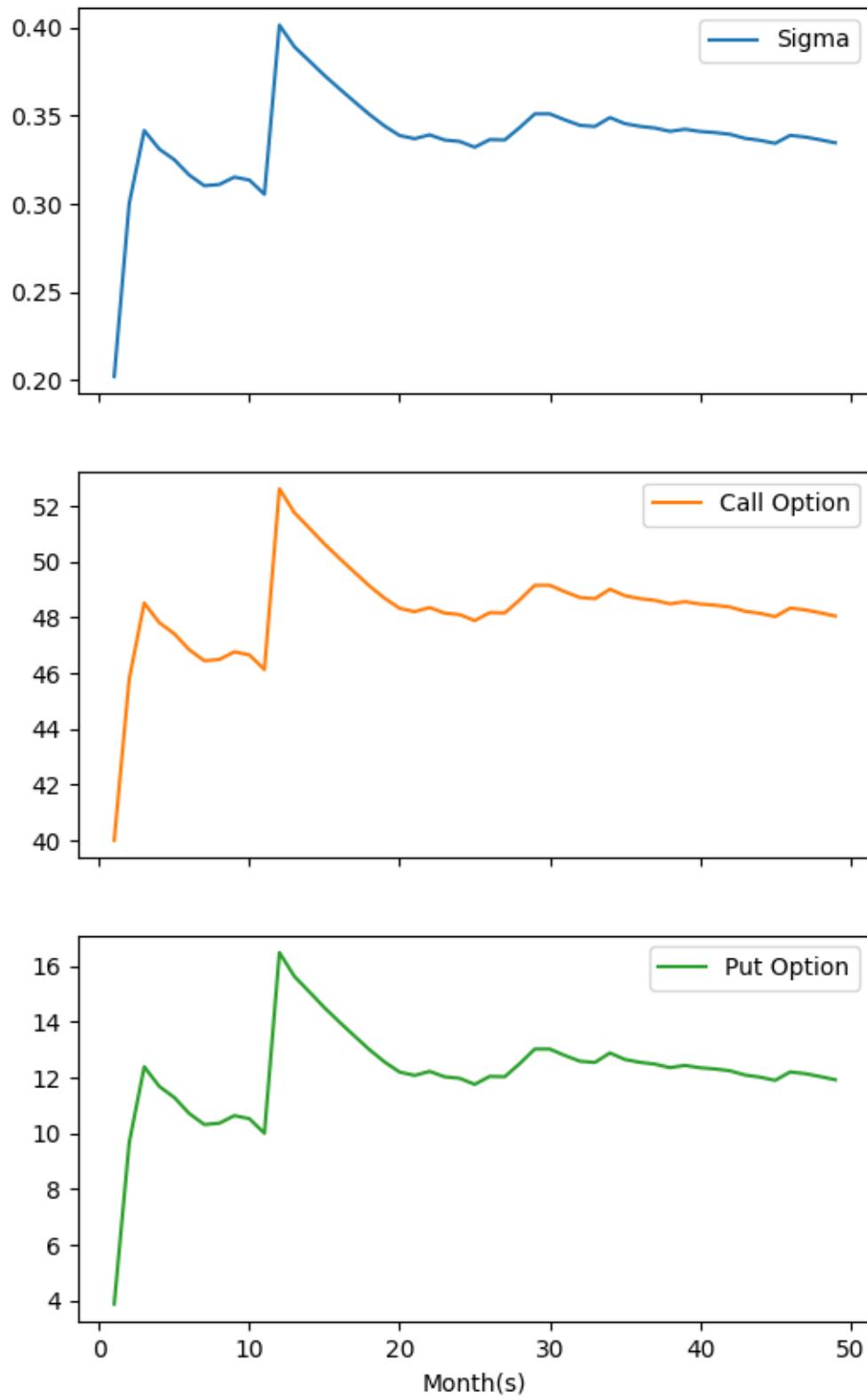
Plot of SBIN (BSE) with A = 0.7



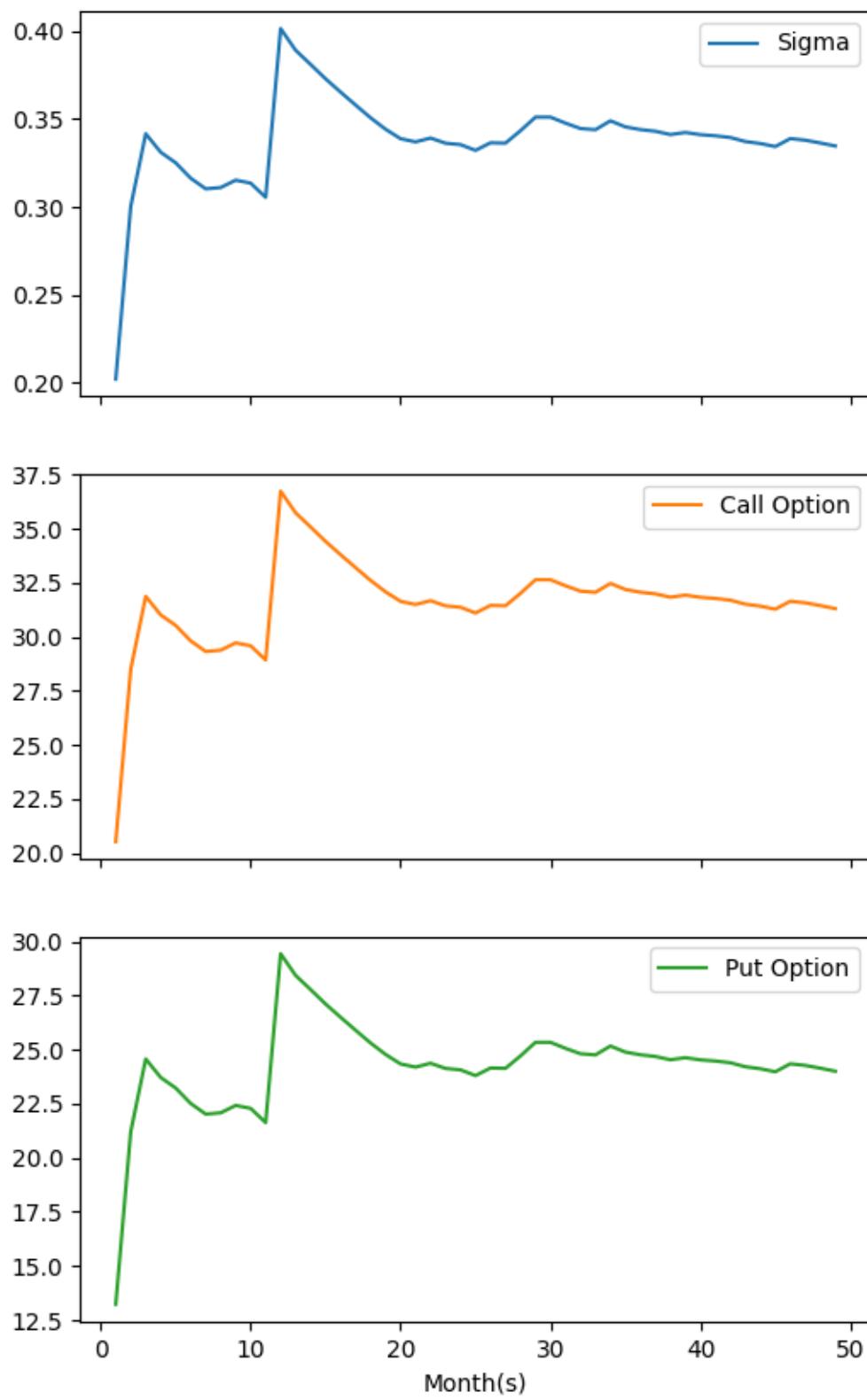
### Plot of SBIN (BSE) with A = 0.8



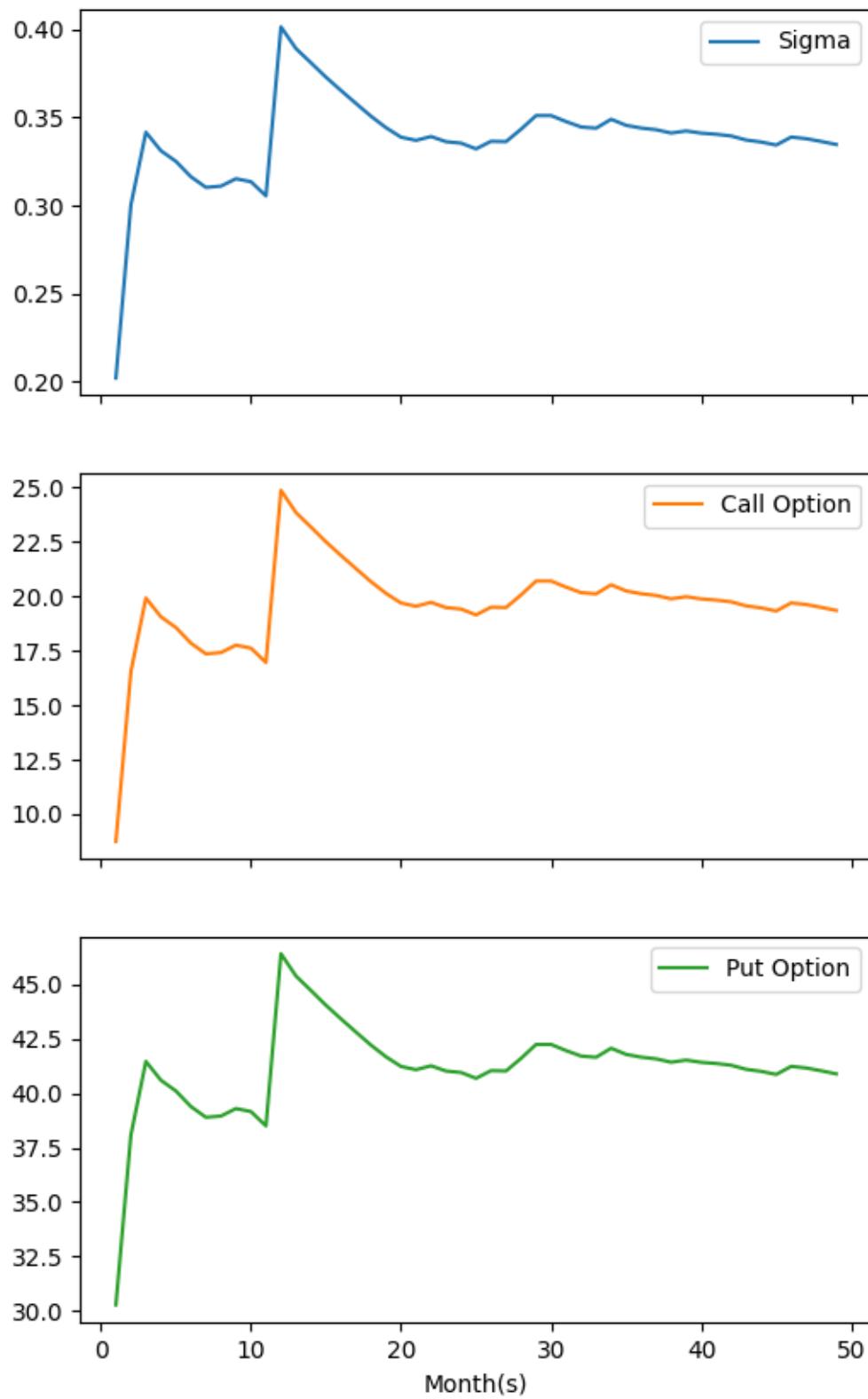
### Plot of SBIN (BSE) with A = 0.9



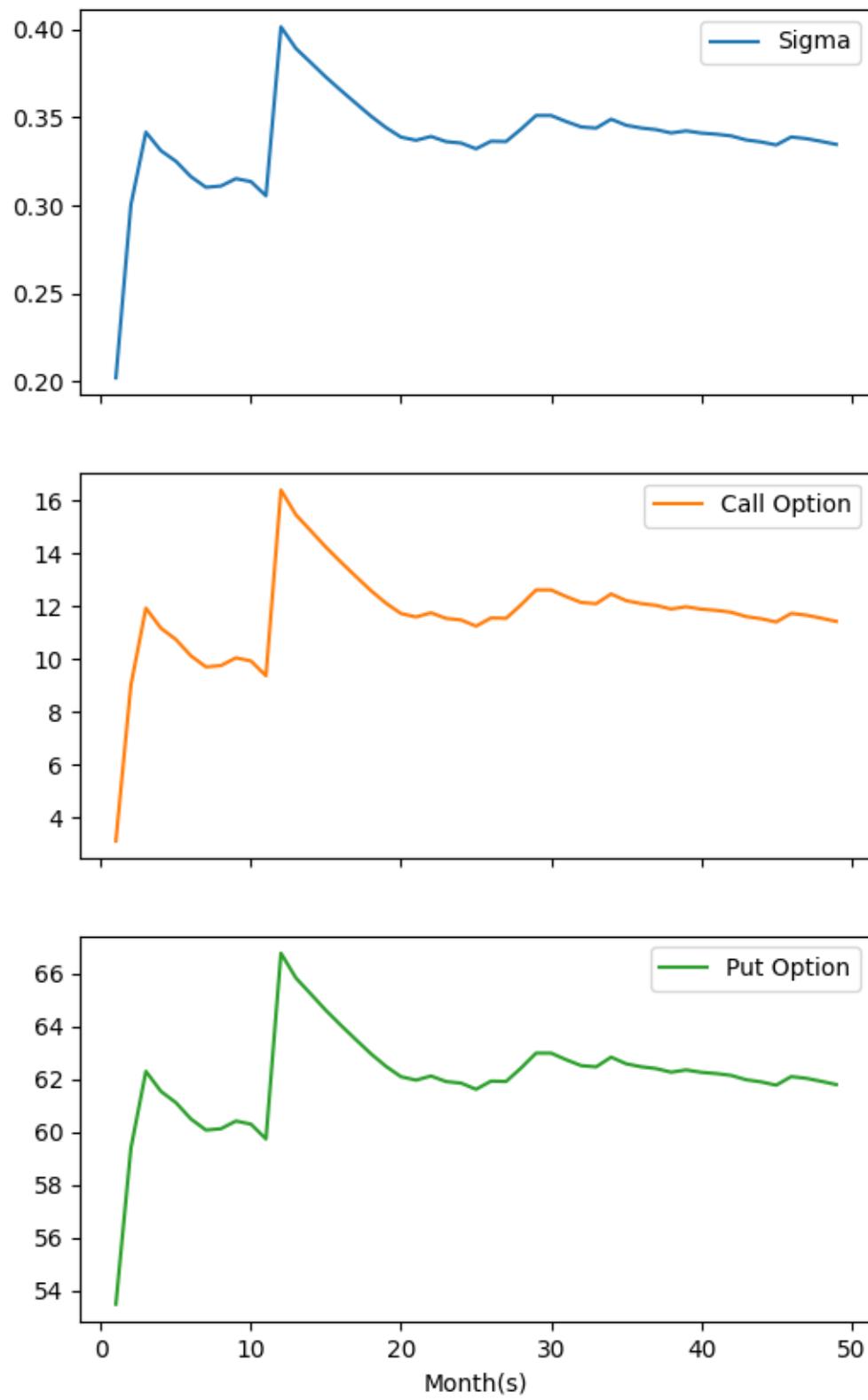
### Plot of SBIN (BSE) with A = 1.0



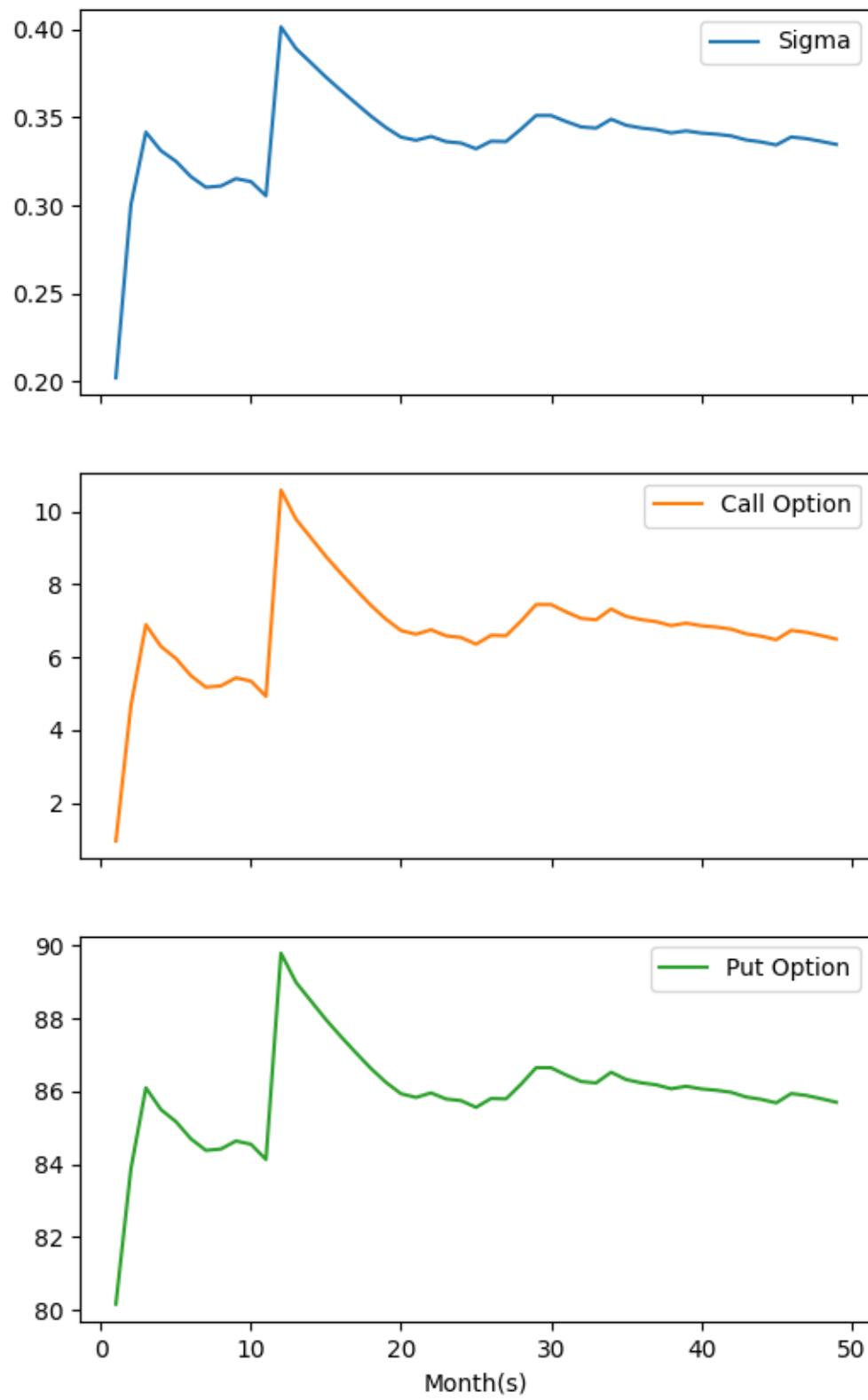
Plot of SBIN (BSE) with A = 1.1



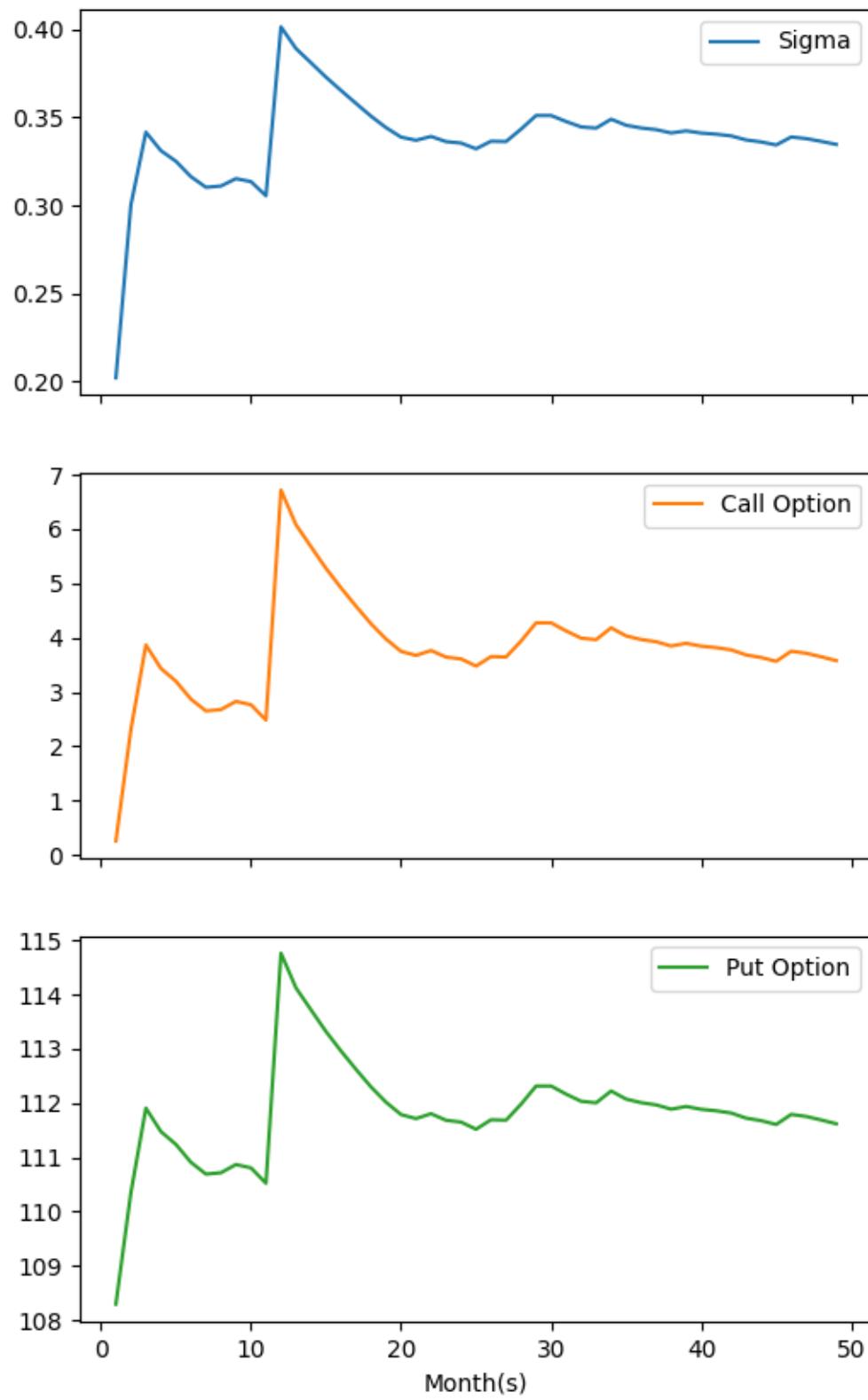
Plot of SBIN (BSE) with A = 1.2



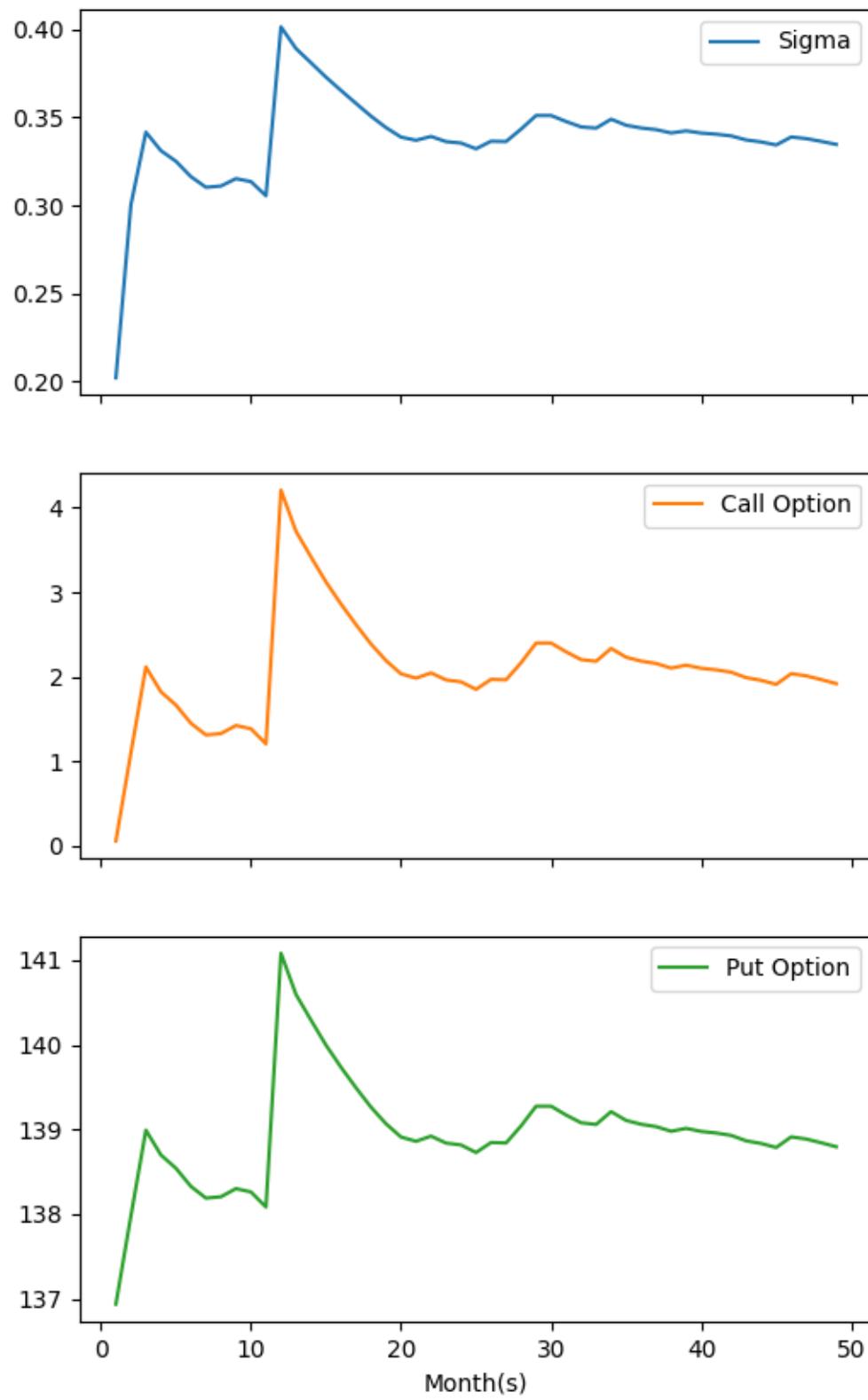
### Plot of SBIN (BSE) with A = 1.3



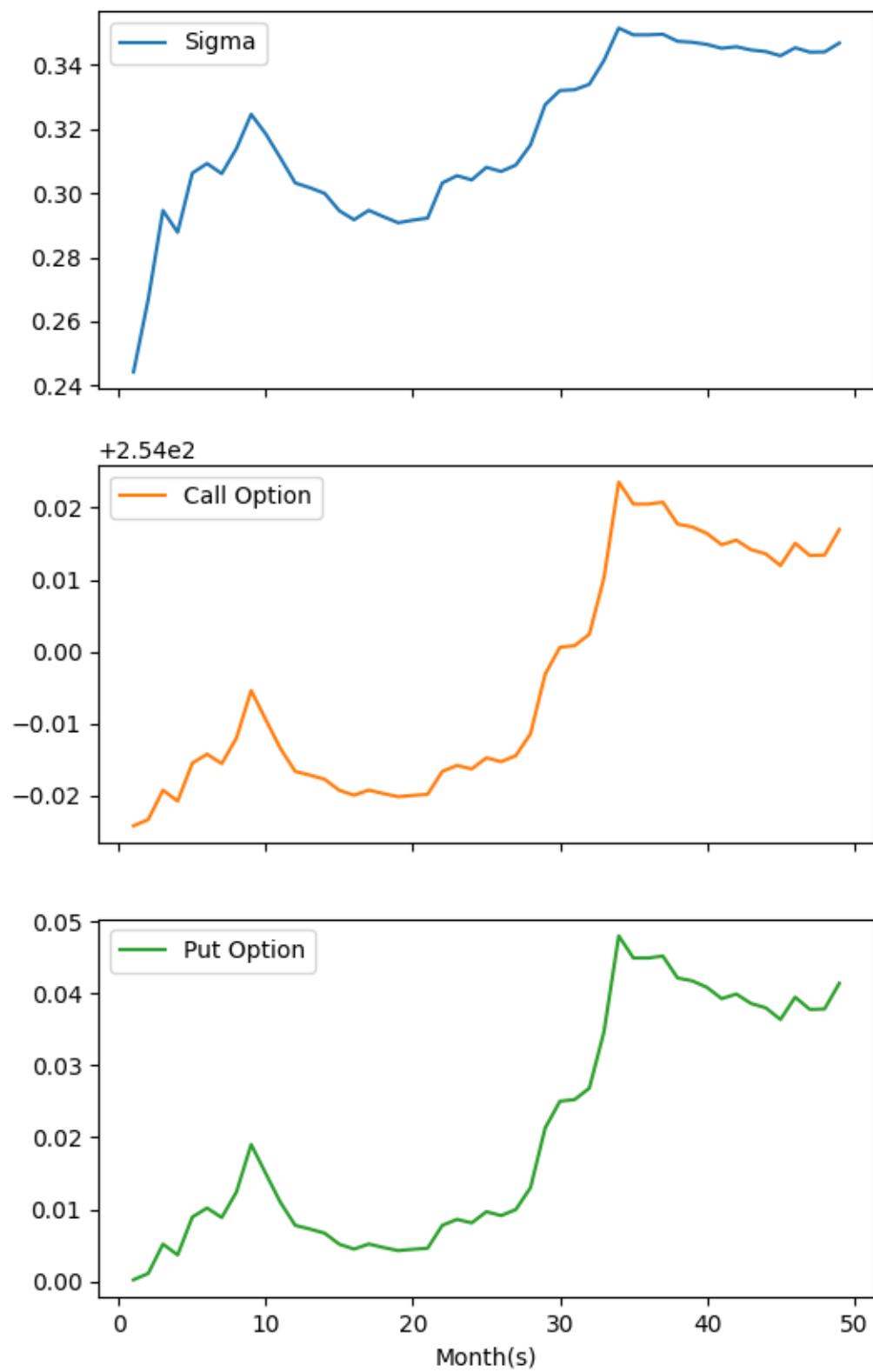
### Plot of SBIN (BSE) with A = 1.4



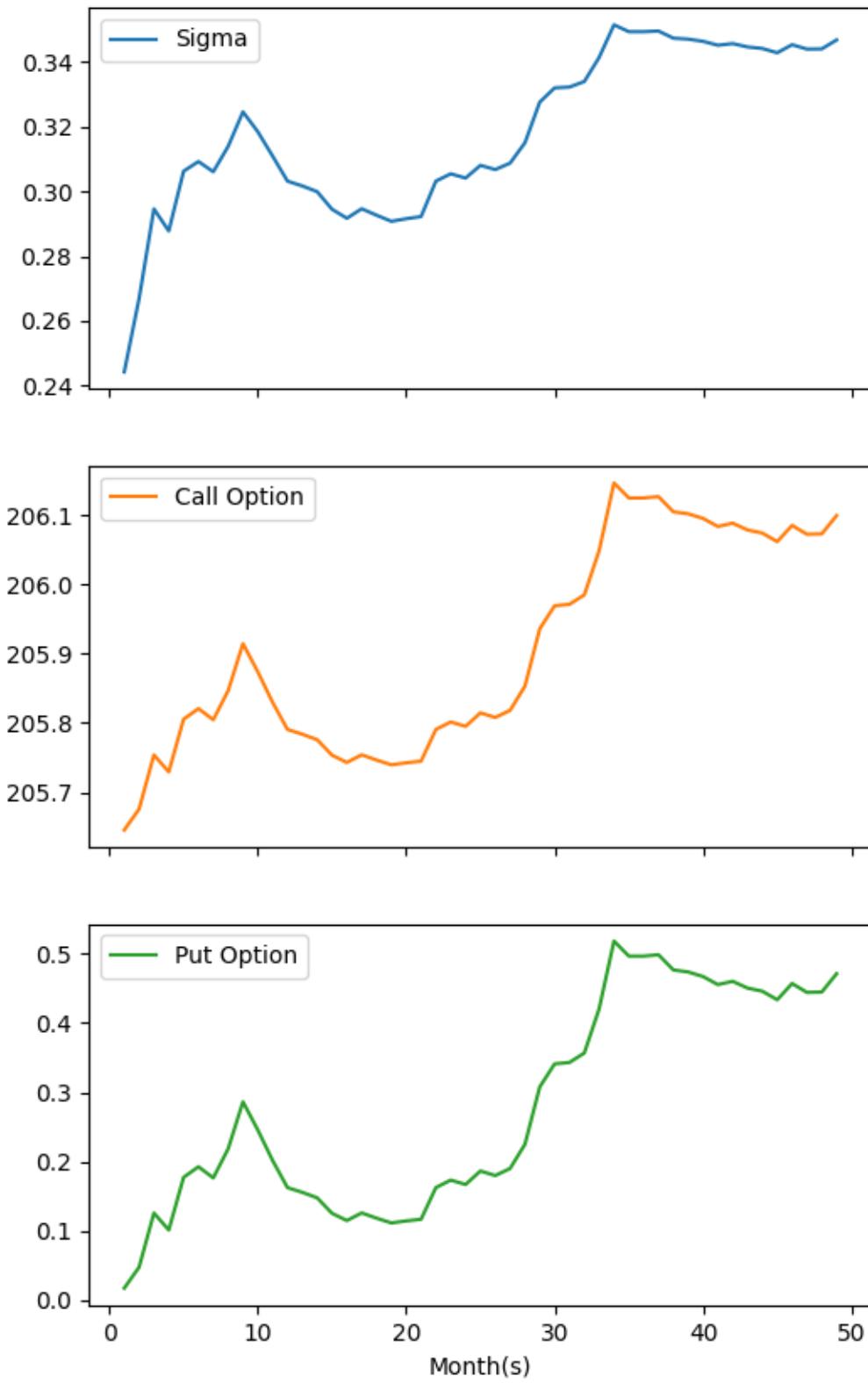
### Plot of SBIN (BSE) with A = 1.5



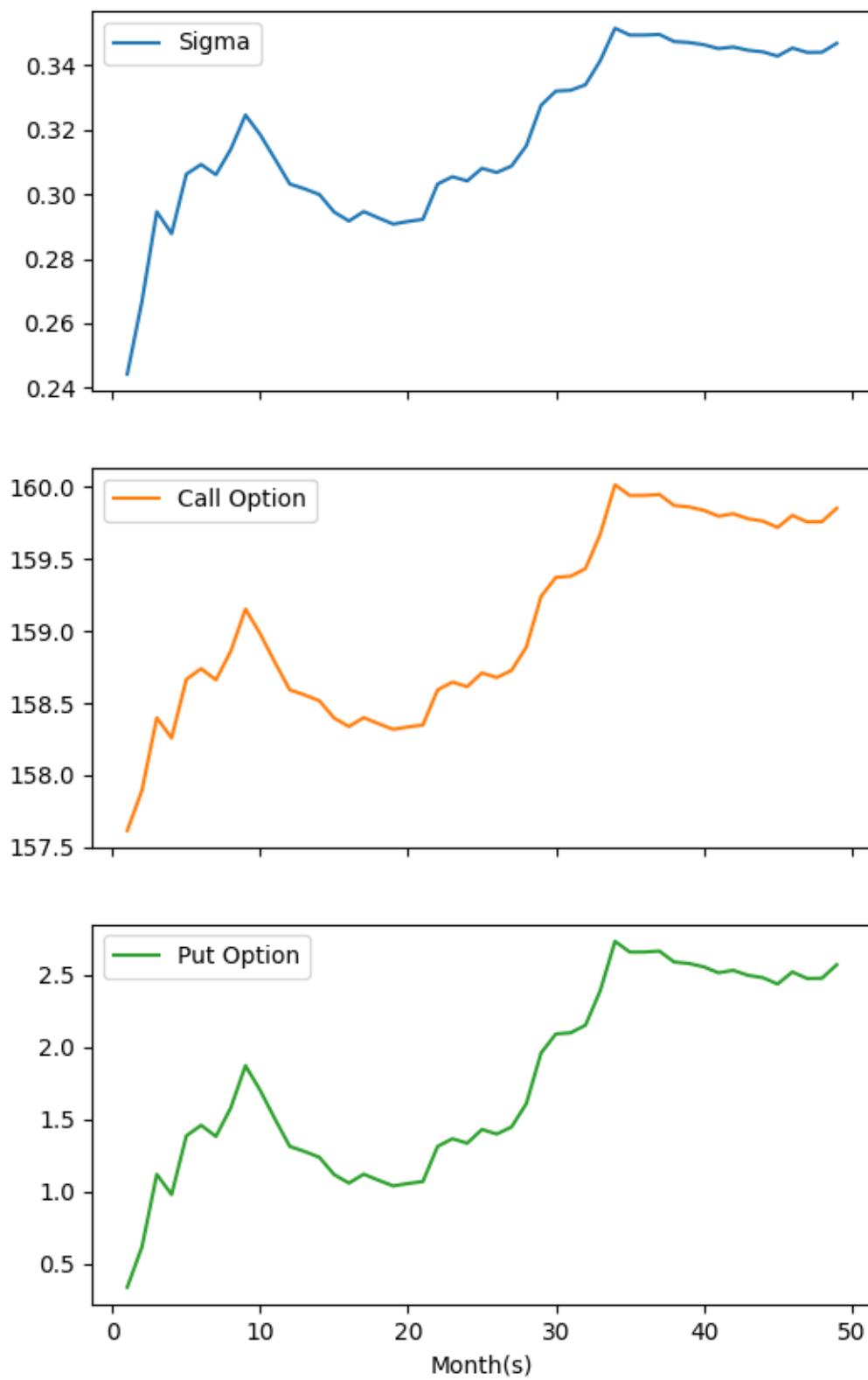
### Plot of TATA STEEL (BSE) with $A = 0.5$



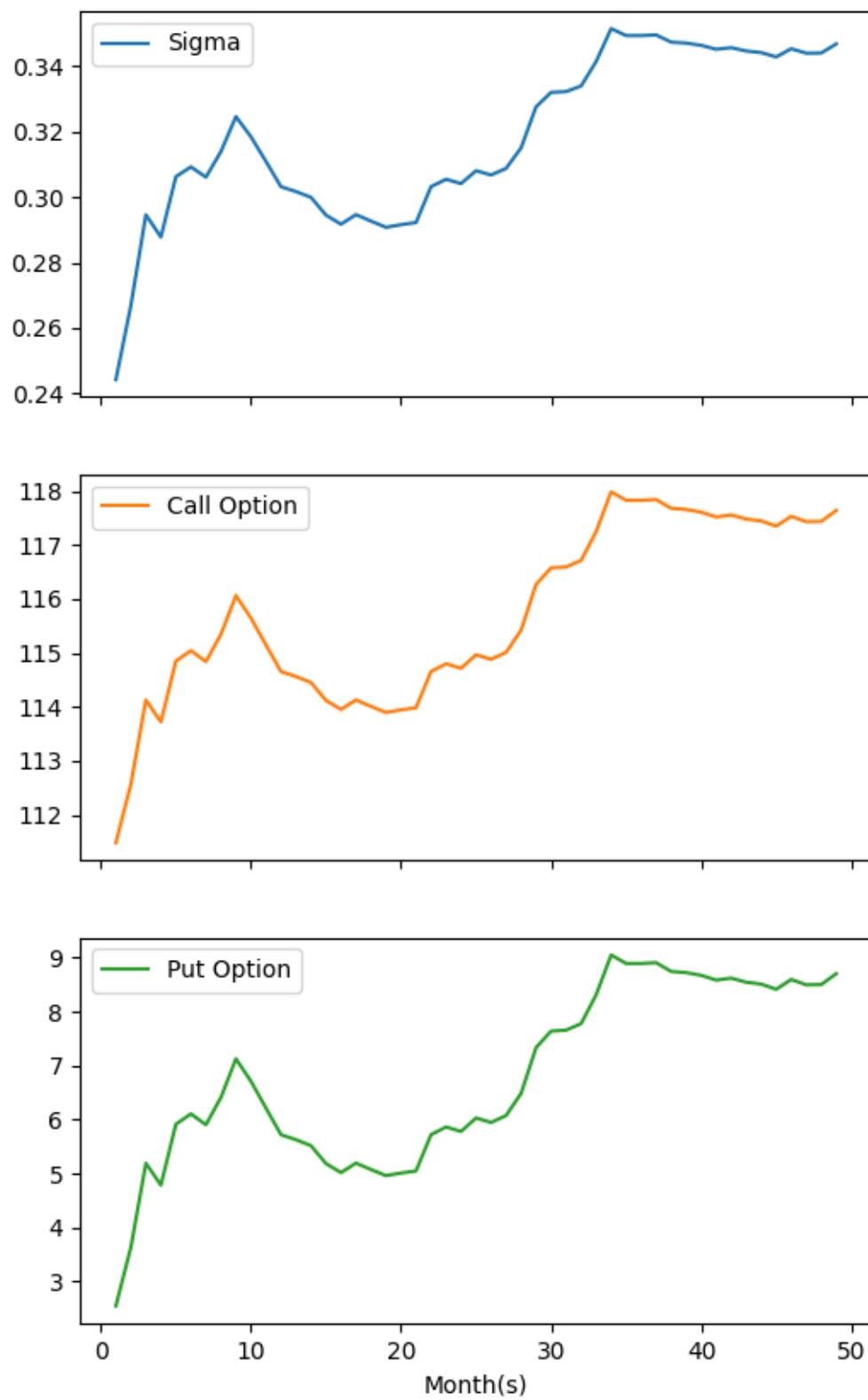
### Plot of TATA STEEL (BSE) with $A = 0.6$



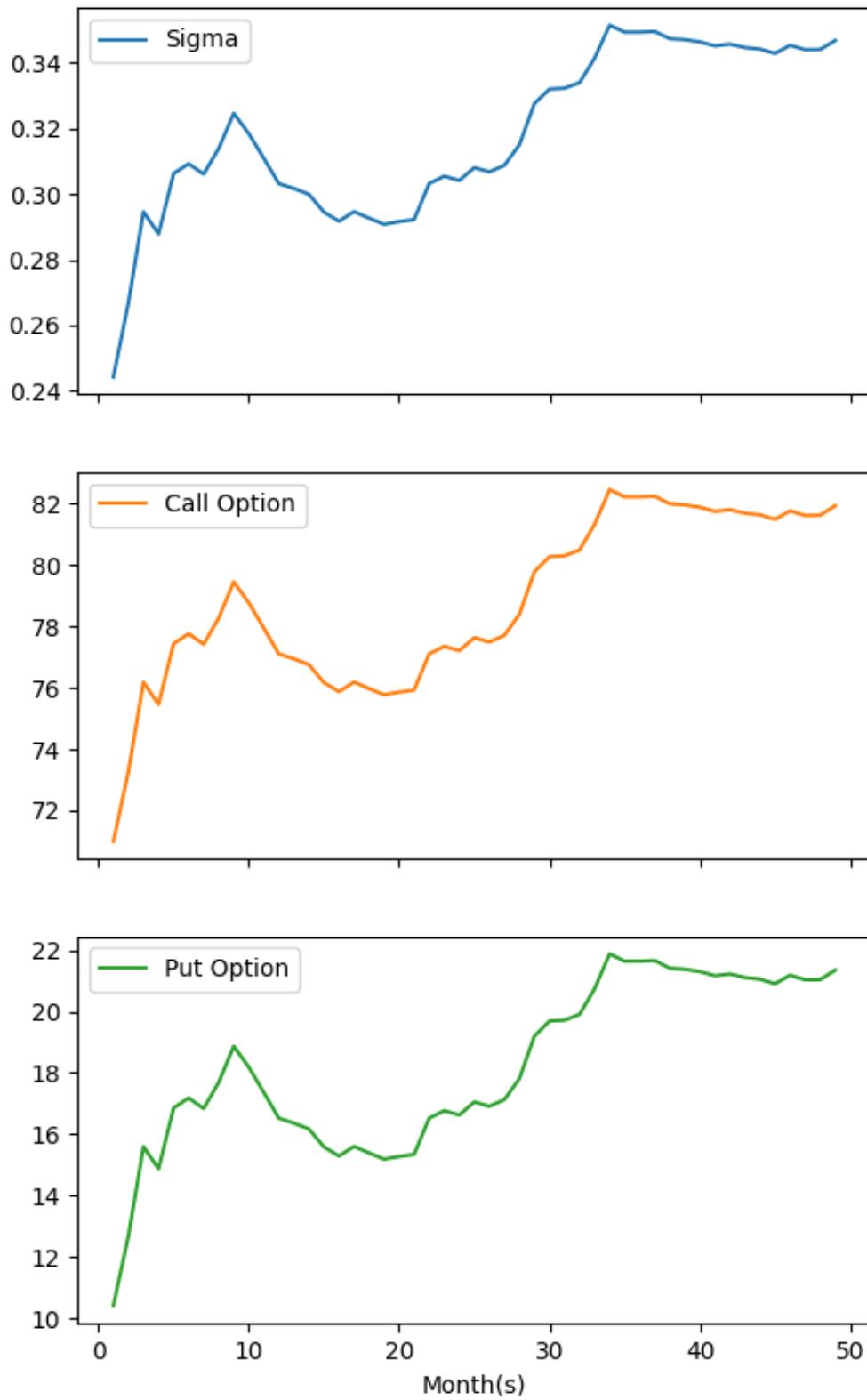
### Plot of TATA STEEL (BSE) with $A = 0.7$



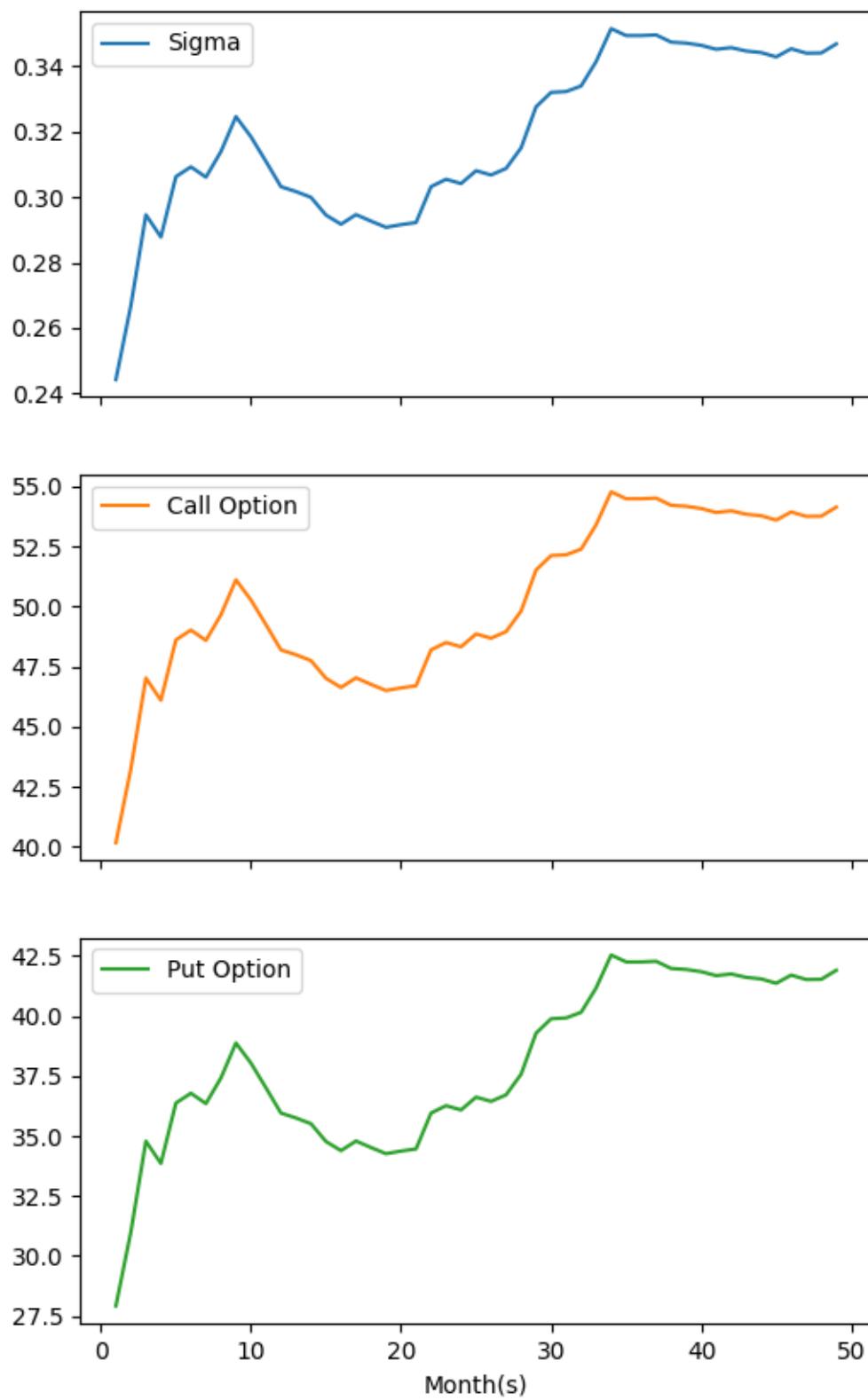
### Plot of TATA STEEL (BSE) with $A = 0.8$



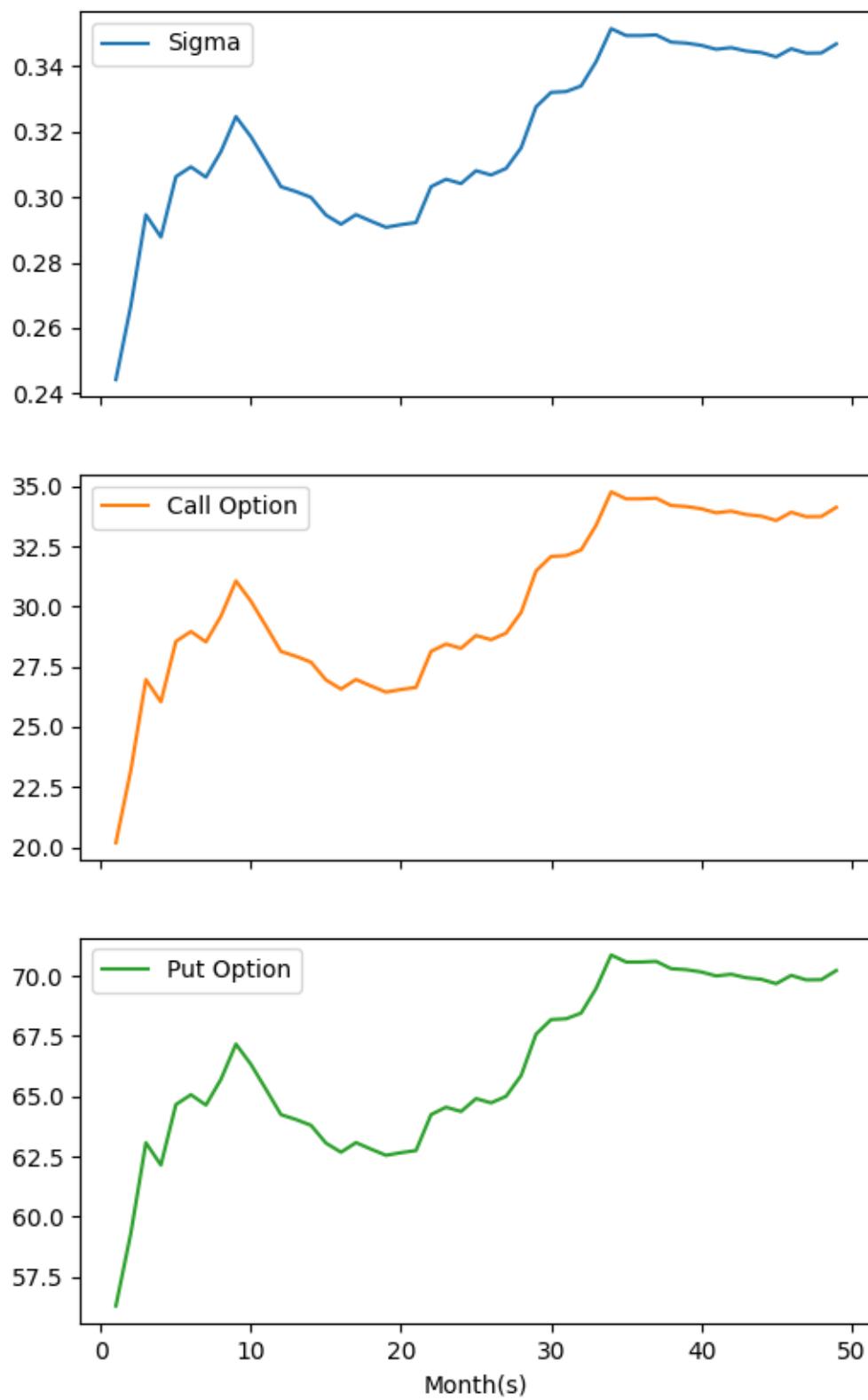
### Plot of TATA STEEL (BSE) with $A = 0.9$



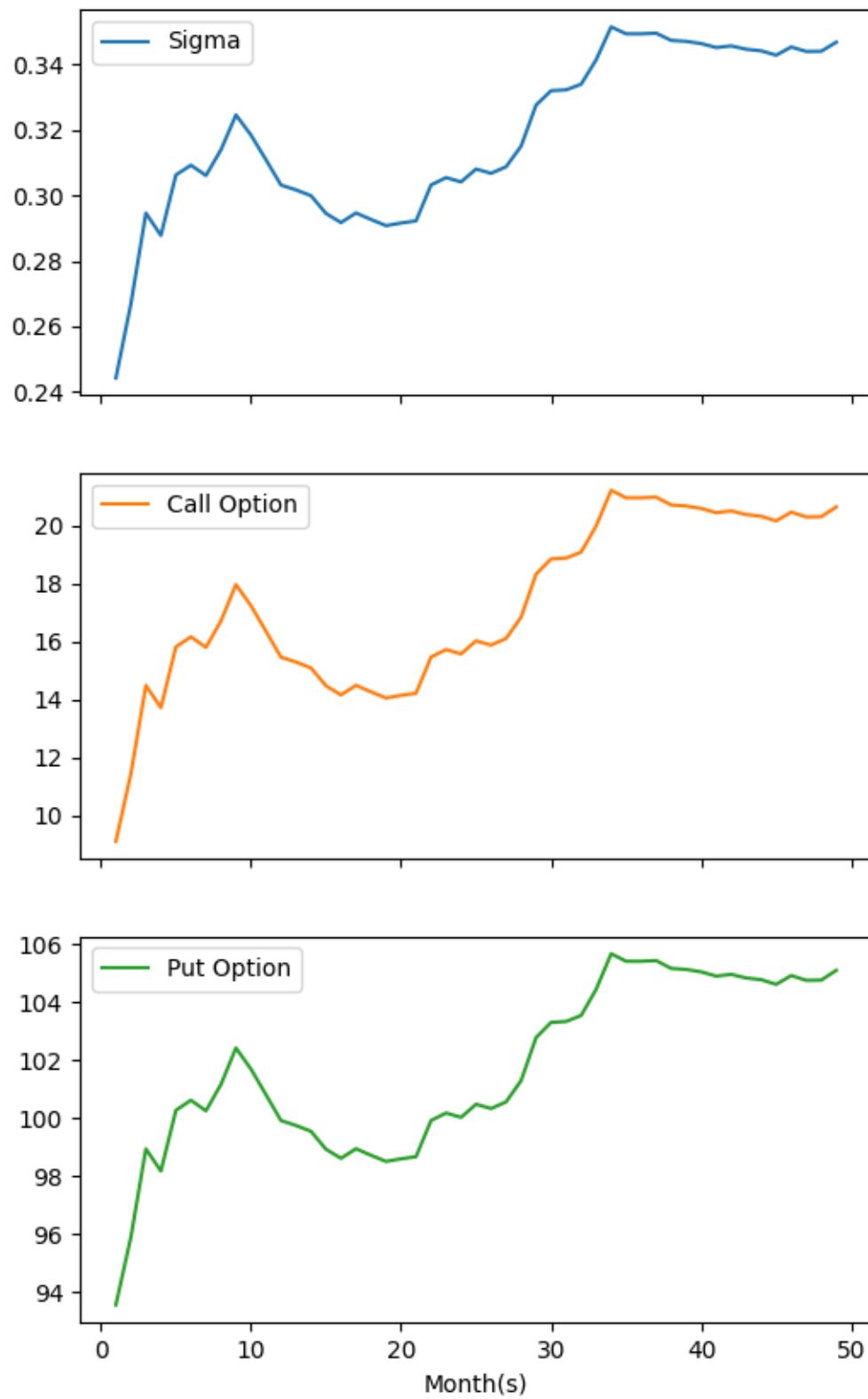
### Plot of TATA STEEL (BSE) with A = 1.0



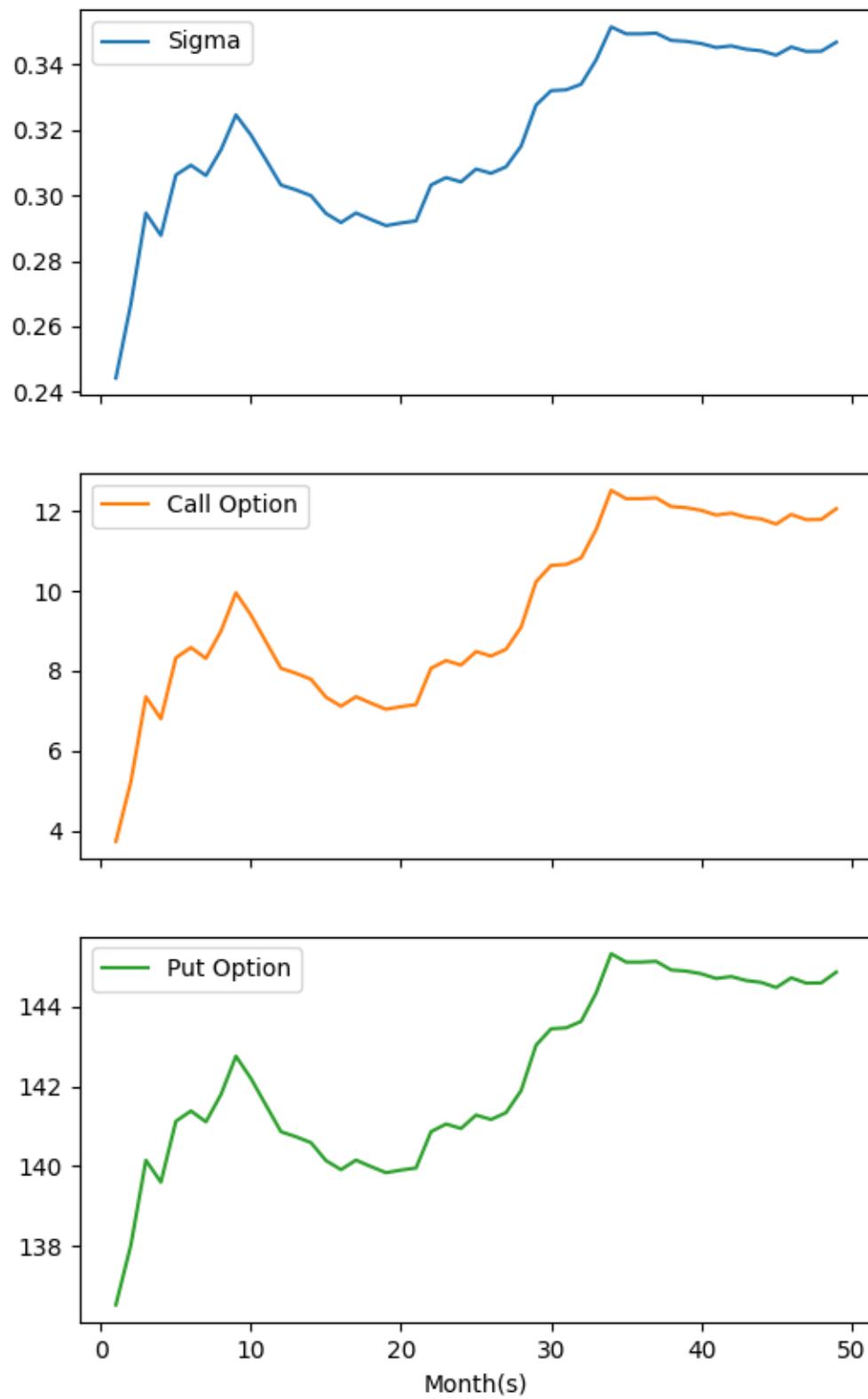
### Plot of TATA STEEL (BSE) with $A = 1.1$



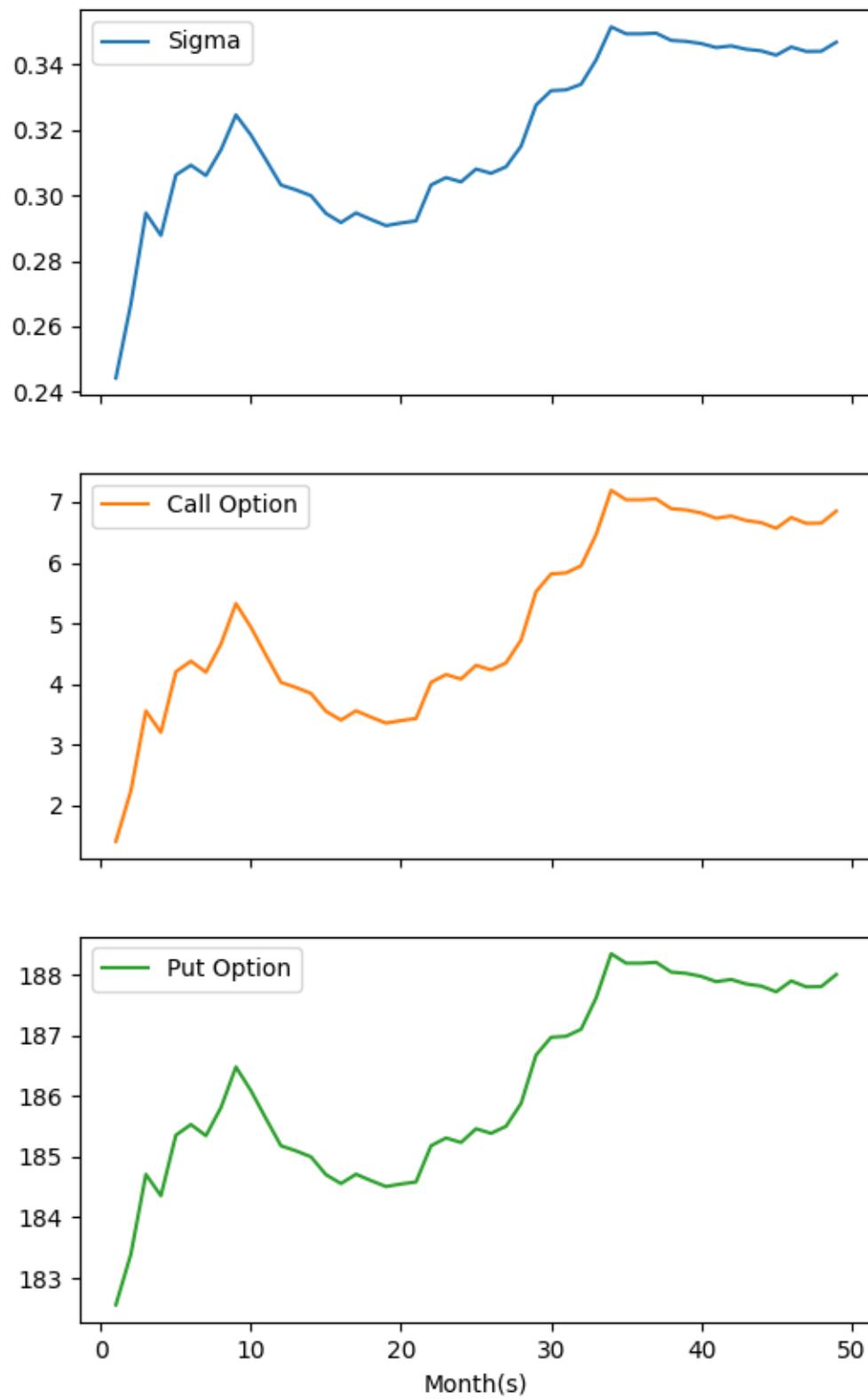
## Plot of TATA STEEL (BSE) with A = 1.2



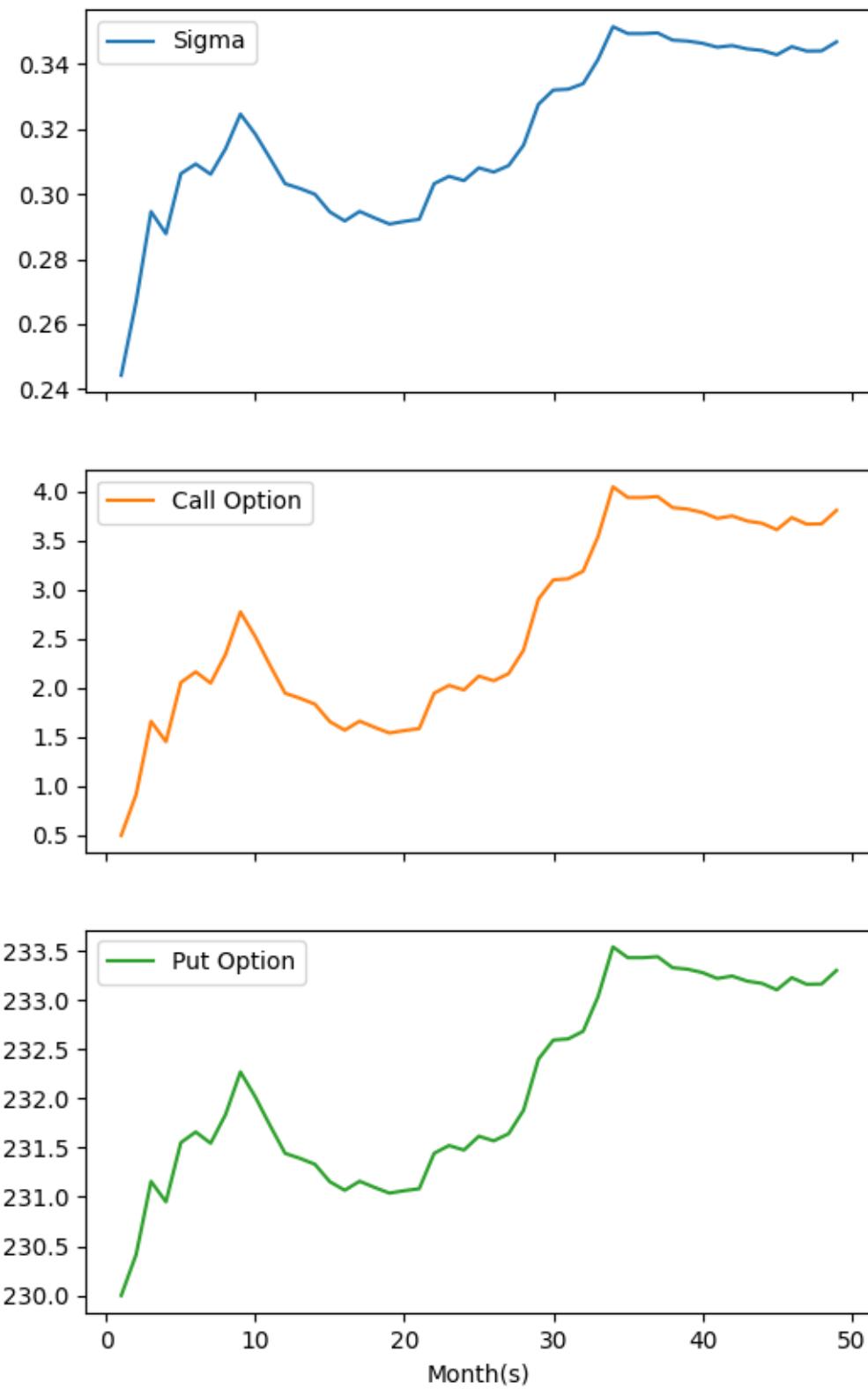
### Plot of TATA STEEL (BSE) with $A = 1.3$



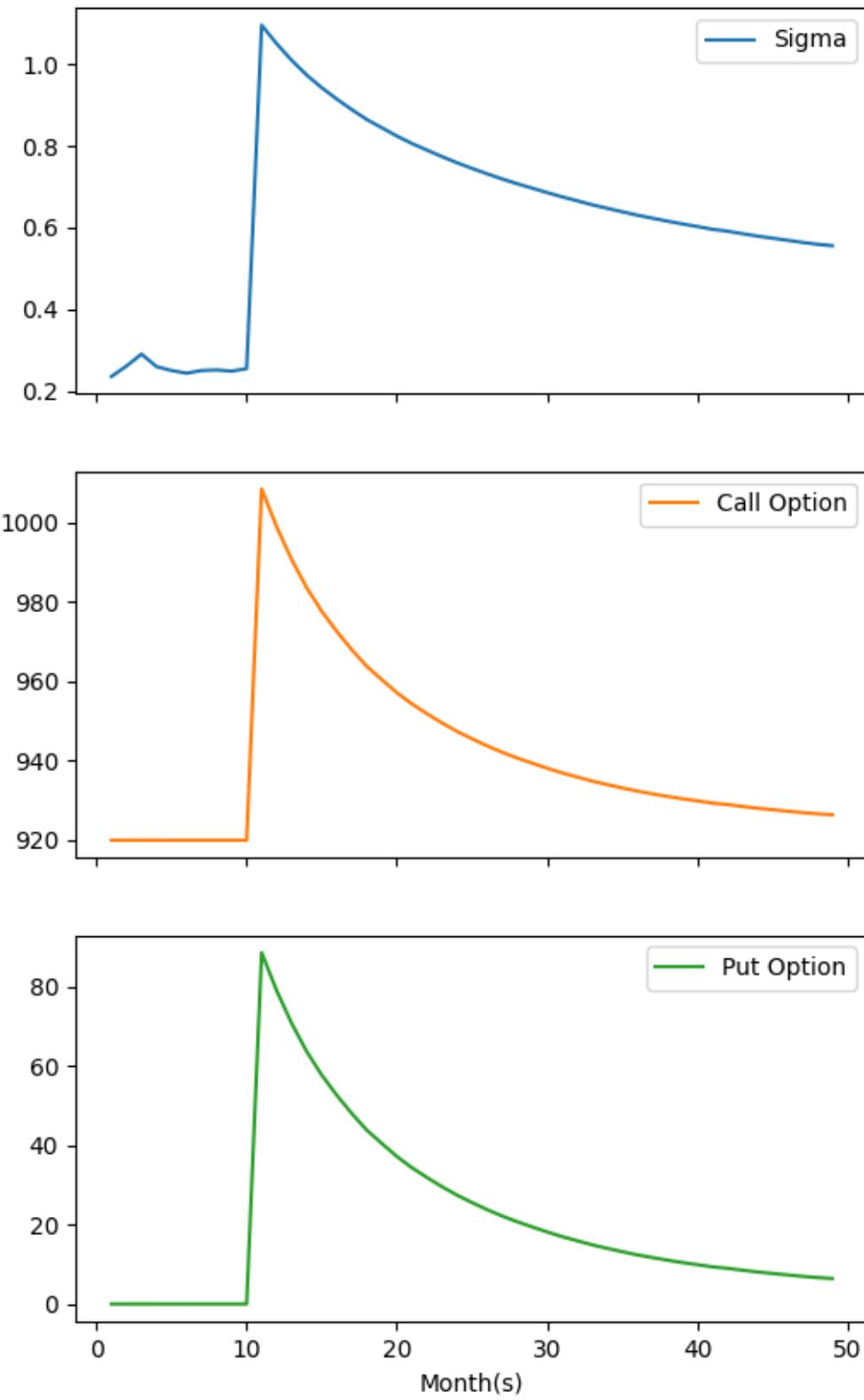
### Plot of TATA STEEL (BSE) with $A = 1.4$



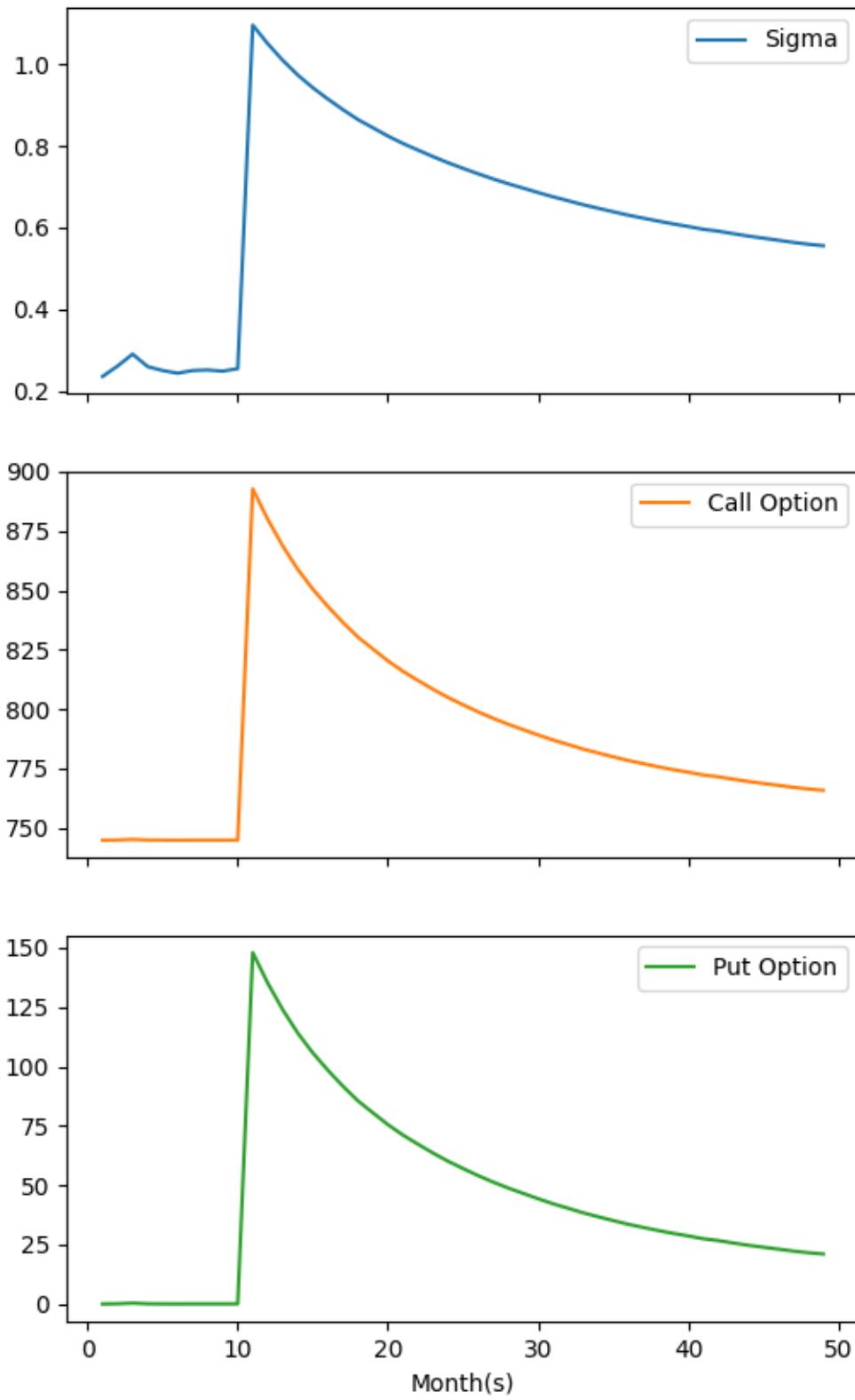
### Plot of TATA STEEL (BSE) with $A = 1.5$



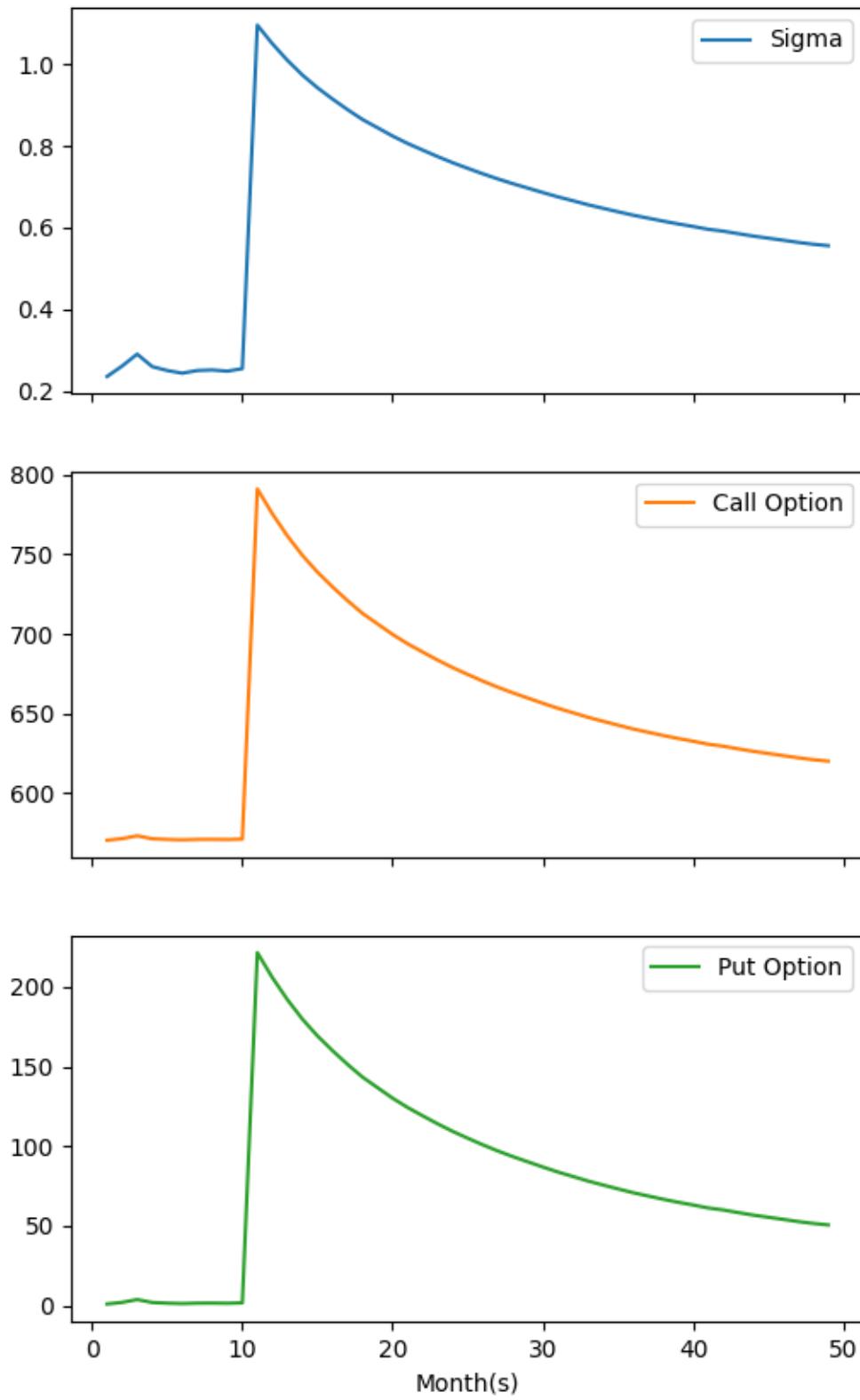
Plot of TCS (BSE) with  $A = 0.5$



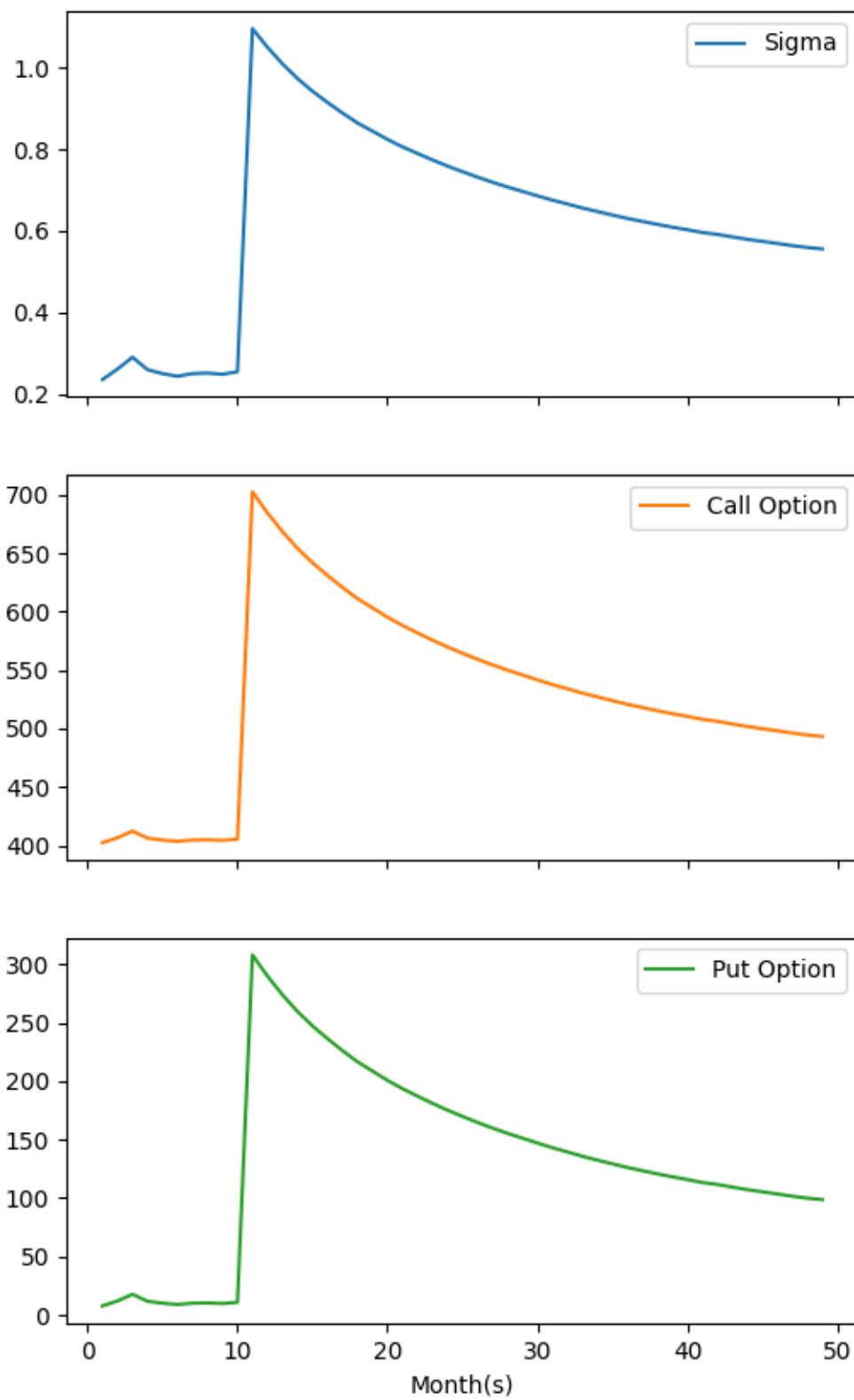
Plot of TCS (BSE) with  $A = 0.6$



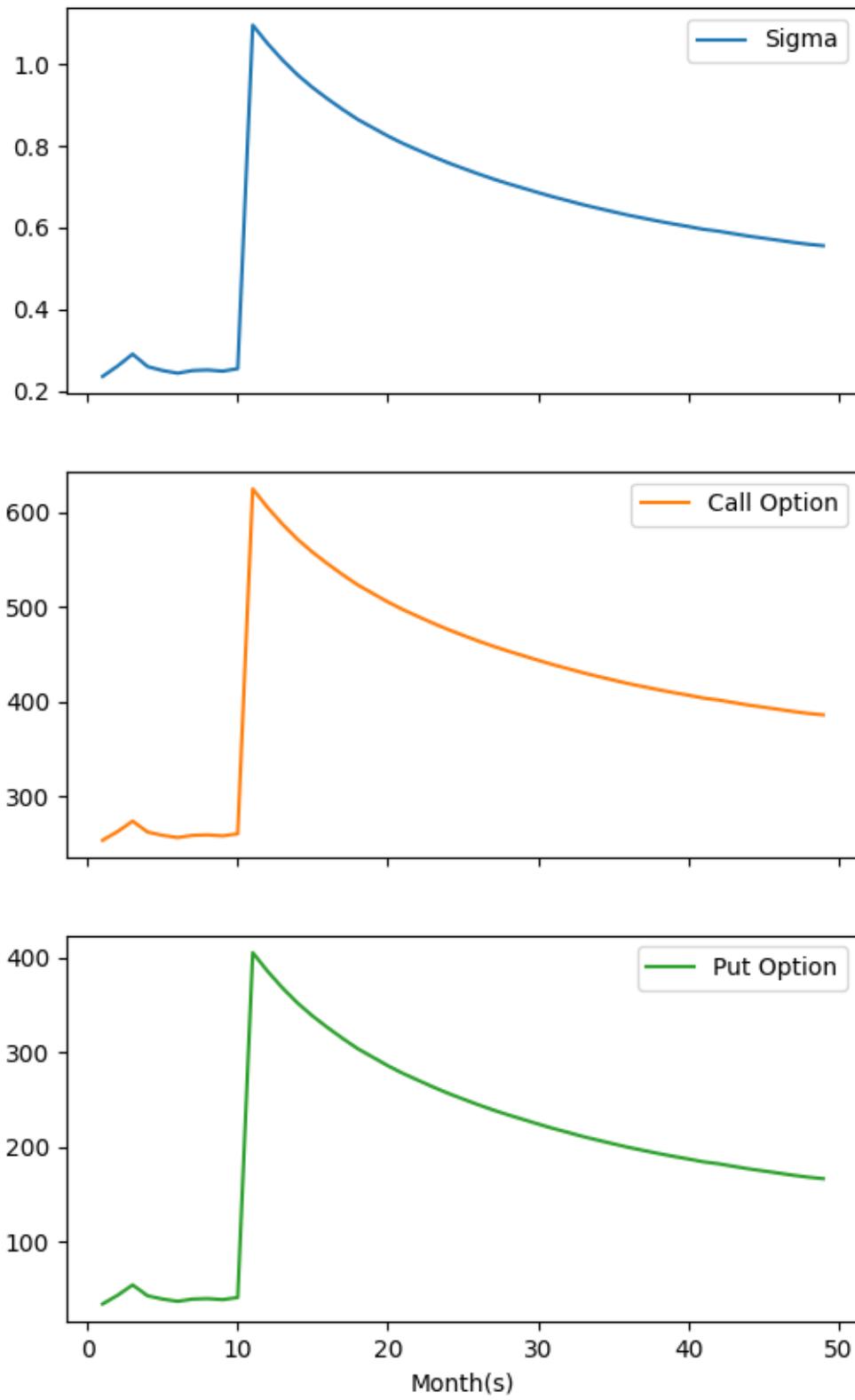
Plot of TCS (BSE) with  $A = 0.7$



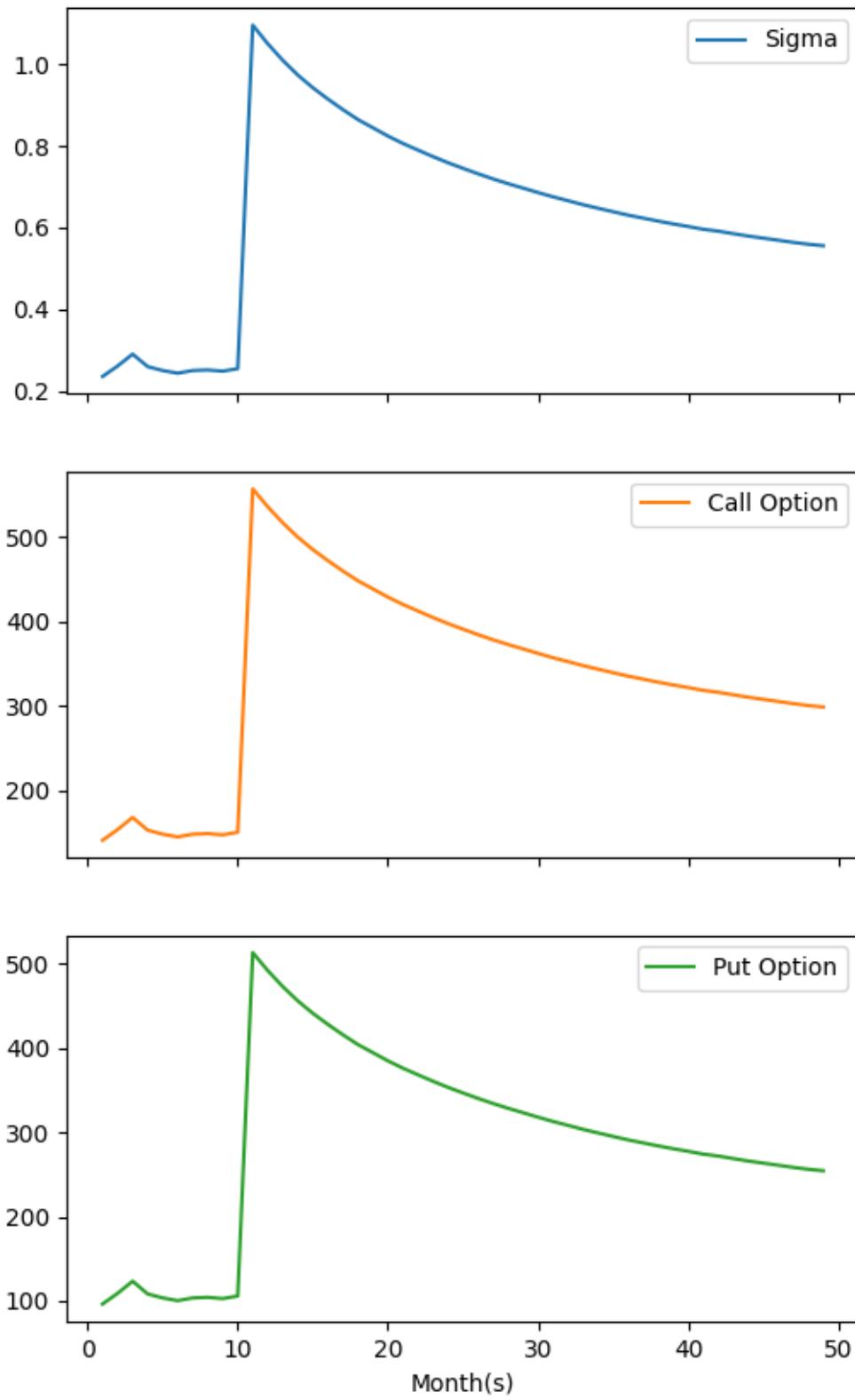
Plot of TCS (BSE) with  $A = 0.8$



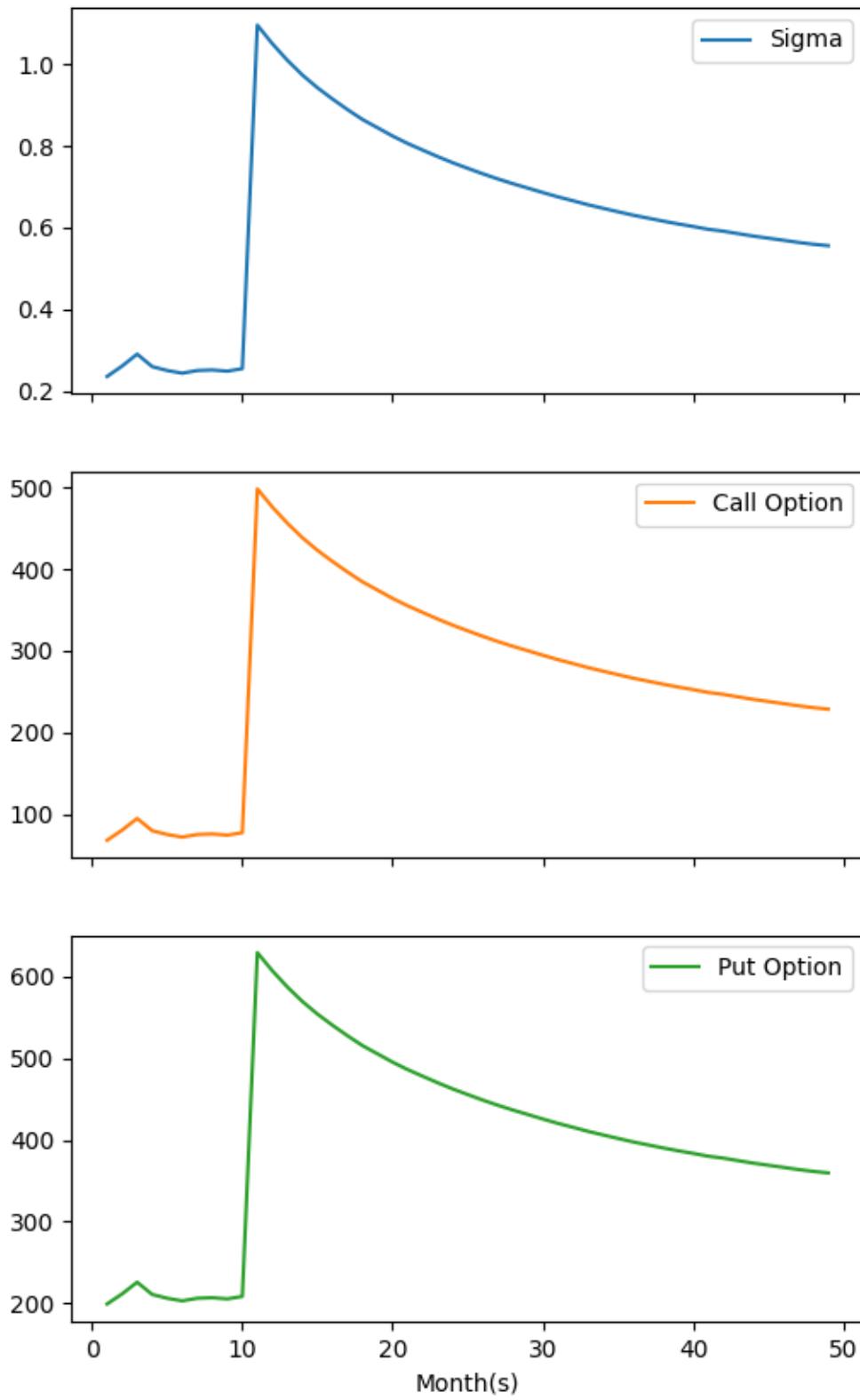
Plot of TCS (BSE) with  $A = 0.9$



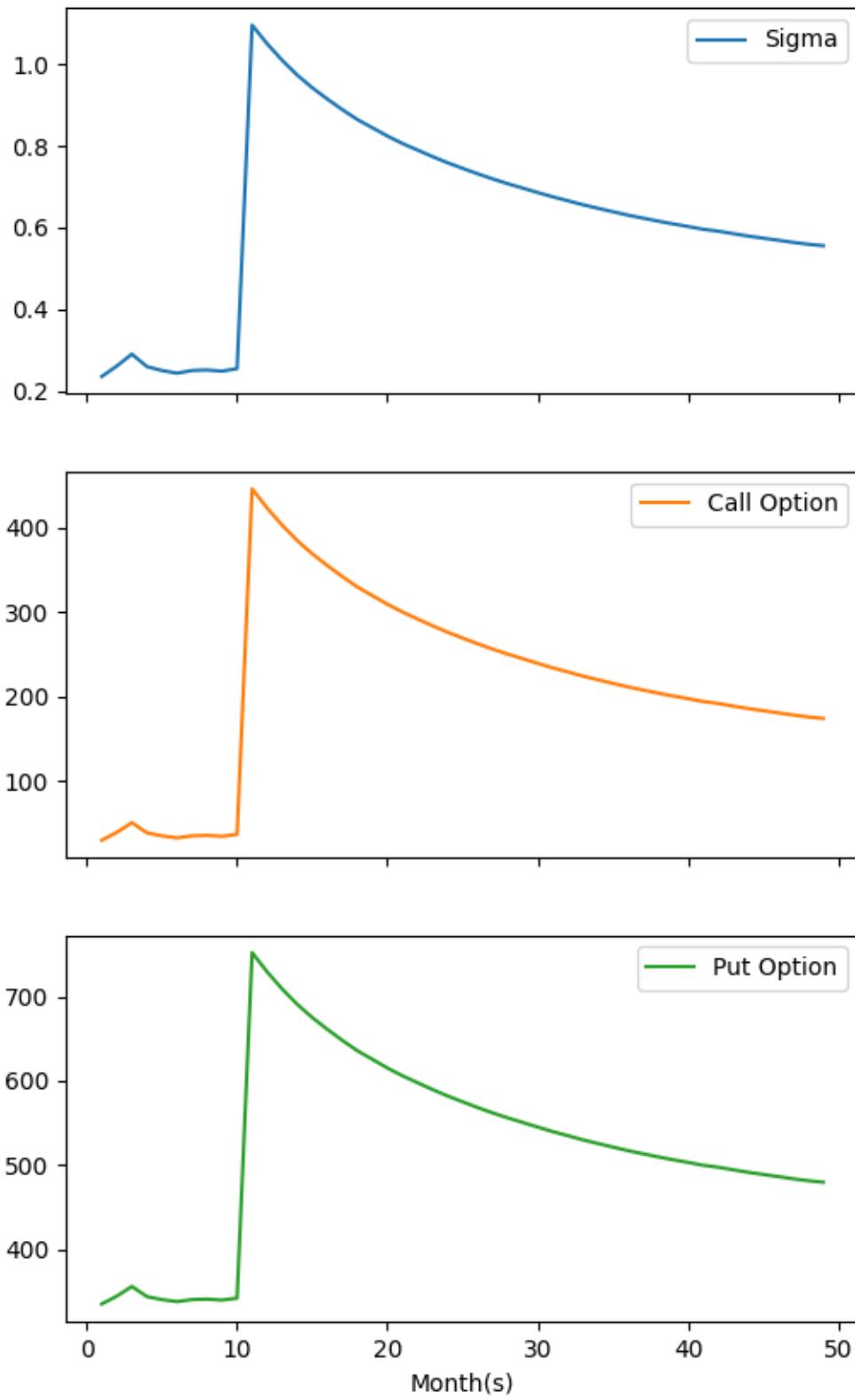
### Plot of TCS (BSE) with $A = 1.0$



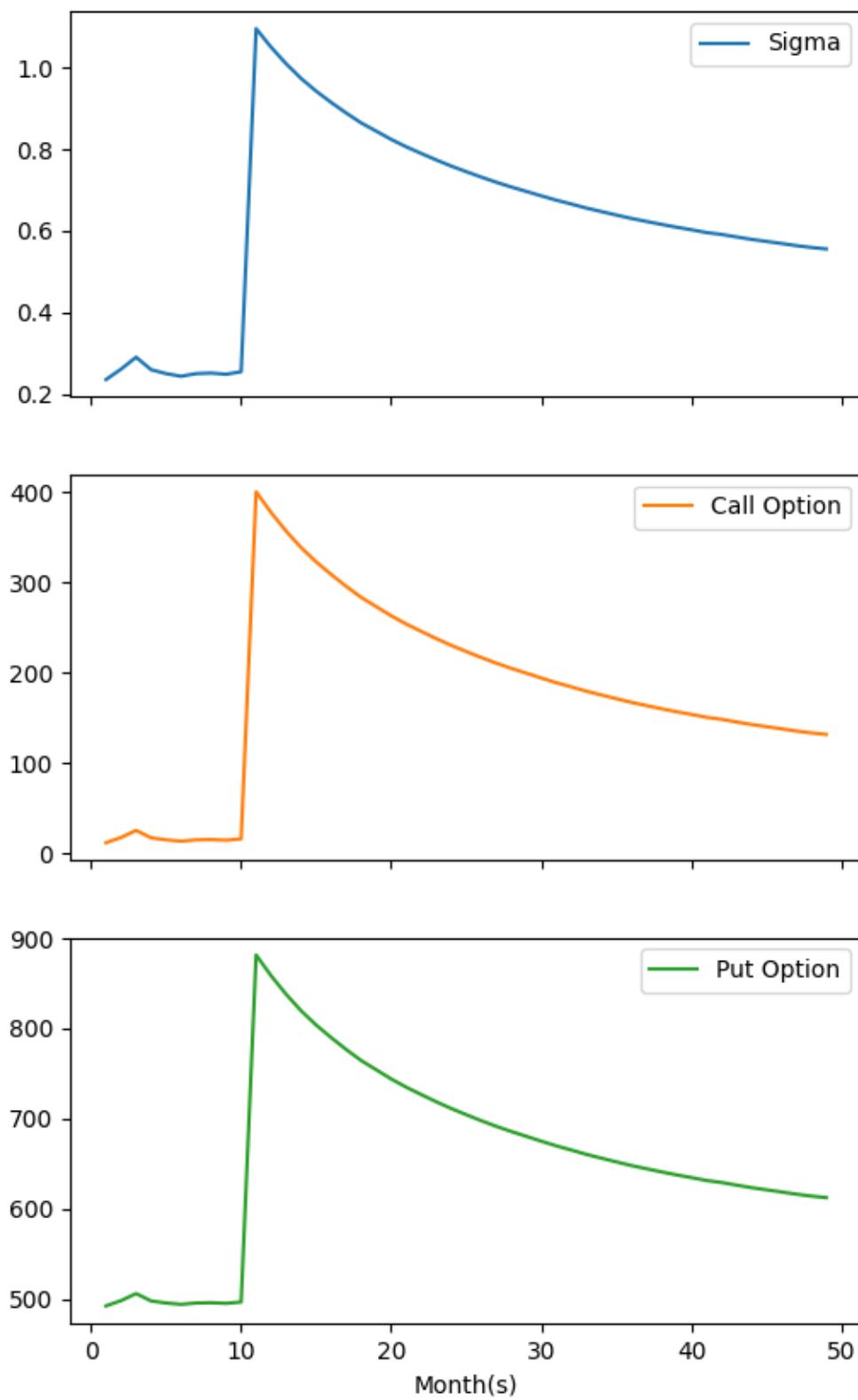
Plot of TCS (BSE) with  $A = 1.1$



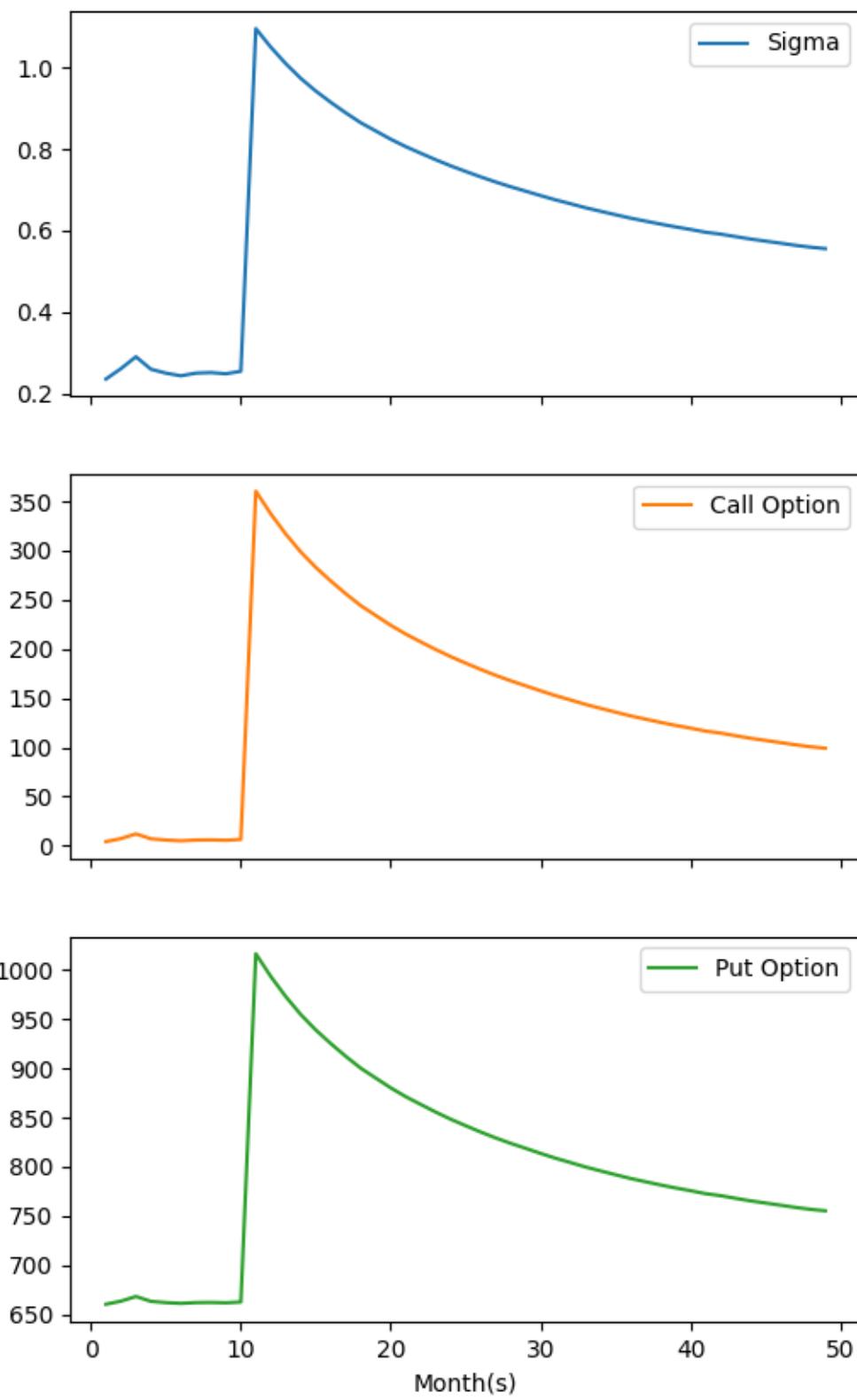
Plot of TCS (BSE) with  $A = 1.2$



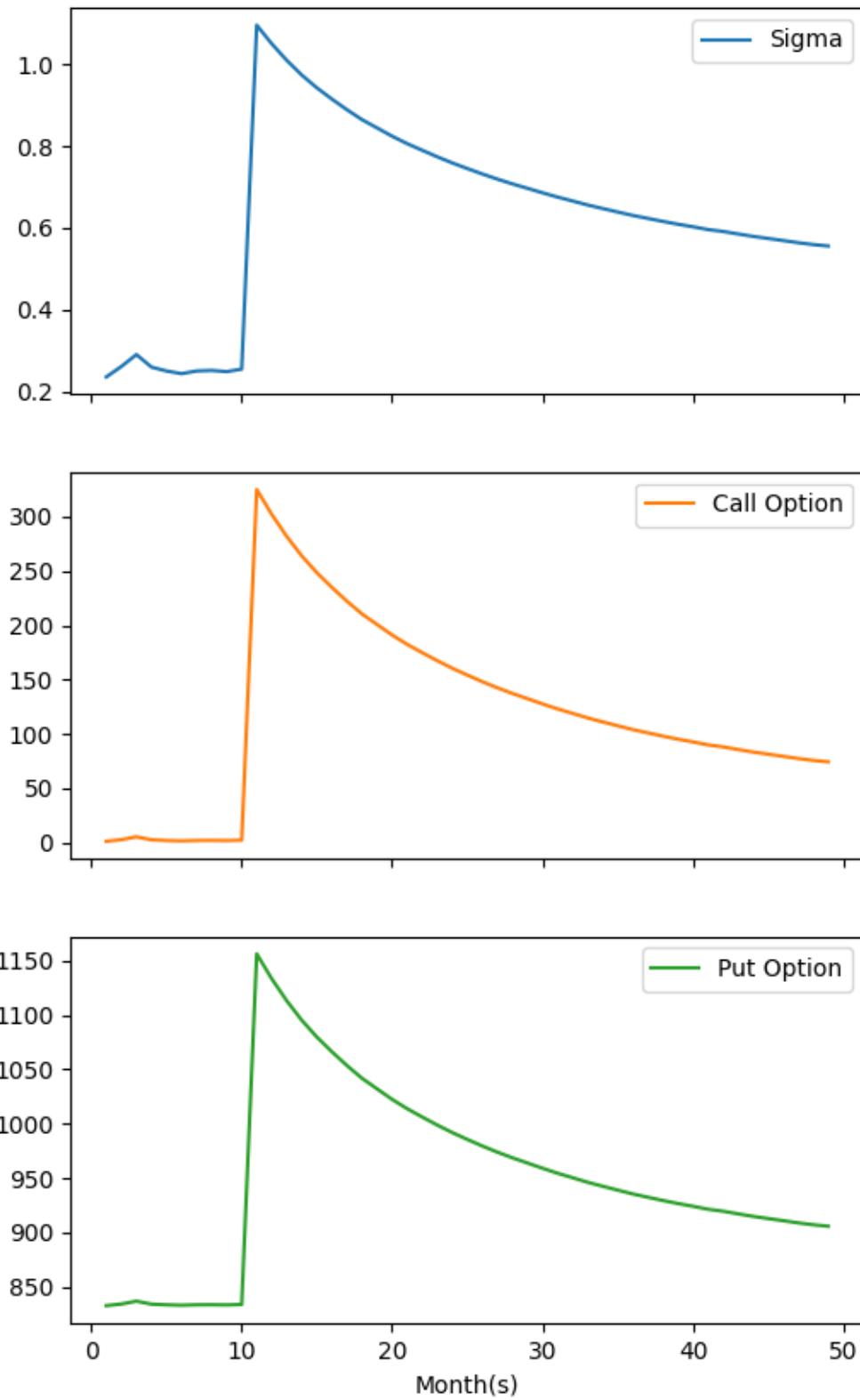
Plot of TCS (BSE) with  $A = 1.3$



Plot of TCS (BSE) with  $A = 1.4$

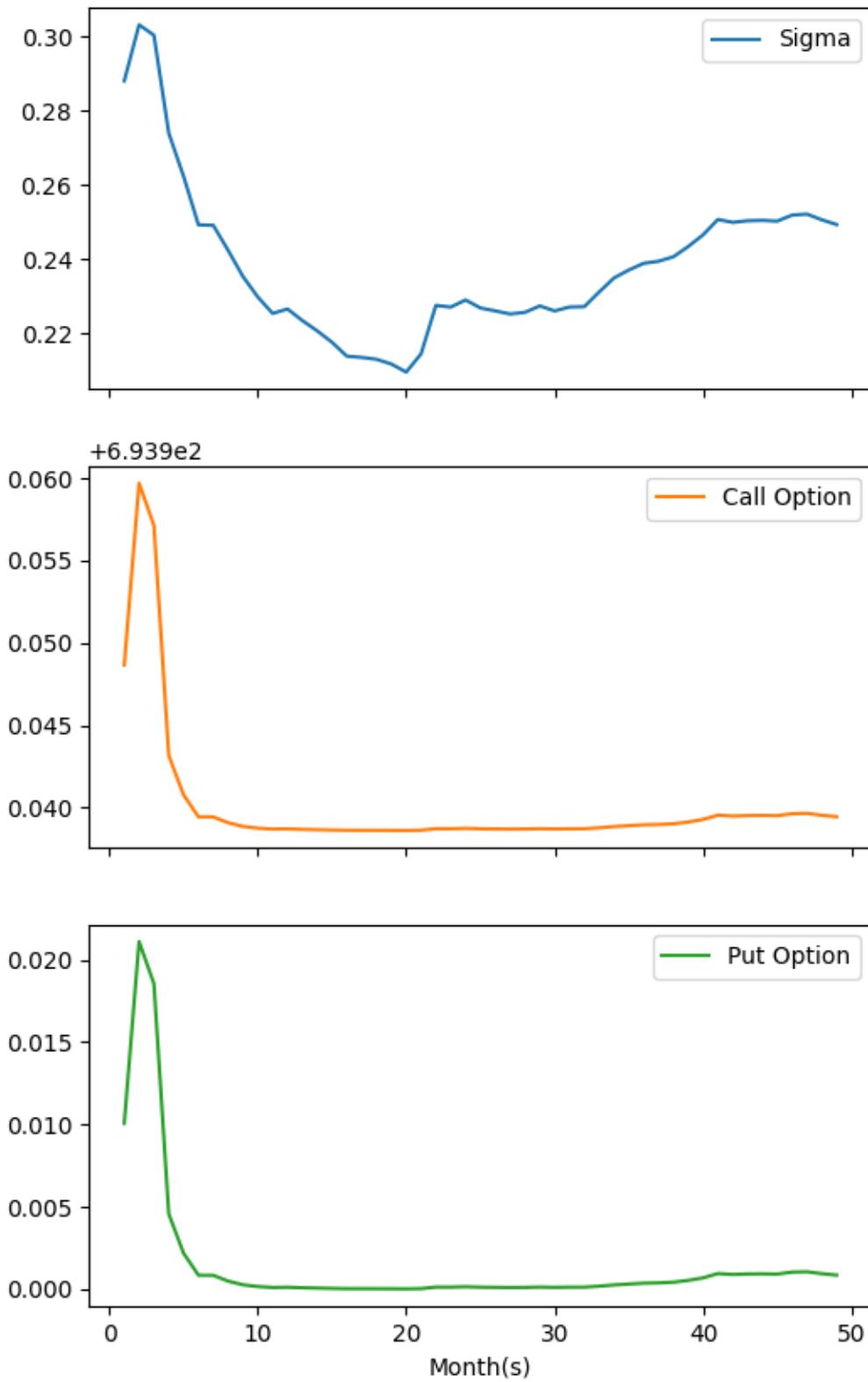


Plot of TCS (BSE) with  $A = 1.5$

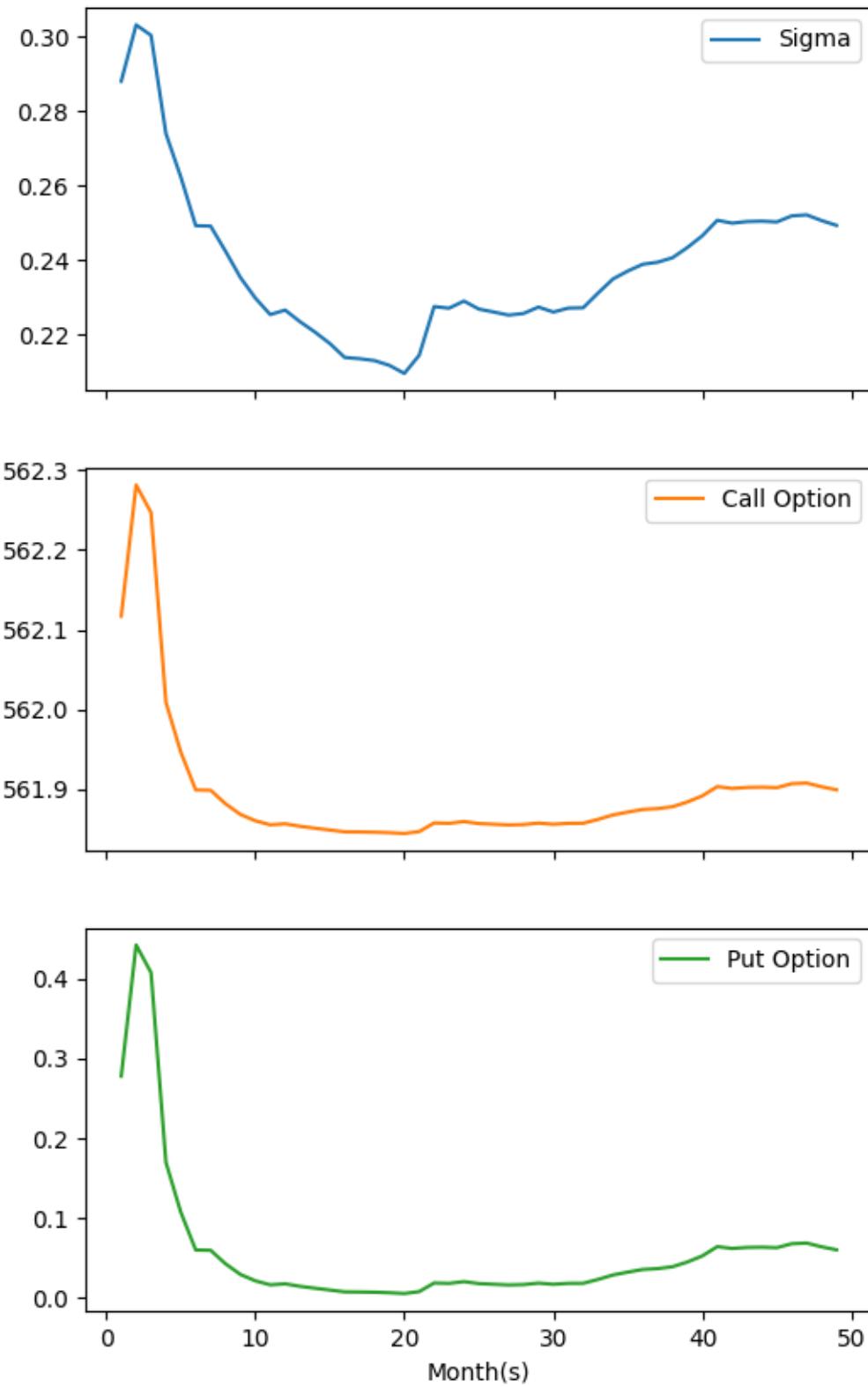


# **NSE Stocks**

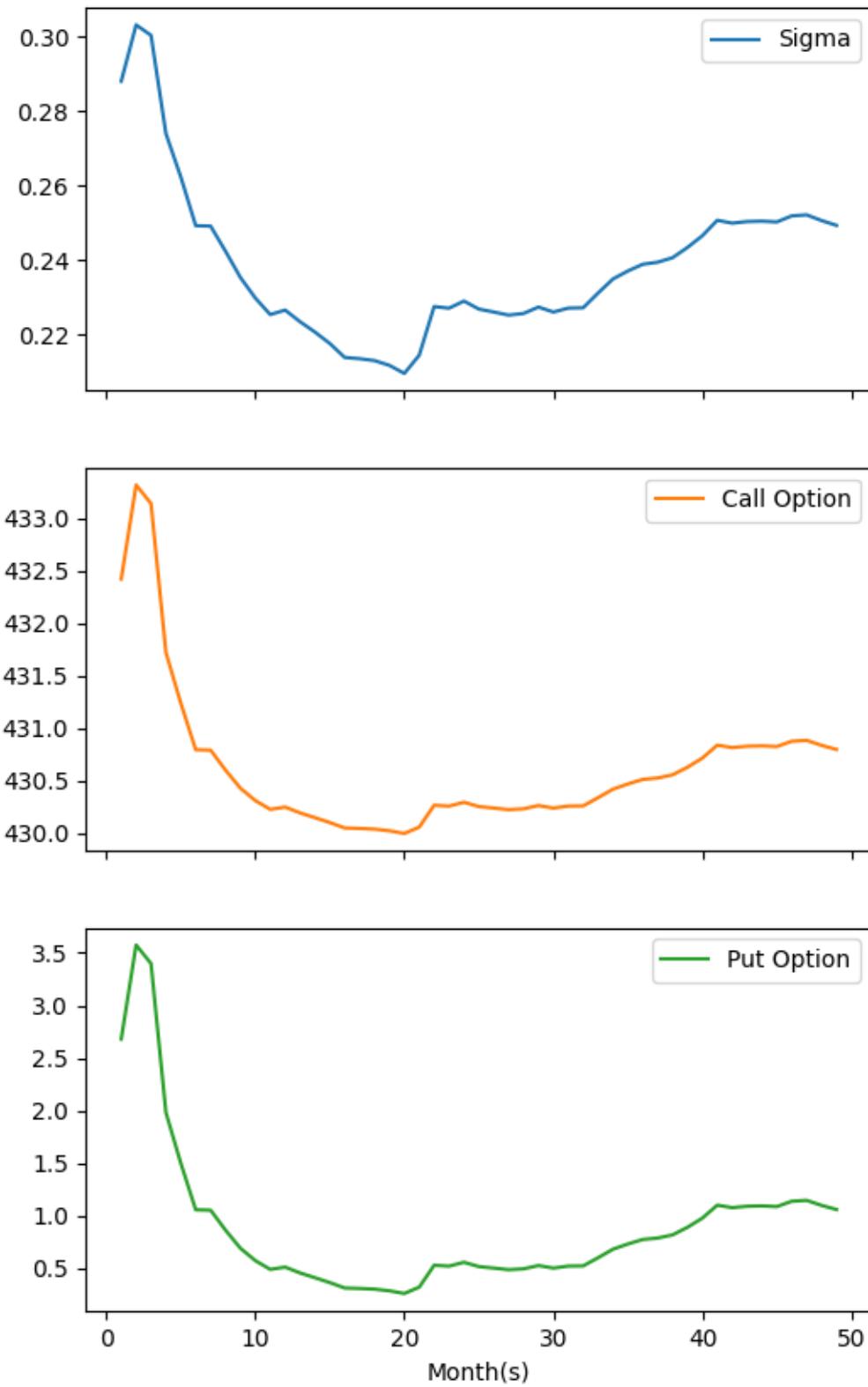
### Plot of ASIANPAINT (NSE) with A = 0.5



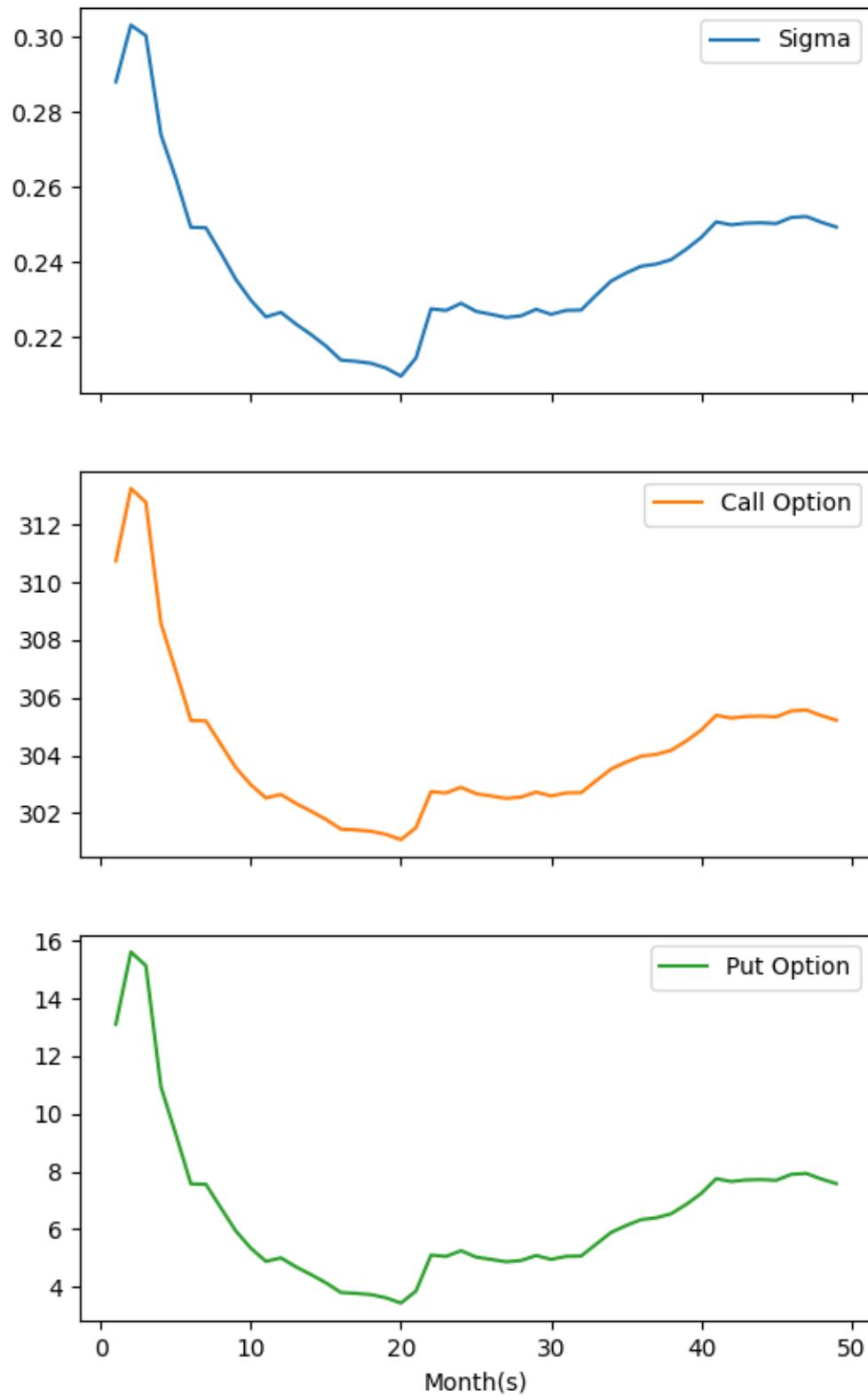
### Plot of ASIANPAINT (NSE) with $A = 0.6$



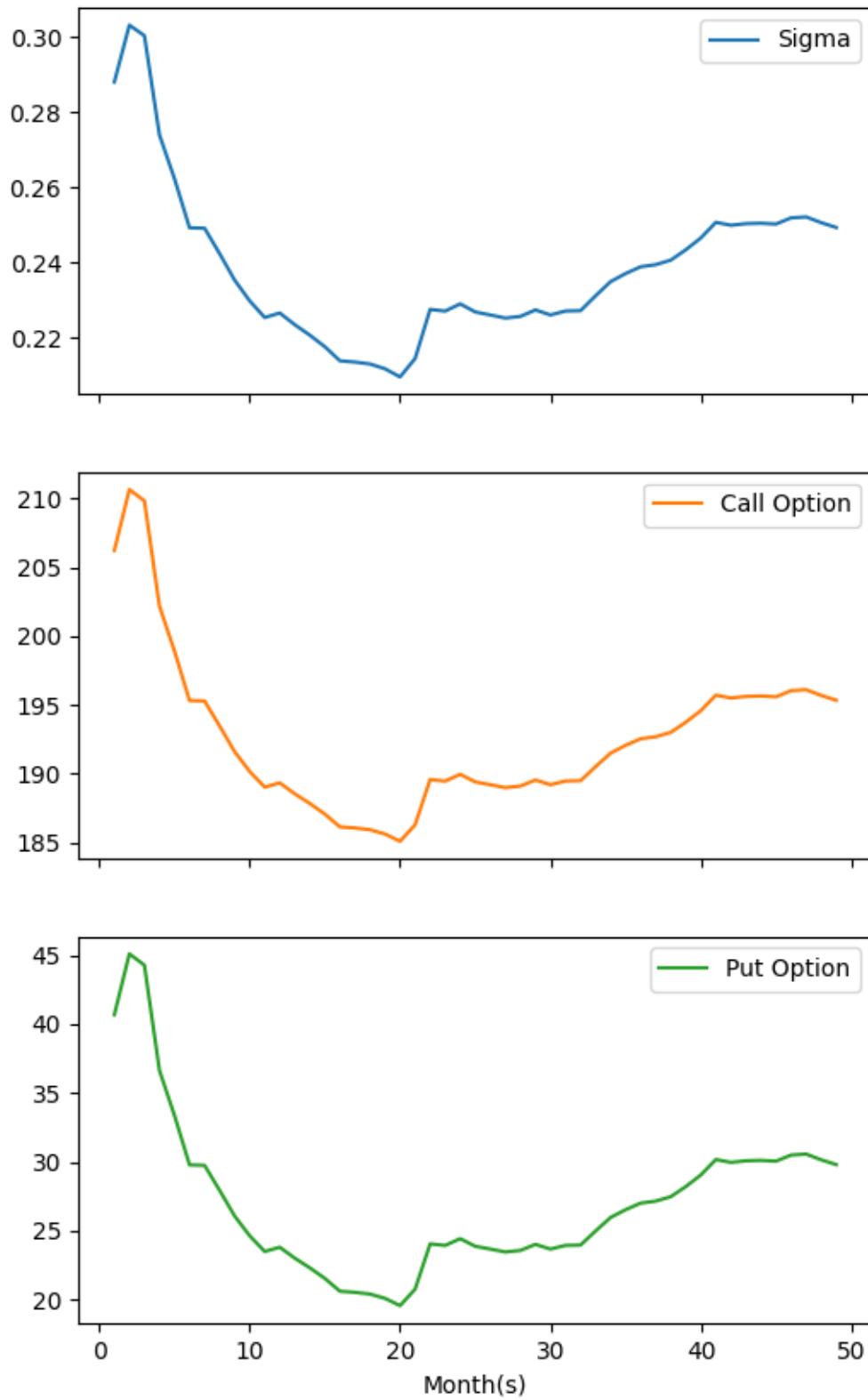
### Plot of ASIANPAINT (NSE) with $A = 0.7$



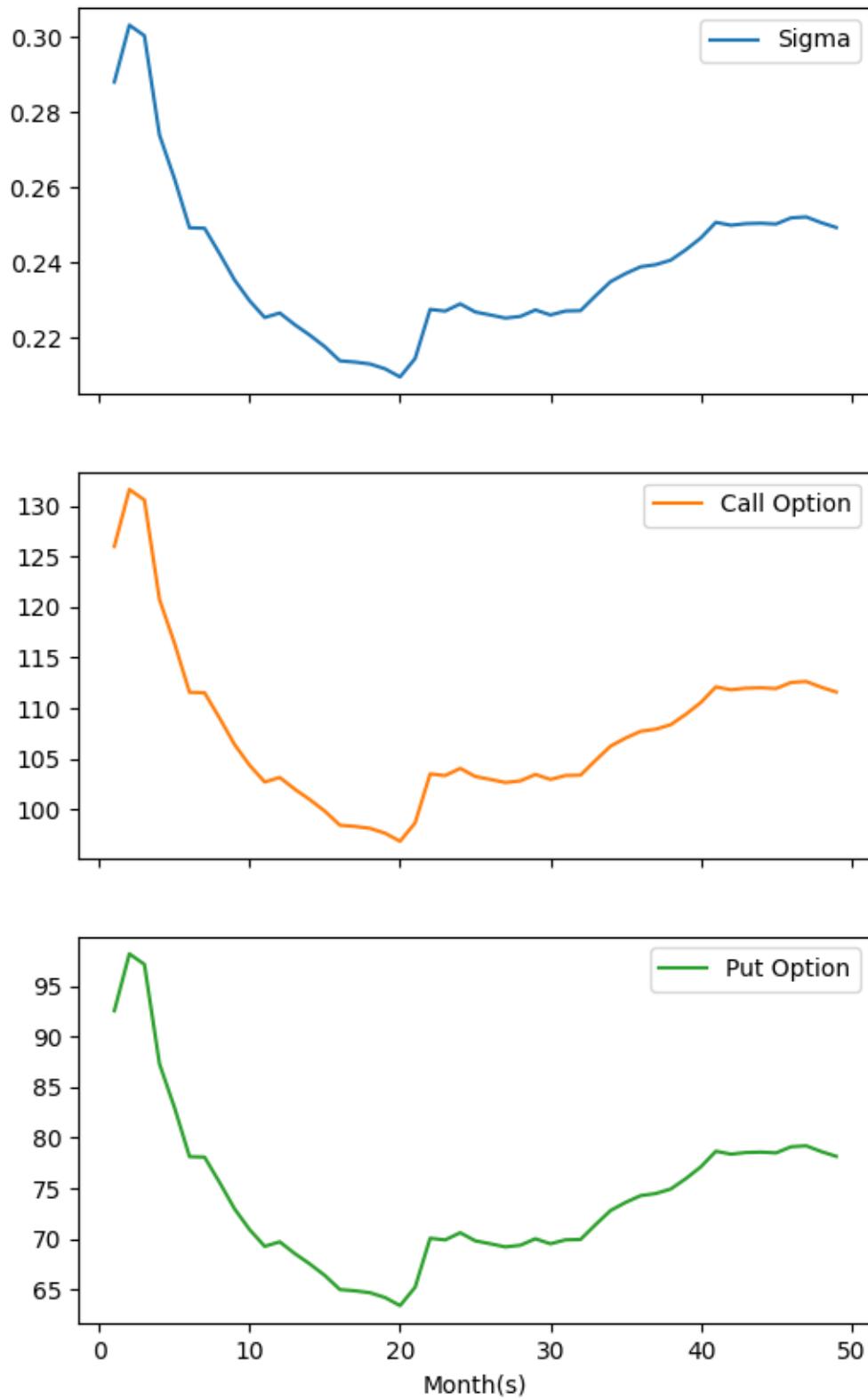
### Plot of ASIANPAINT (NSE) with $A = 0.8$



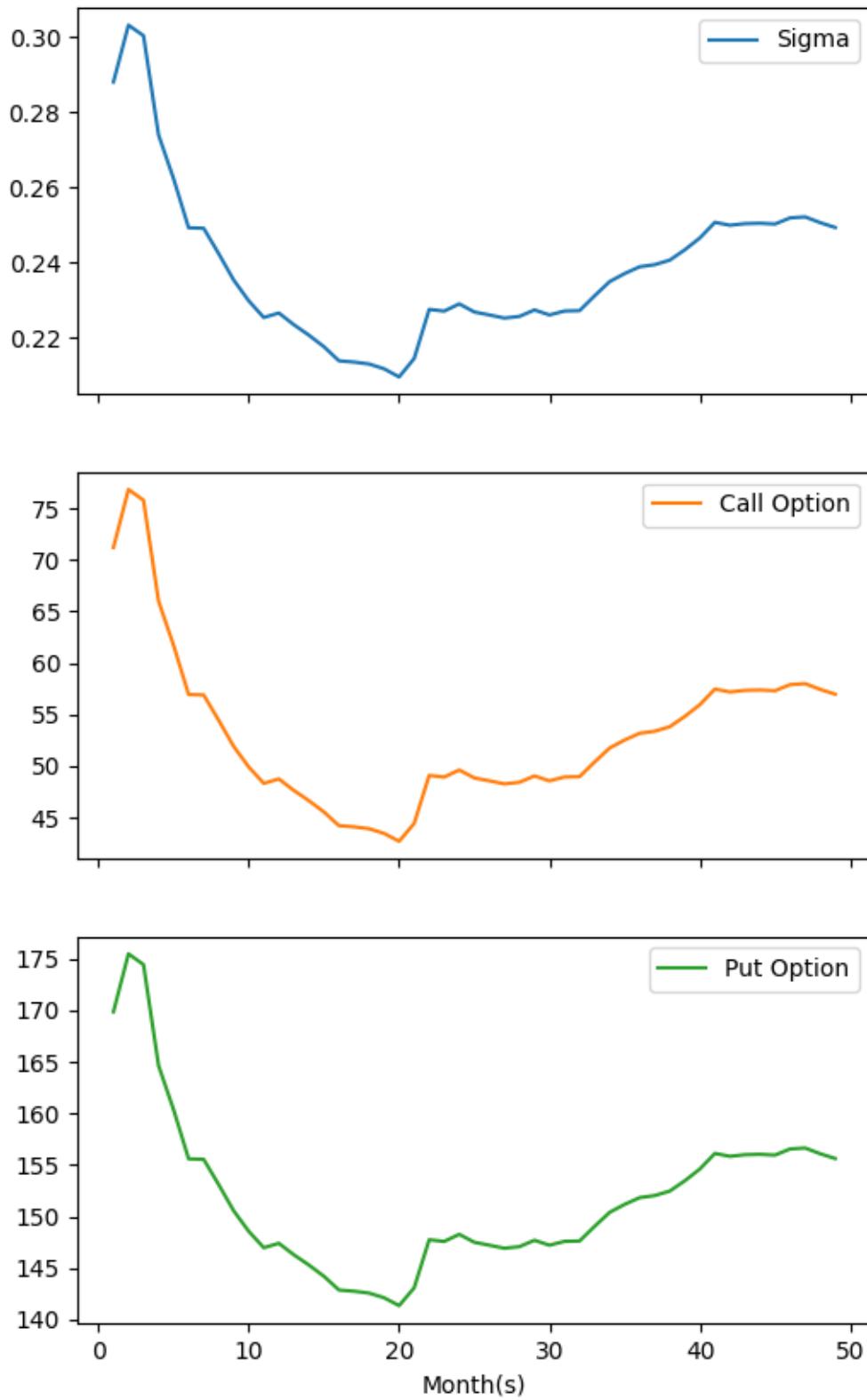
### Plot of ASIANPAINT (NSE) with $A = 0.9$



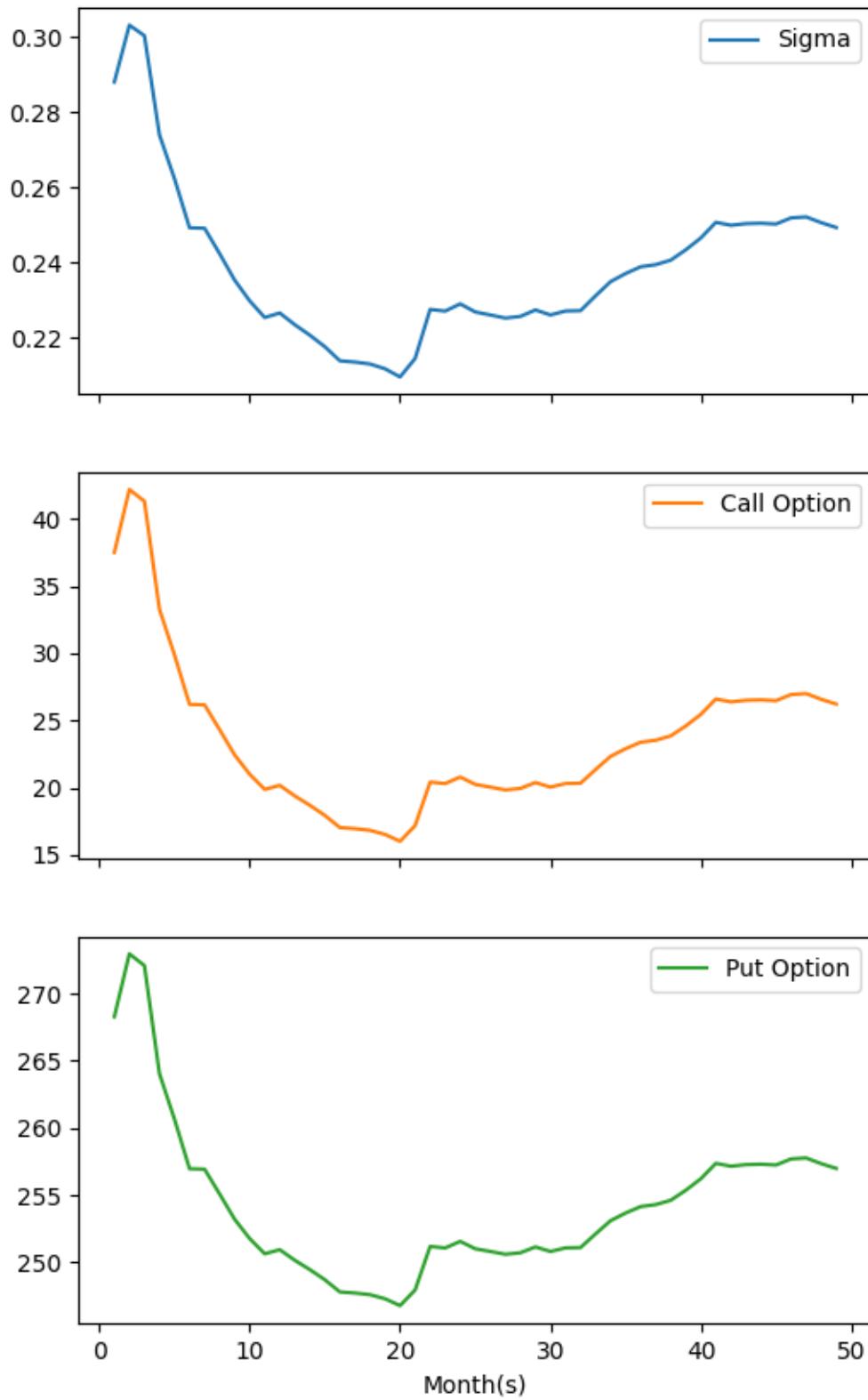
### Plot of ASIANPAINT (NSE) with A = 1.0



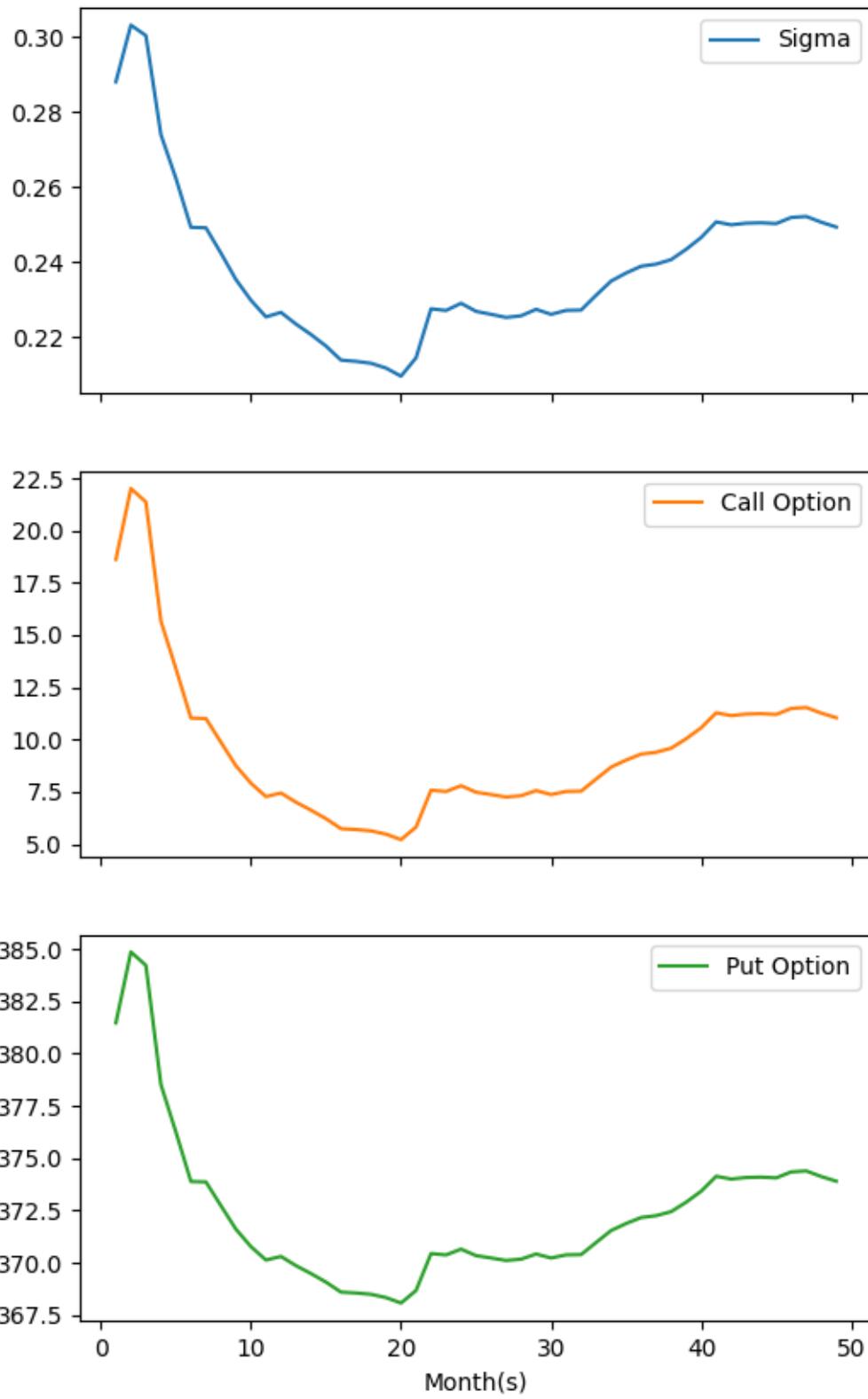
### Plot of ASIANPAINT (NSE) with A = 1.1



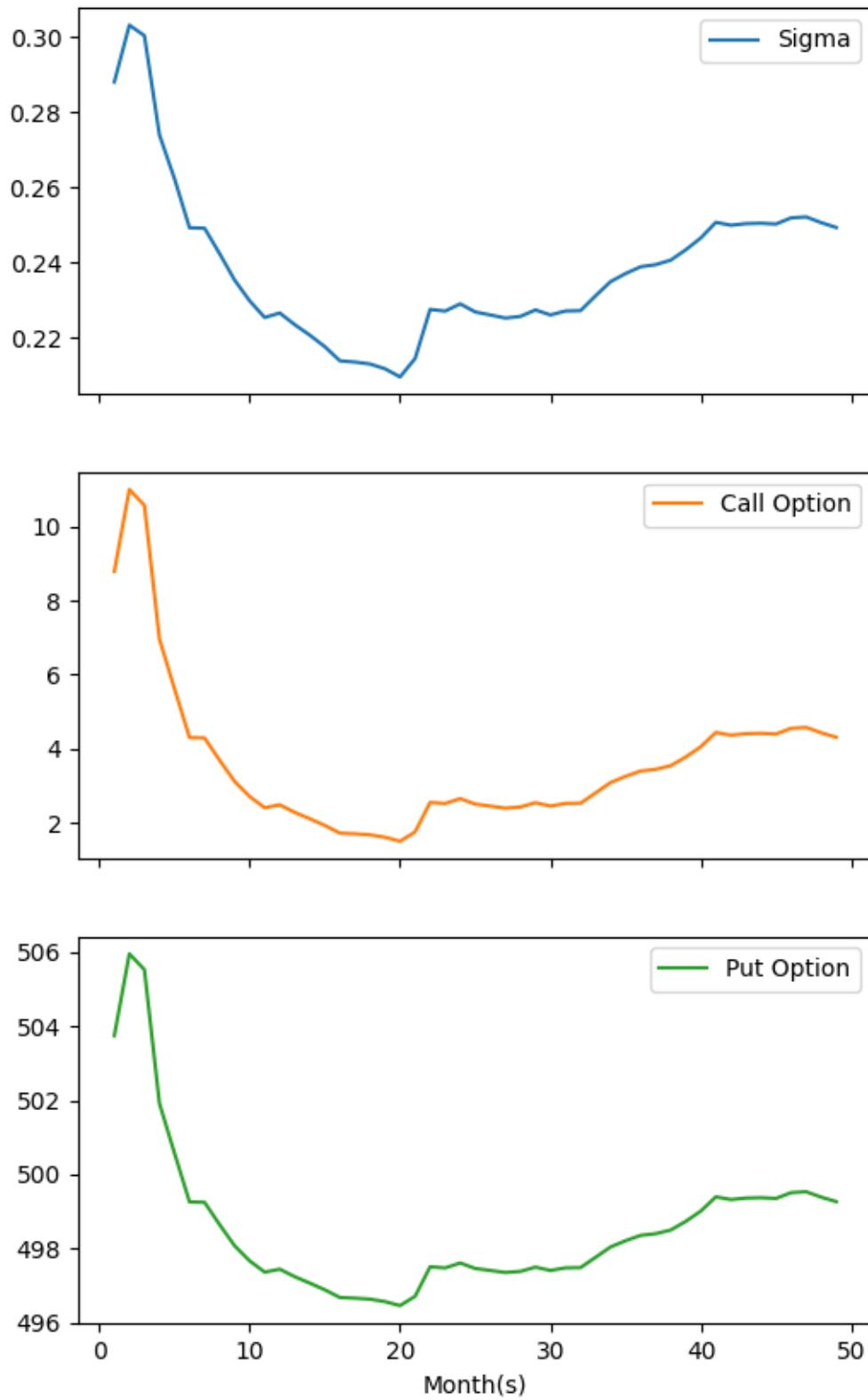
### Plot of ASIANPAINT (NSE) with $A = 1.2$



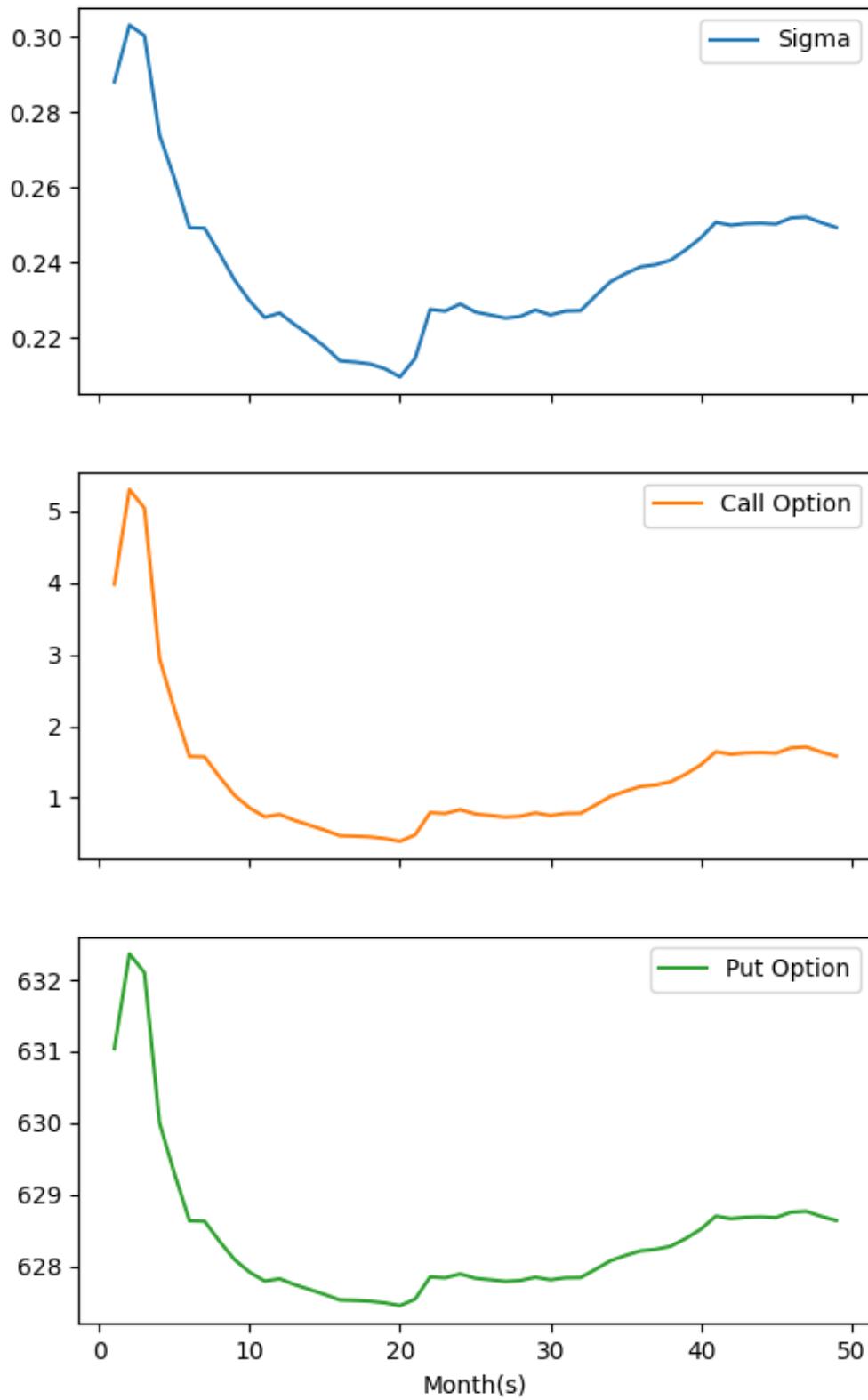
### Plot of ASIANPAINT (NSE) with A = 1.3



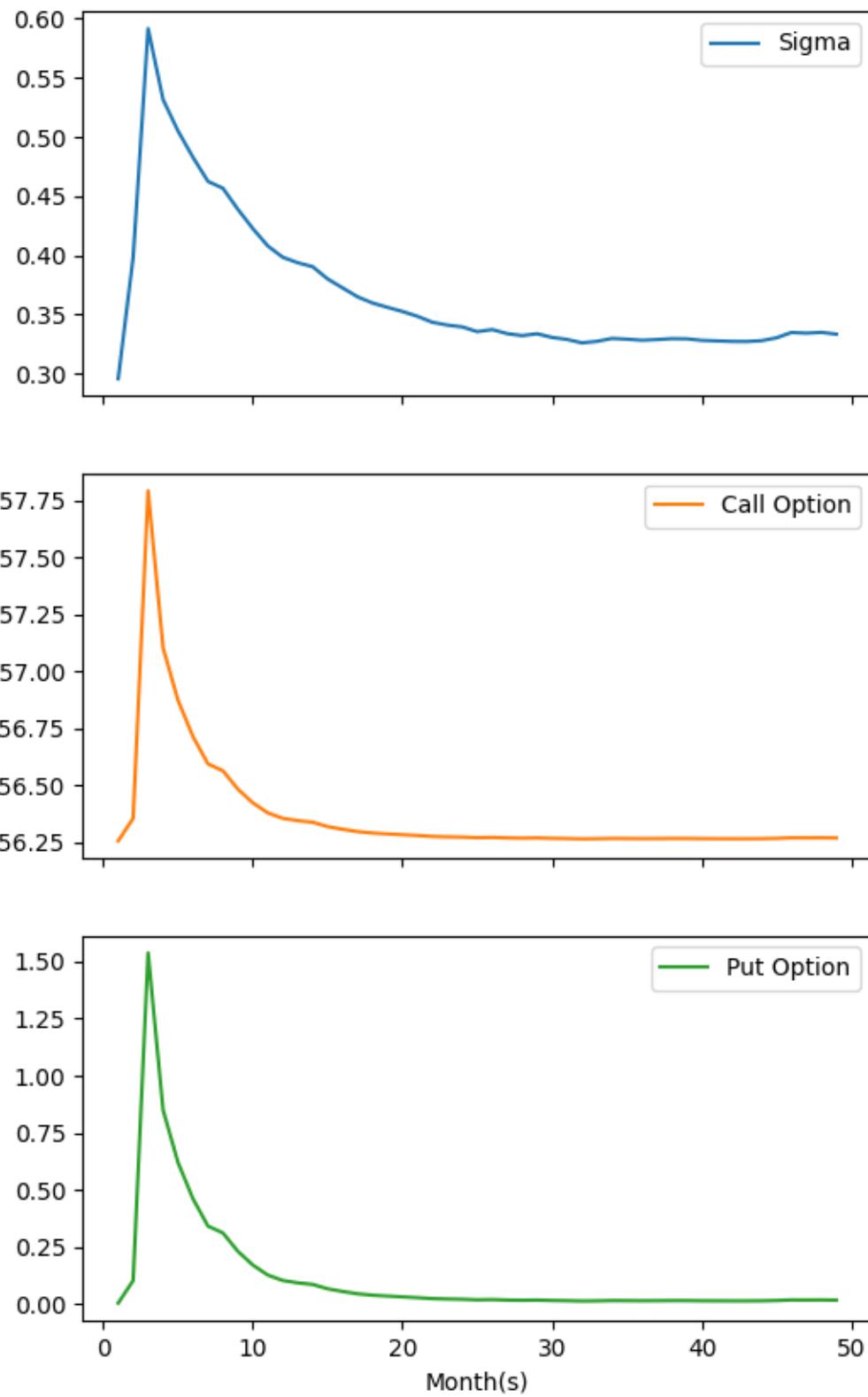
### Plot of ASIANPAINT (NSE) with $A = 1.4$



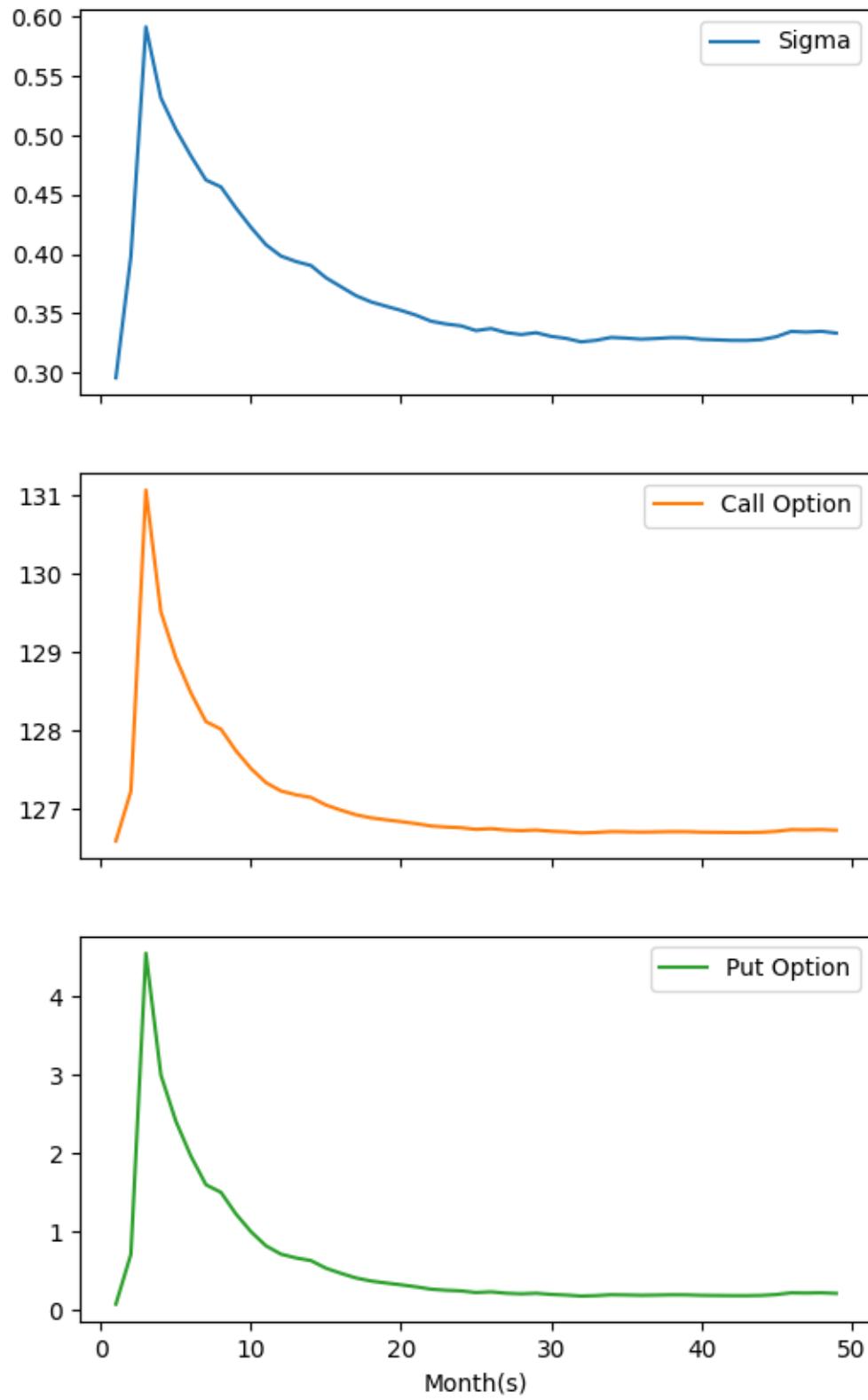
### Plot of ASIANPAINT (NSE) with A = 1.5



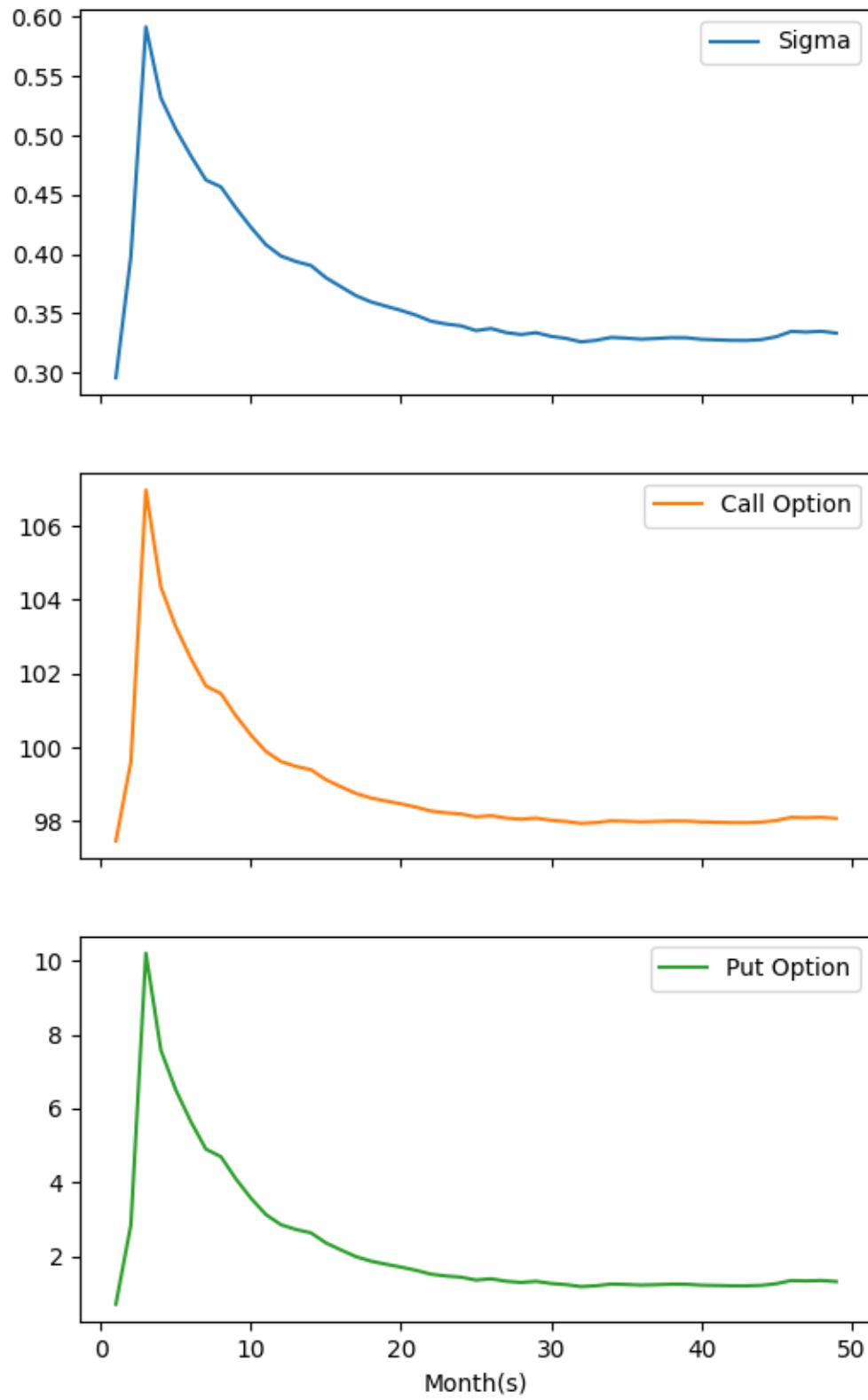
### Plot of BPCL (NSE) with A = 0.5



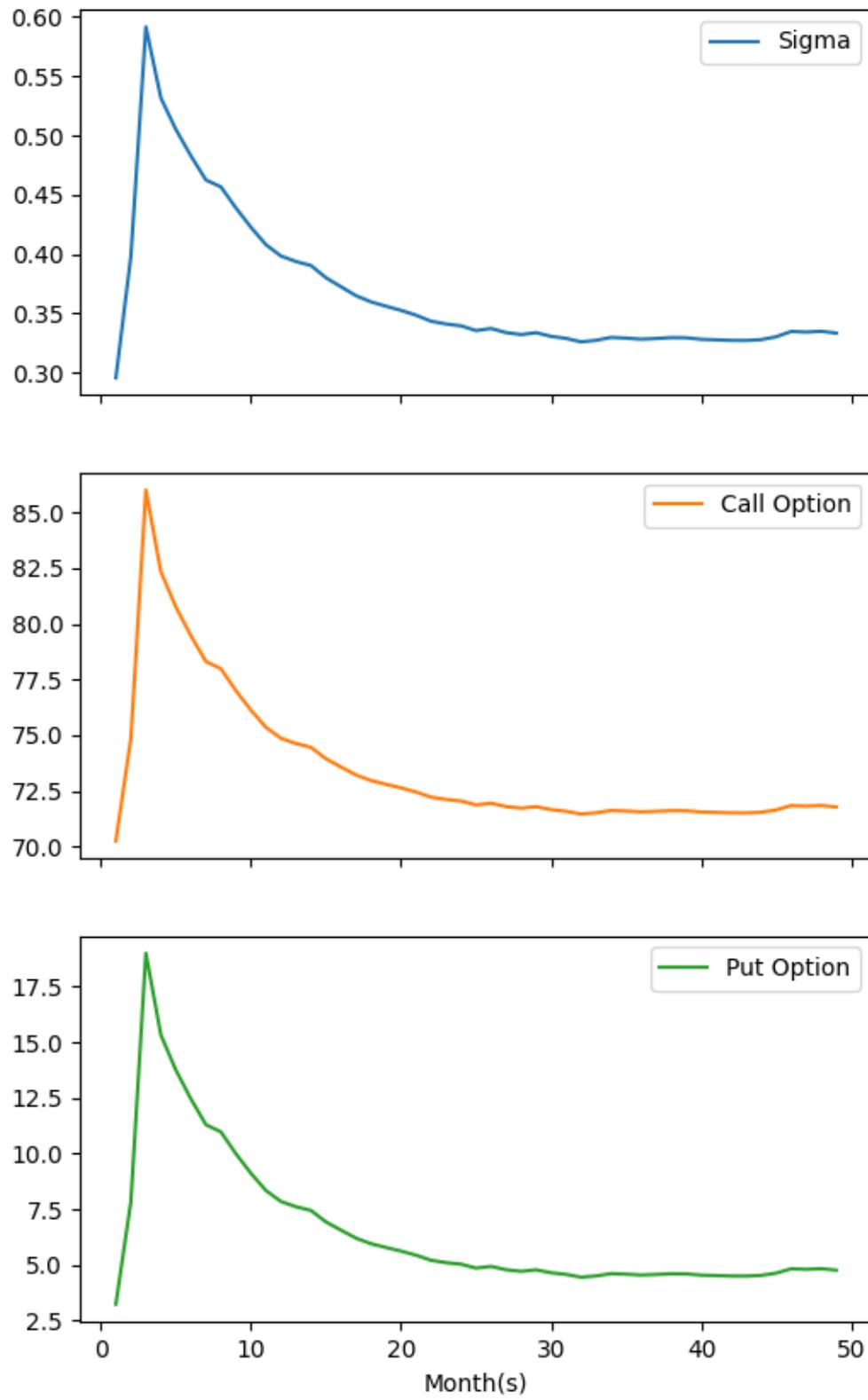
### Plot of BPCL (NSE) with A = 0.6



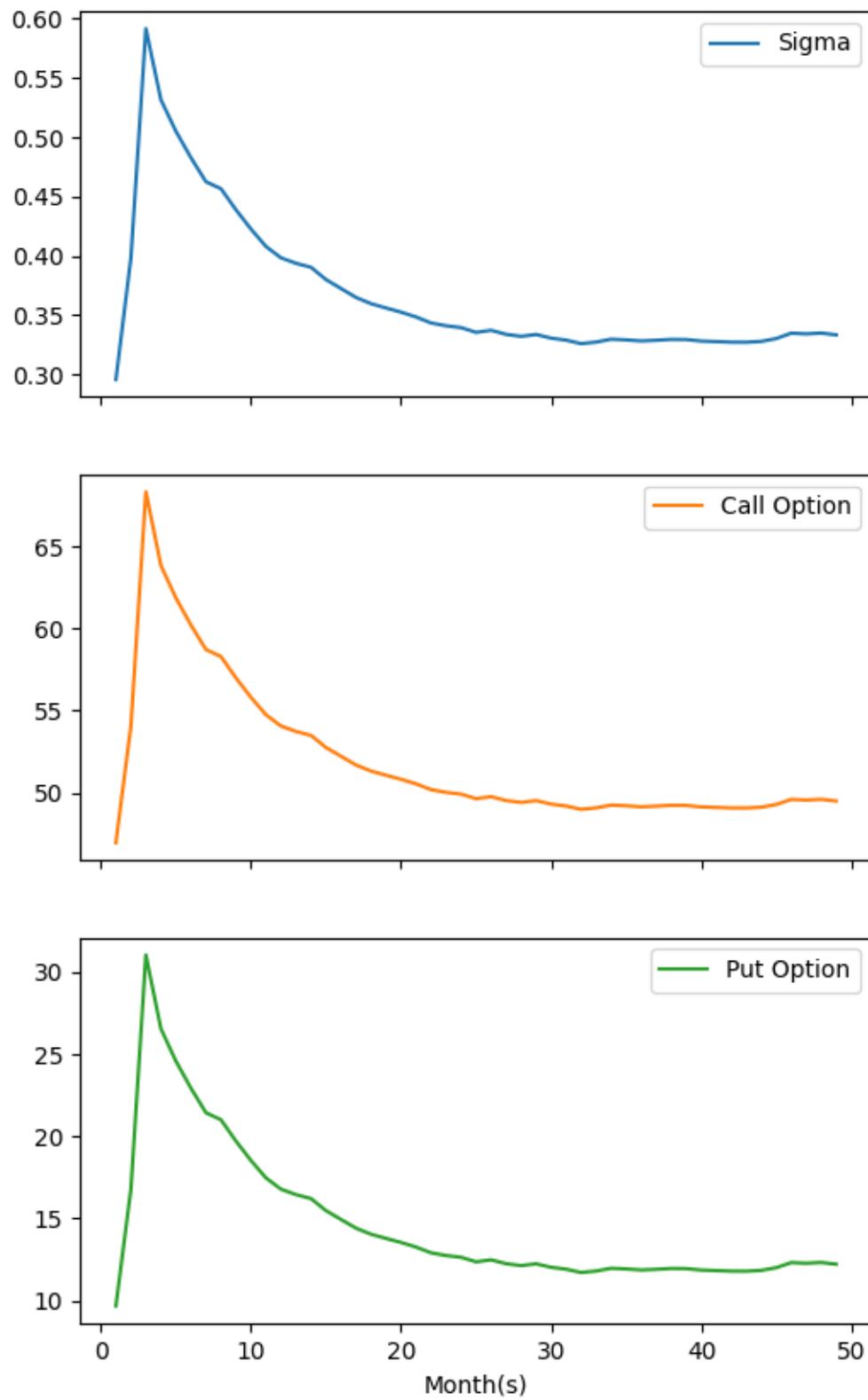
Plot of BPCL (NSE) with A = 0.7



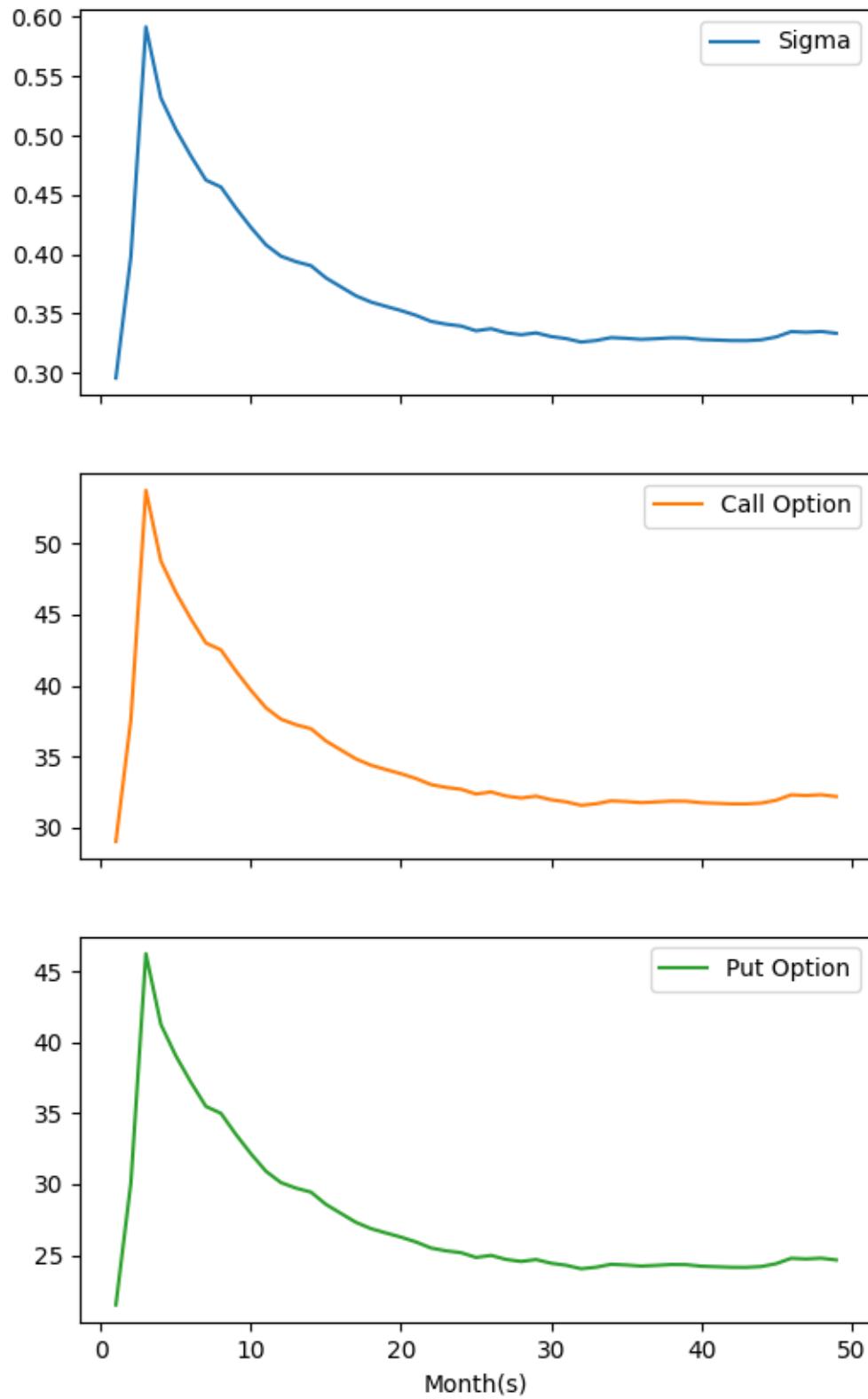
Plot of BPCL (NSE) with A = 0.8



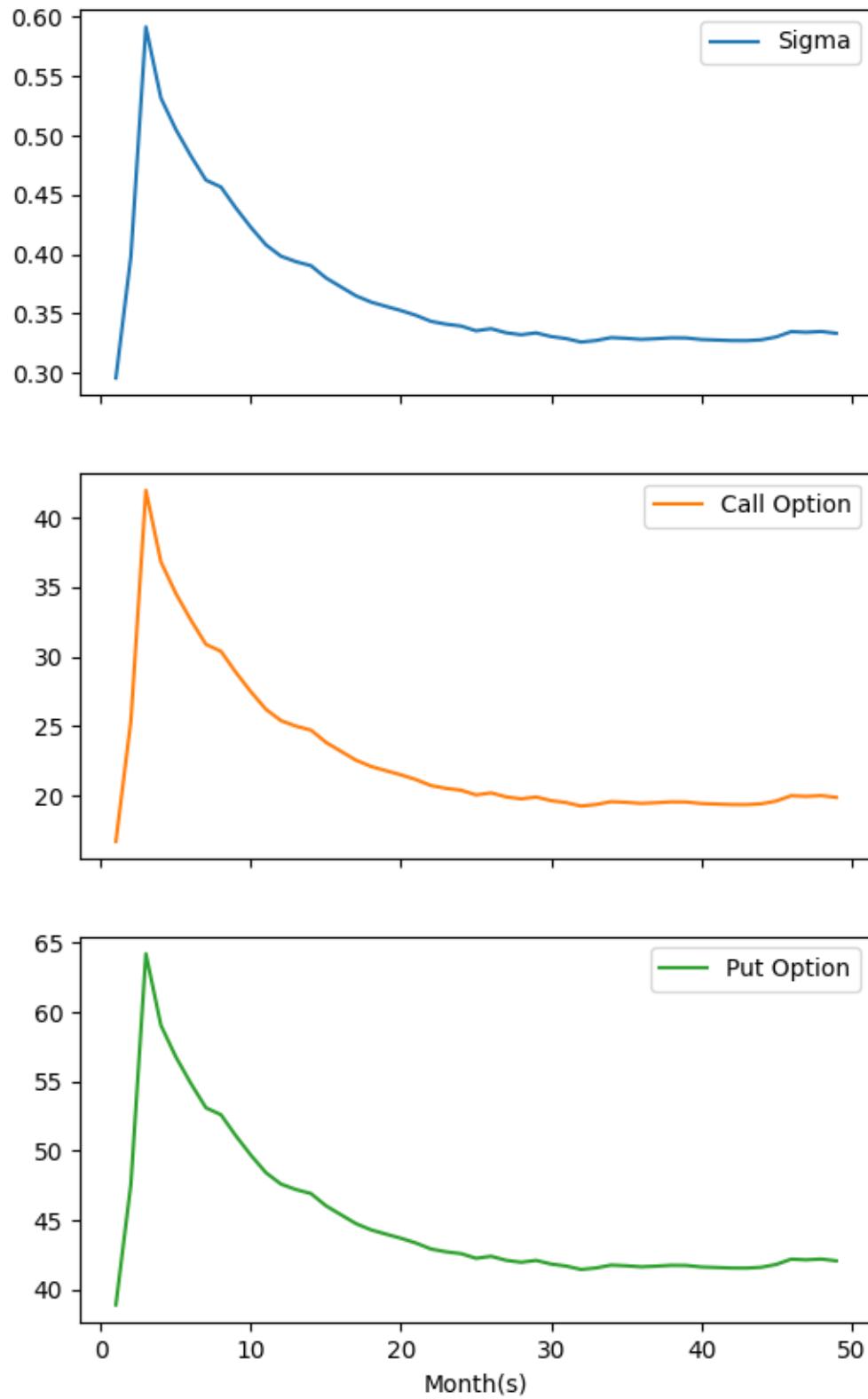
### Plot of BPCL (NSE) with A = 0.9



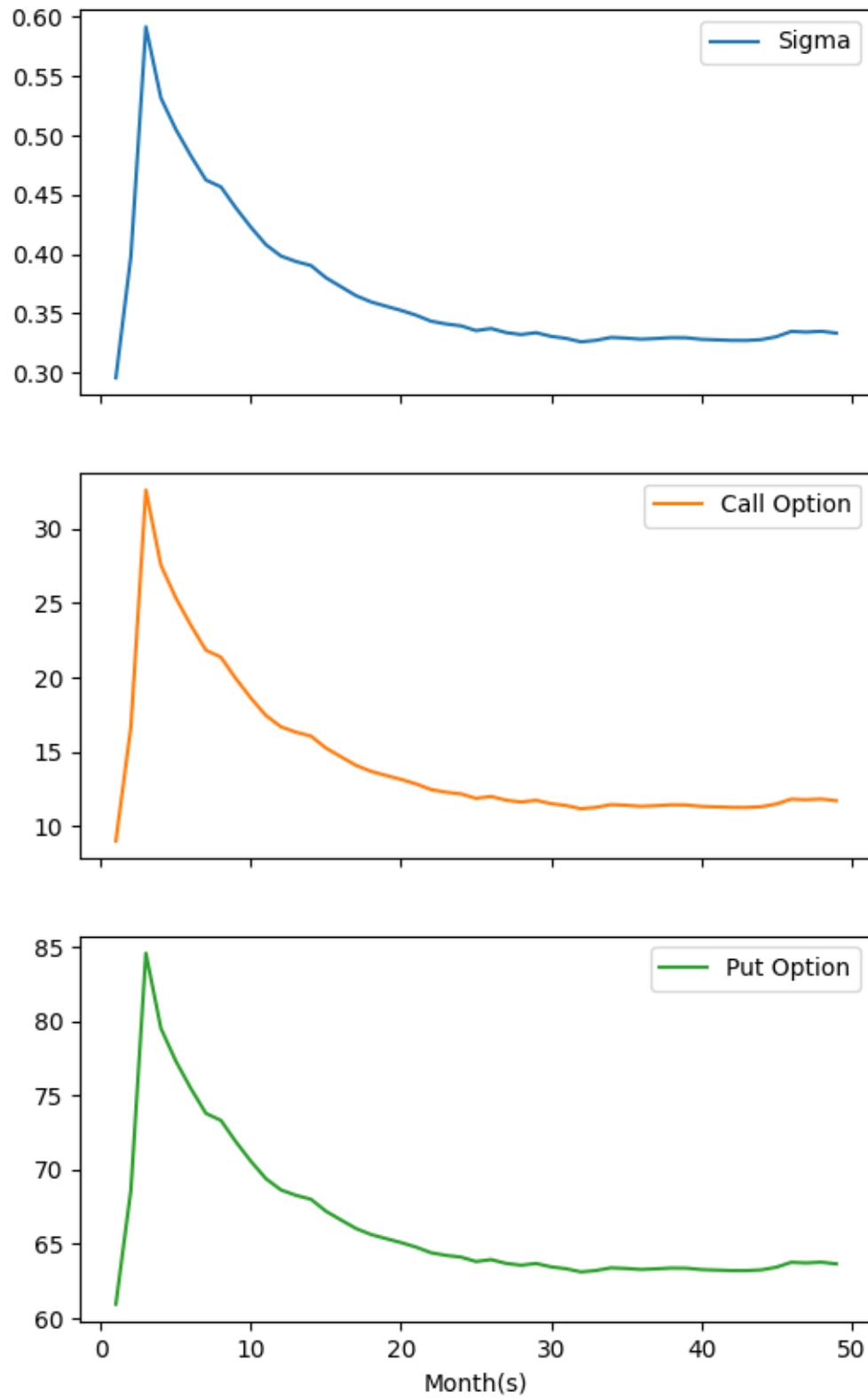
### Plot of BPCL (NSE) with A = 1.0



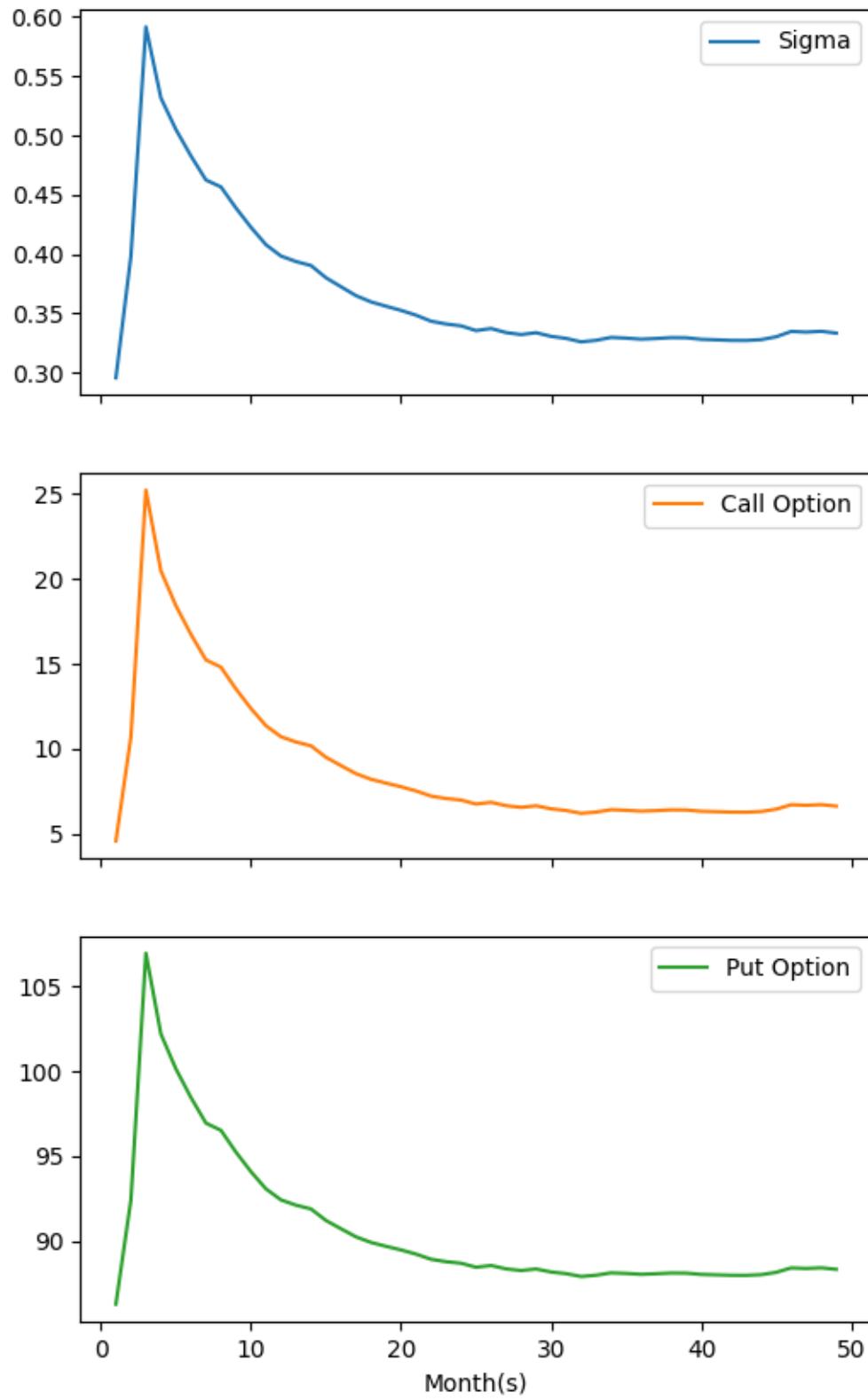
### Plot of BPCL (NSE) with A = 1.1



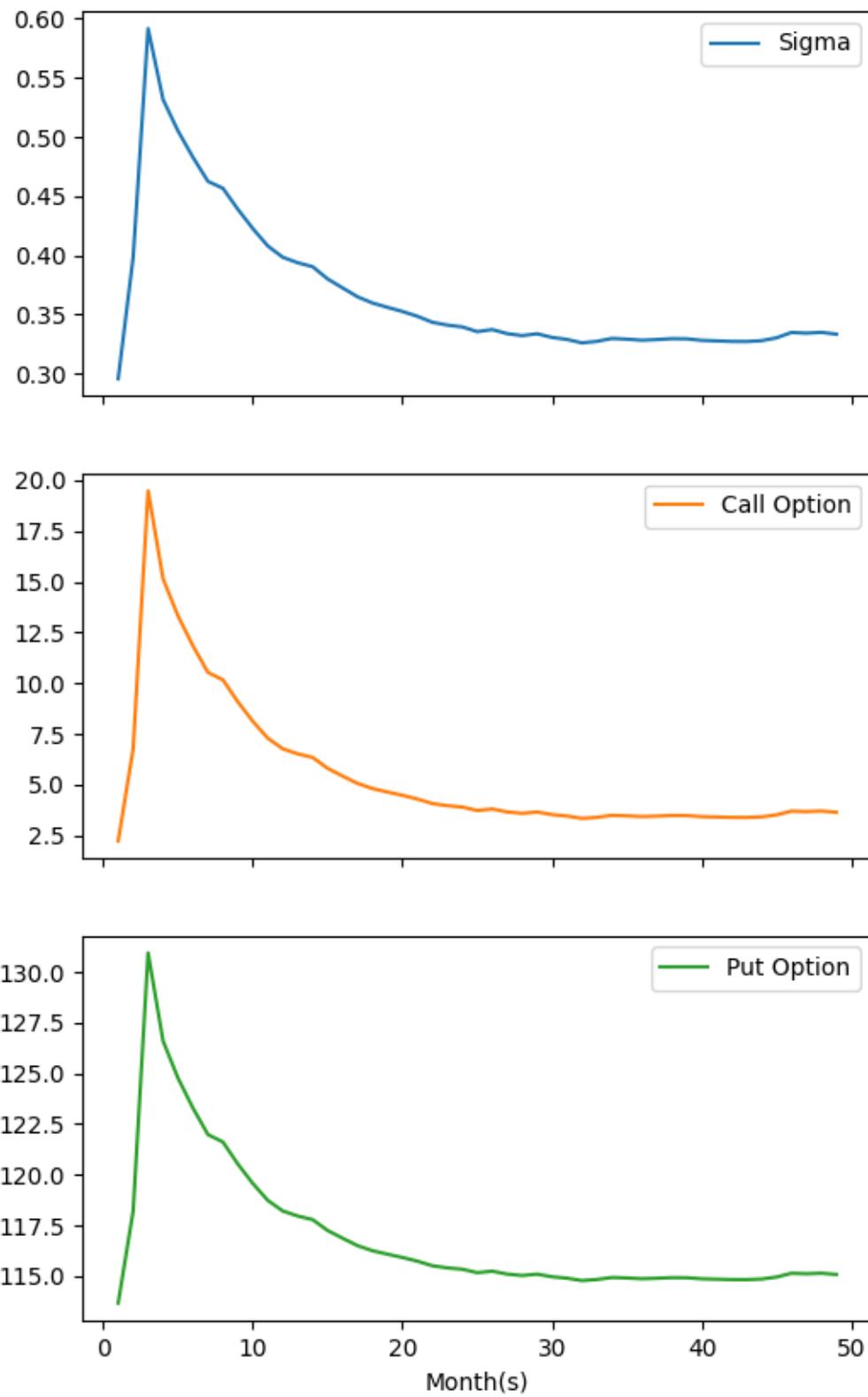
Plot of BPCL (NSE) with A = 1.2



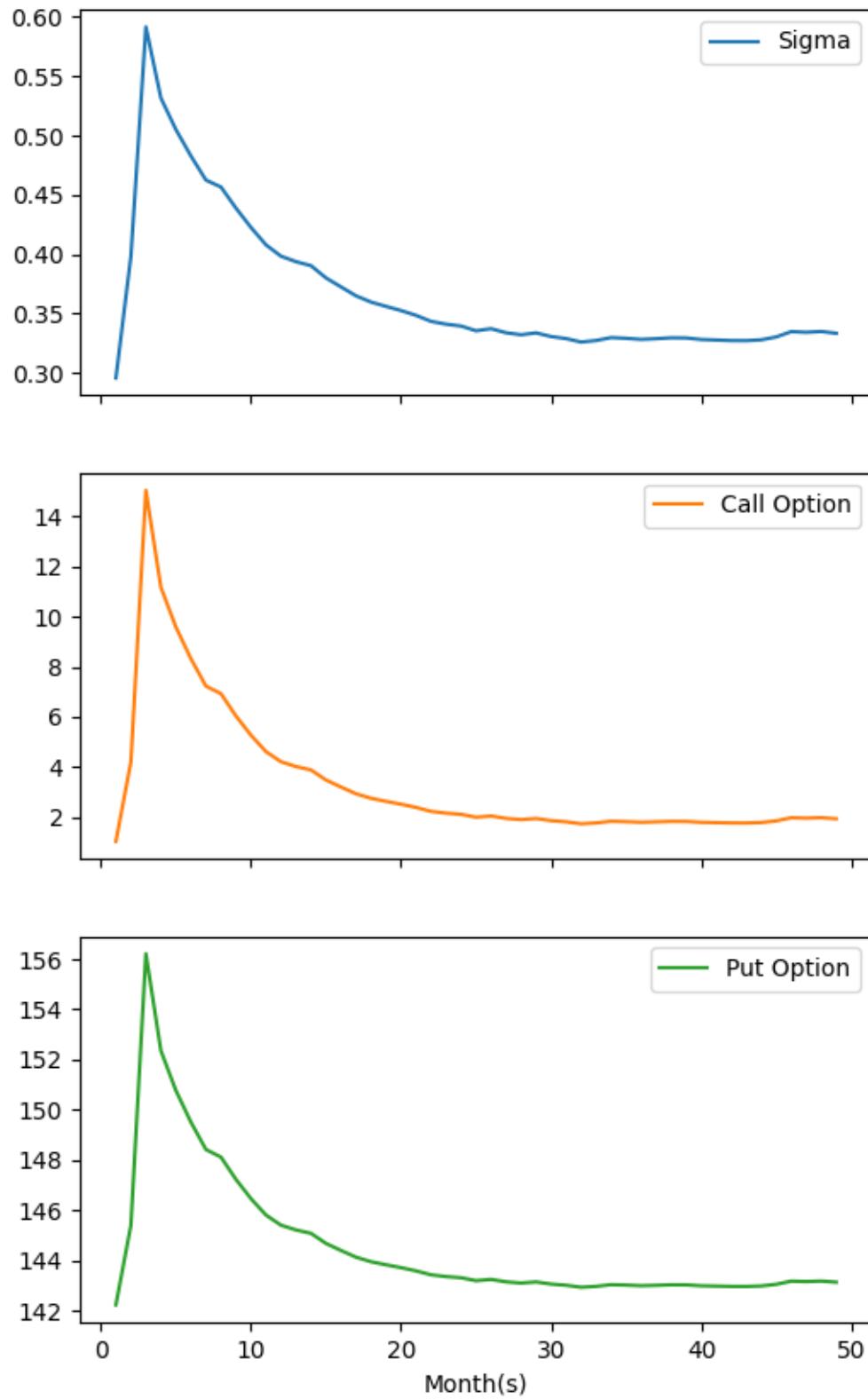
### Plot of BPCL (NSE) with A = 1.3



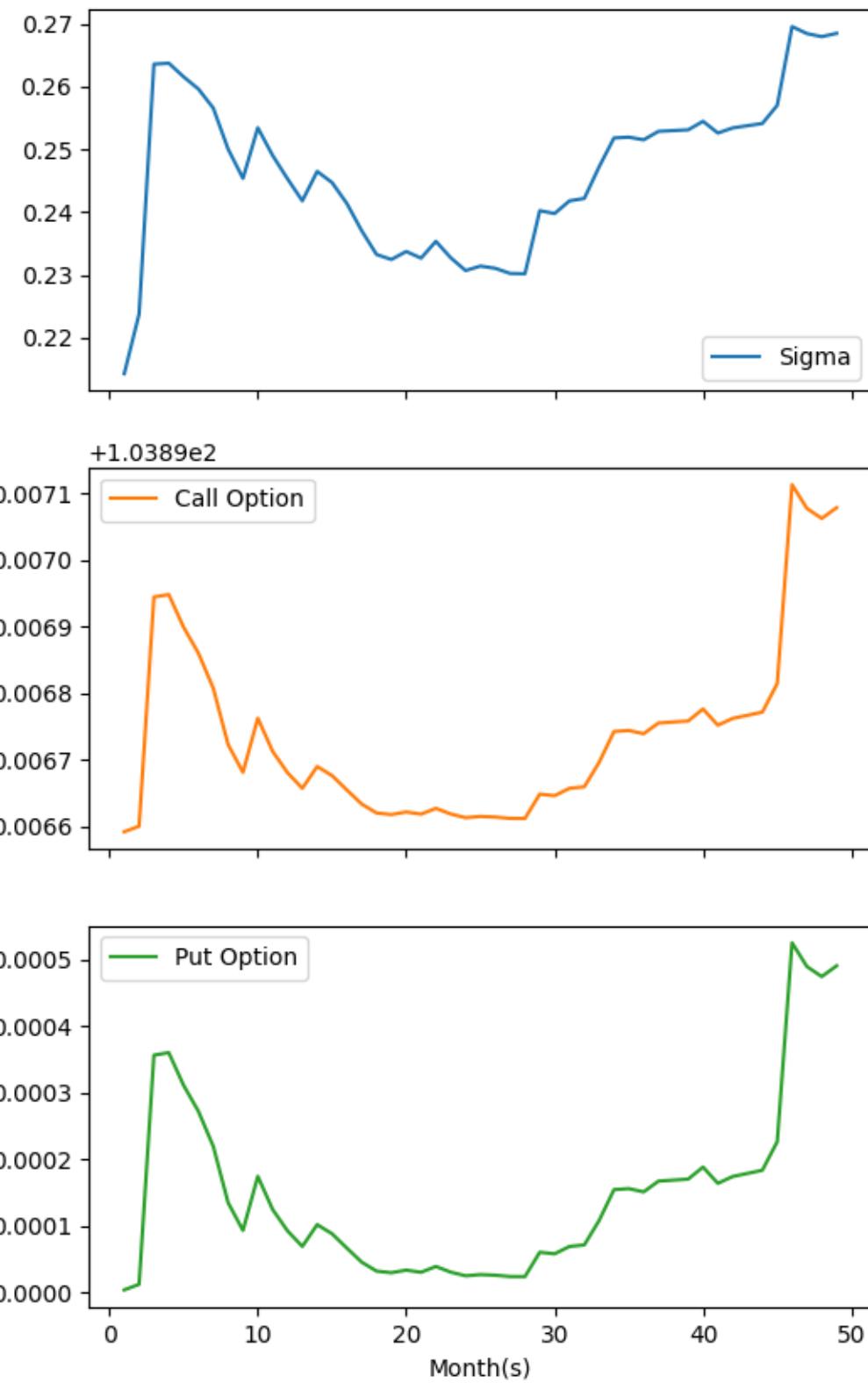
### Plot of BPCL (NSE) with A = 1.4



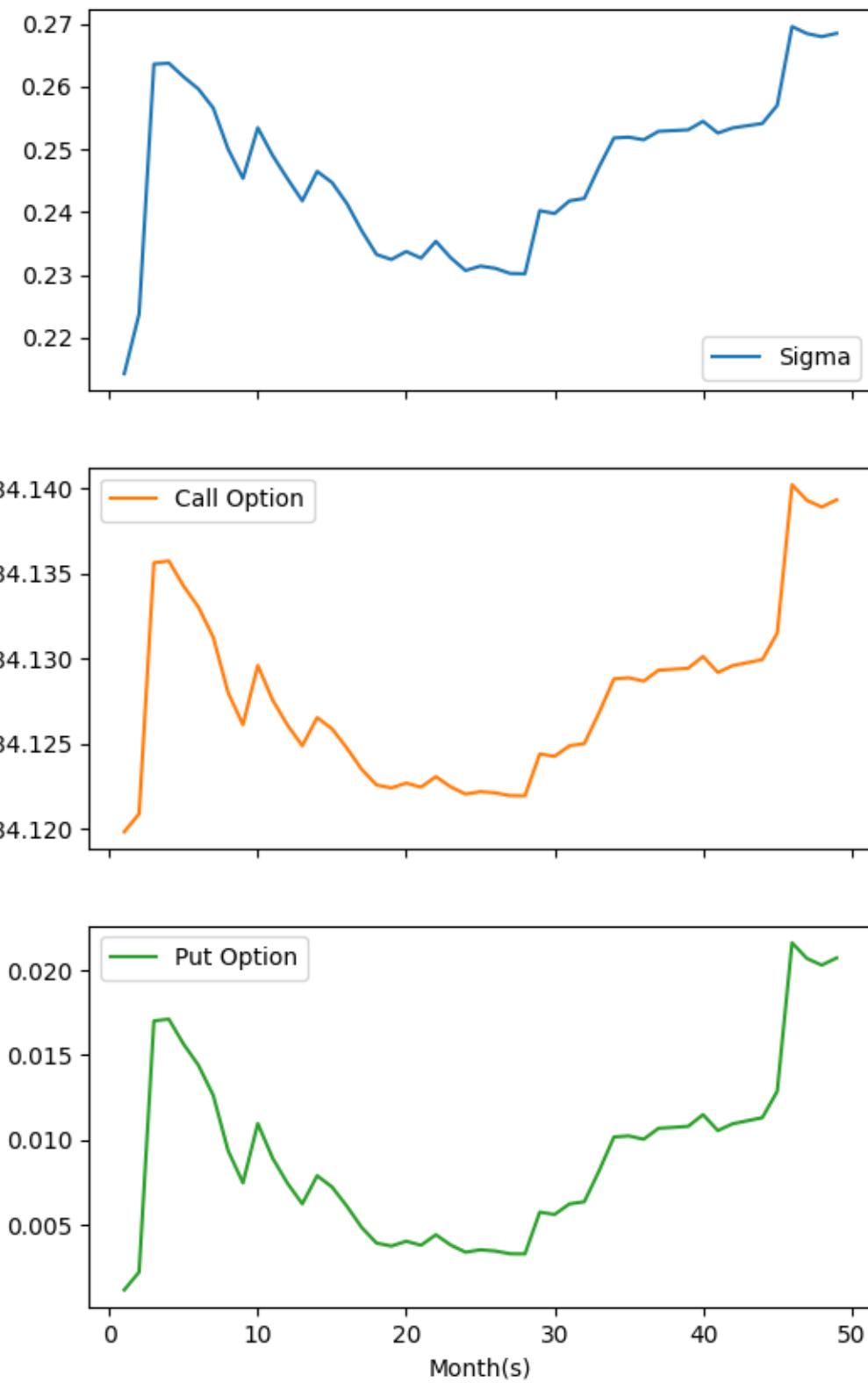
### Plot of BPCL (NSE) with A = 1.5



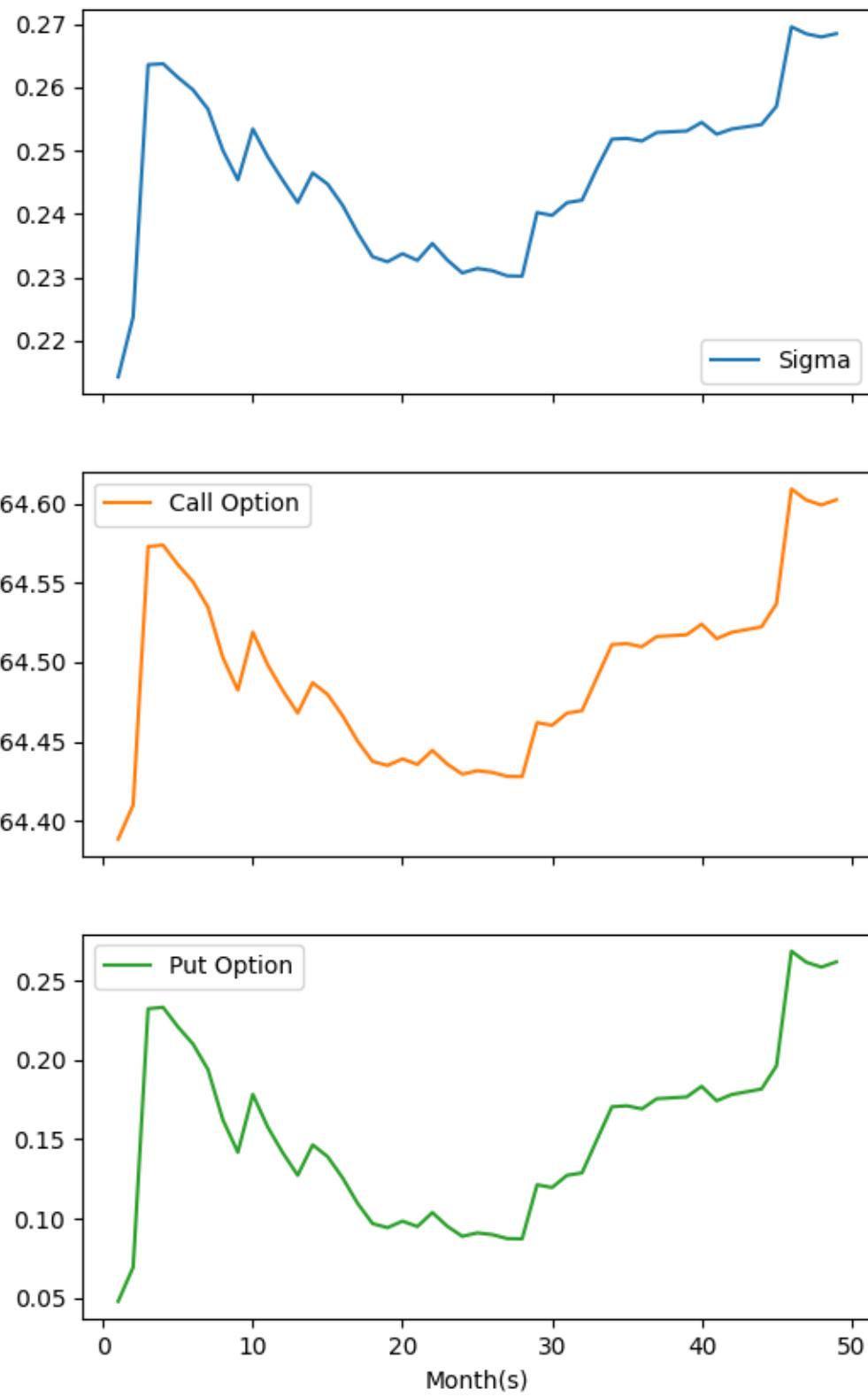
Plot of COALINDIA (NSE) with  $A = 0.5$



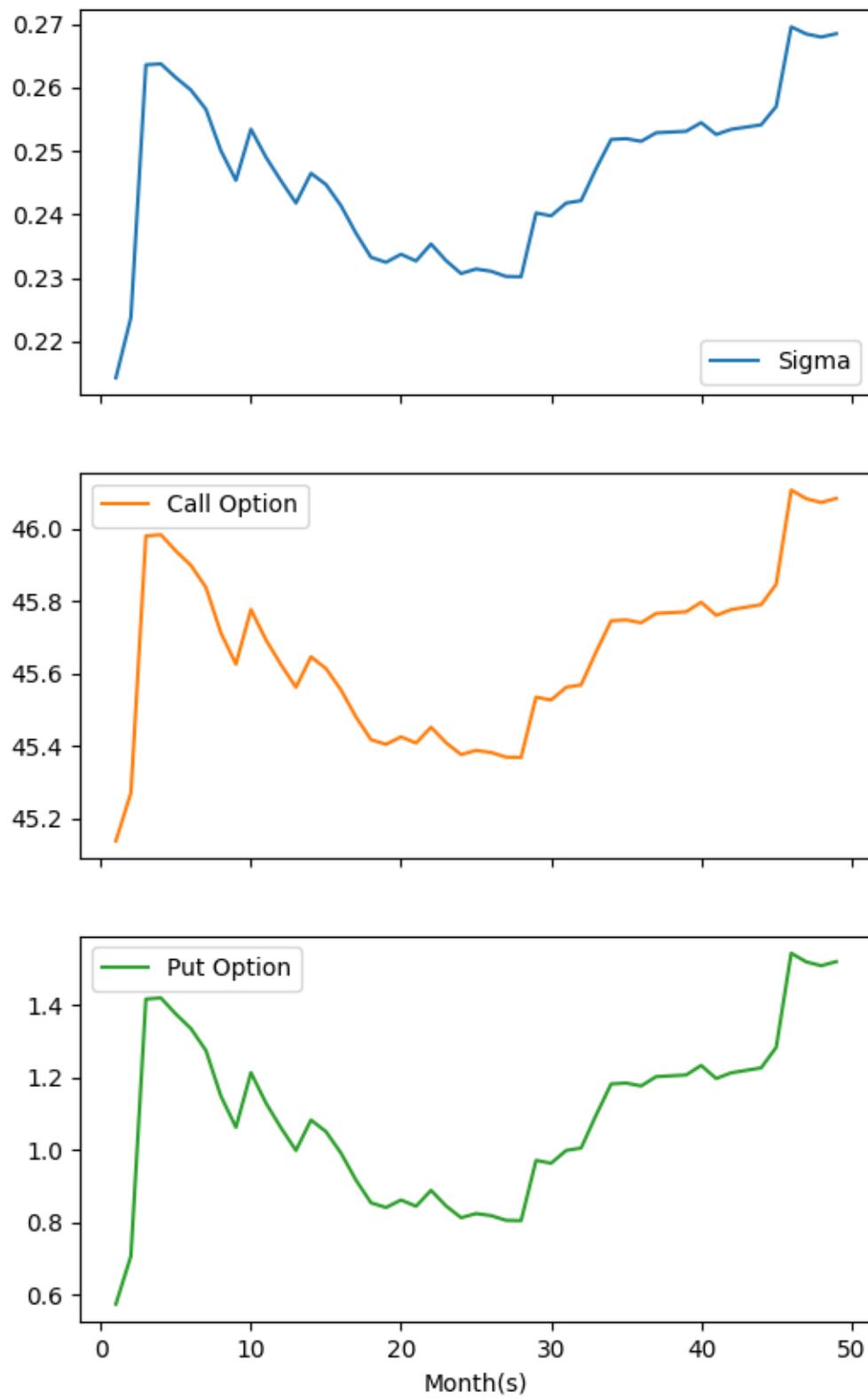
### Plot of COALINDIA (NSE) with $A = 0.6$



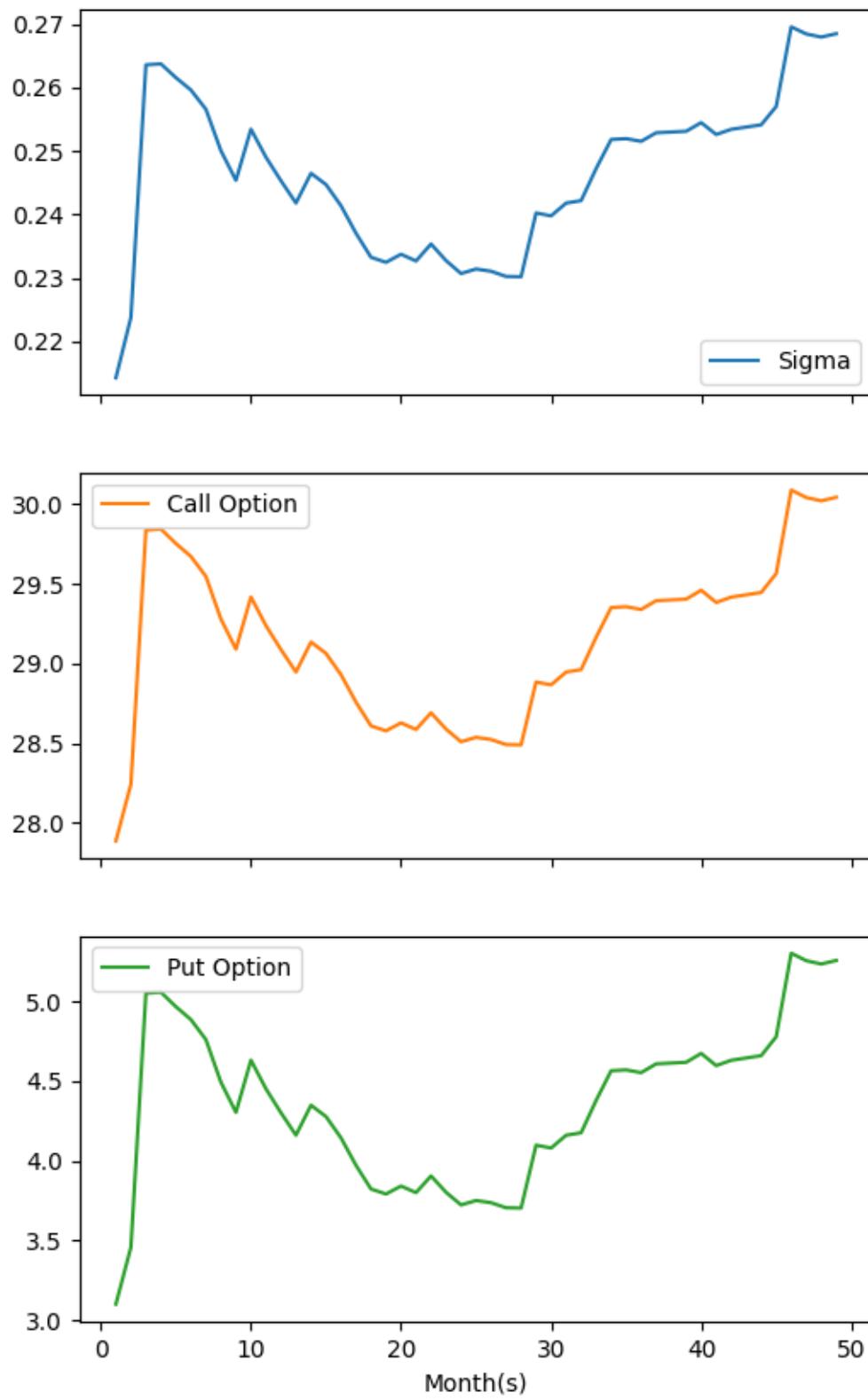
Plot of COALINDIA (NSE) with  $A = 0.7$



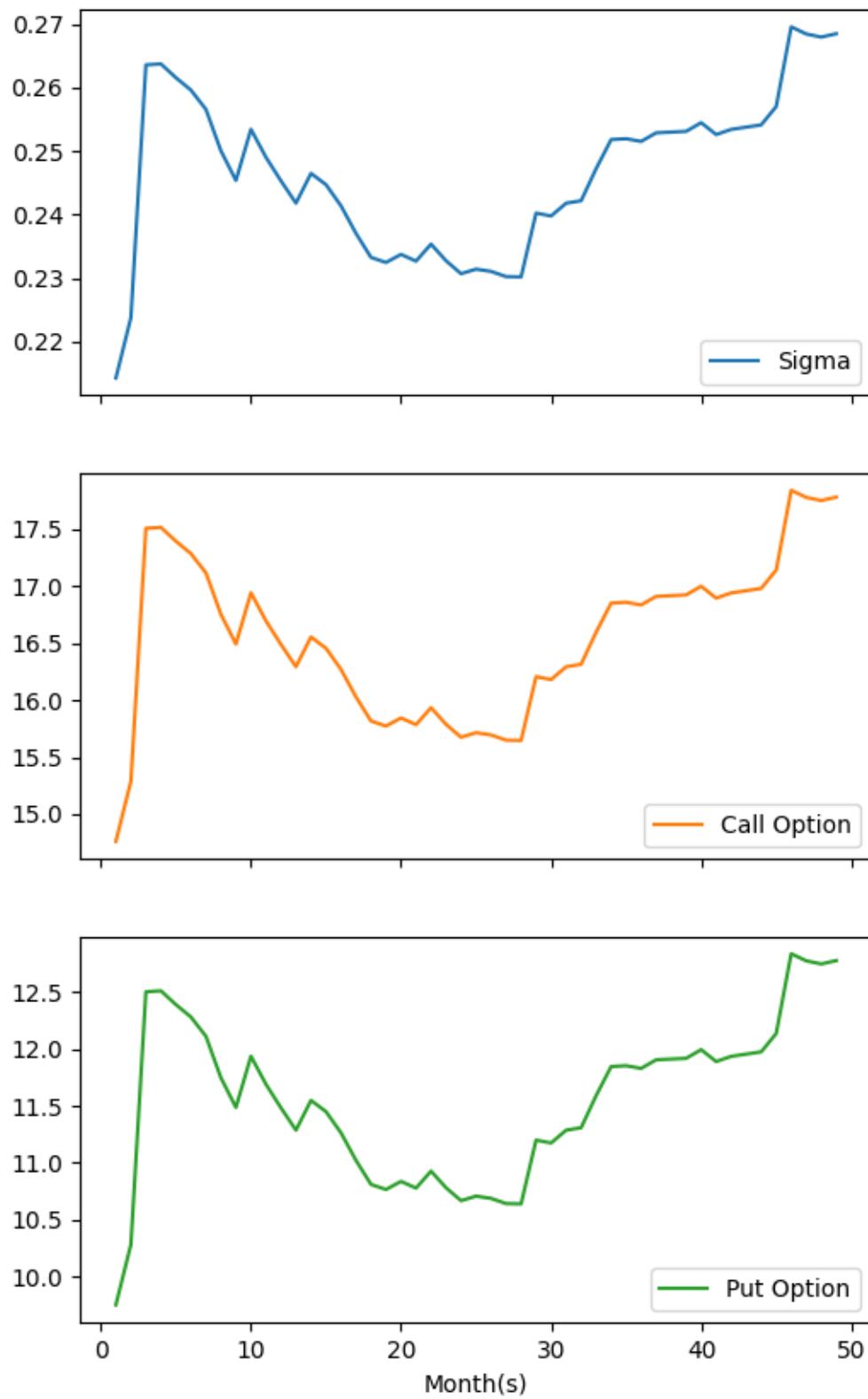
### Plot of COALINDIA (NSE) with $A = 0.8$



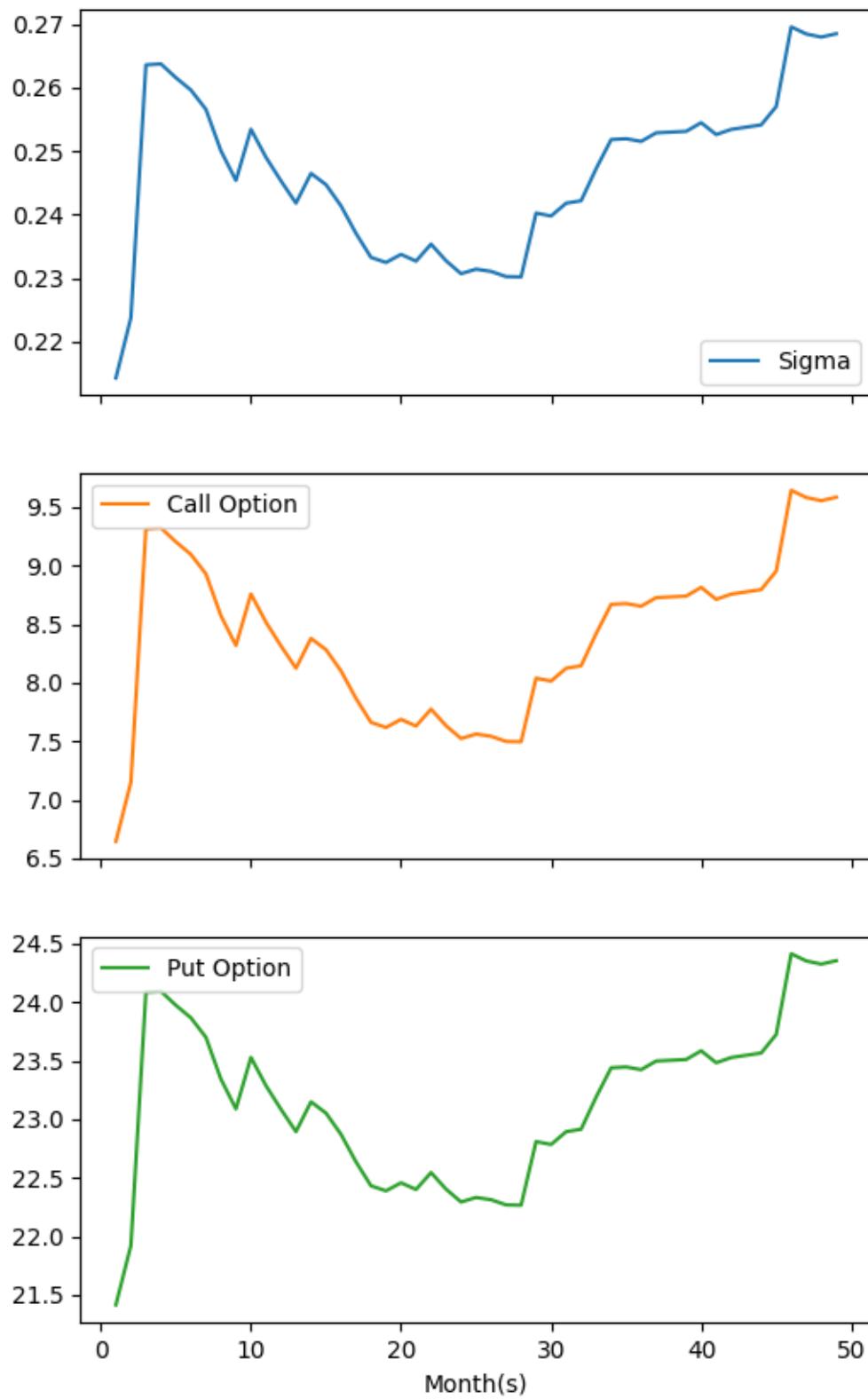
Plot of COALINDIA (NSE) with  $A = 0.9$



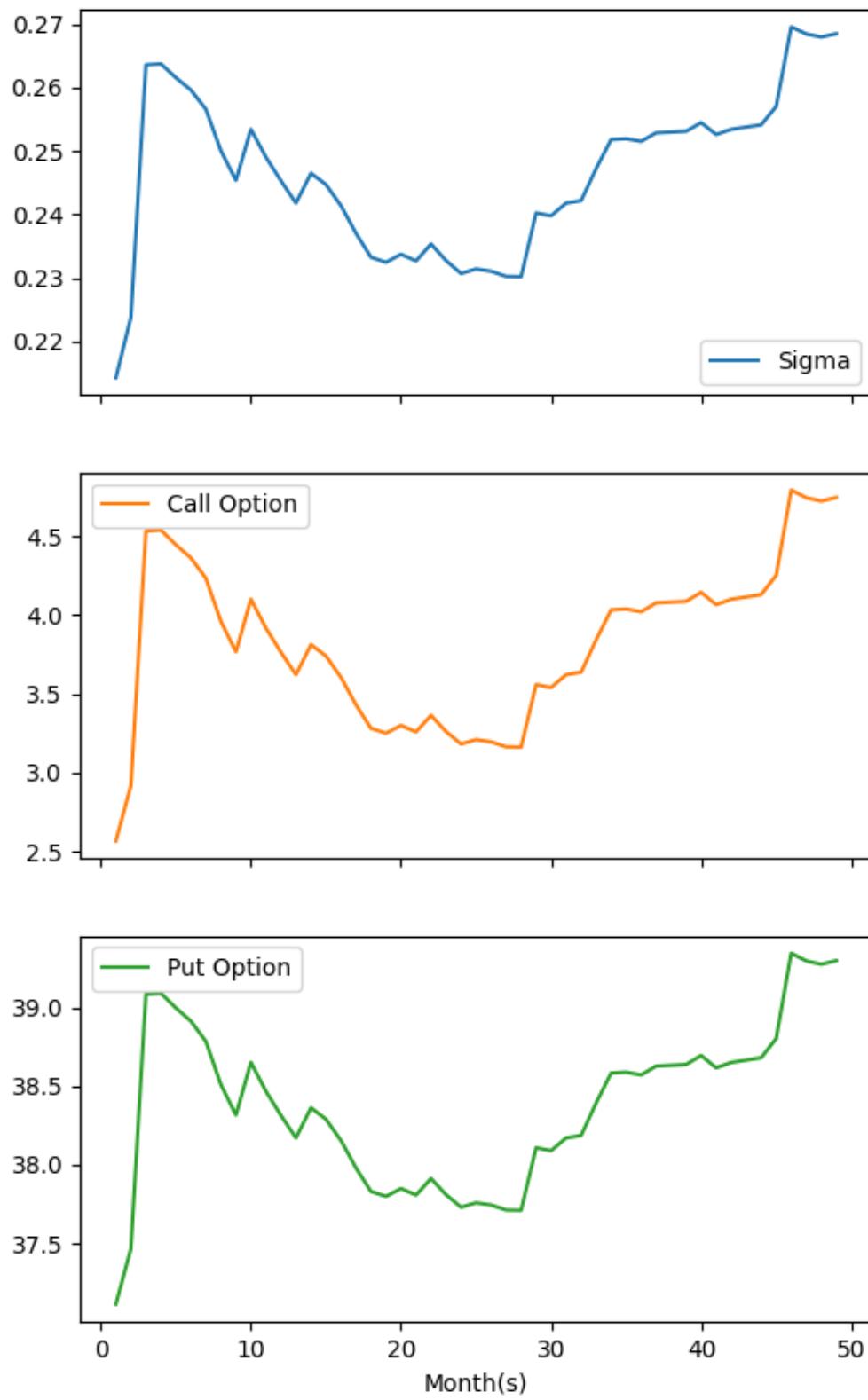
### Plot of COALINDIA (NSE) with A = 1.0



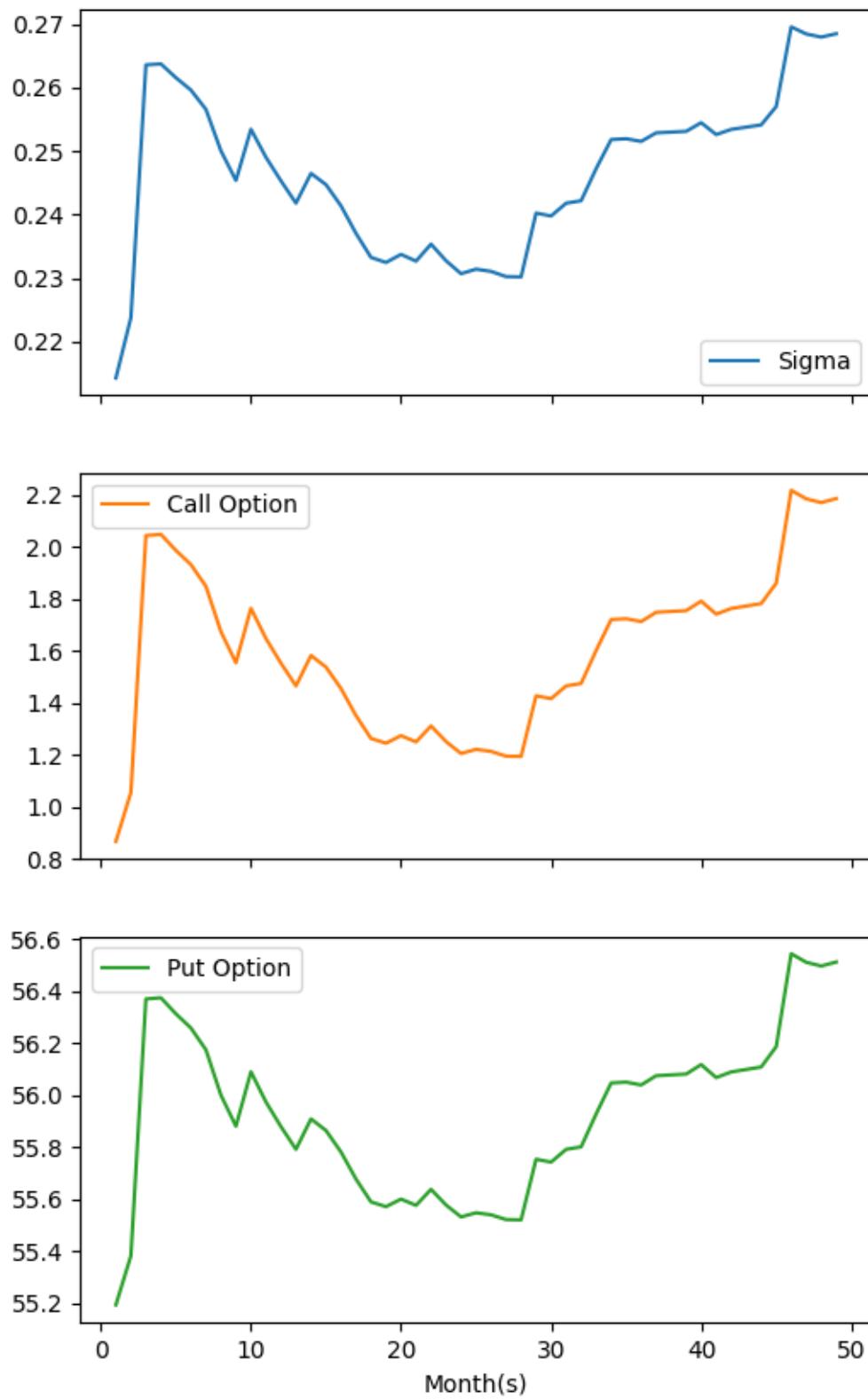
### Plot of COALINDIA (NSE) with $A = 1.1$



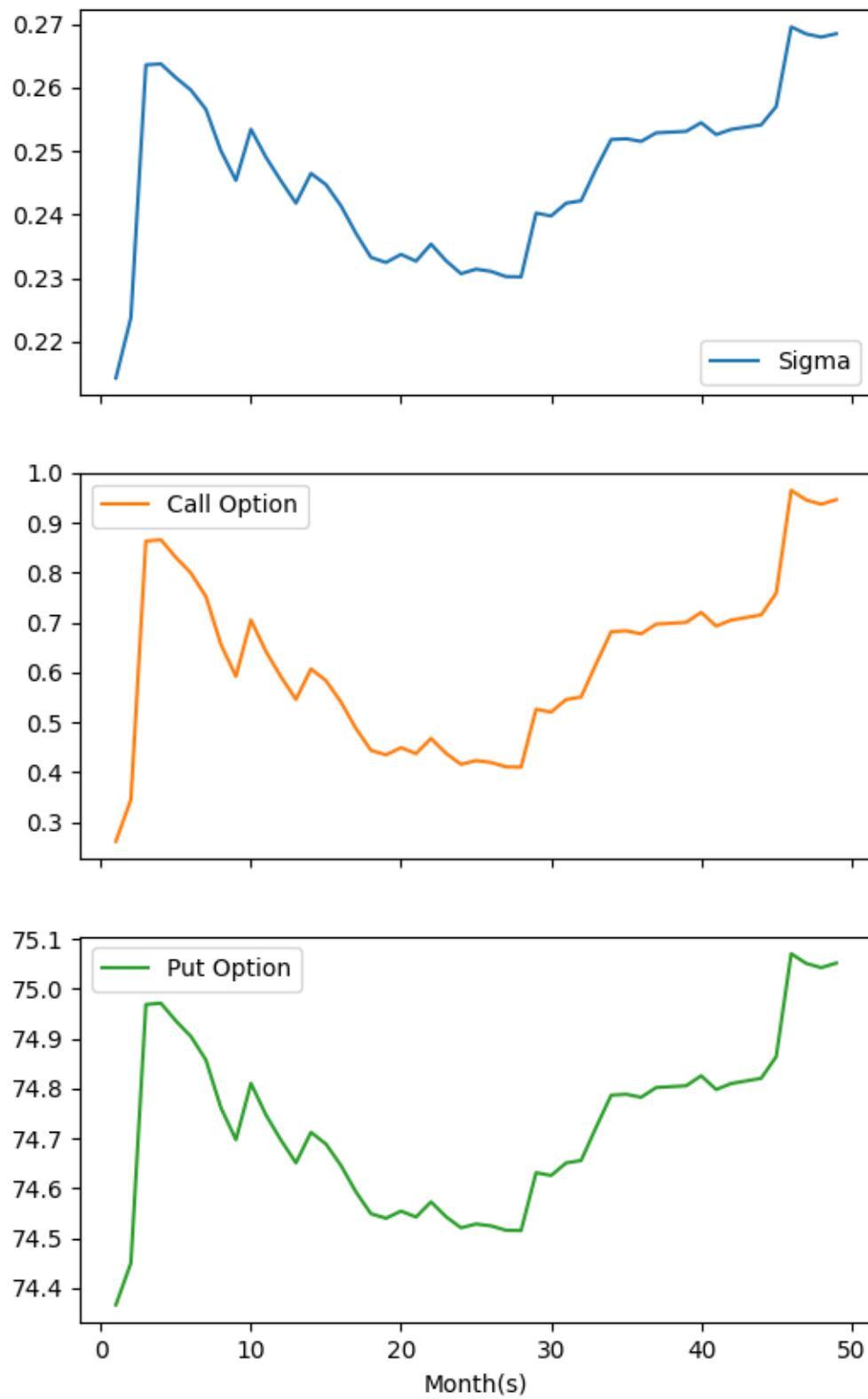
### Plot of COALINDIA (NSE) with $A = 1.2$



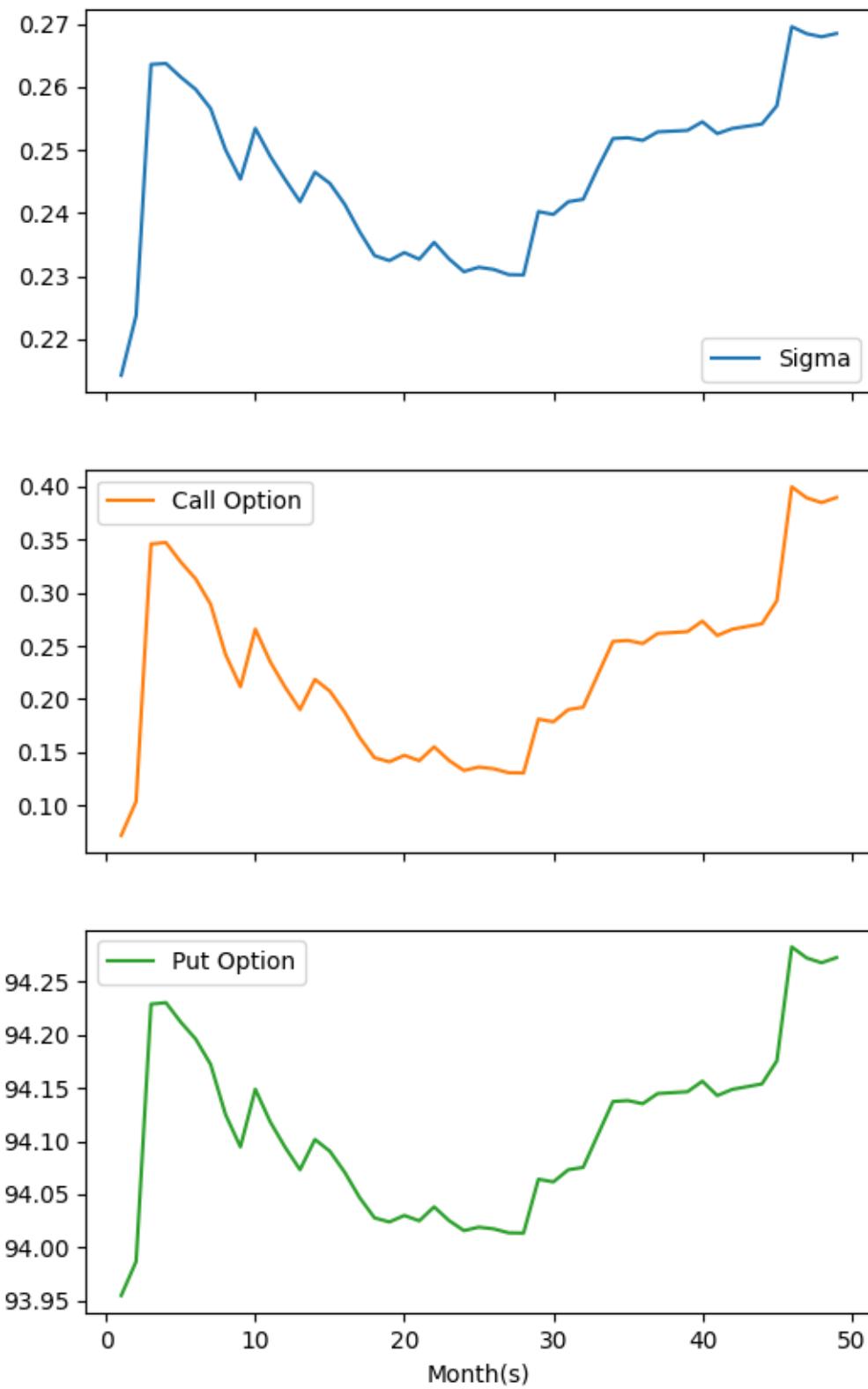
### Plot of COALINDIA (NSE) with $A = 1.3$



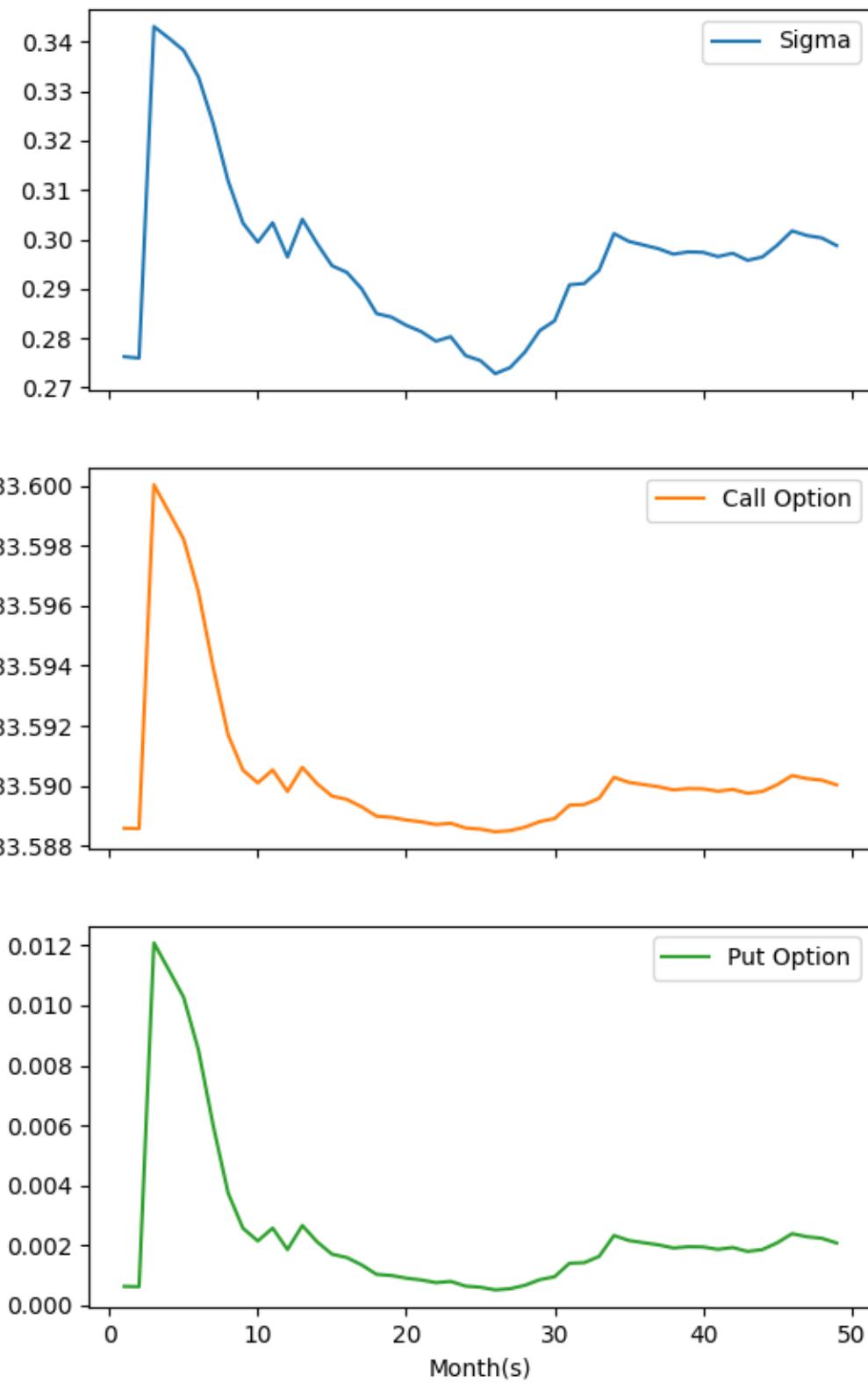
### Plot of COALINDIA (NSE) with $A = 1.4$



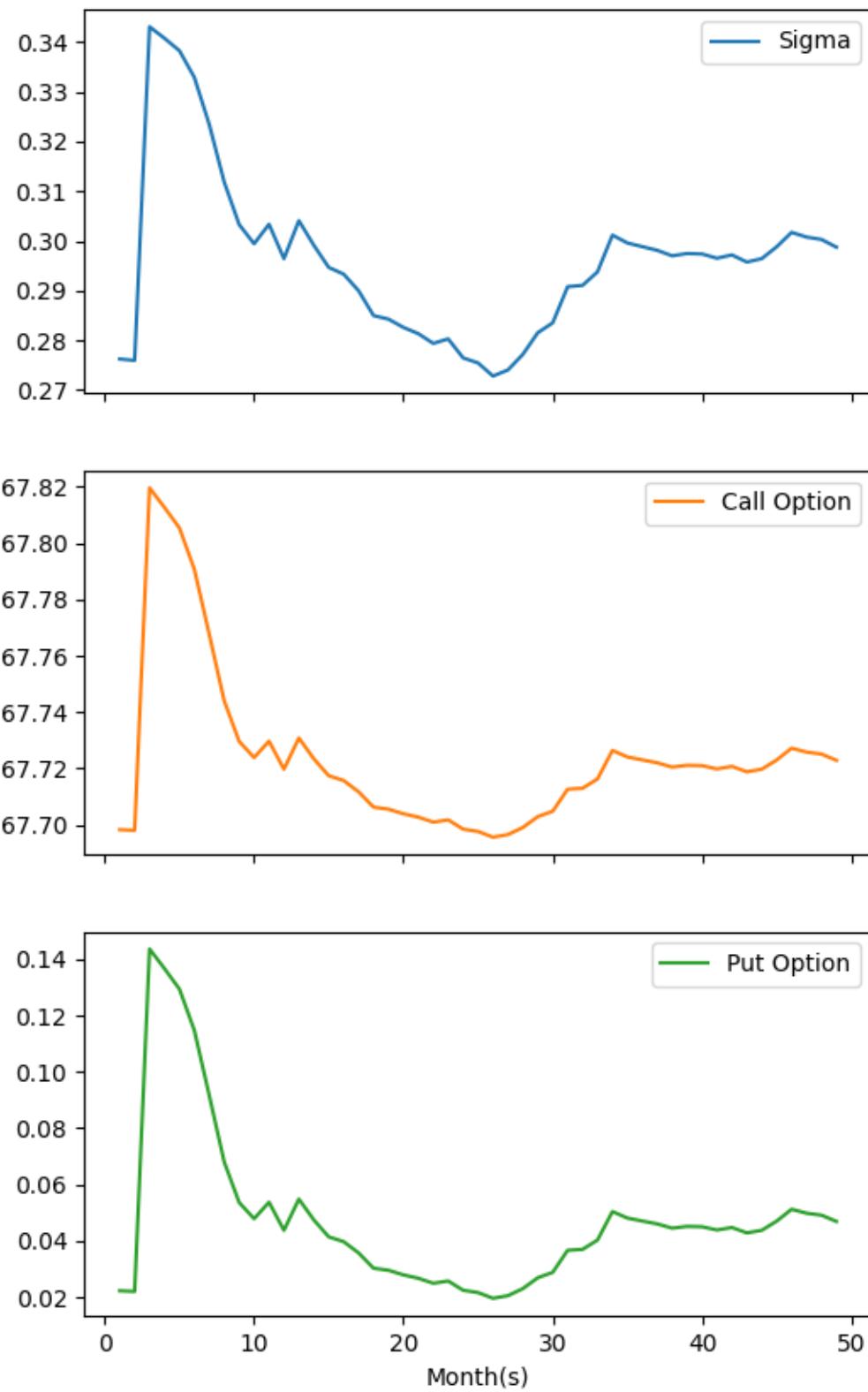
### Plot of COALINDIA (NSE) with $A = 1.5$



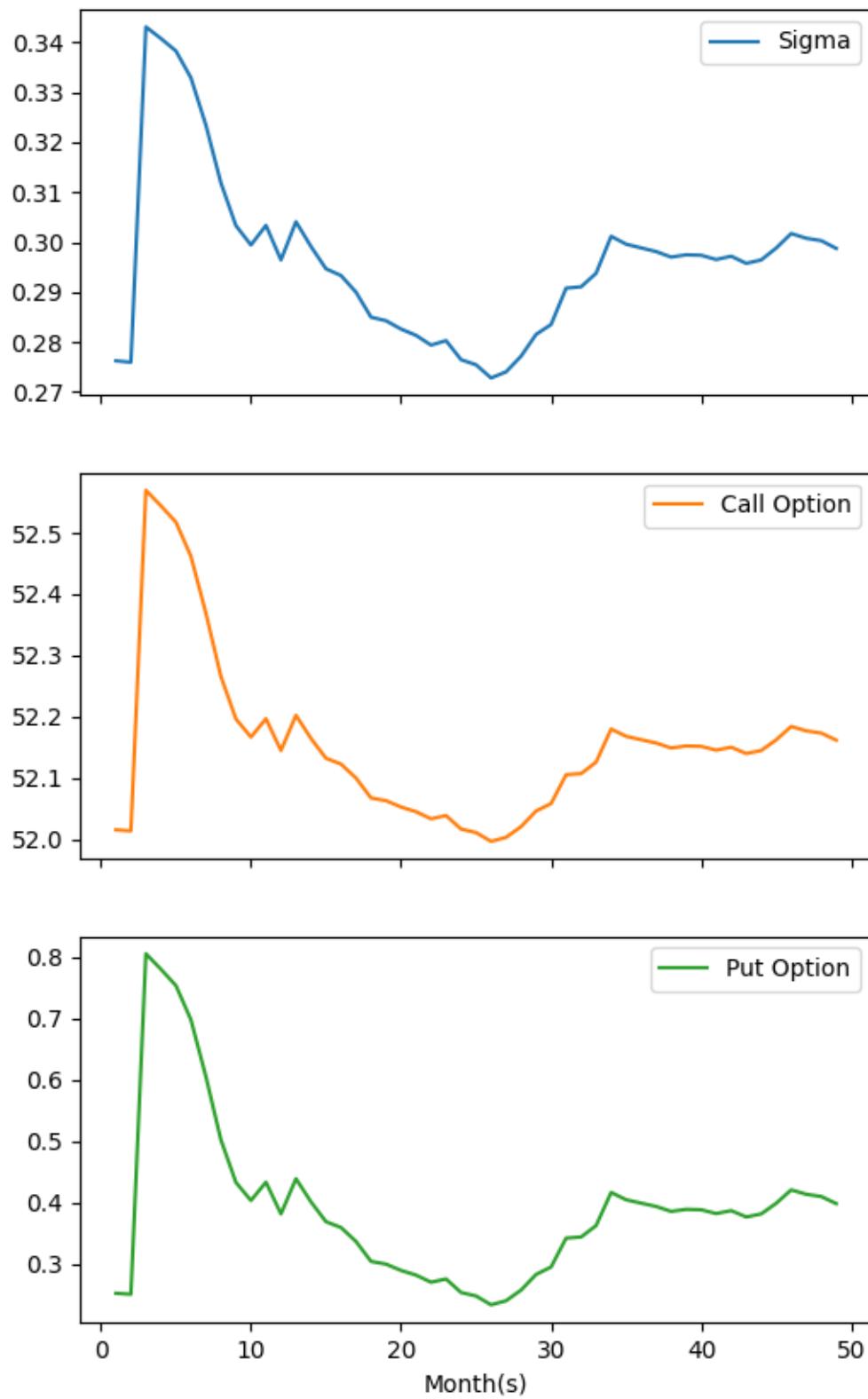
Plot of GAIL (NSE) with A = 0.5



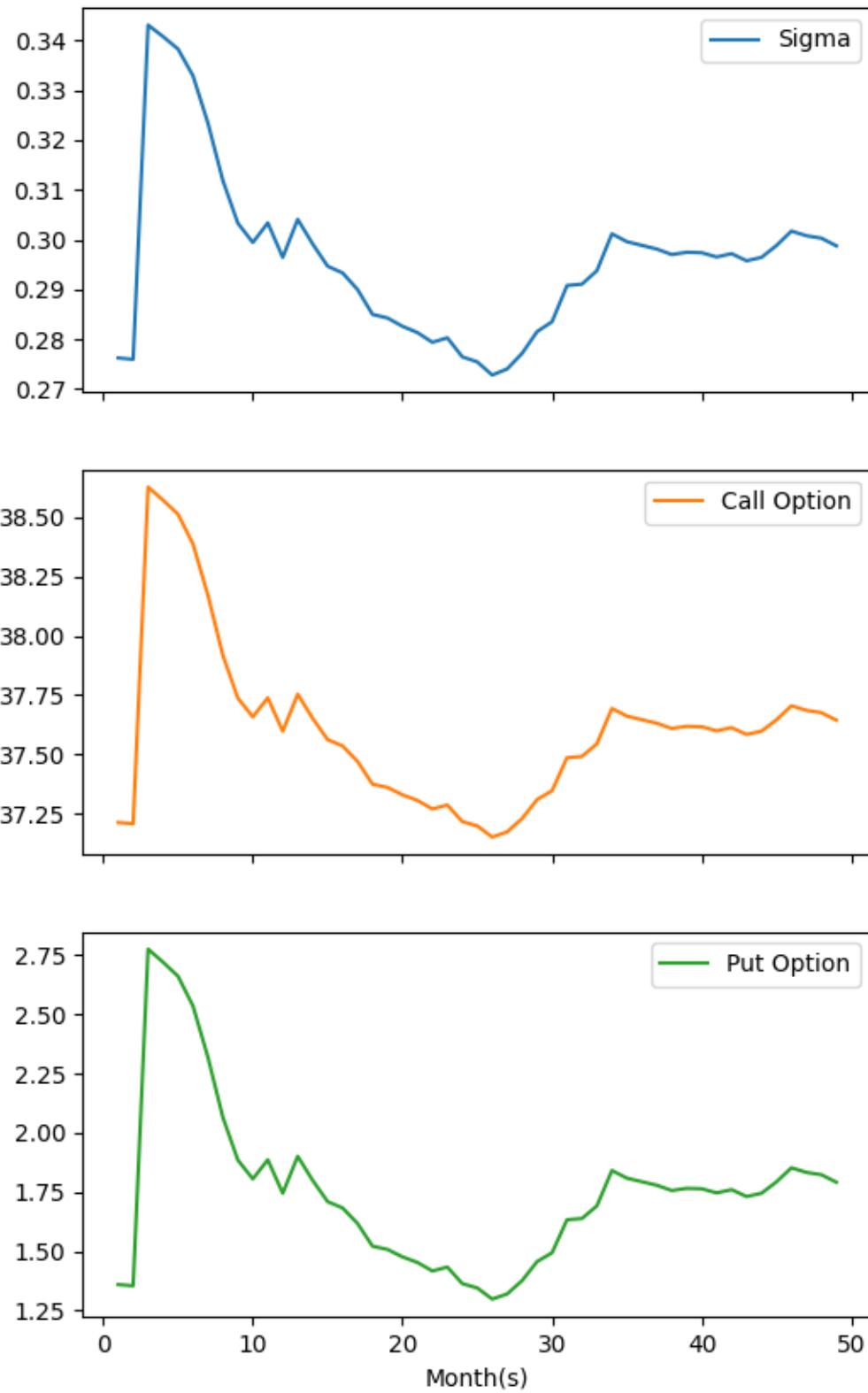
Plot of GAIL (NSE) with A = 0.6



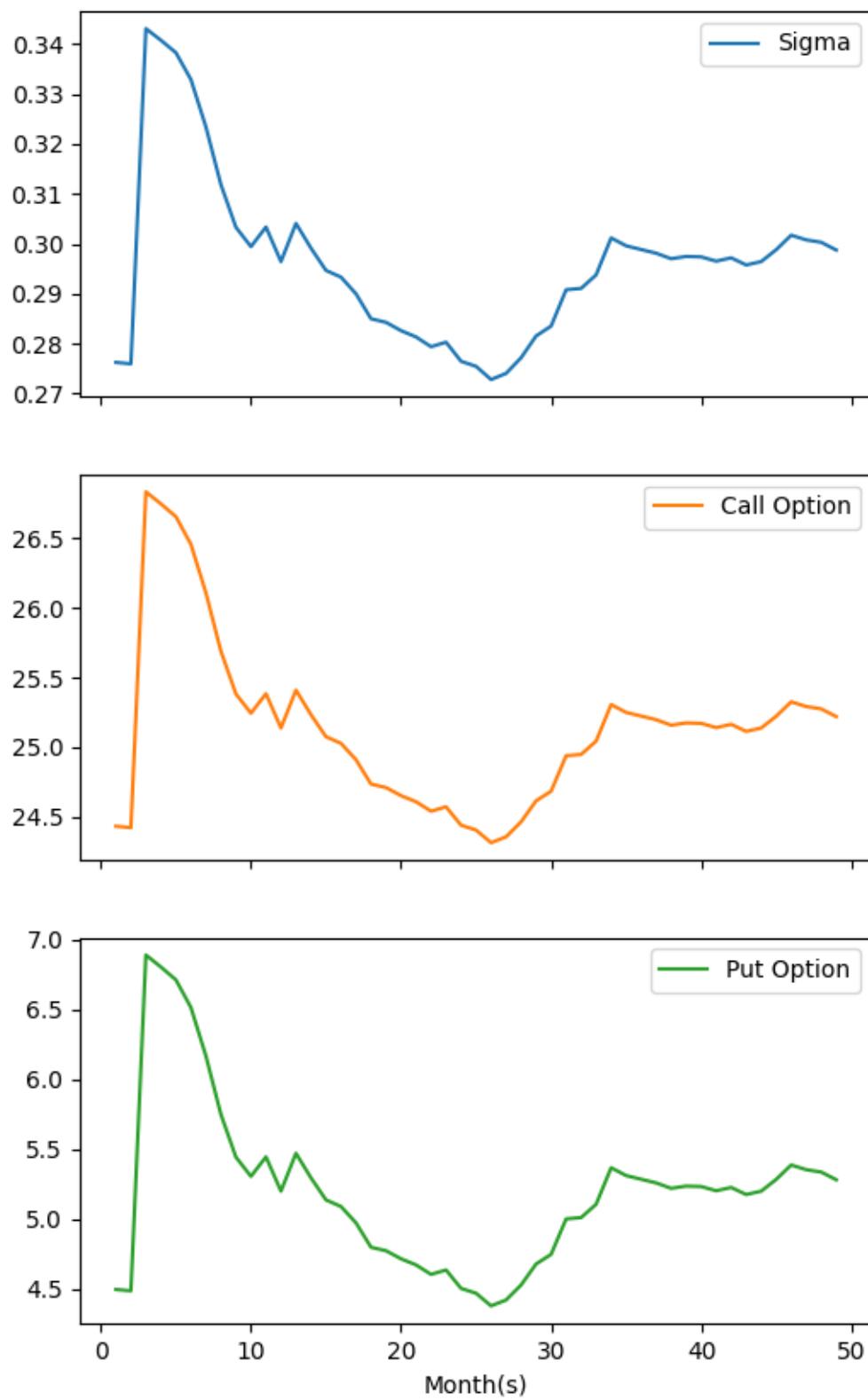
Plot of GAIL (NSE) with A = 0.7



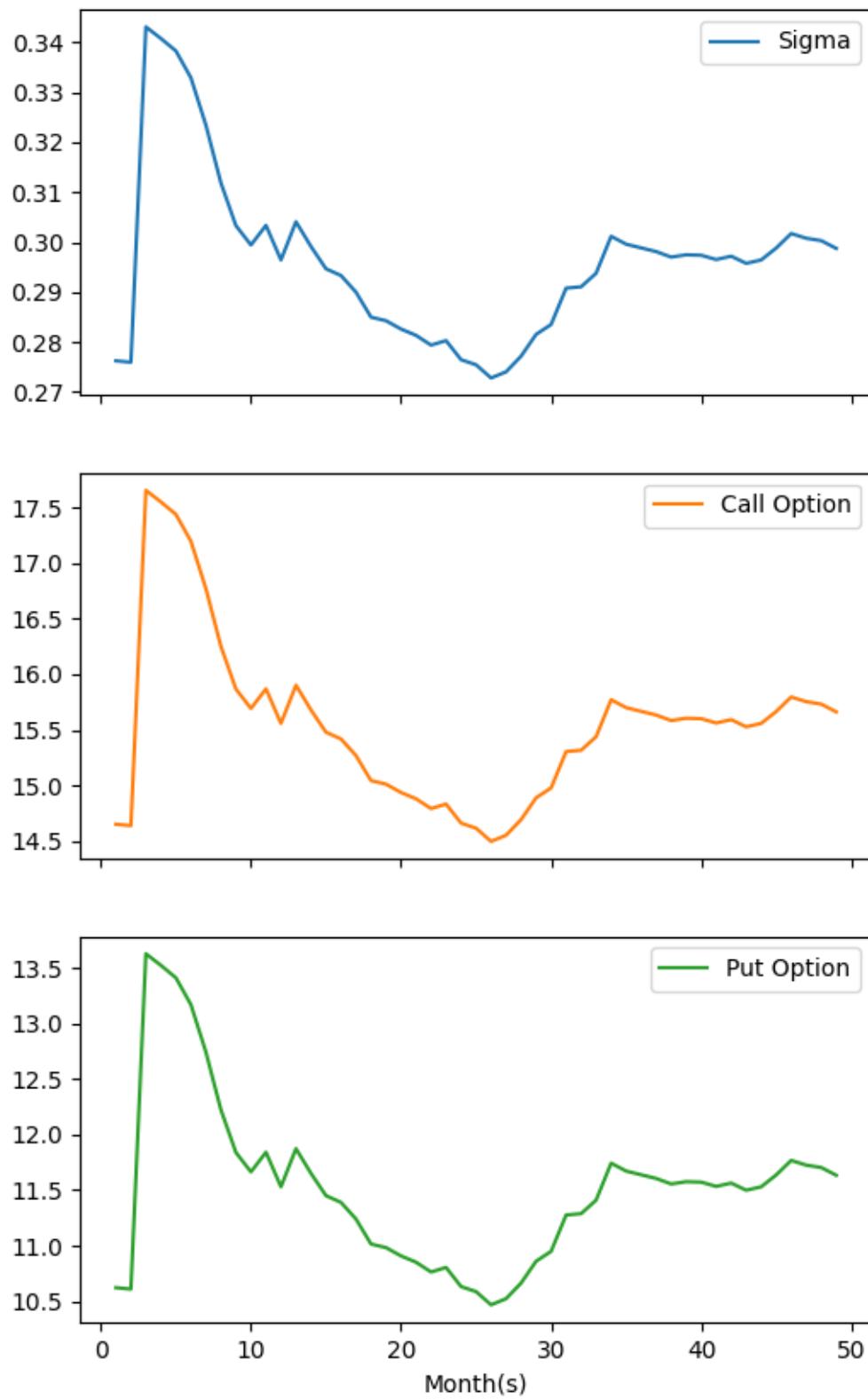
Plot of GAIL (NSE) with A = 0.8



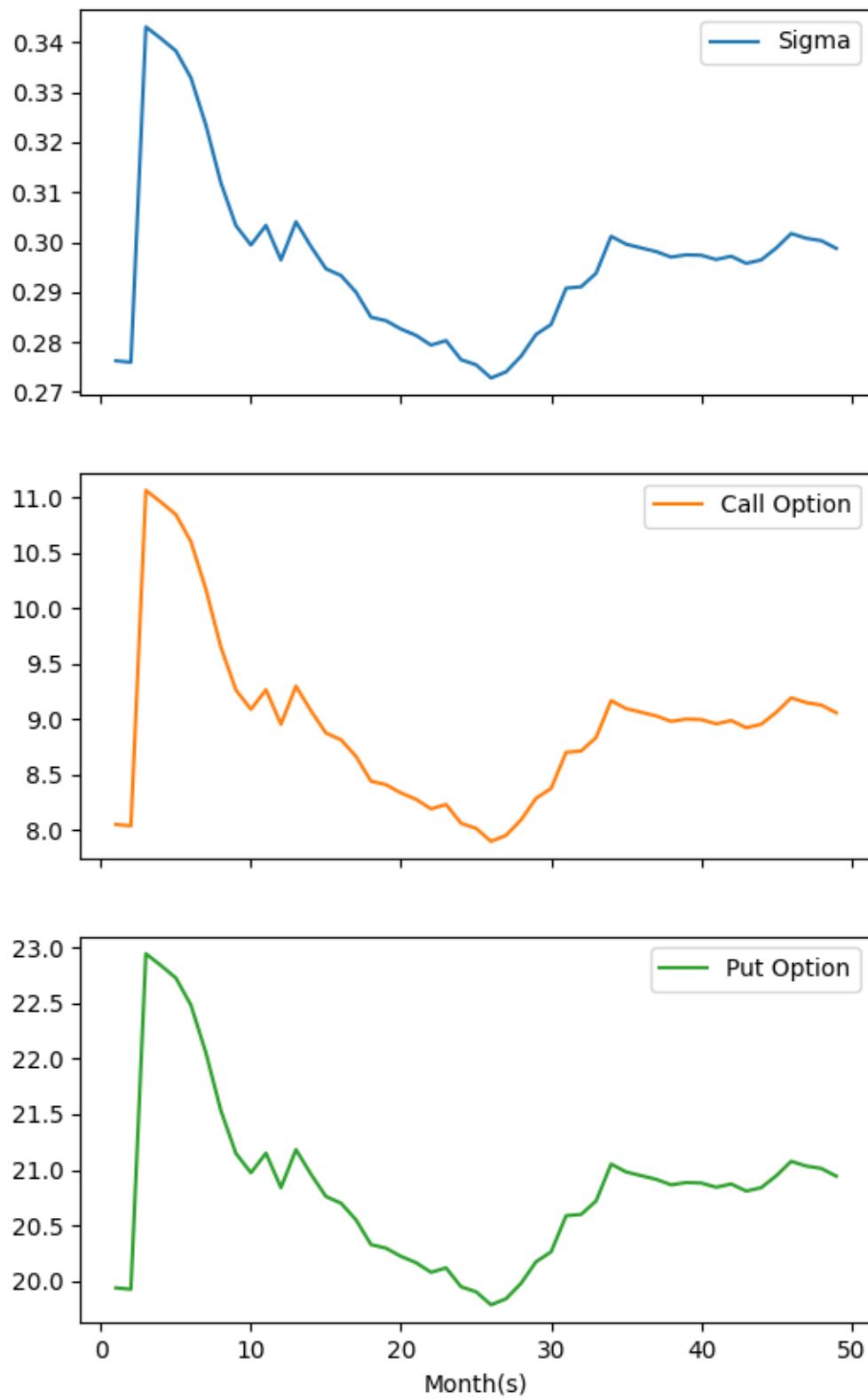
Plot of GAIL (NSE) with A = 0.9



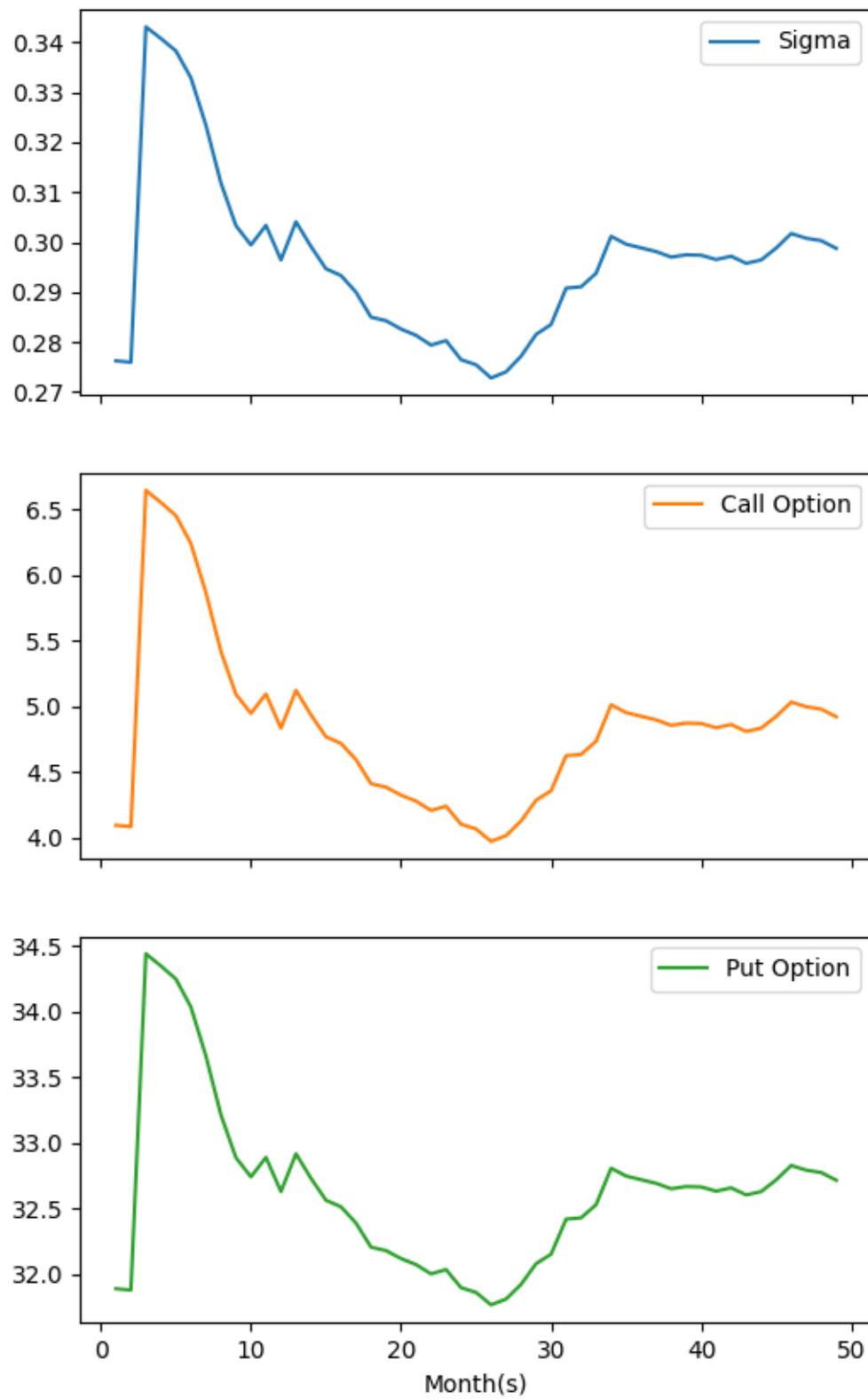
Plot of GAIL (NSE) with A = 1.0



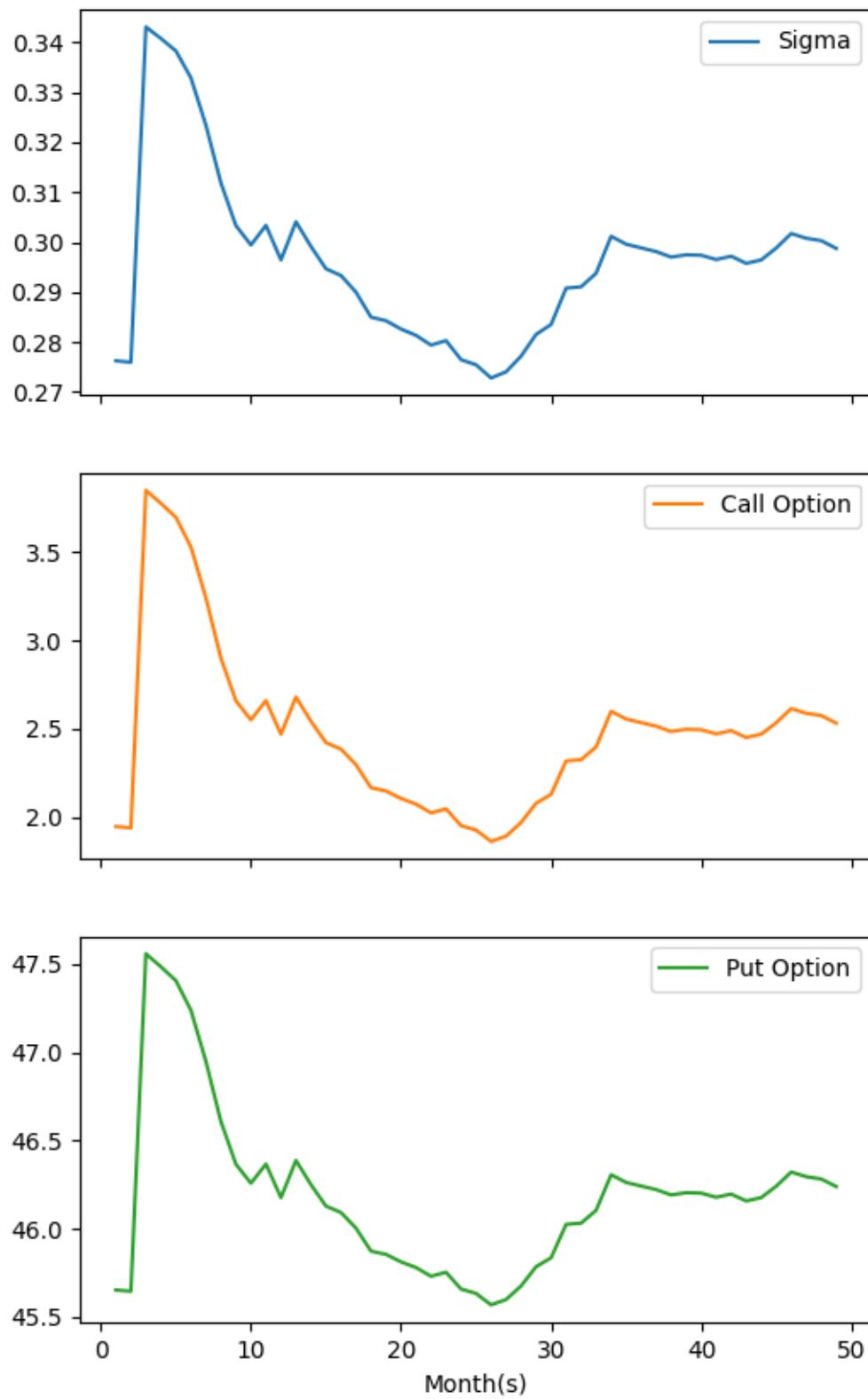
Plot of GAIL (NSE) with A = 1.1



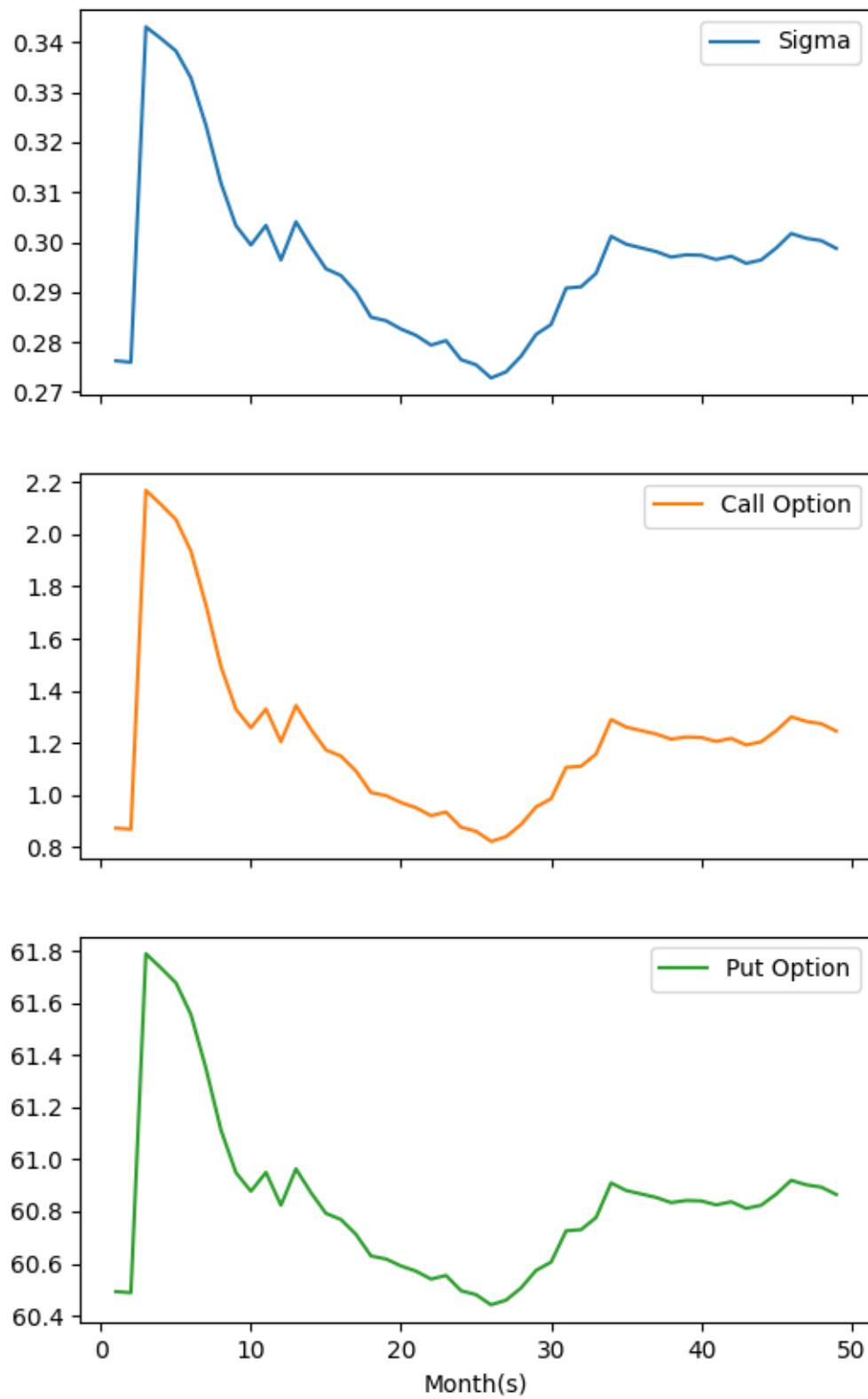
Plot of GAIL (NSE) with A = 1.2



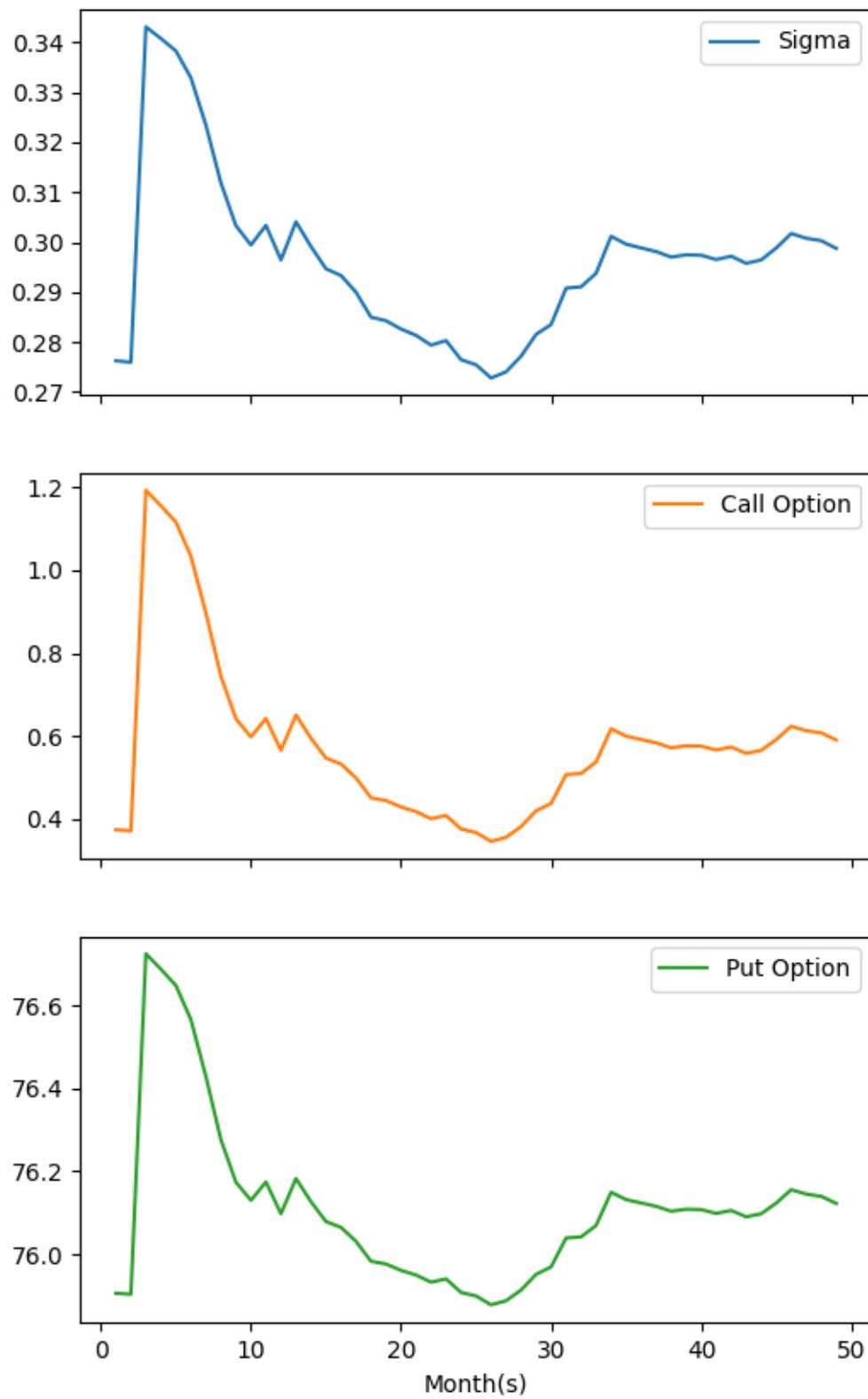
Plot of GAIL (NSE) with A = 1.3



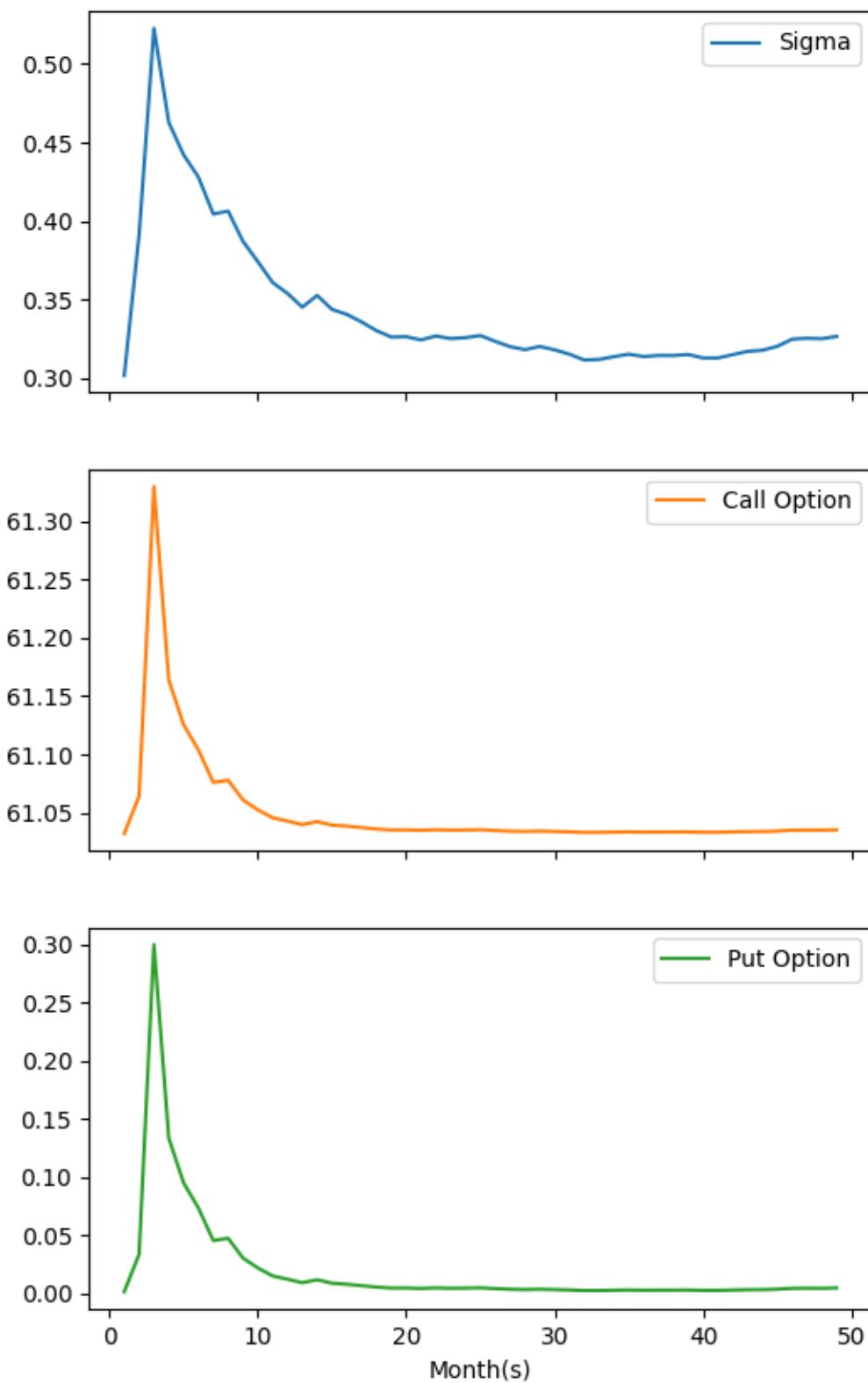
Plot of GAIL (NSE) with A = 1.4



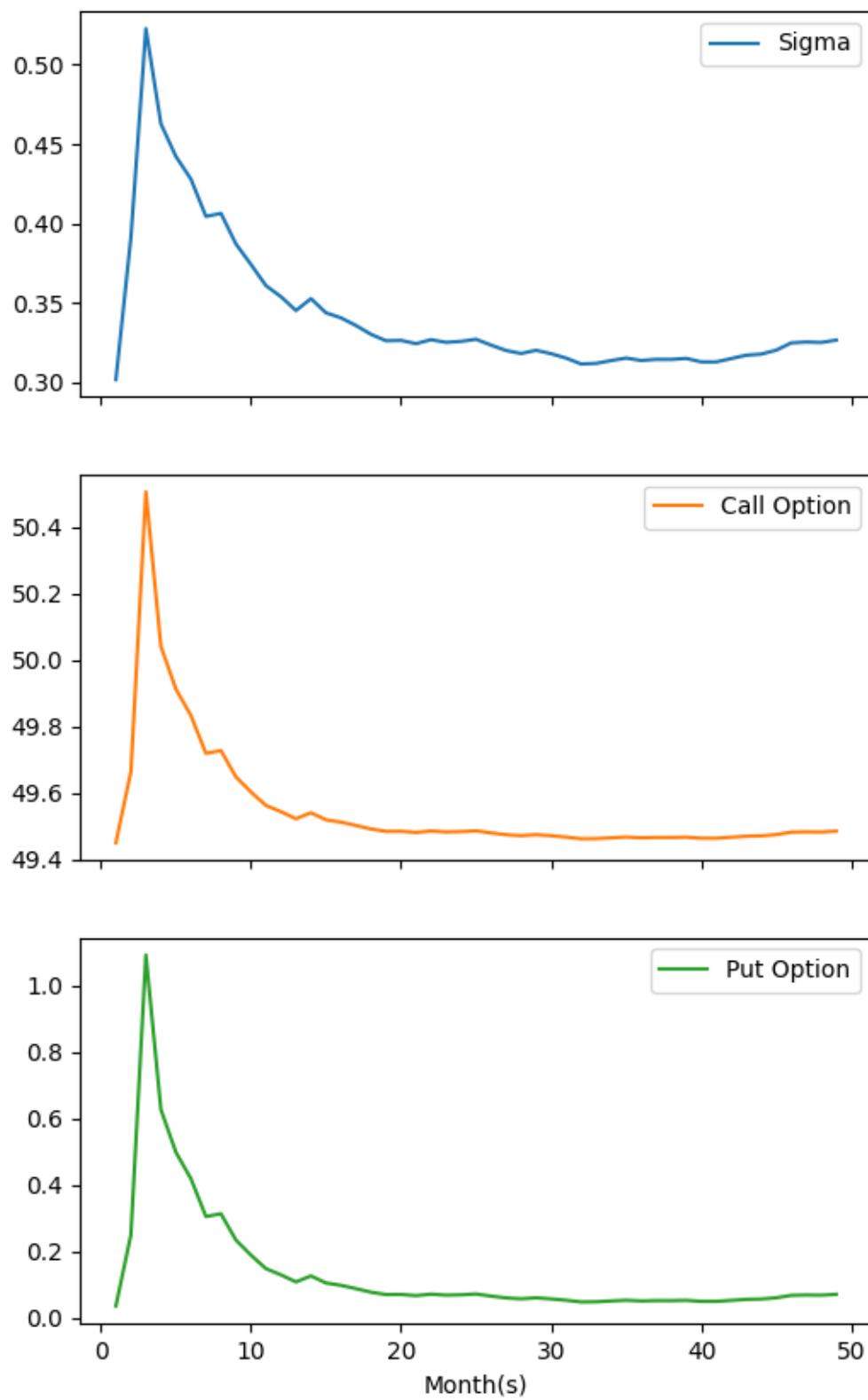
Plot of GAIL (NSE) with A = 1.5



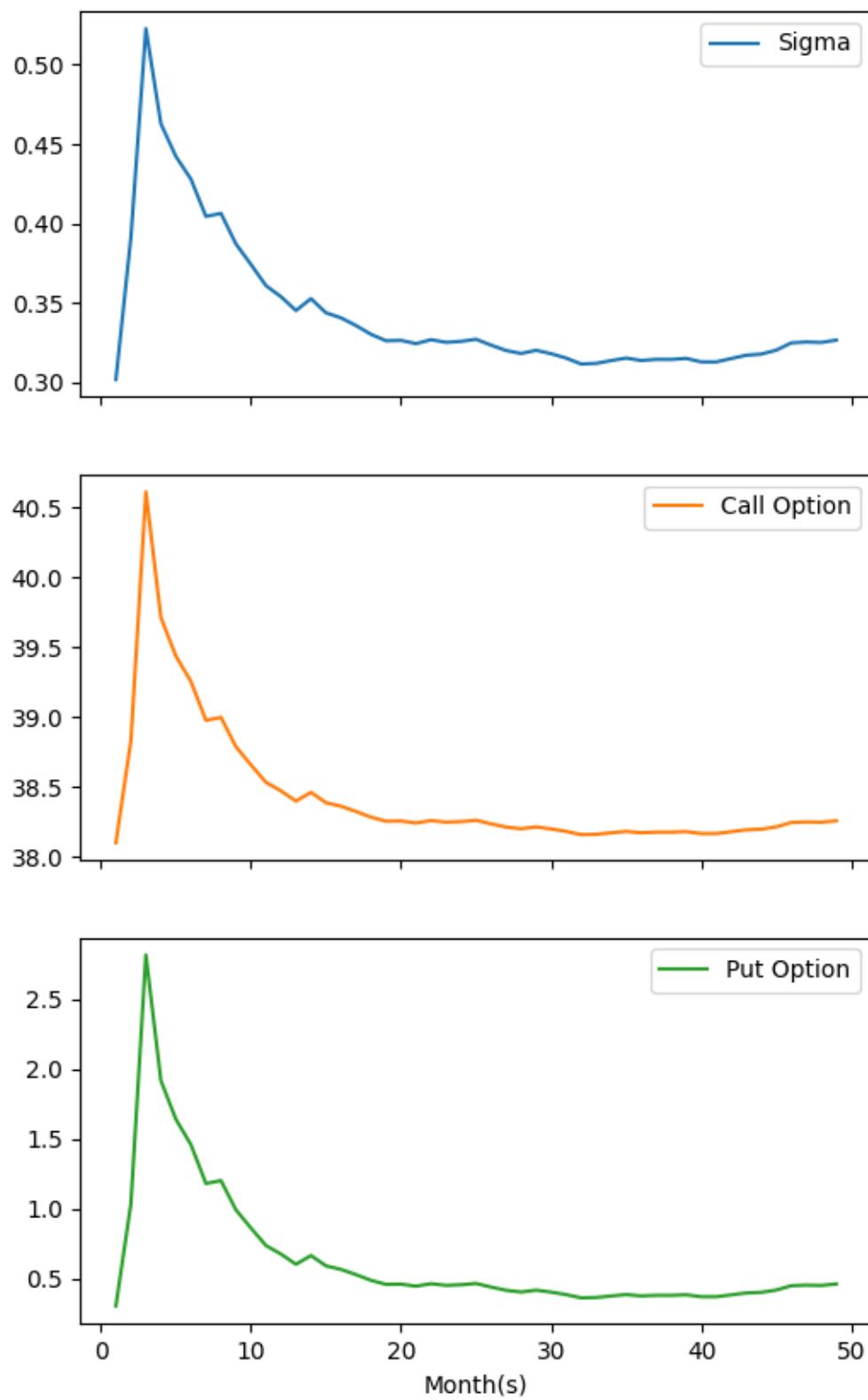
Plot of IOC (NSE) with A = 0.5



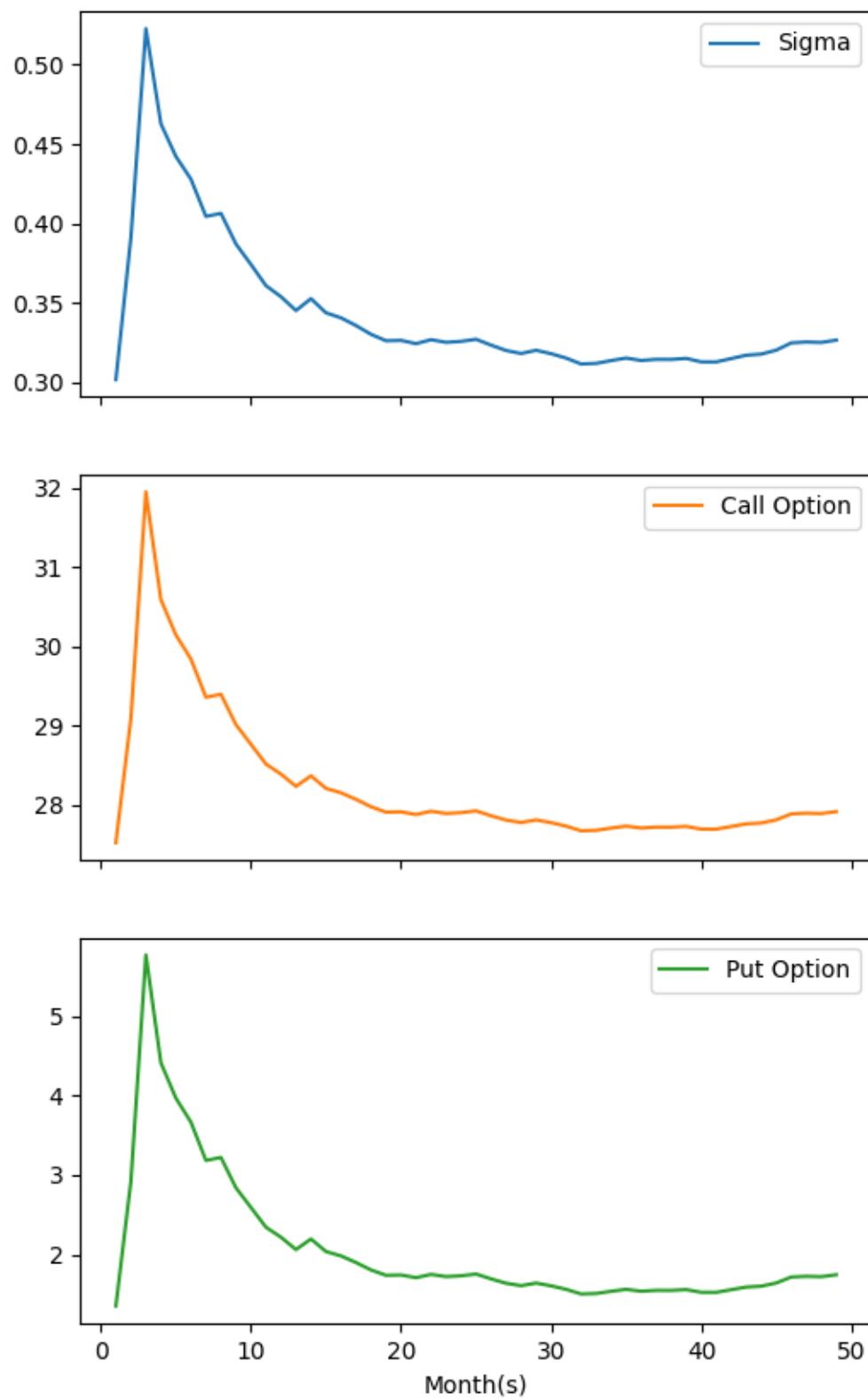
### Plot of IOC (NSE) with A = 0.6



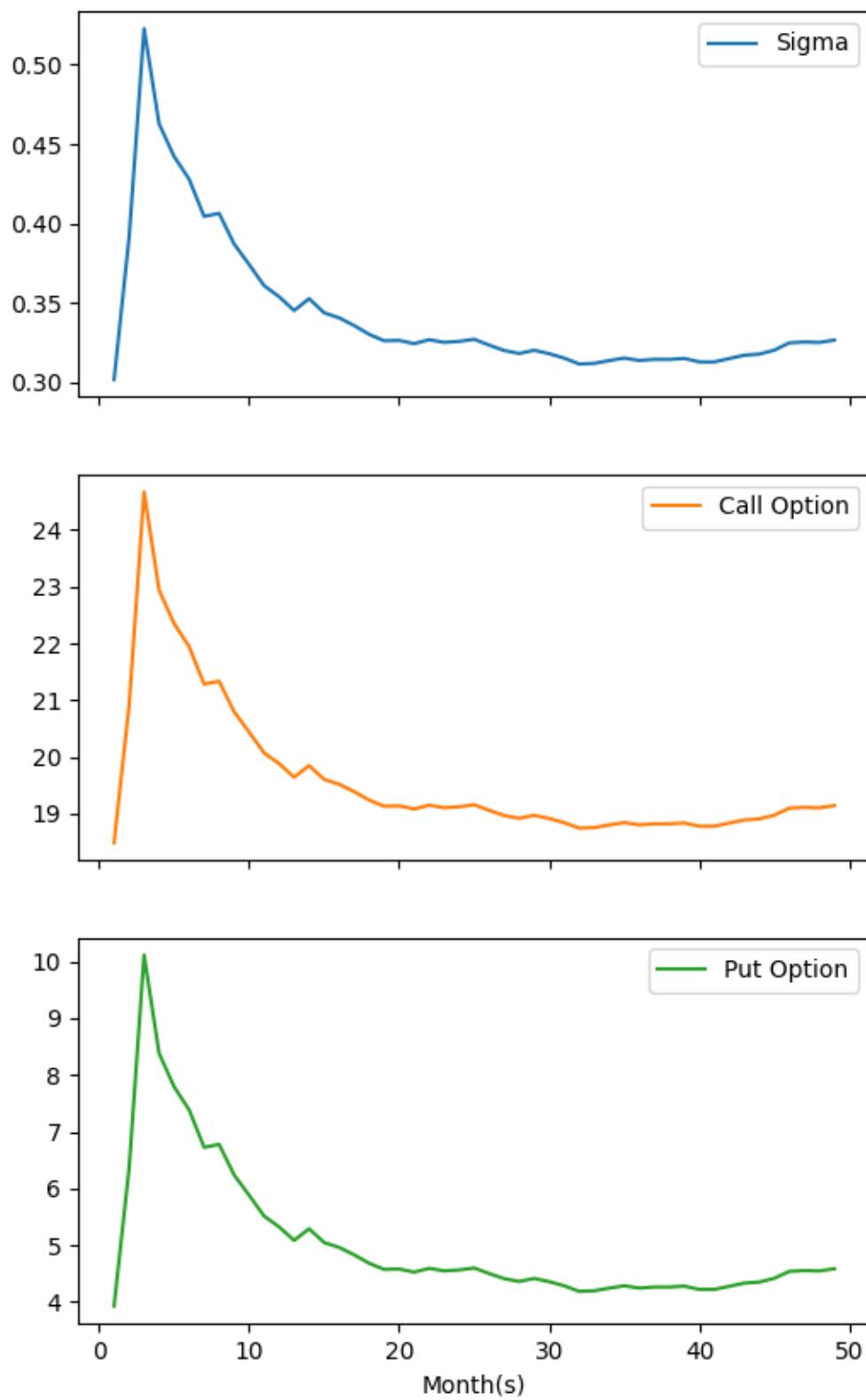
Plot of IOC (NSE) with A = 0.7



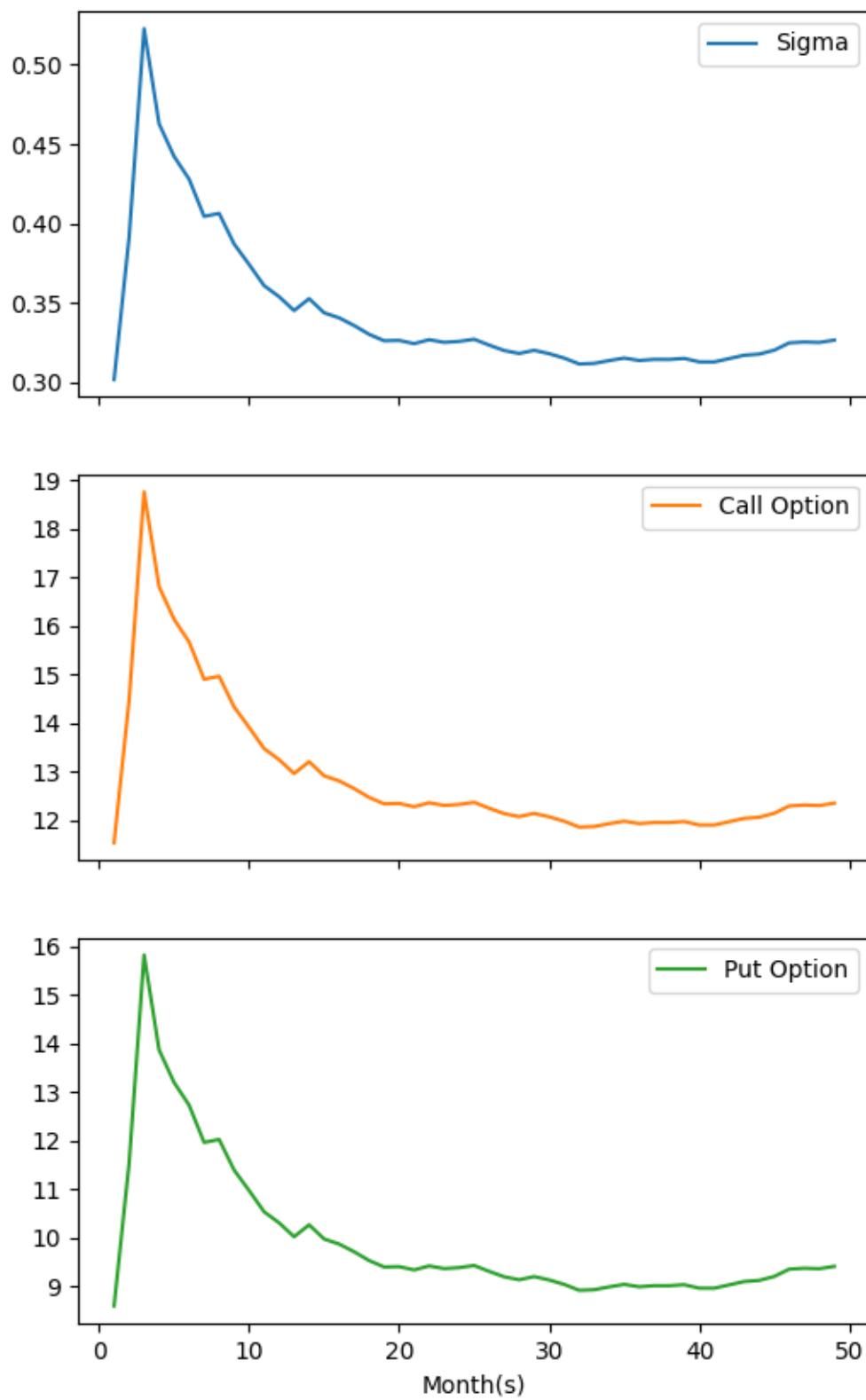
Plot of IOC (NSE) with A = 0.8



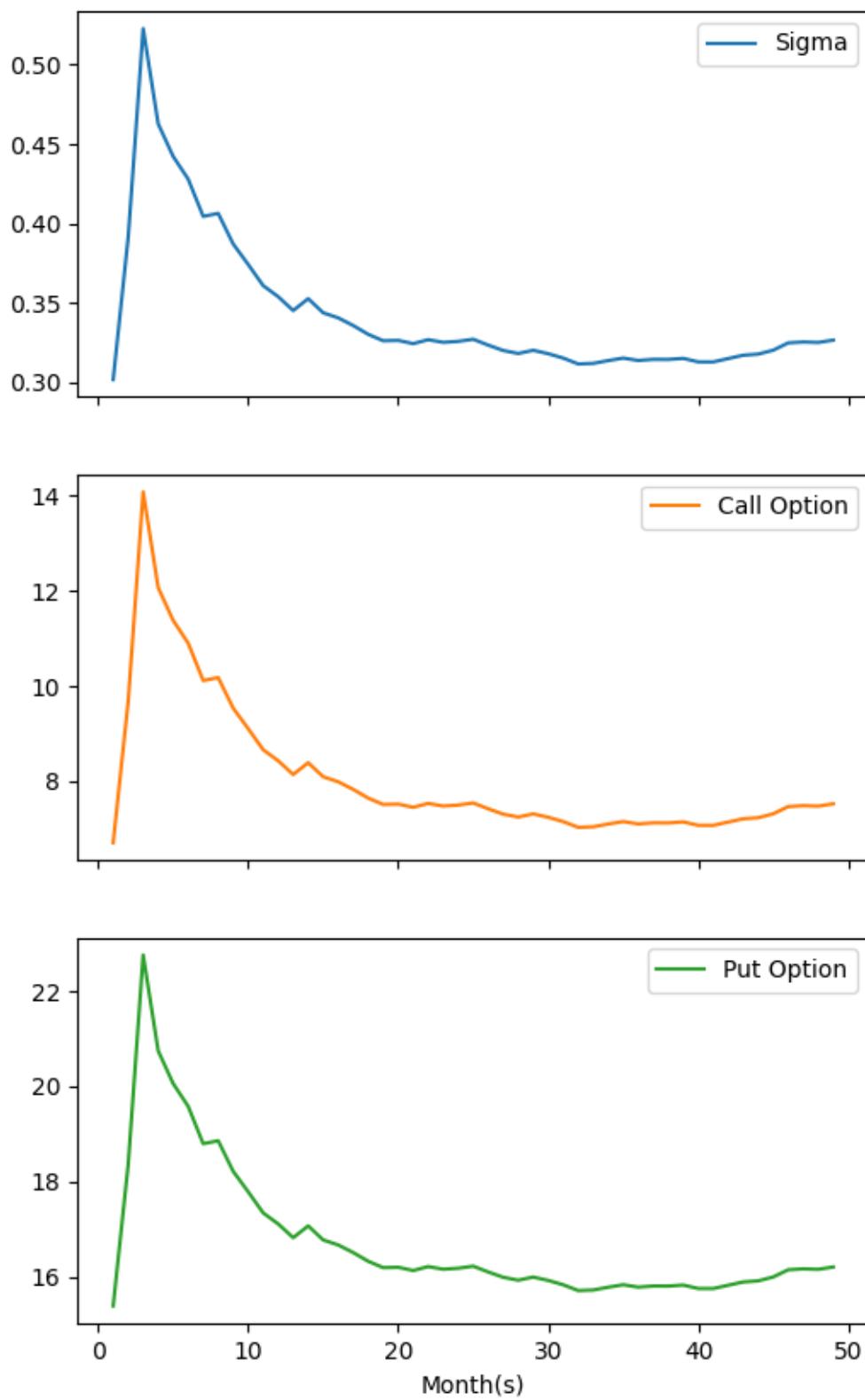
Plot of IOC (NSE) with A = 0.9



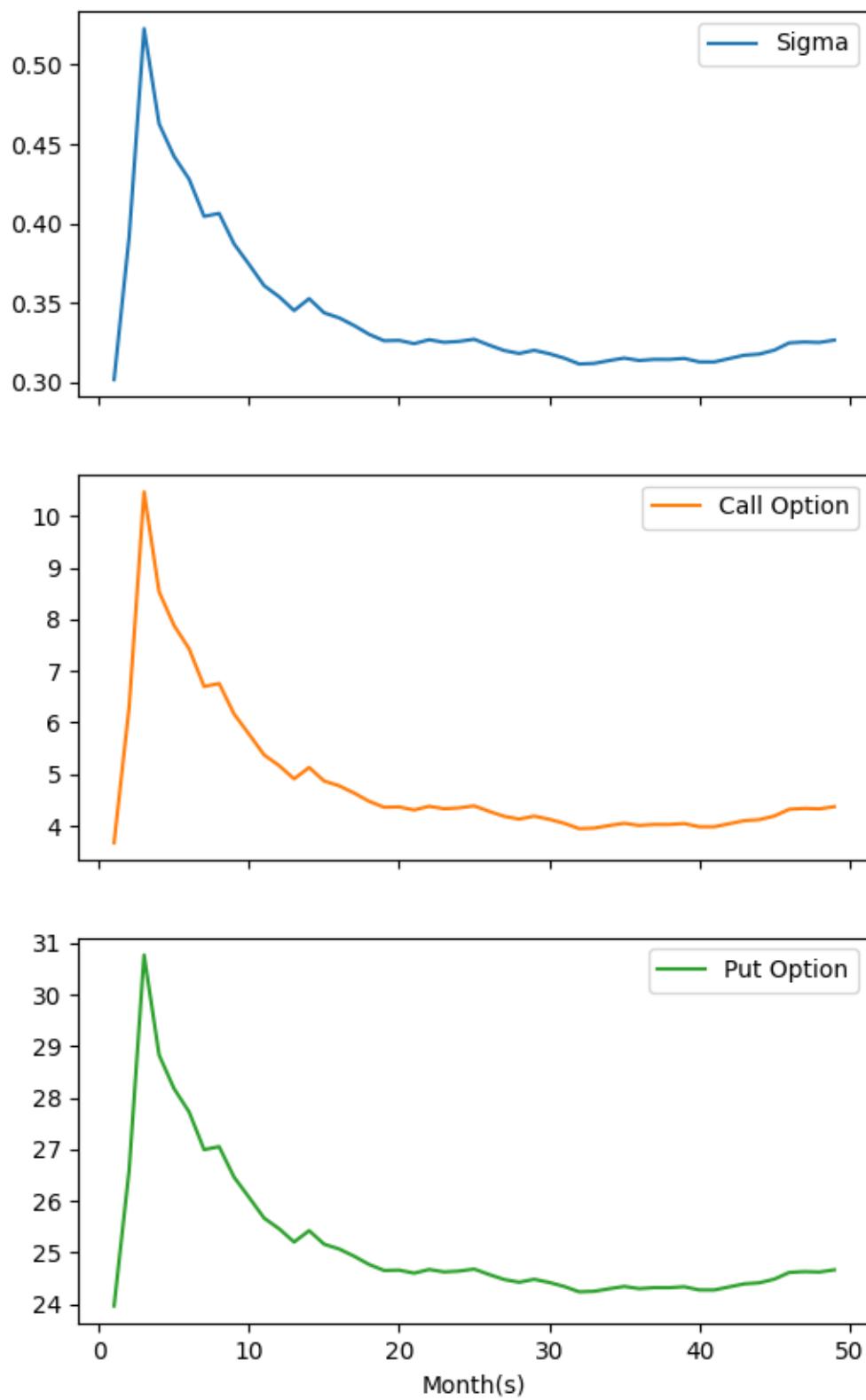
### Plot of IOC (NSE) with A = 1.0



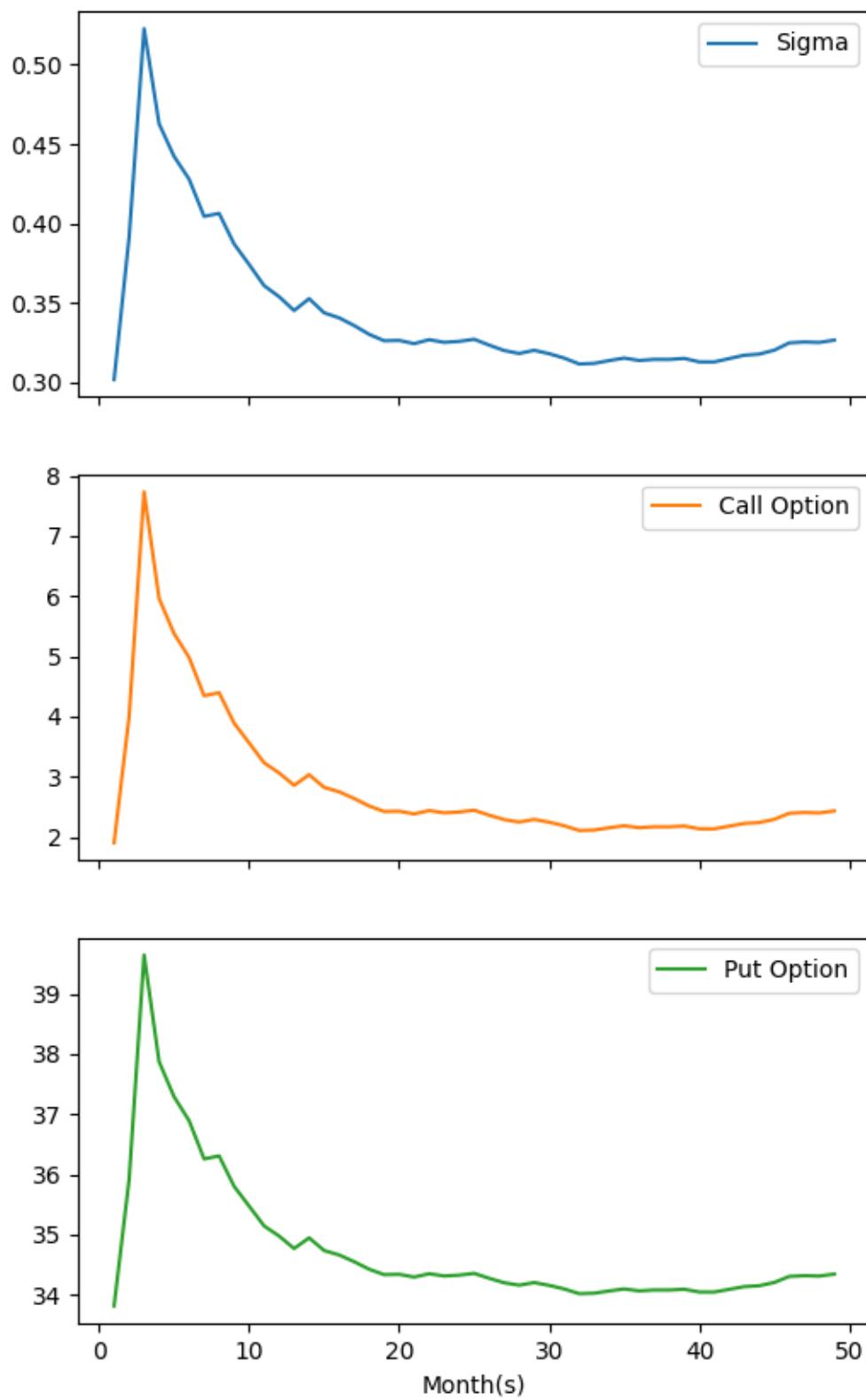
Plot of IOC (NSE) with  $A = 1.1$



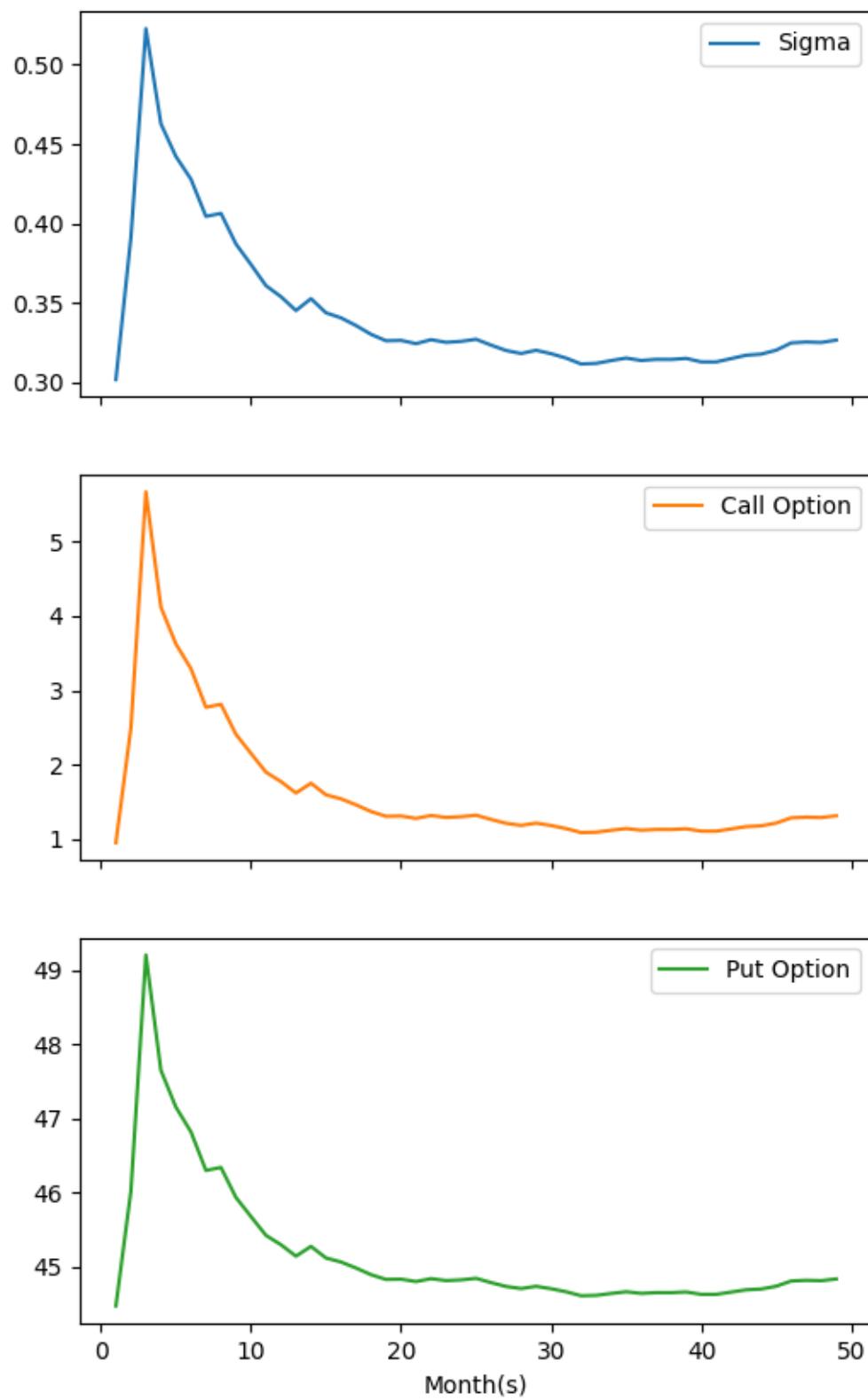
Plot of IOC (NSE) with  $A = 1.2$



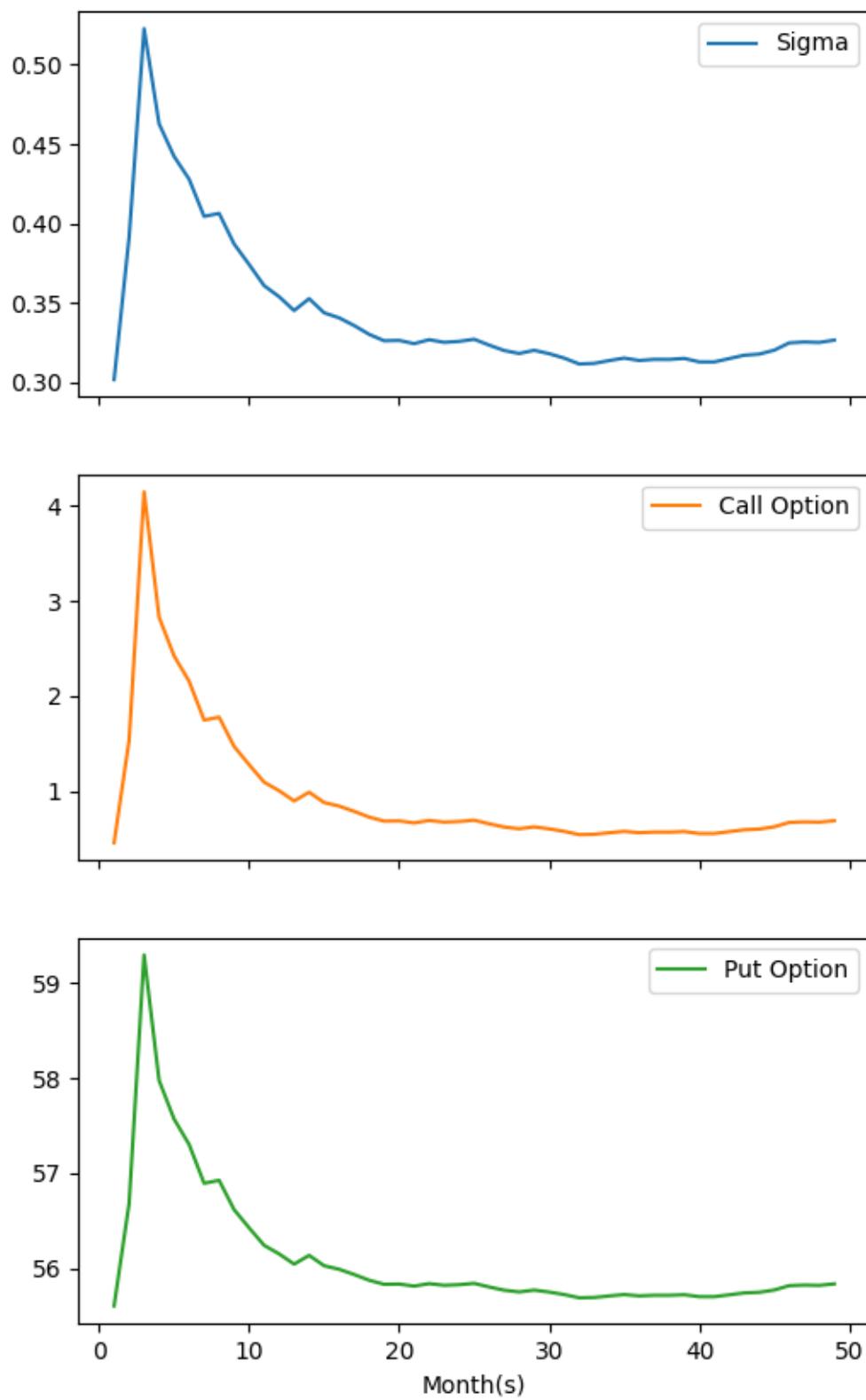
Plot of IOC (NSE) with  $A = 1.3$



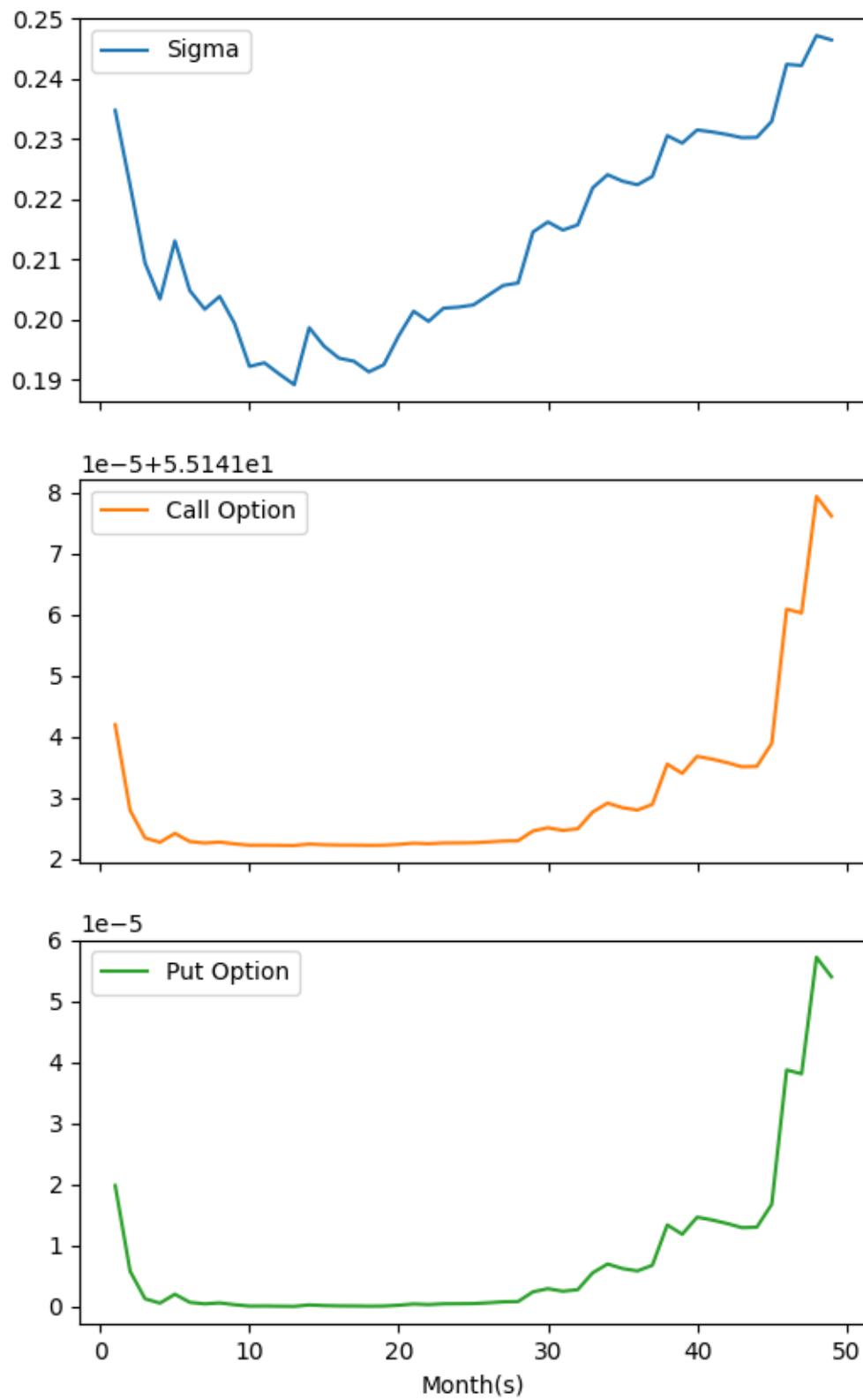
Plot of IOC (NSE) with  $A = 1.4$



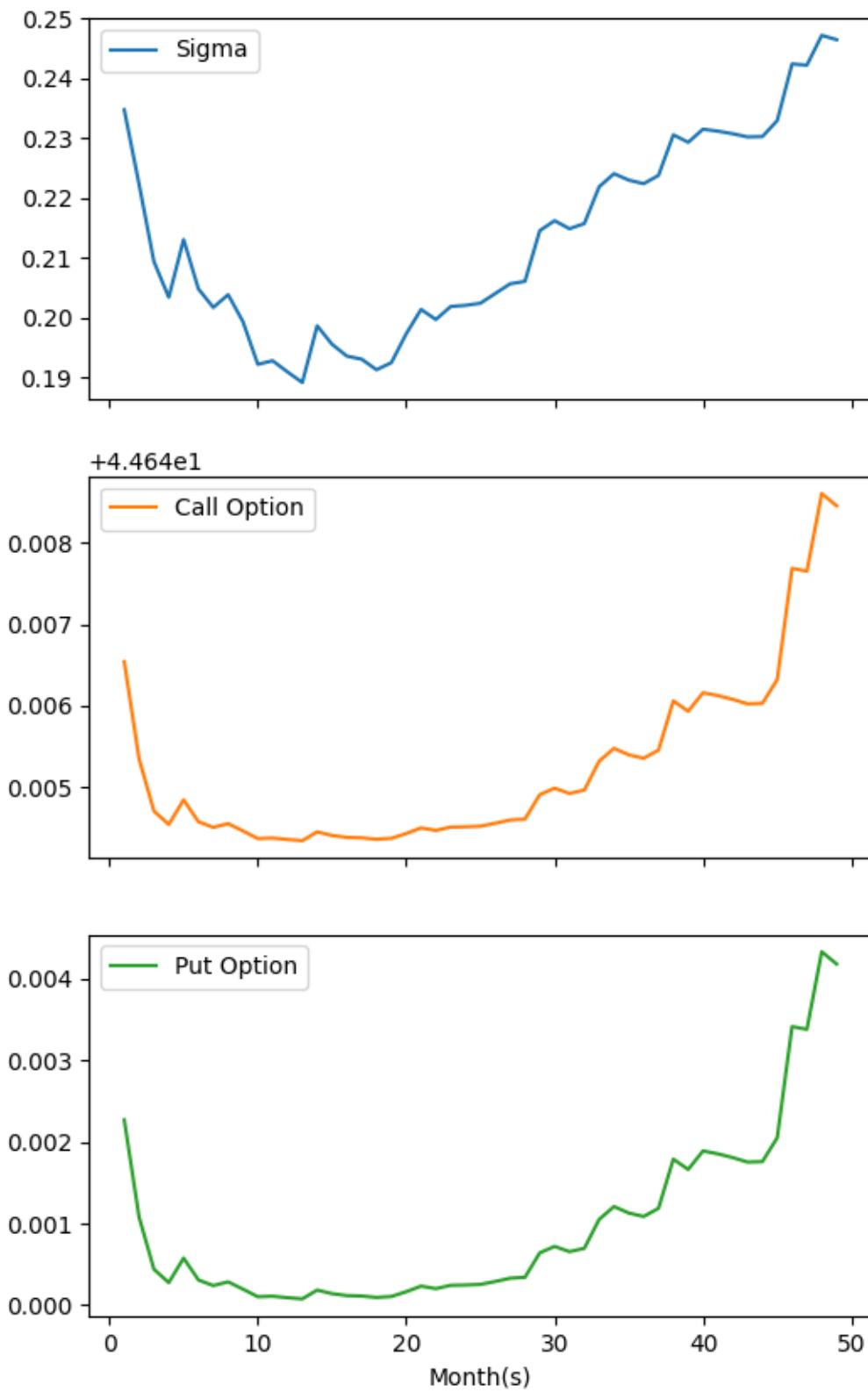
Plot of IOC (NSE) with  $A = 1.5$



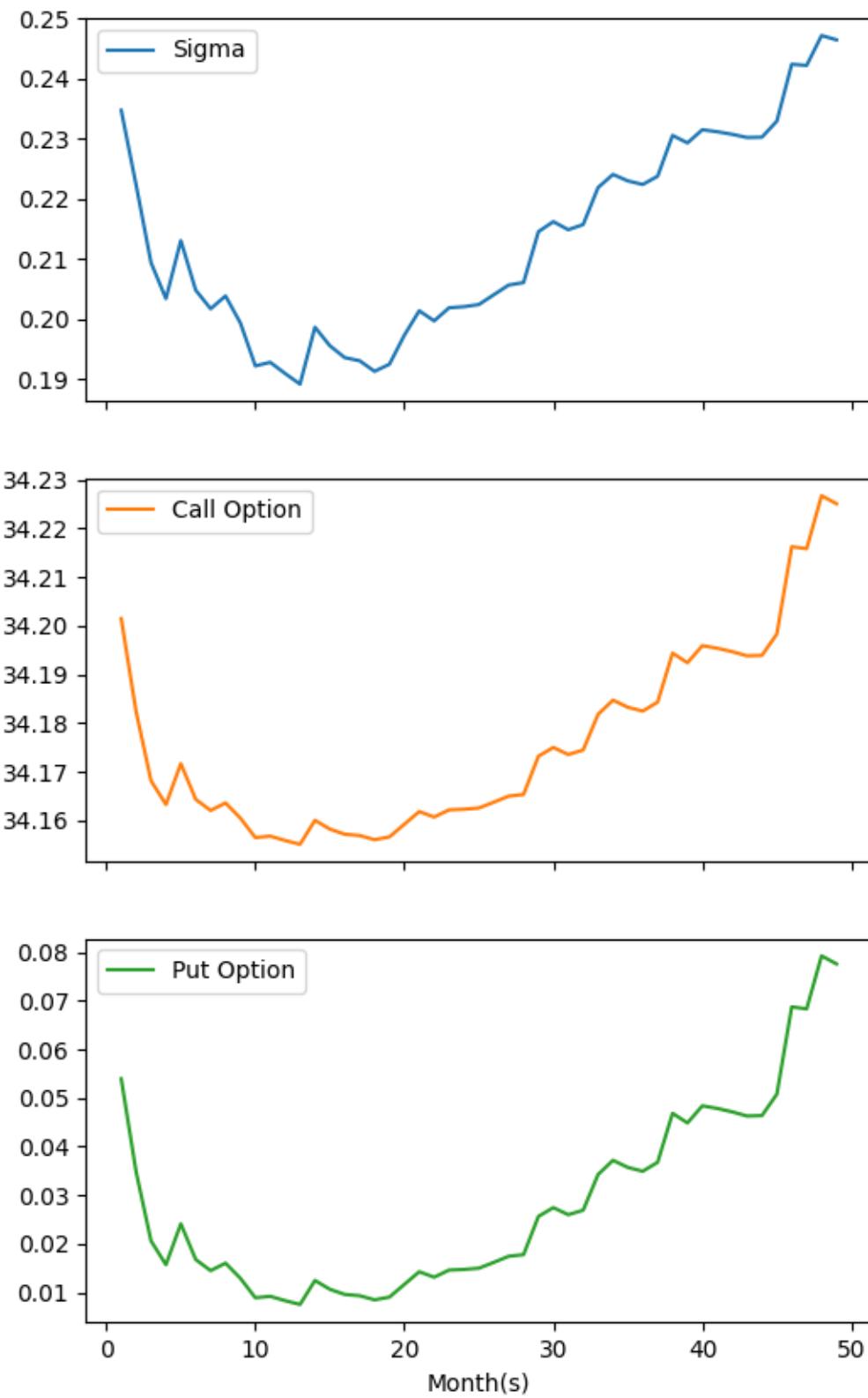
Plot of NTPC (NSE) with A = 0.5



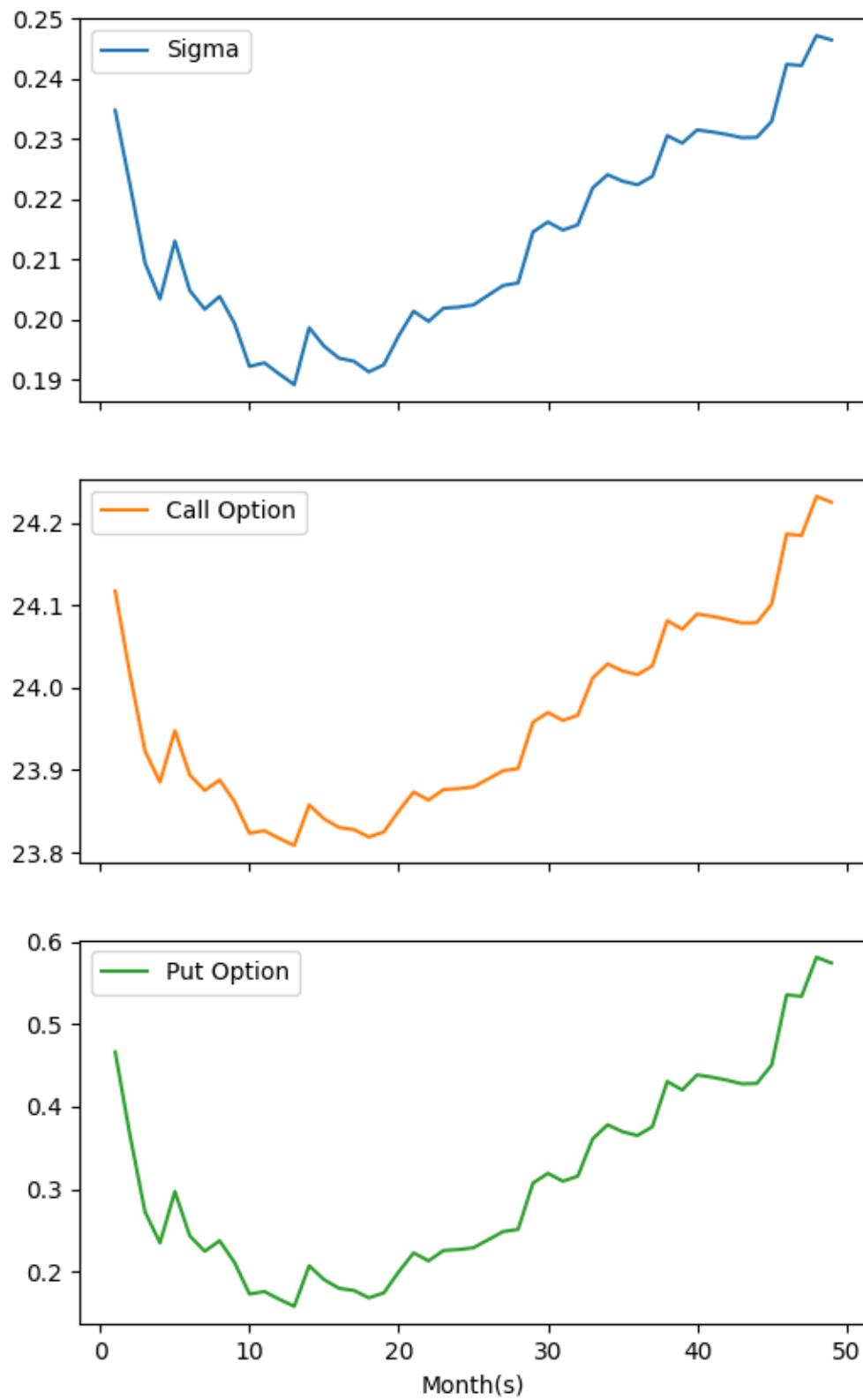
### Plot of NTPC (NSE) with A = 0.6



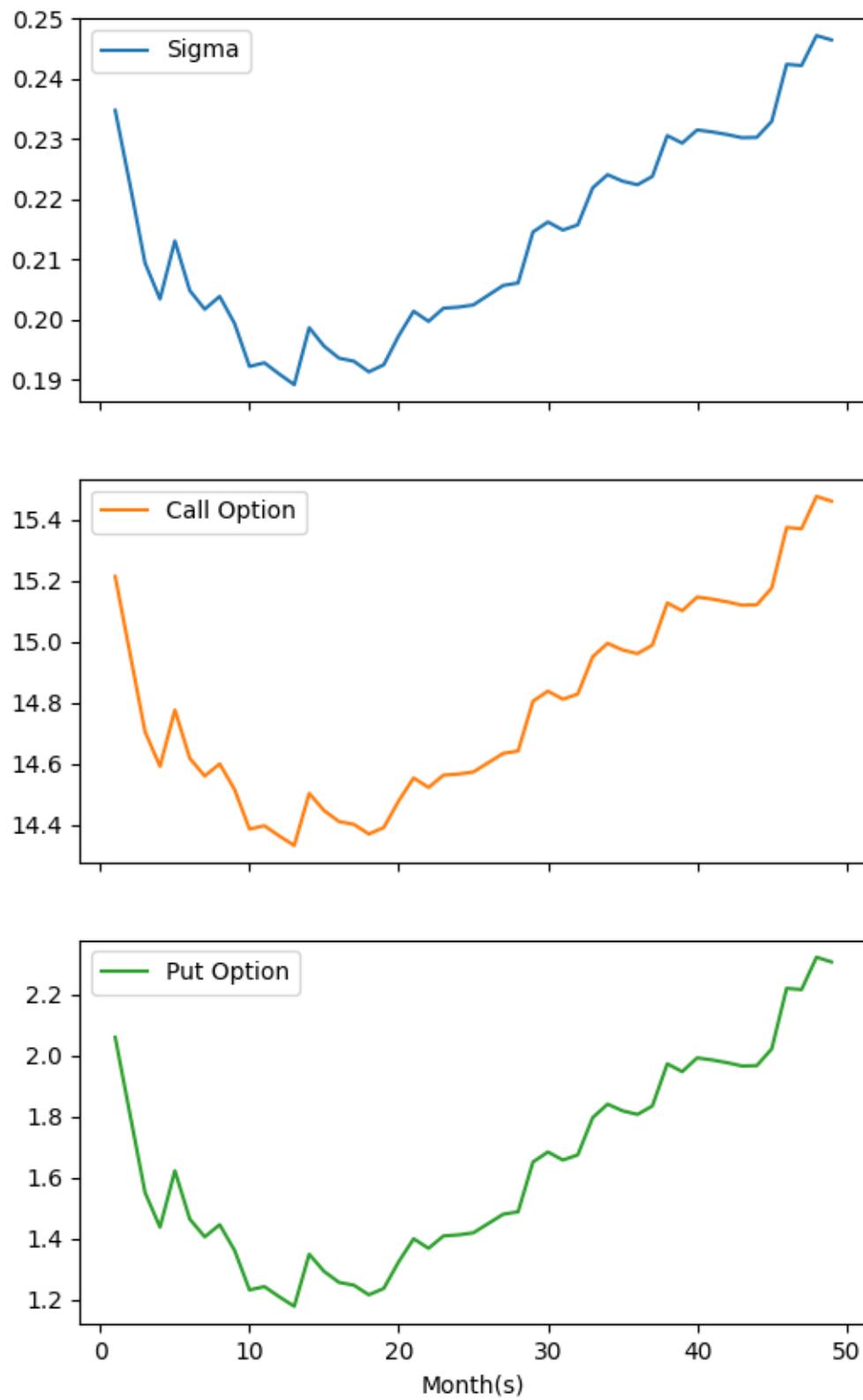
Plot of NTPC (NSE) with A = 0.7



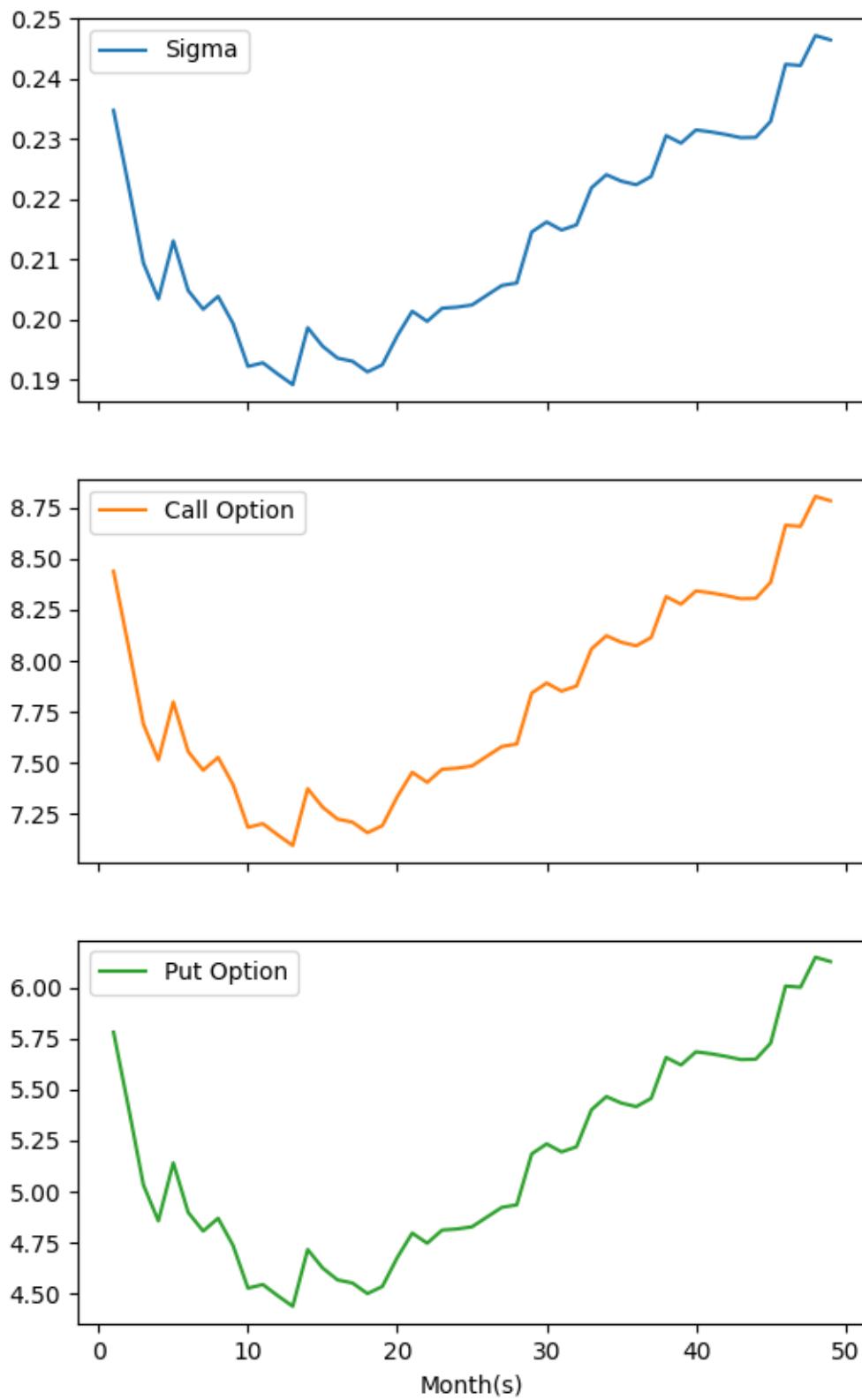
Plot of NTPC (NSE) with  $A = 0.8$



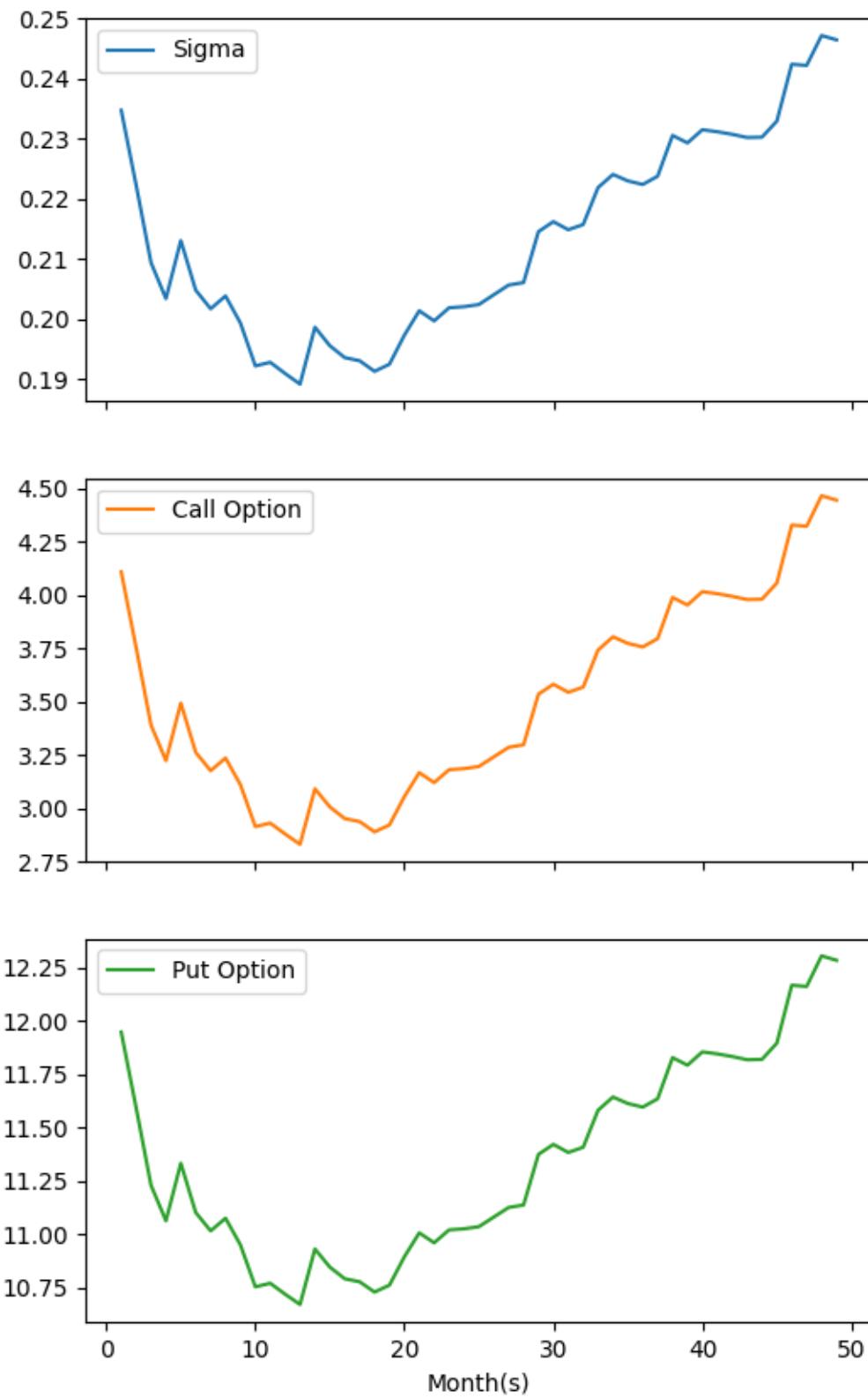
Plot of NTPC (NSE) with A = 0.9



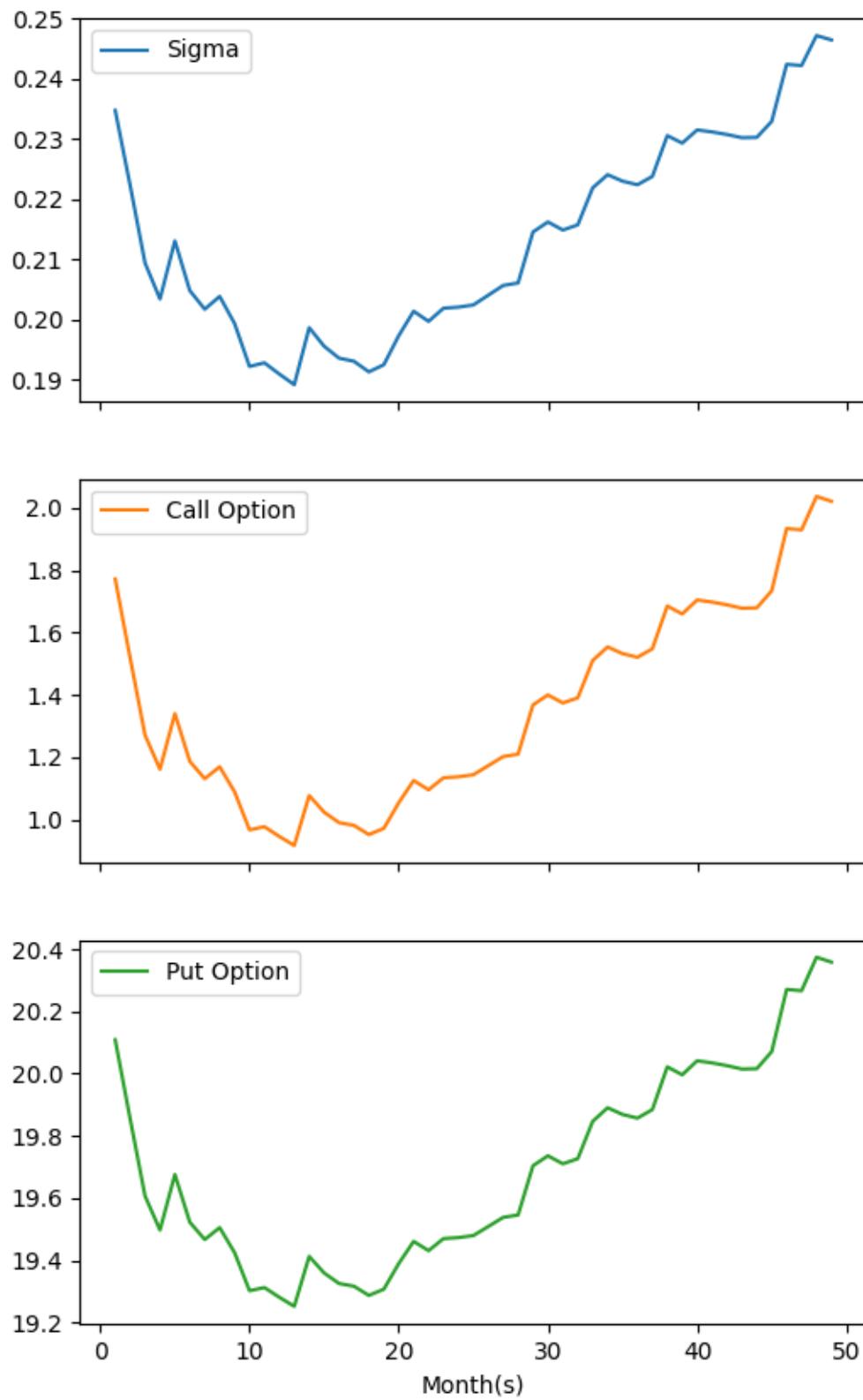
### Plot of NTPC (NSE) with A = 1.0



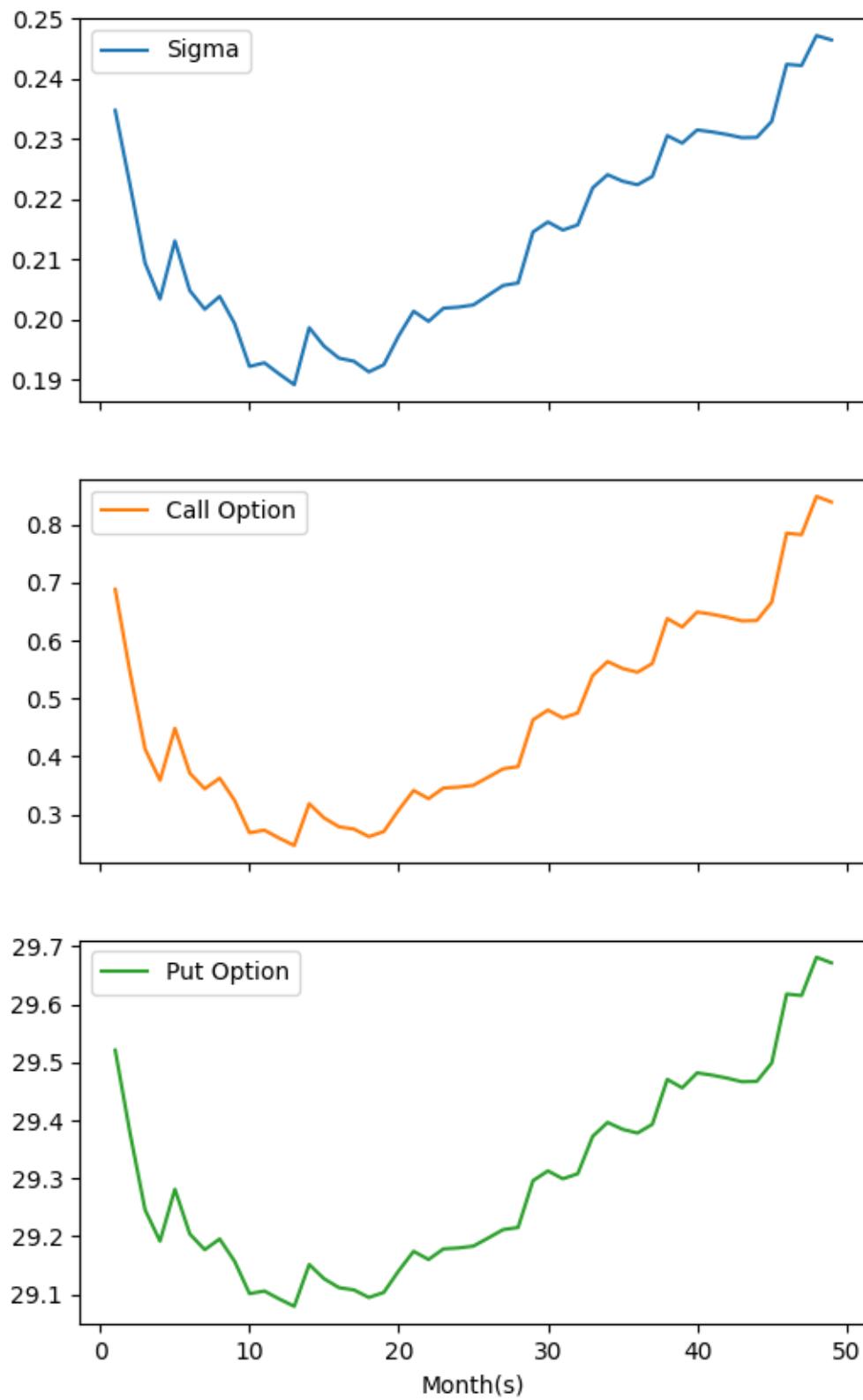
Plot of NTPC (NSE) with A = 1.1



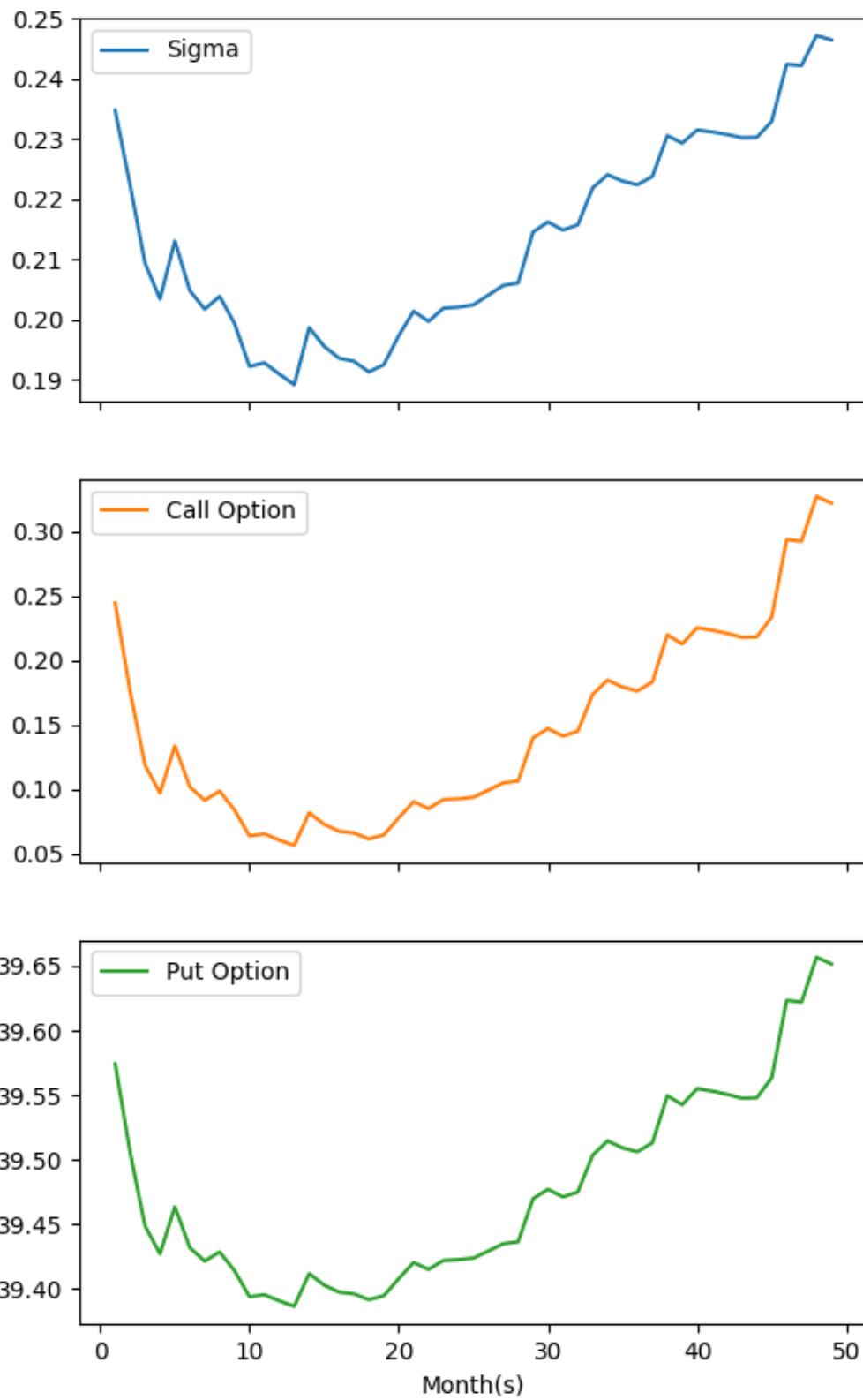
Plot of NTPC (NSE) with  $A = 1.2$



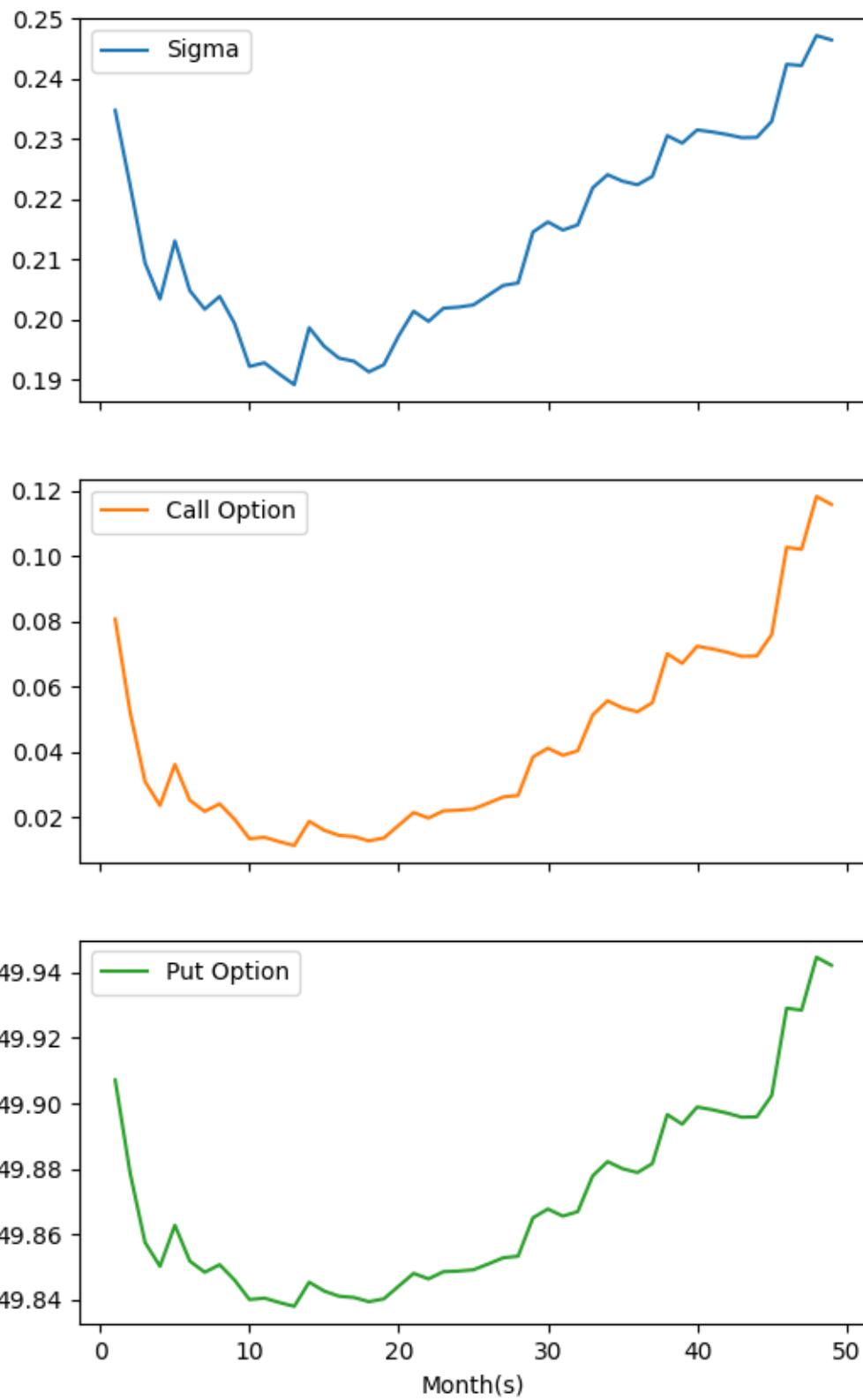
Plot of NTPC (NSE) with  $A = 1.3$



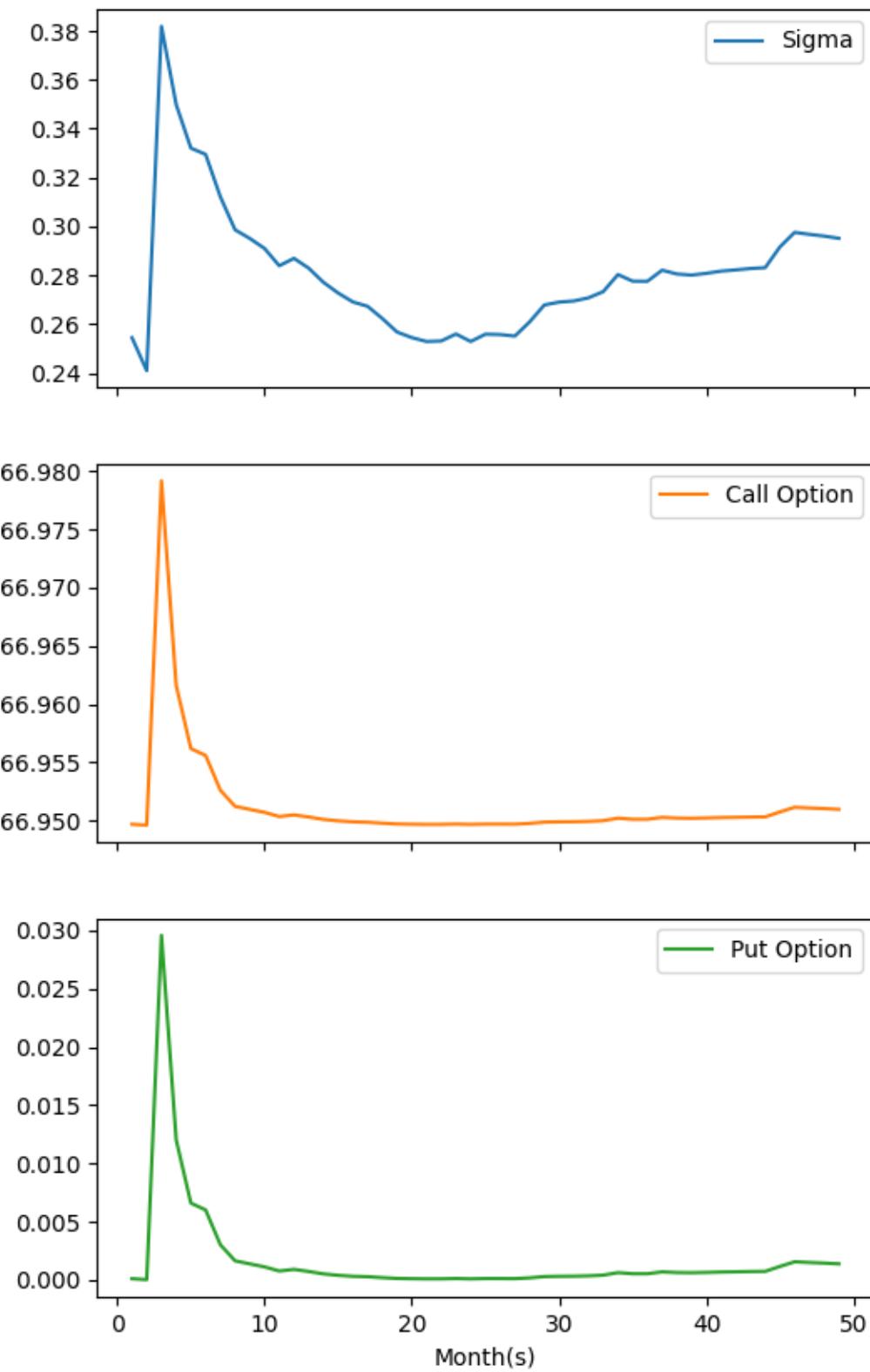
### Plot of NTPC (NSE) with A = 1.4



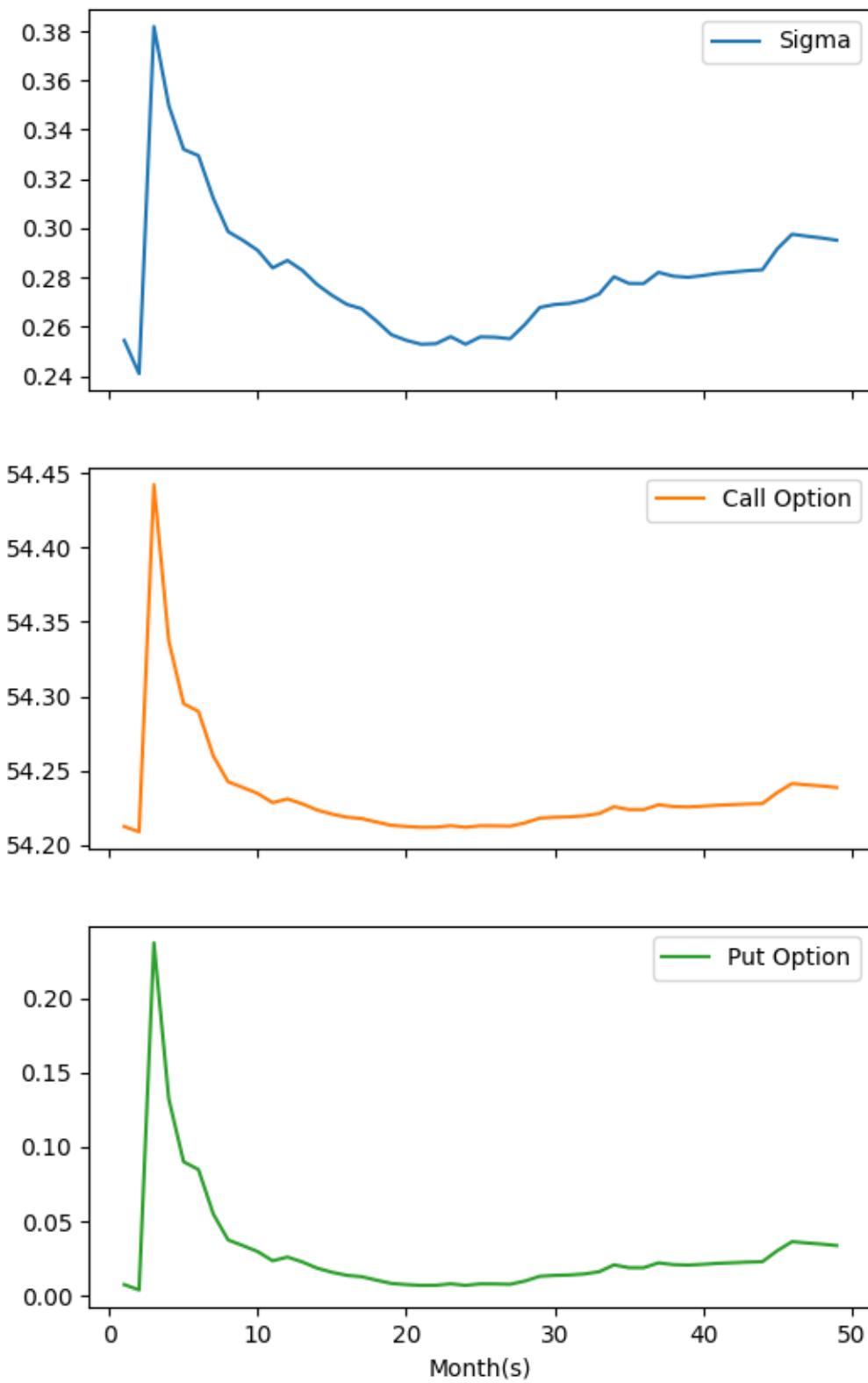
### Plot of NTPC (NSE) with A = 1.5



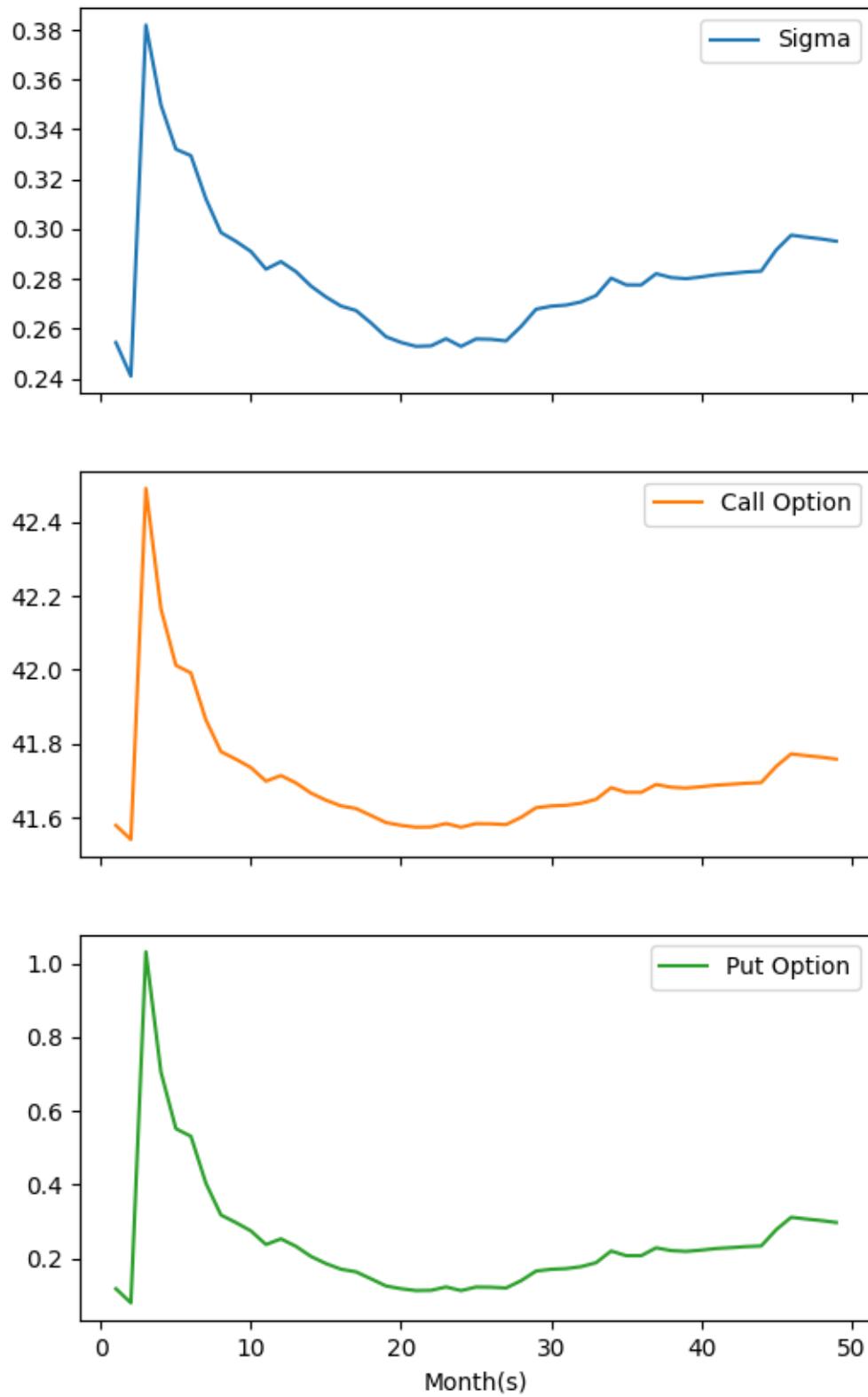
Plot of ONGC (NSE) with  $A = 0.5$



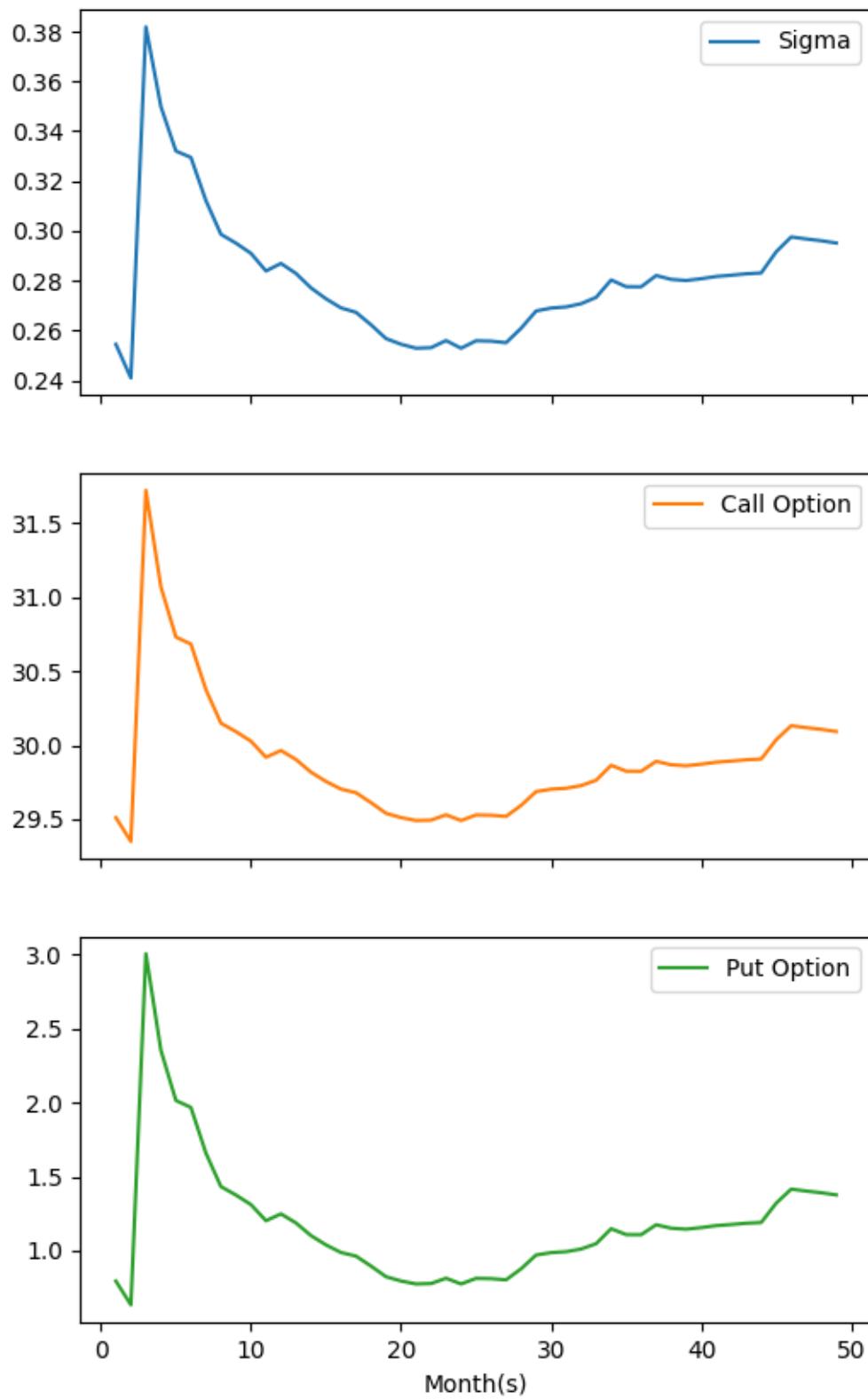
Plot of ONGC (NSE) with  $A = 0.6$



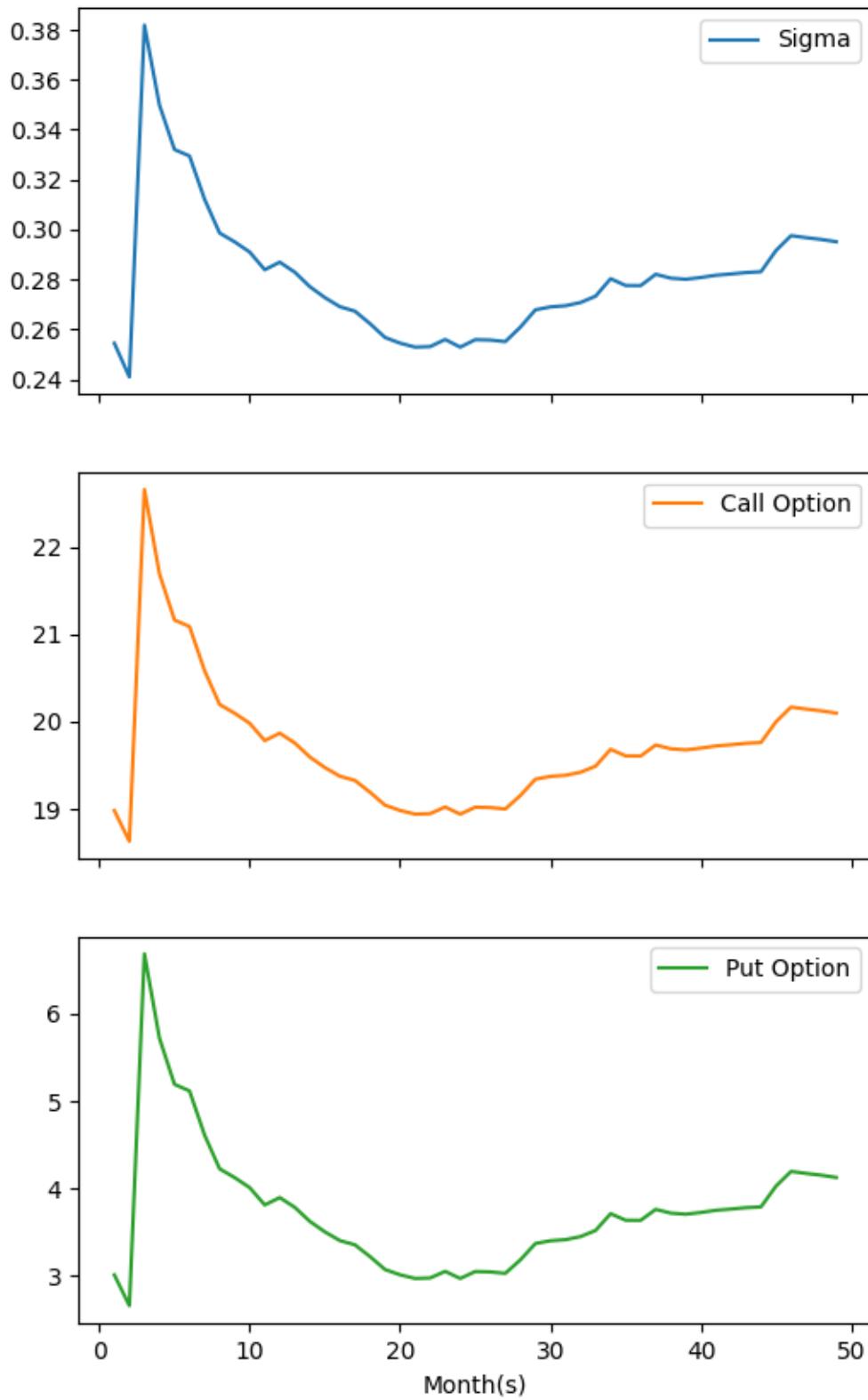
Plot of ONGC (NSE) with  $A = 0.7$



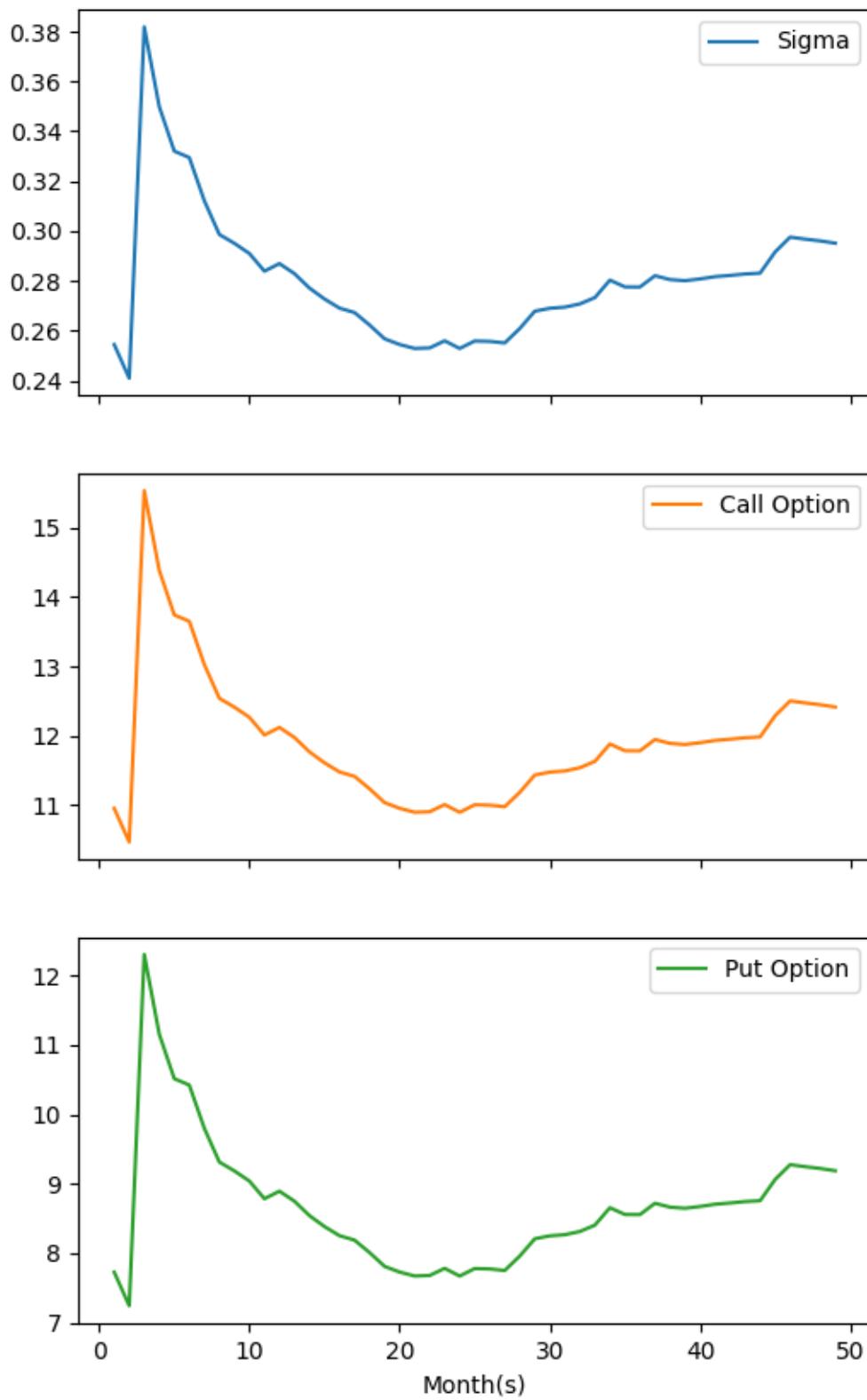
Plot of ONGC (NSE) with  $A = 0.8$



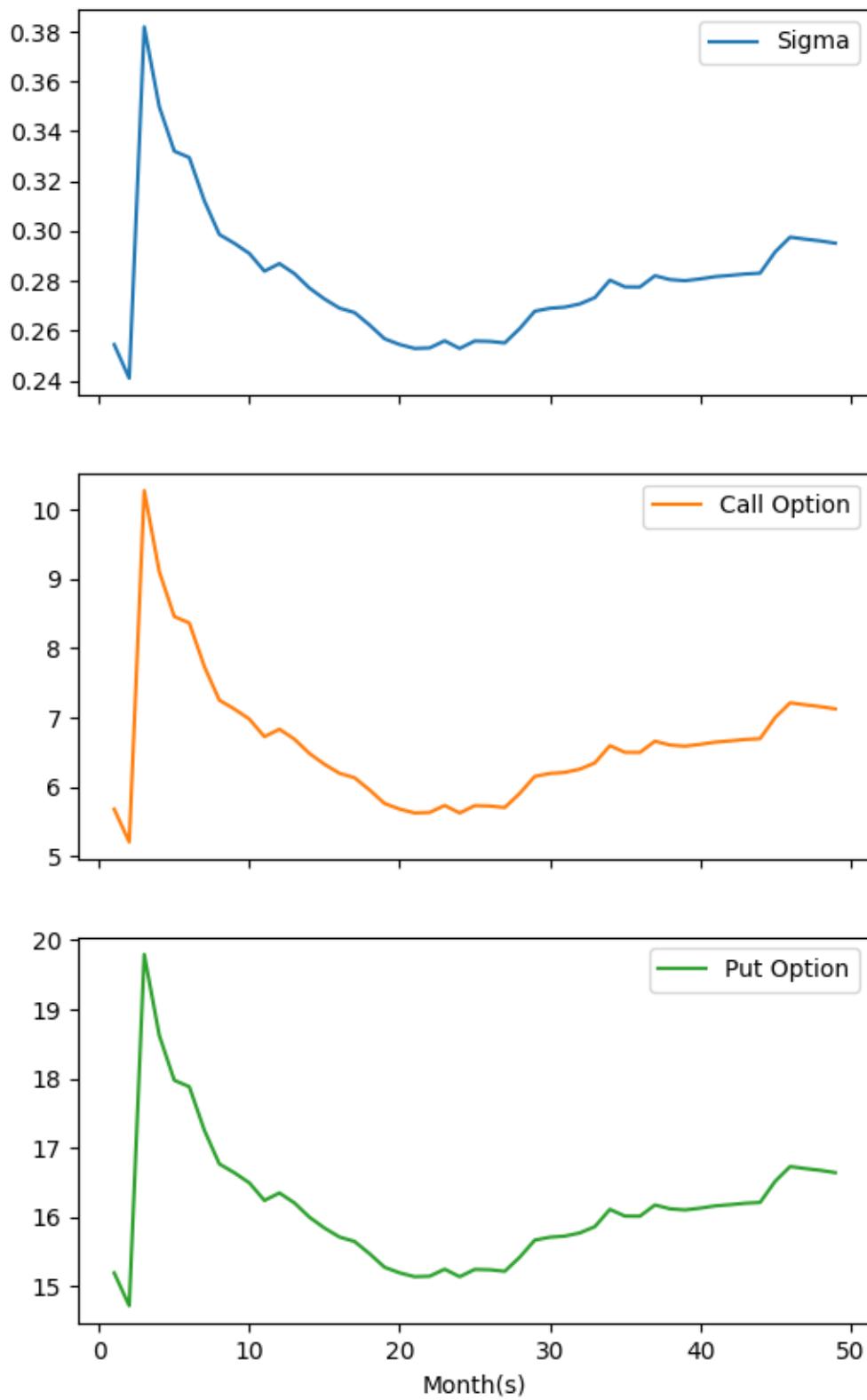
Plot of ONGC (NSE) with  $A = 0.9$



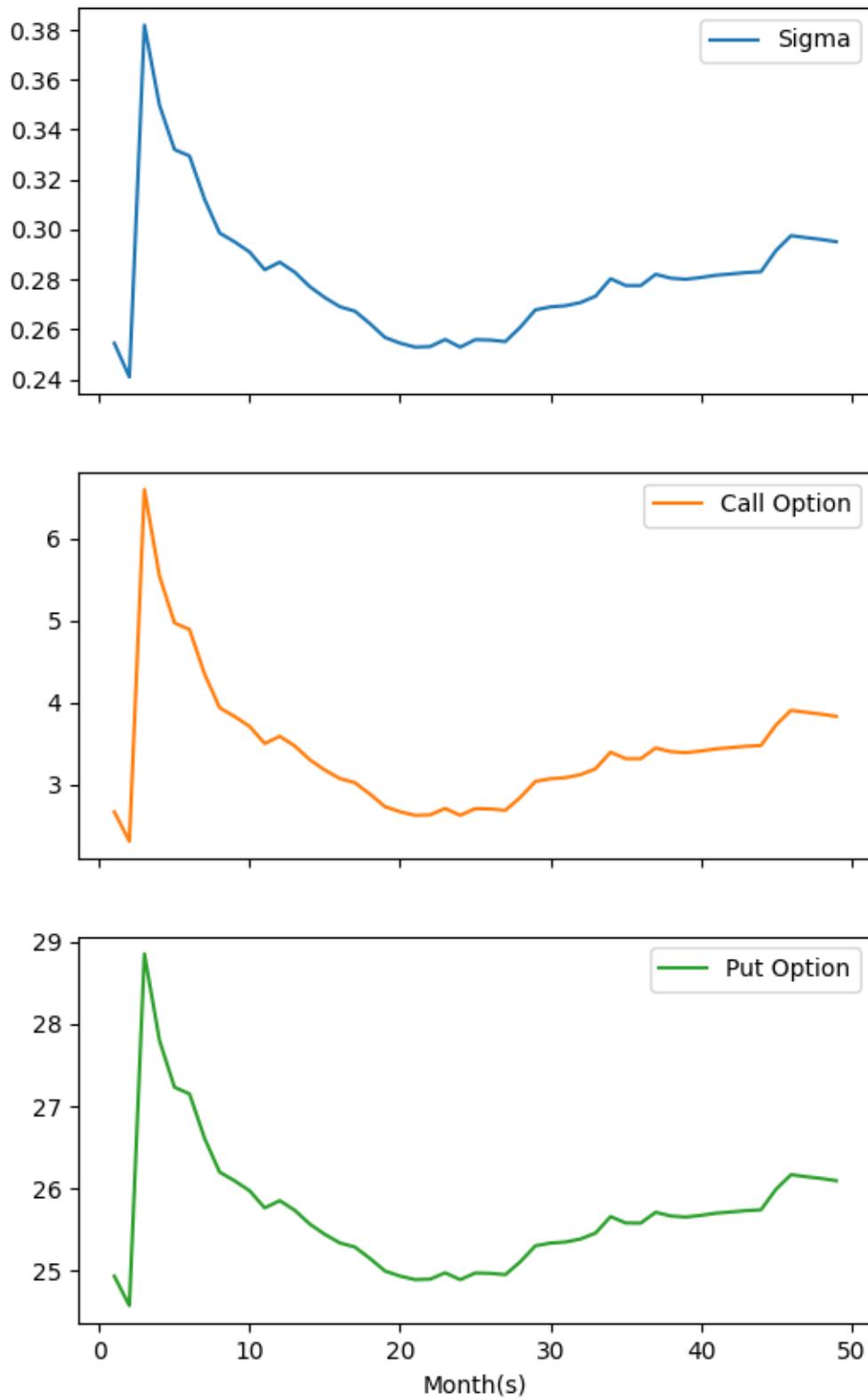
### Plot of ONGC (NSE) with $A = 1.0$



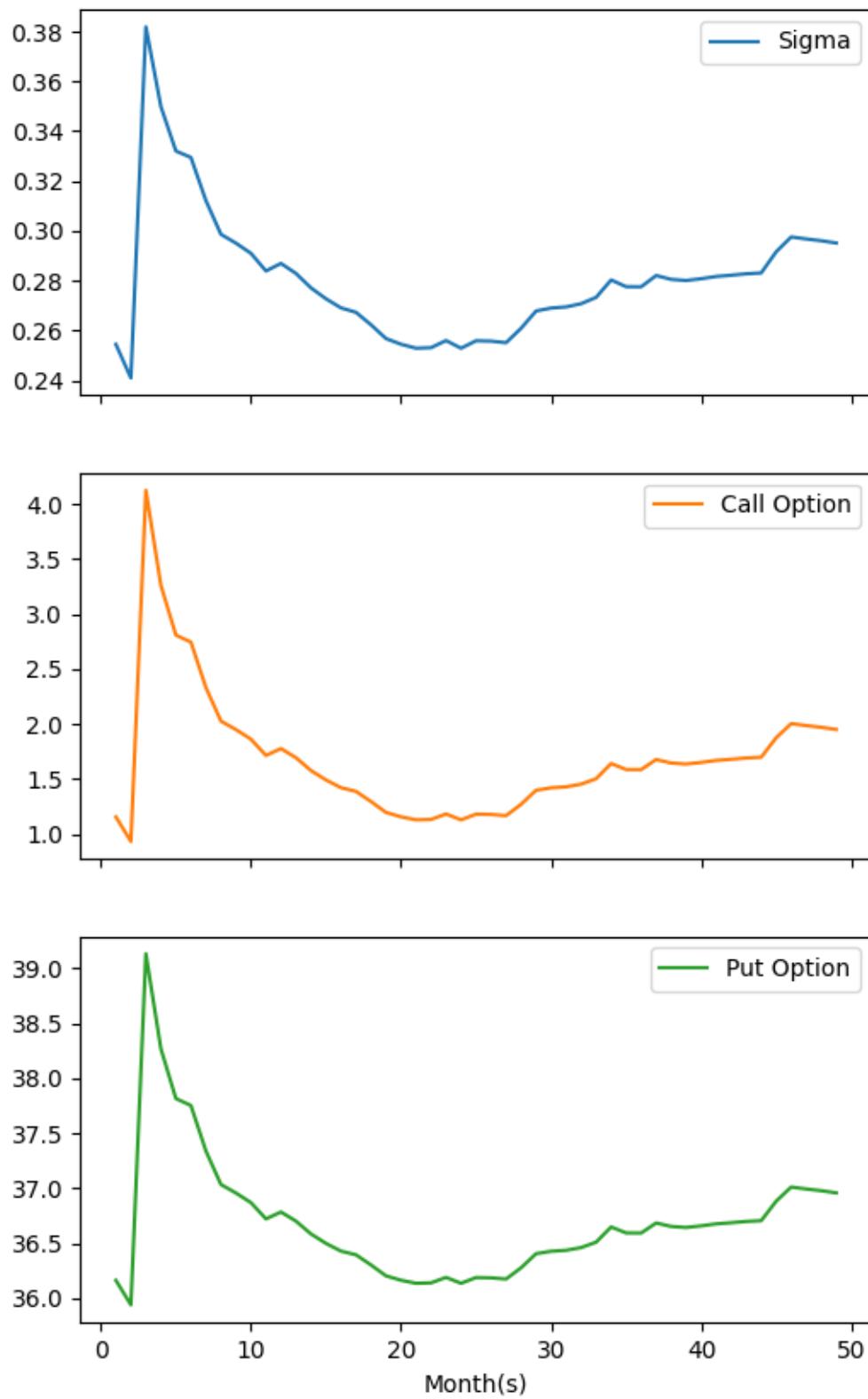
Plot of ONGC (NSE) with  $A = 1.1$



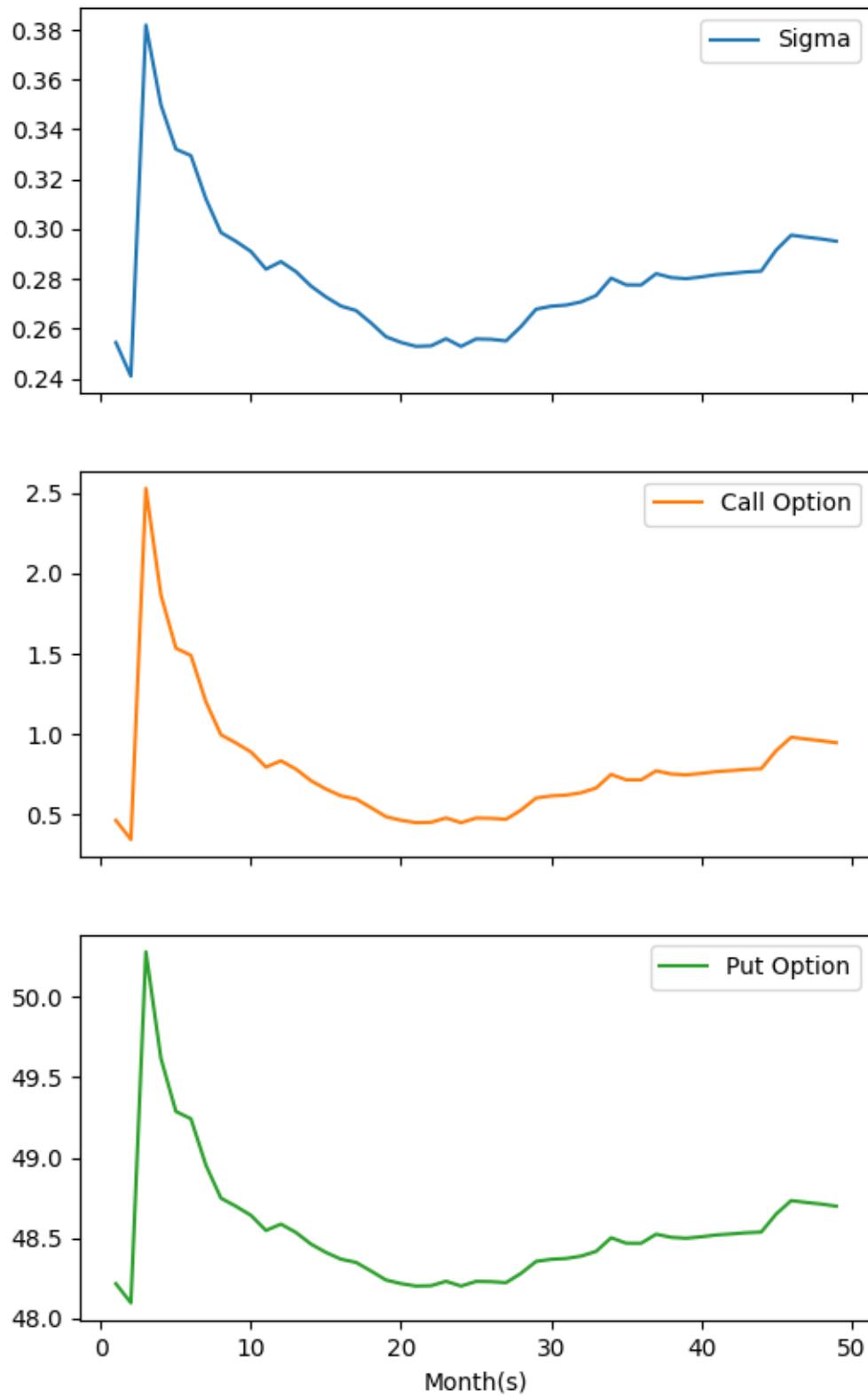
Plot of ONGC (NSE) with  $A = 1.2$



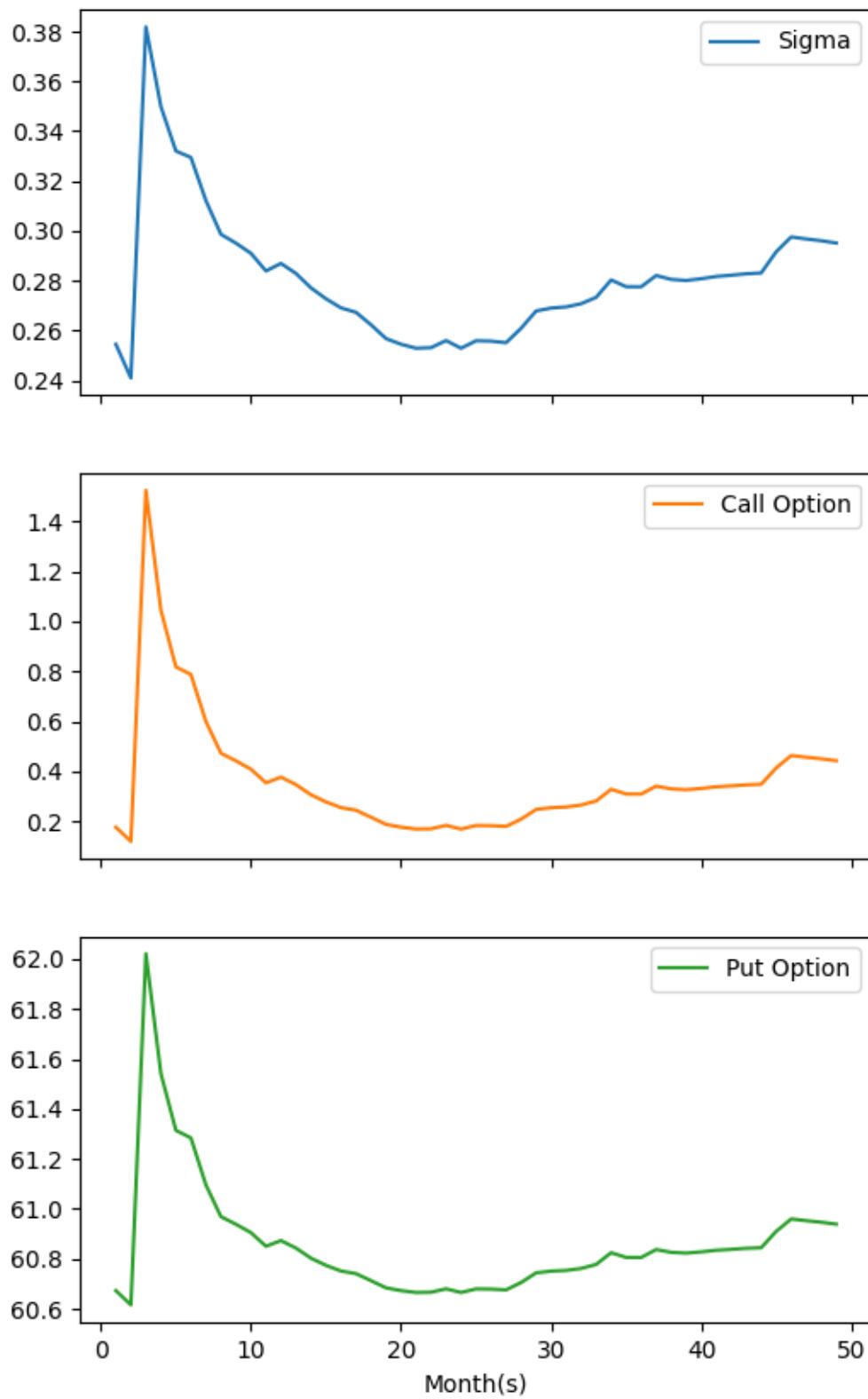
Plot of ONGC (NSE) with  $A = 1.3$



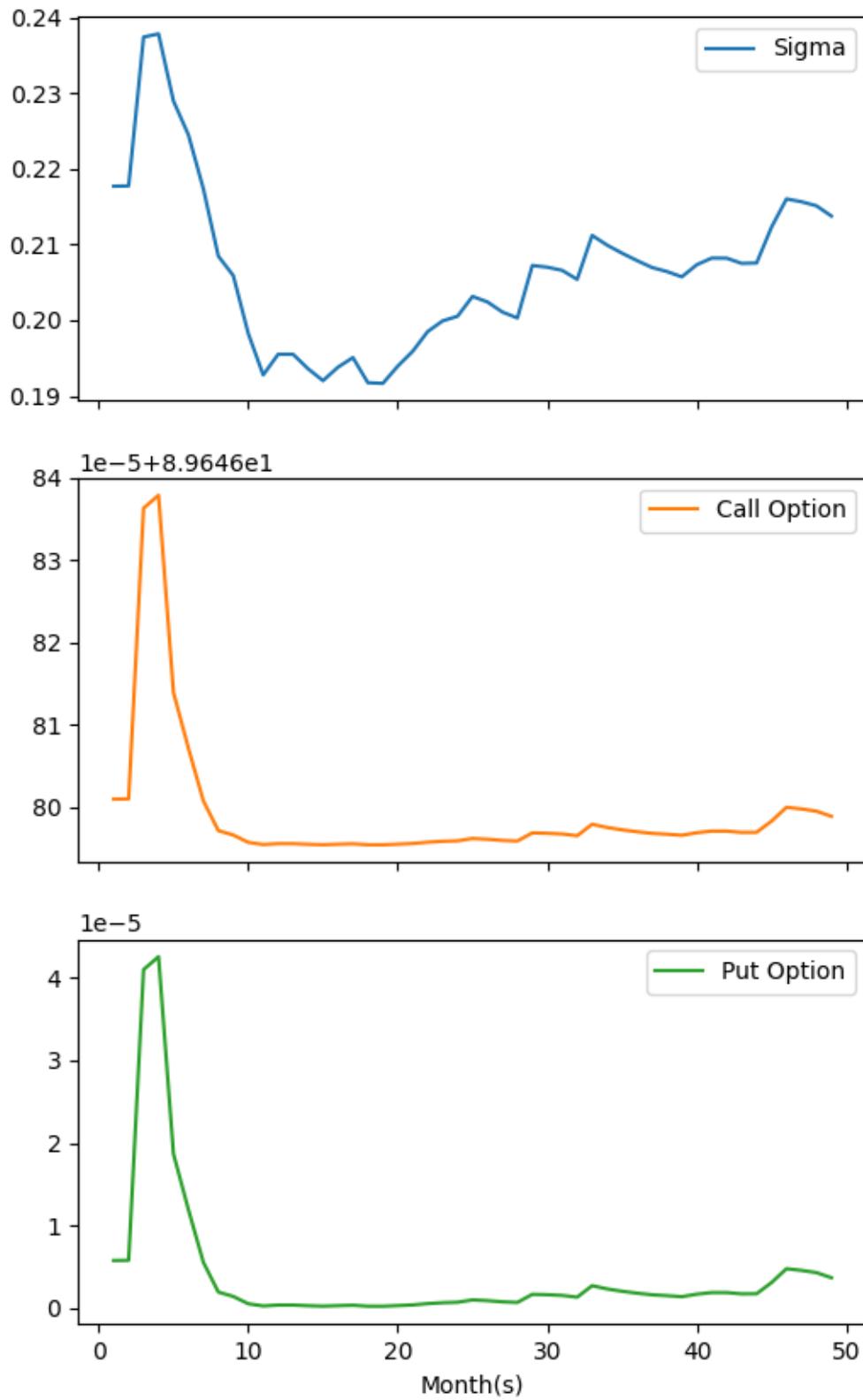
Plot of ONGC (NSE) with  $A = 1.4$



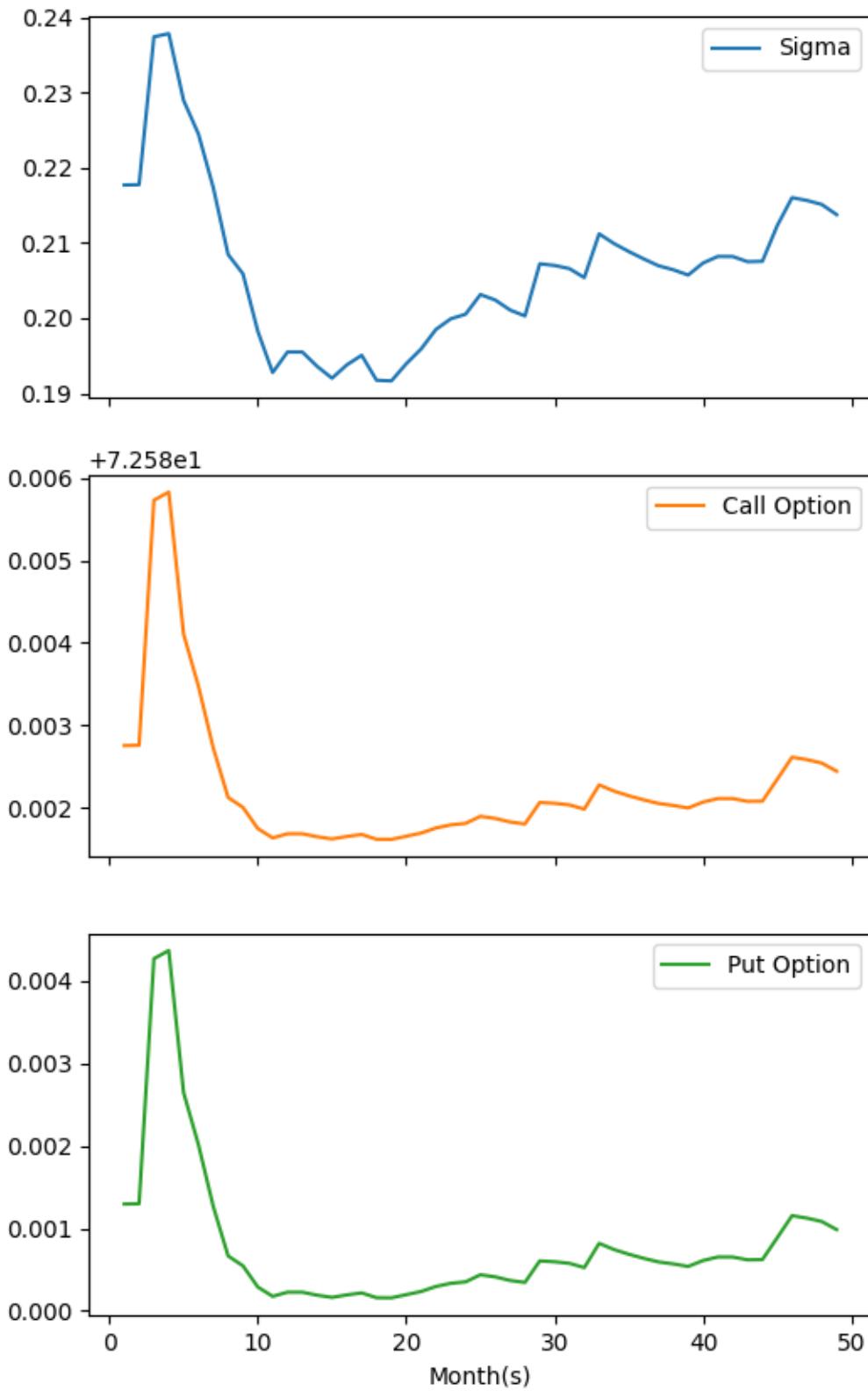
Plot of ONGC (NSE) with  $A = 1.5$



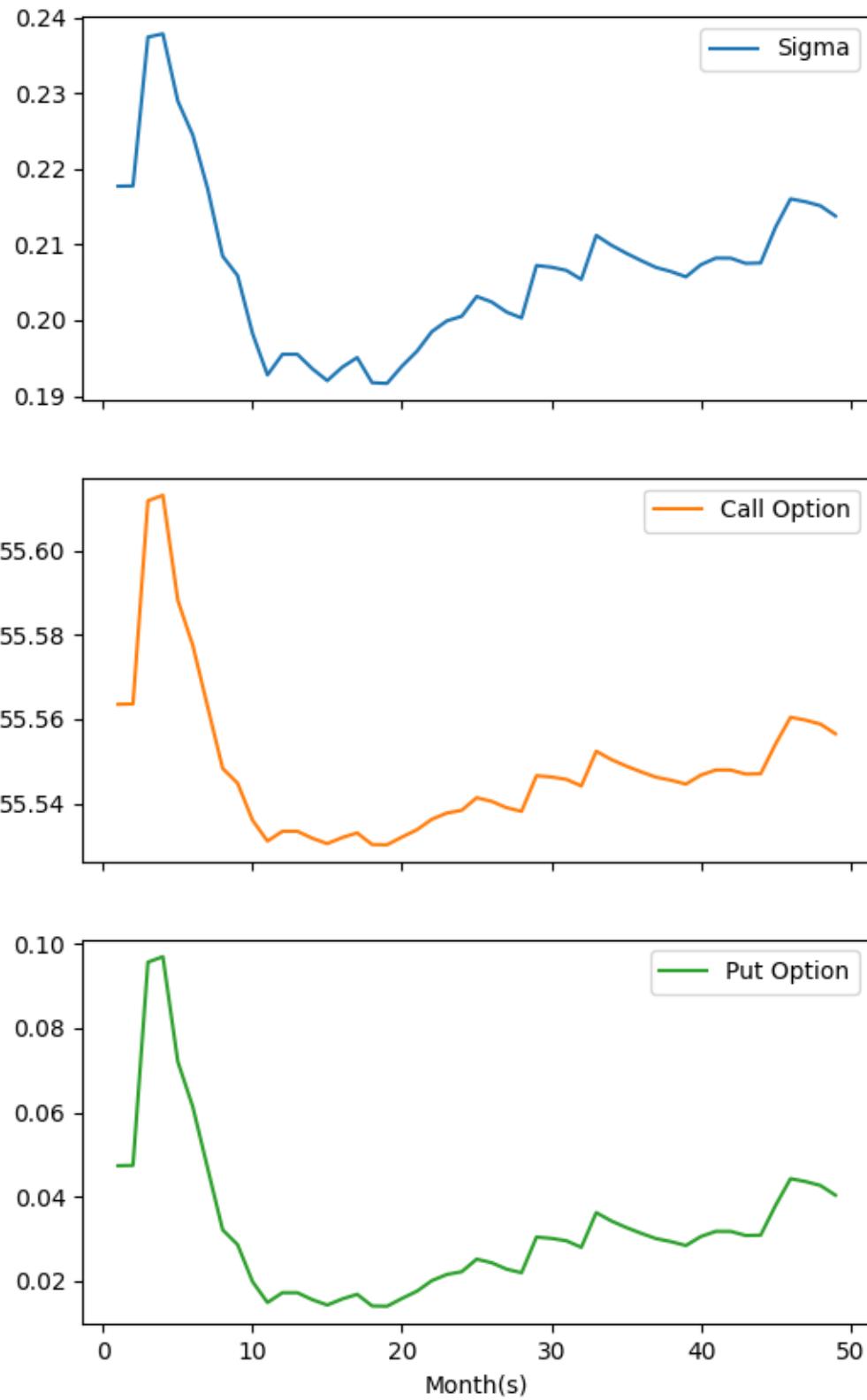
### Plot of POWERGRID (NSE) with A = 0.5



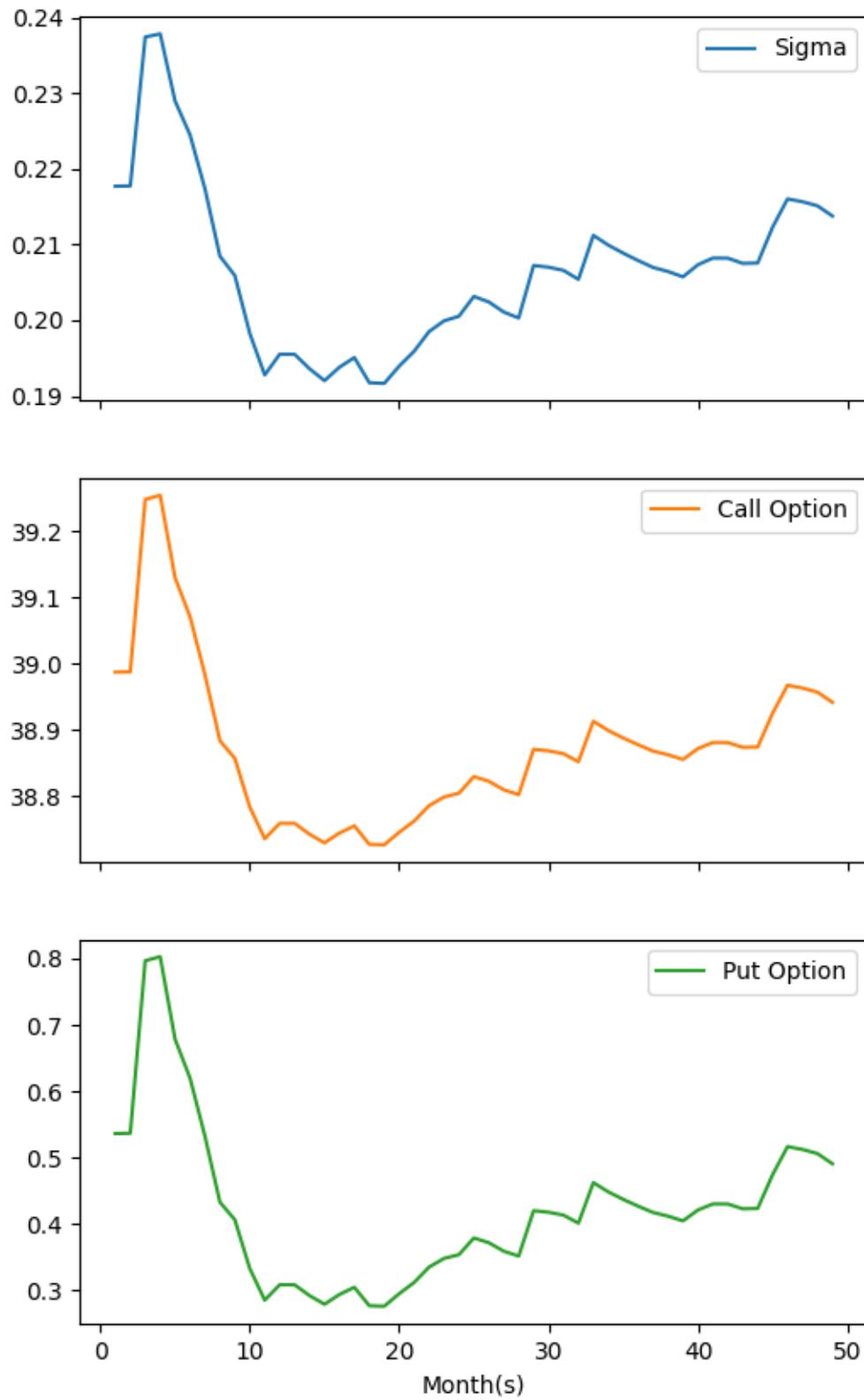
### Plot of POWERGRID (NSE) with A = 0.6



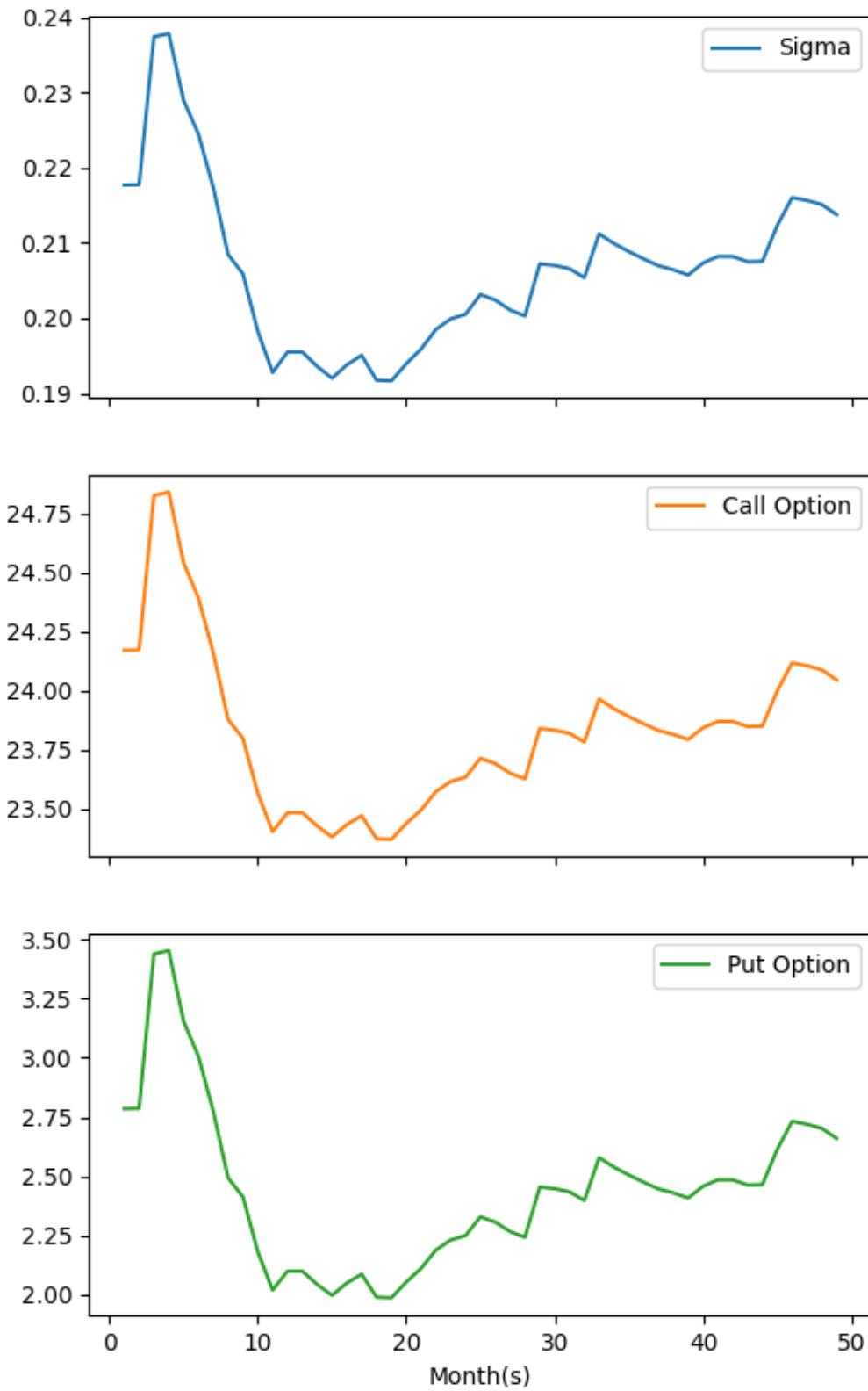
### Plot of POWERGRID (NSE) with A = 0.7



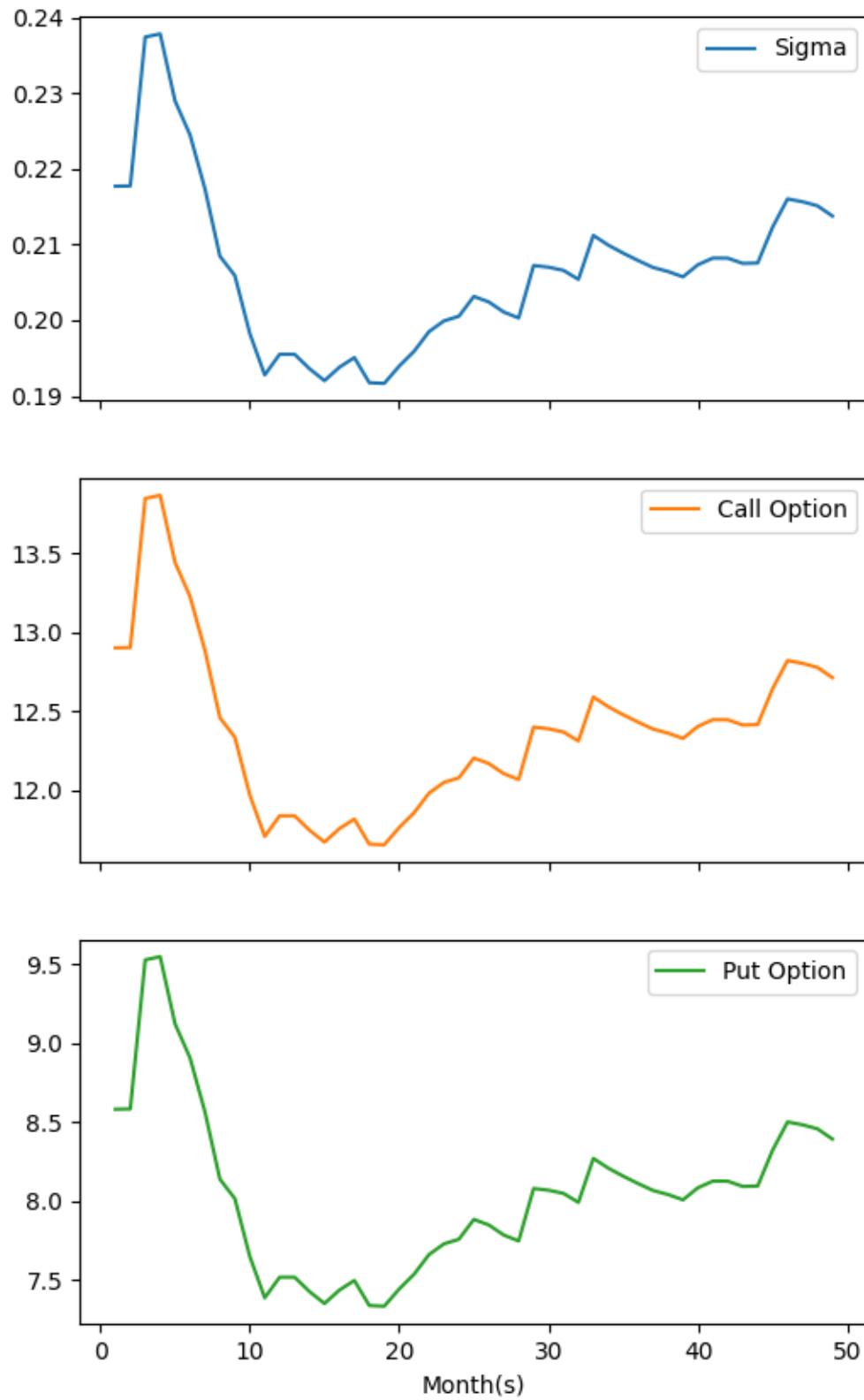
### Plot of POWERGRID (NSE) with $A = 0.8$



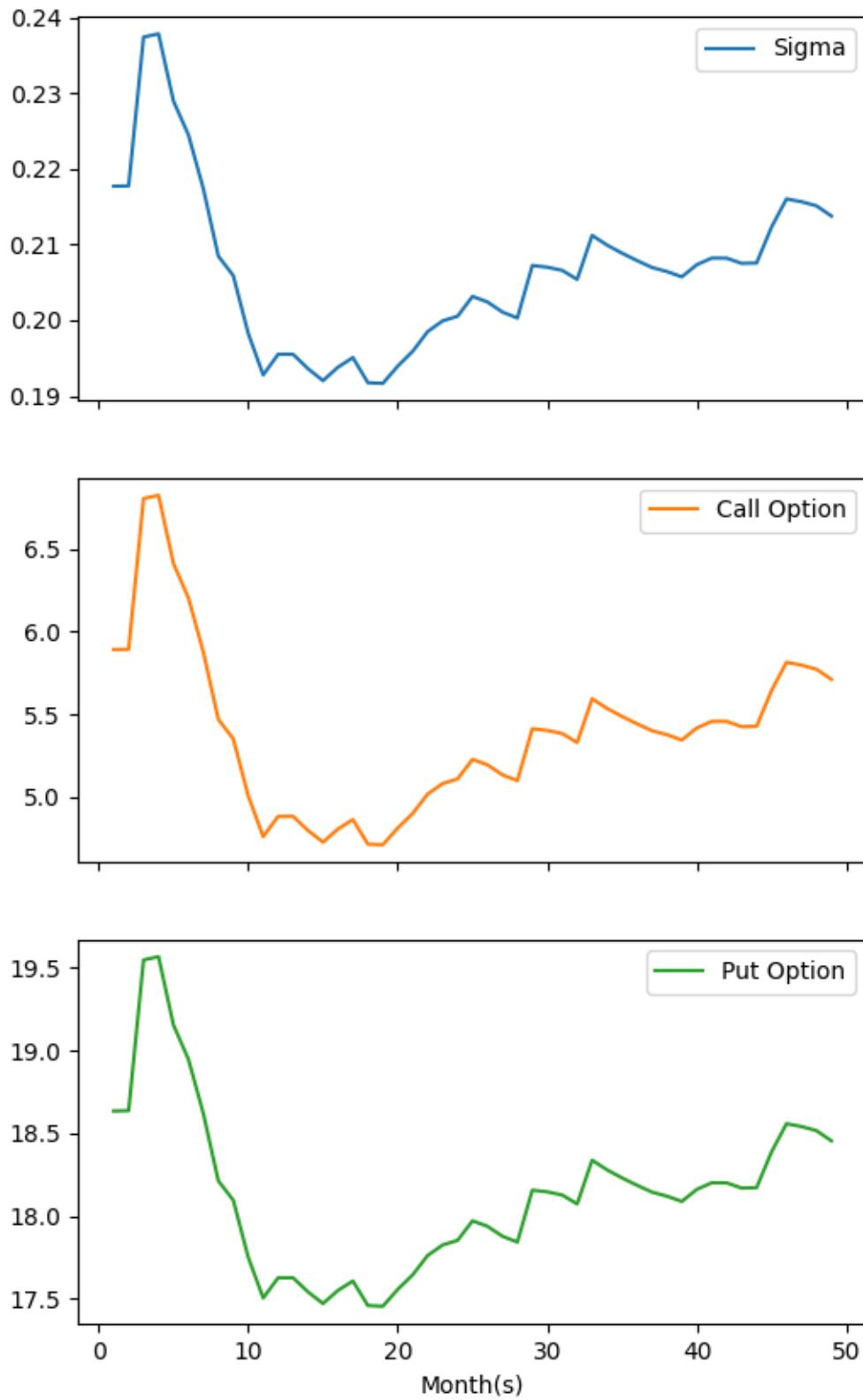
### Plot of POWERGRID (NSE) with A = 0.9



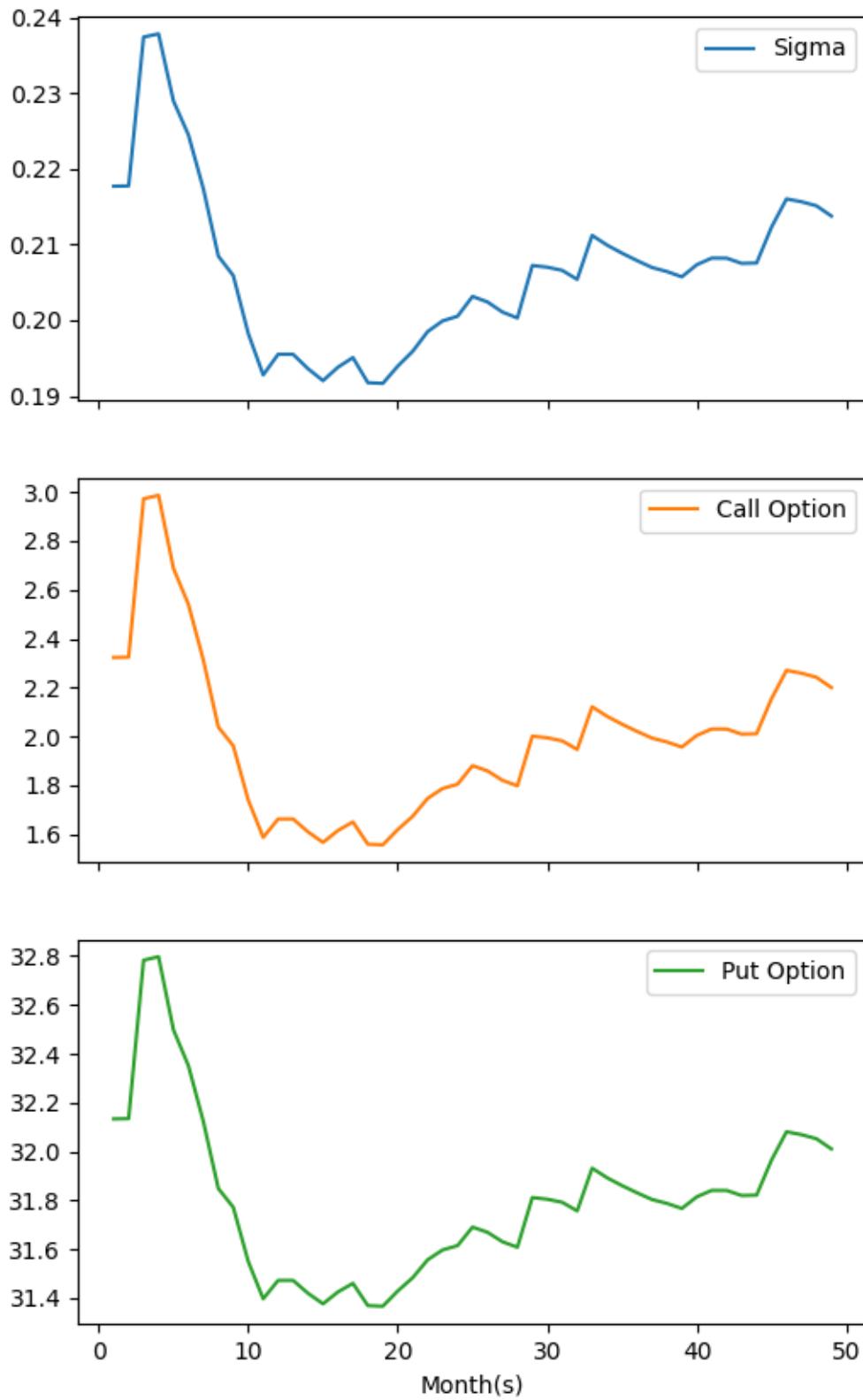
### Plot of POWERGRID (NSE) with A = 1.0



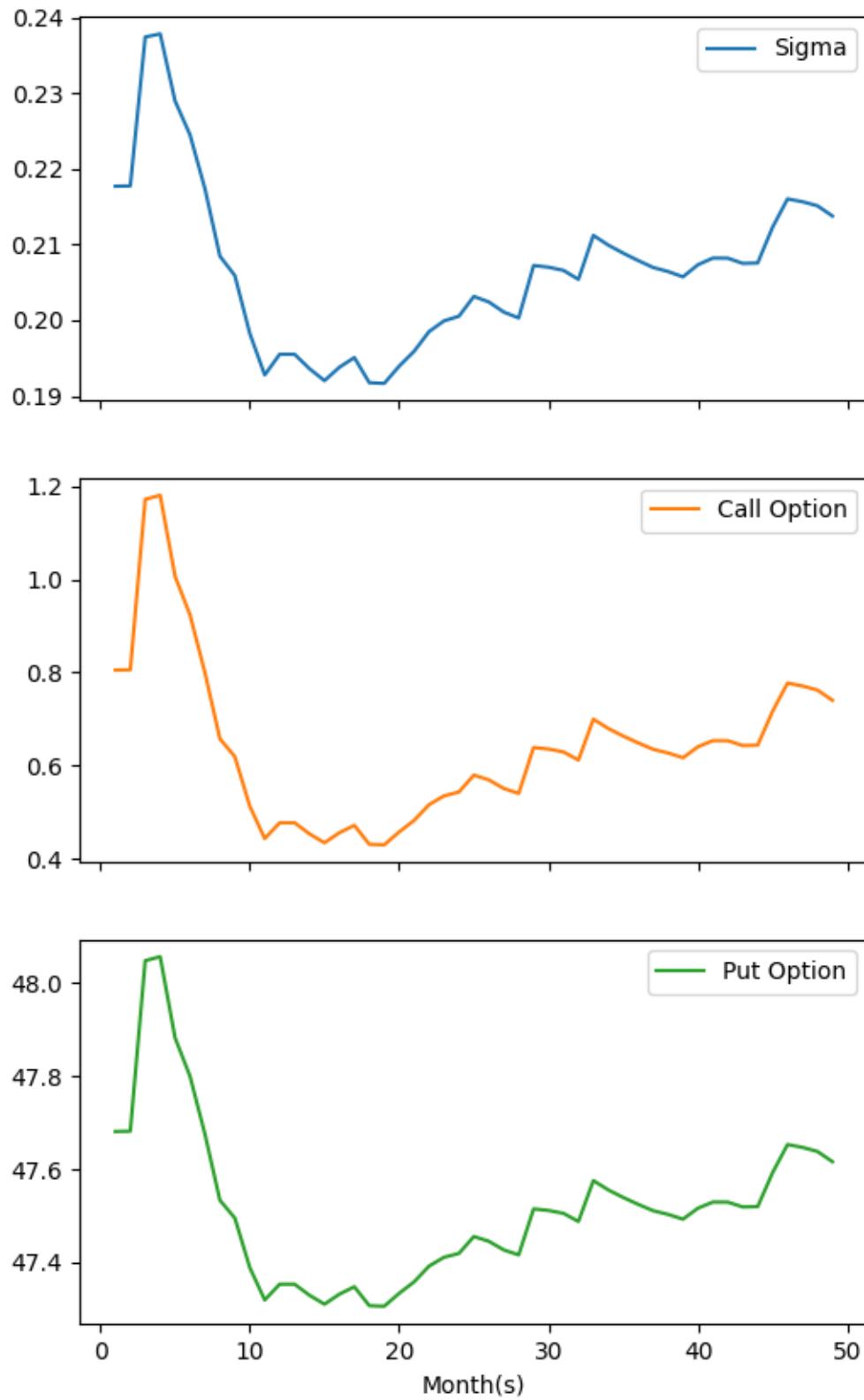
Plot of POWERGRID (NSE) with A = 1.1



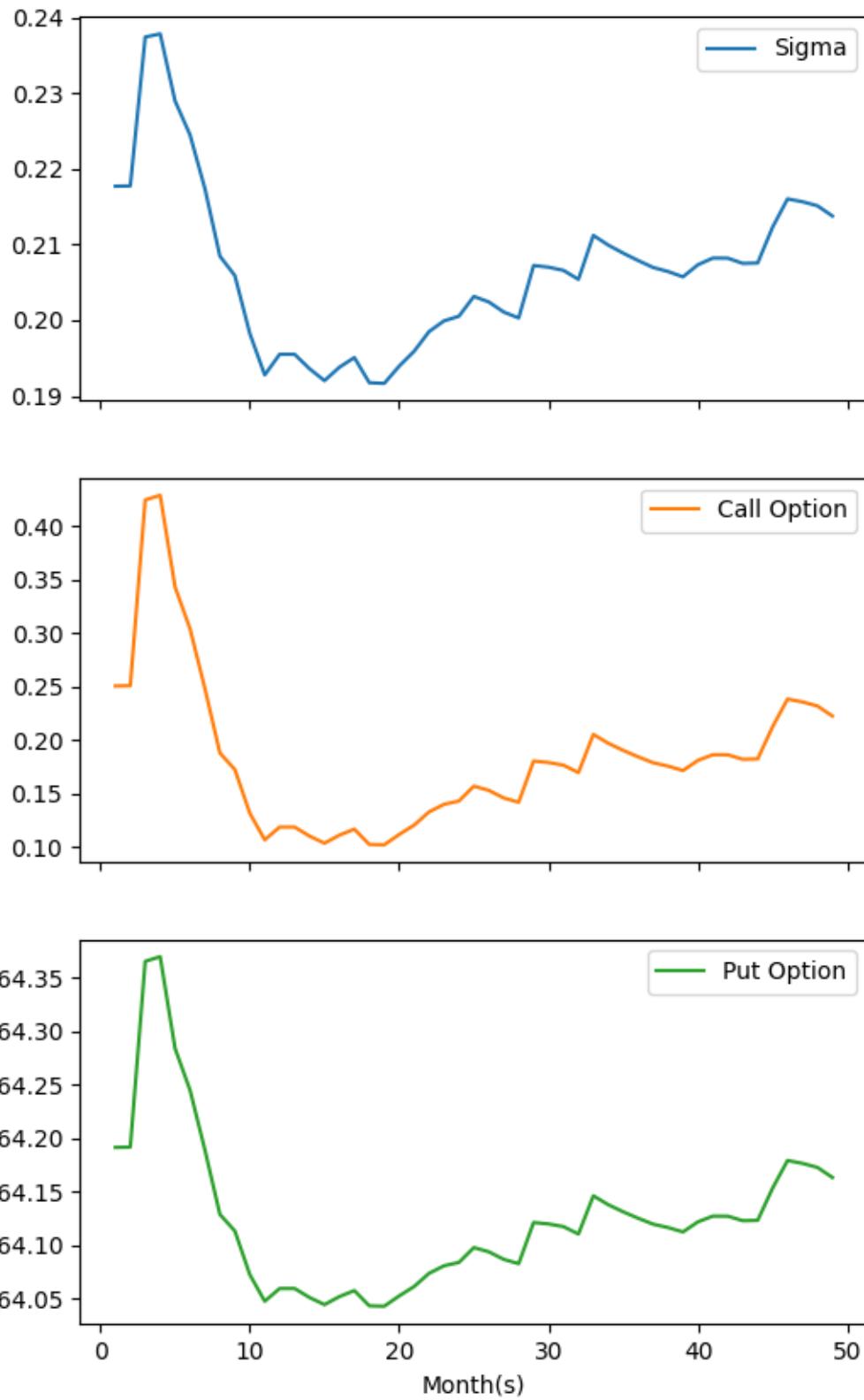
Plot of POWERGRID (NSE) with A = 1.2



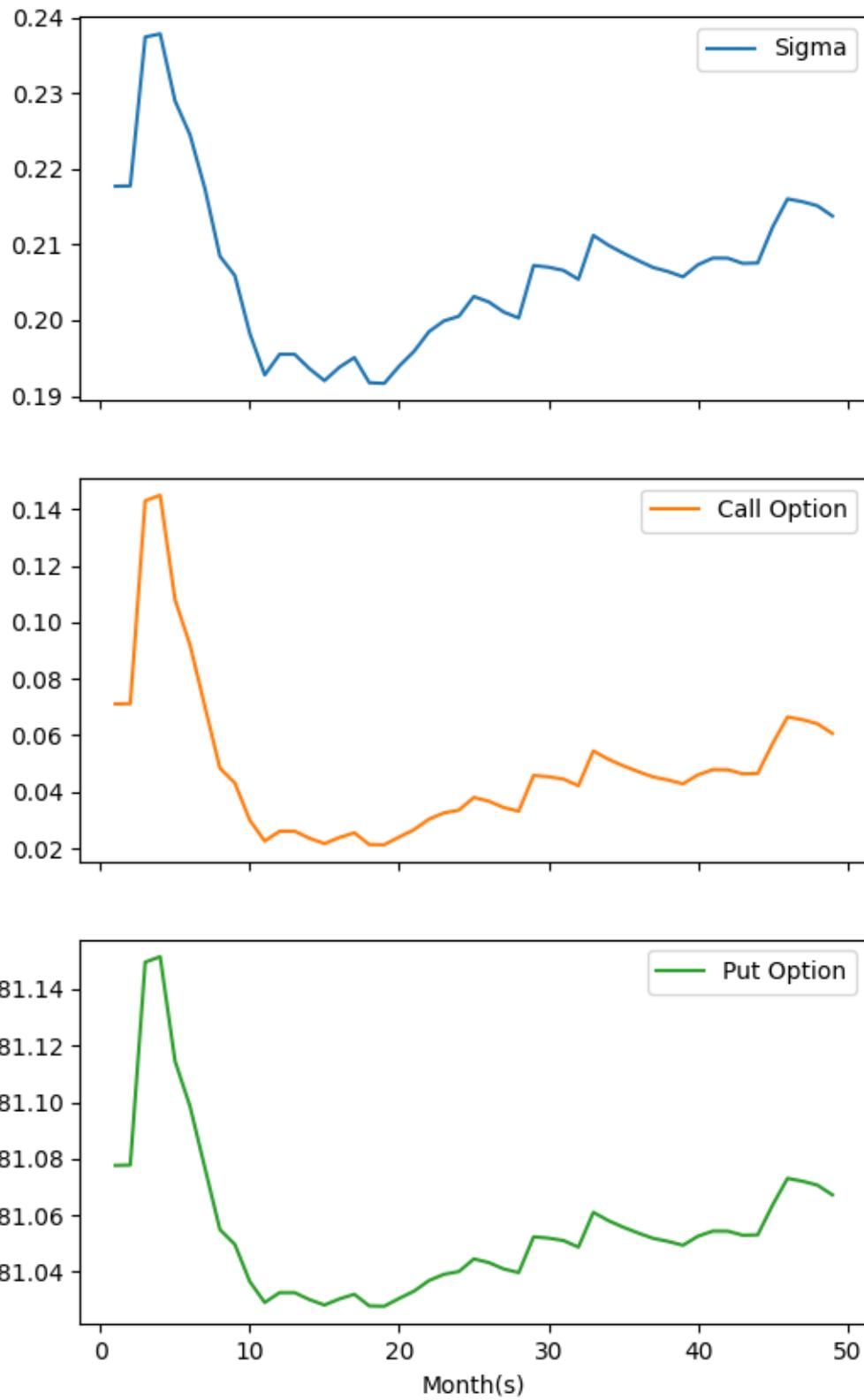
### Plot of POWERGRID (NSE) with A = 1.3



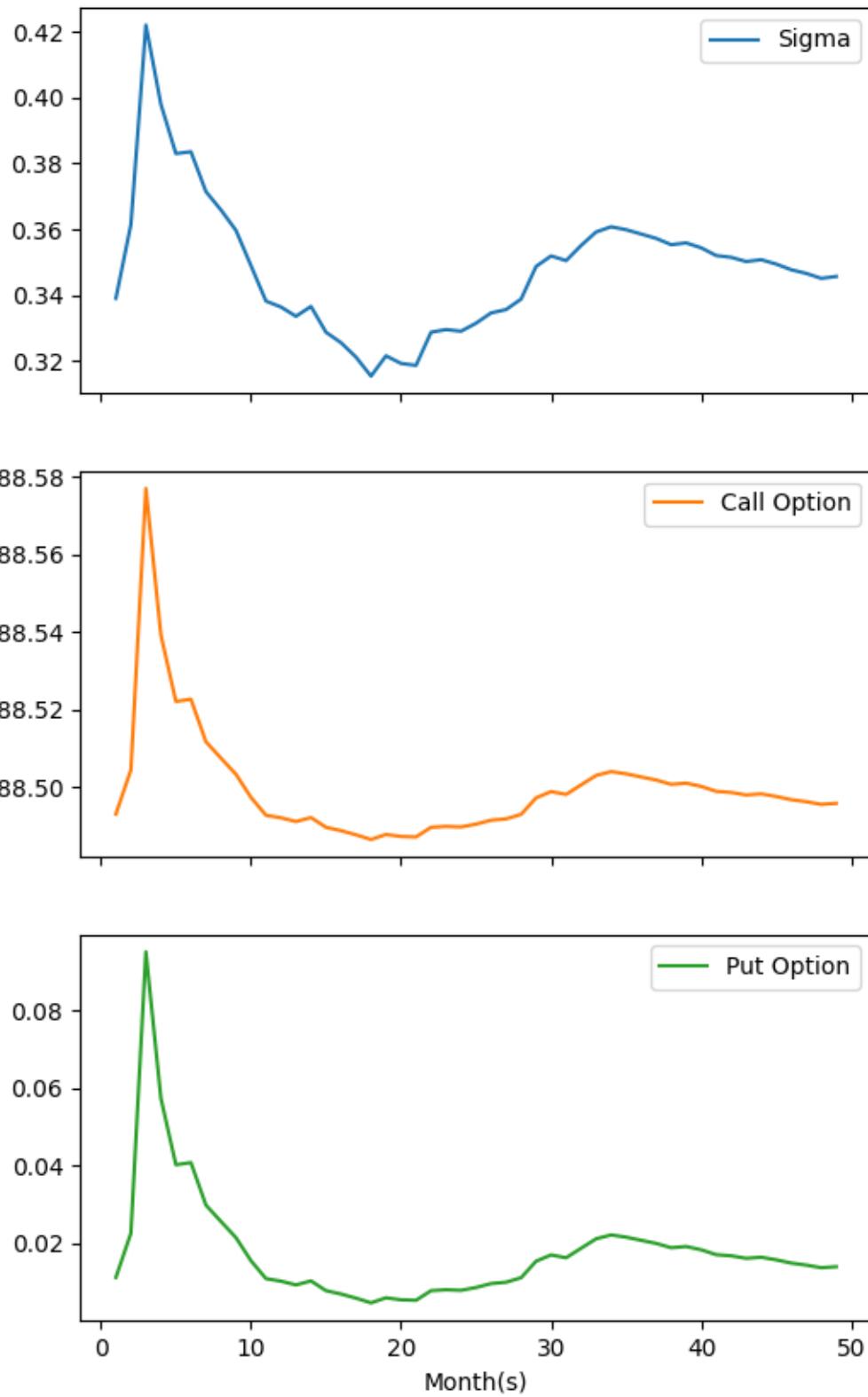
### Plot of POWERGRID (NSE) with A = 1.4



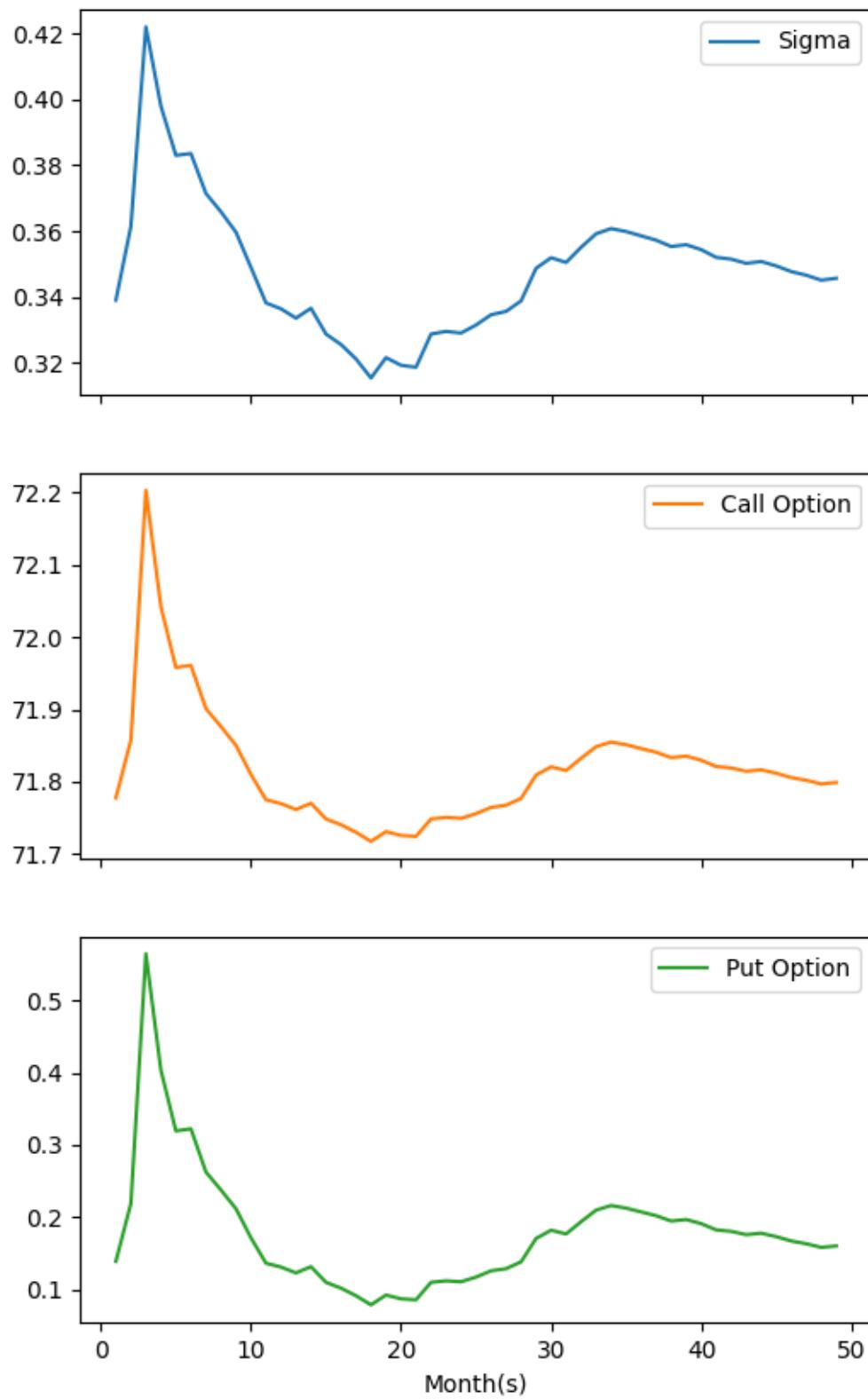
### Plot of POWERGRID (NSE) with A = 1.5



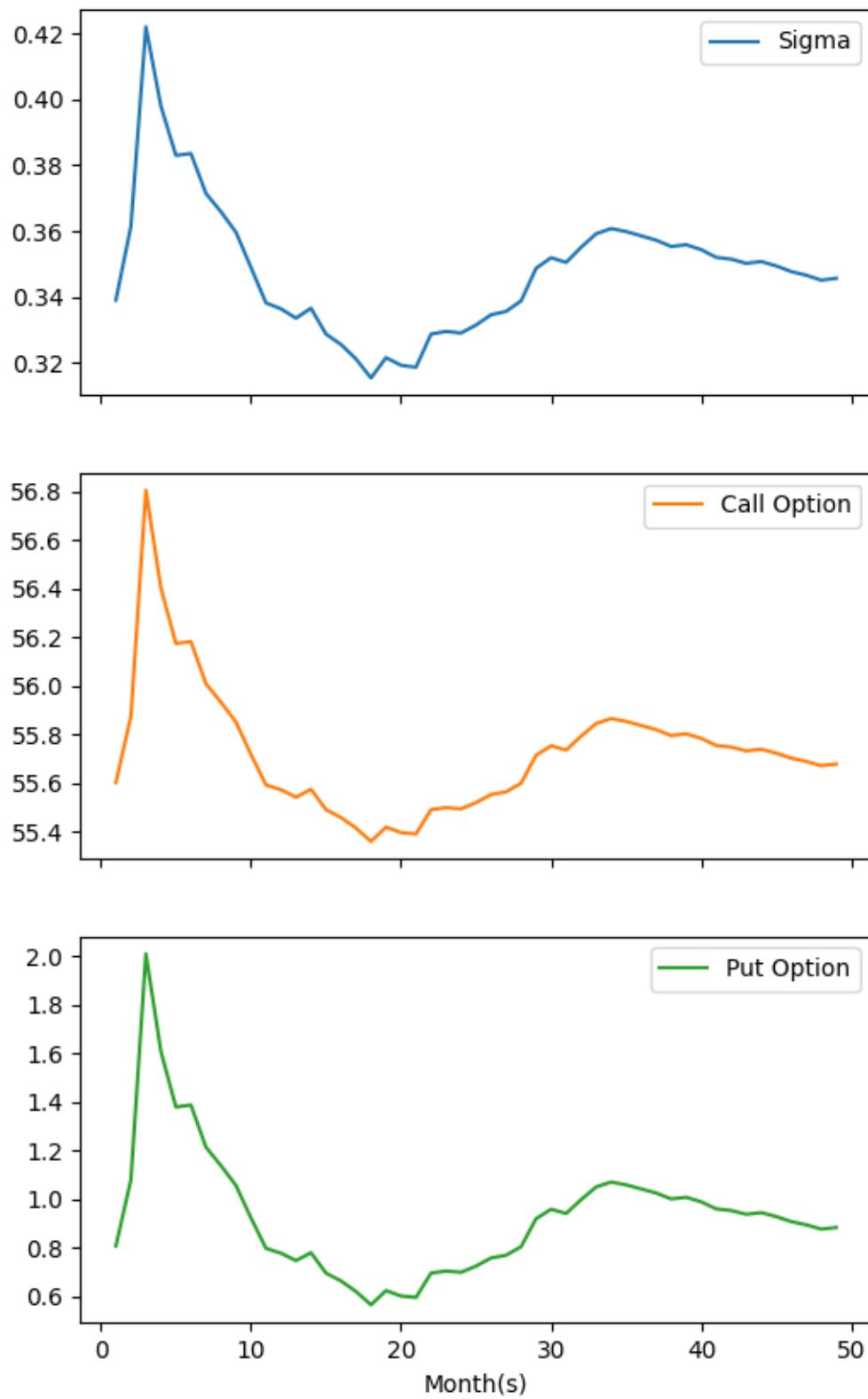
### Plot of TATAMOTORS (NSE) with A = 0.5



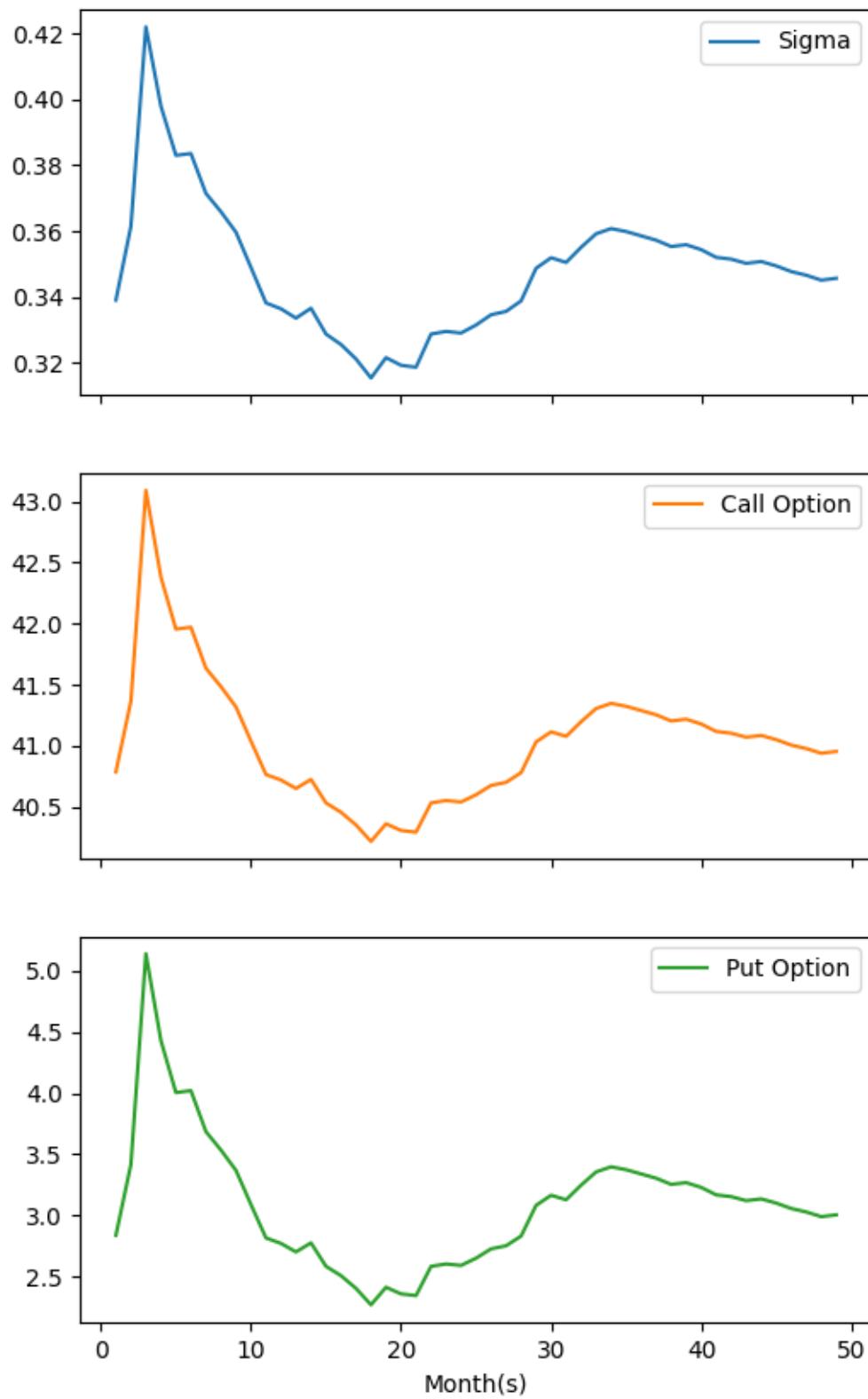
### Plot of TATAMOTORS (NSE) with $A = 0.6$



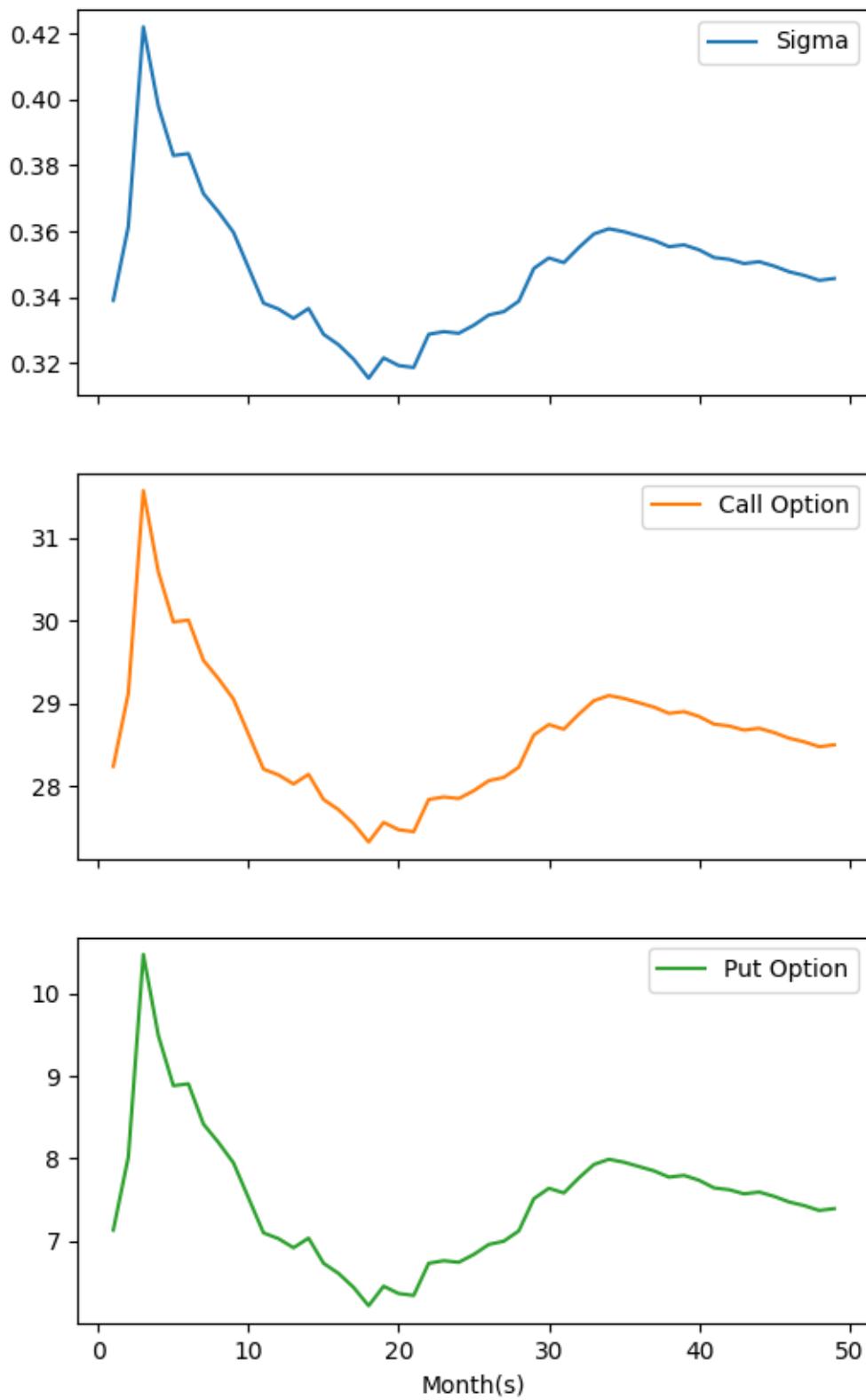
### Plot of TATAMOTORS (NSE) with $A = 0.7$



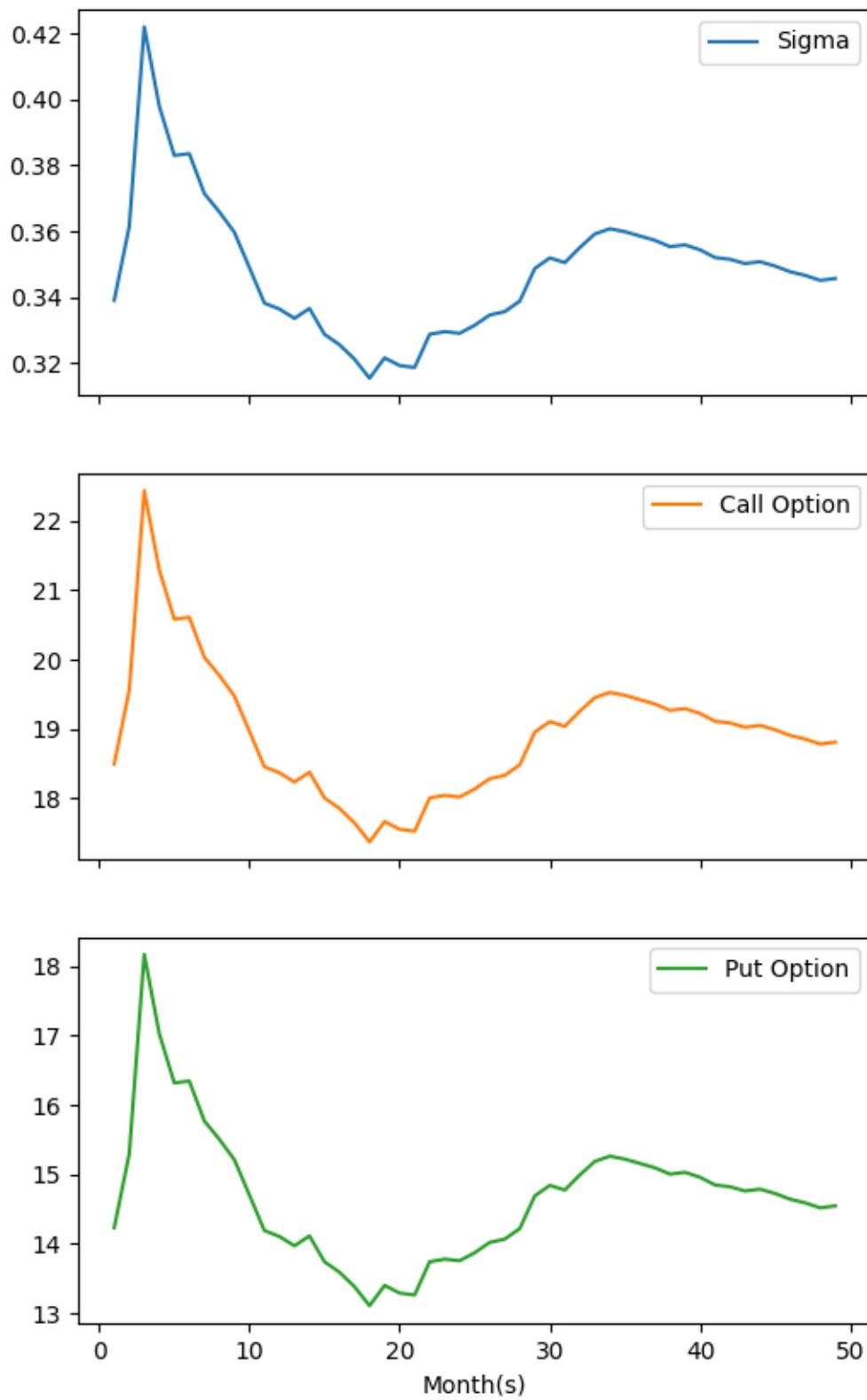
### Plot of TATAMOTORS (NSE) with $A = 0.8$



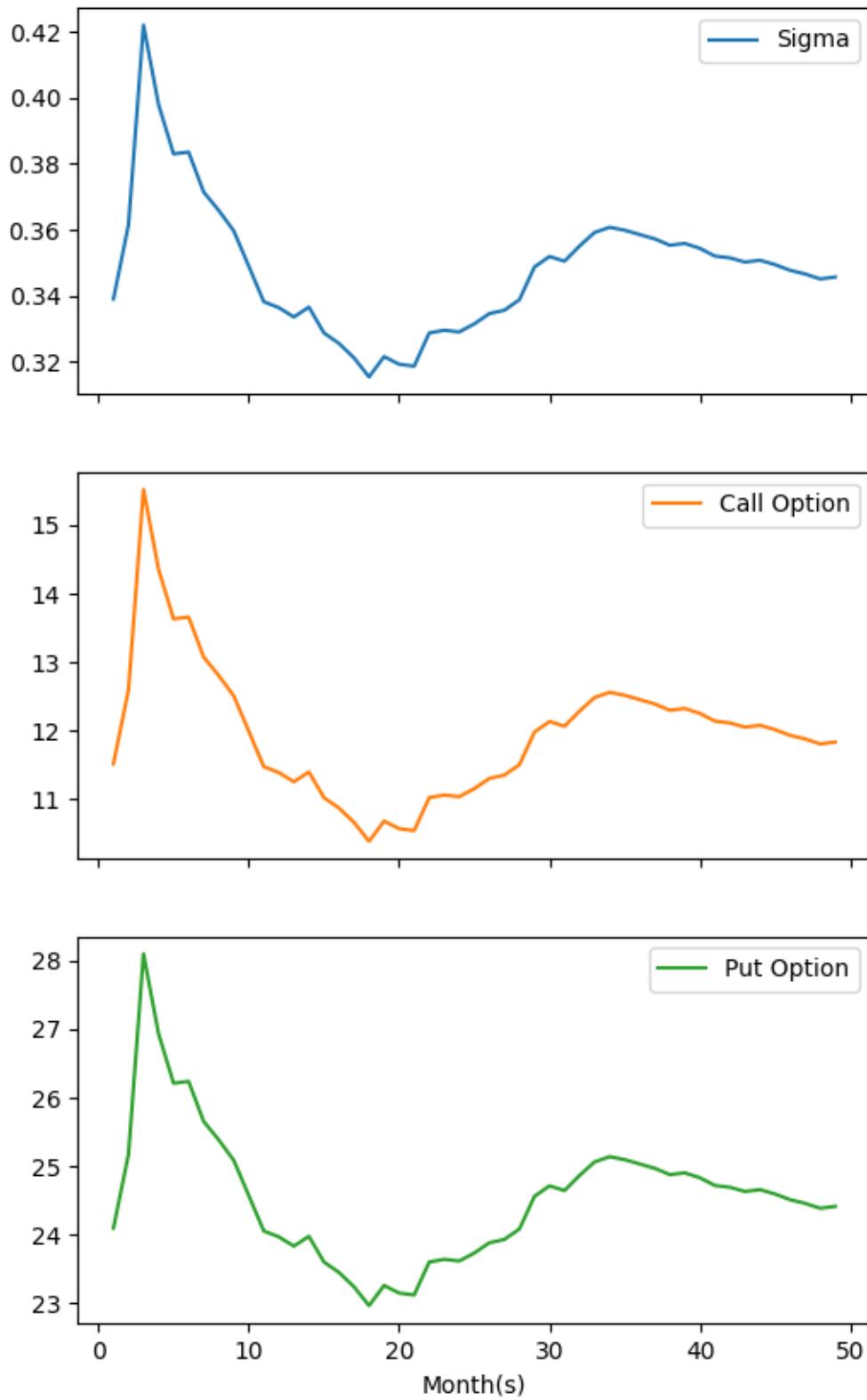
### Plot of TATAMOTORS (NSE) with $A = 0.9$



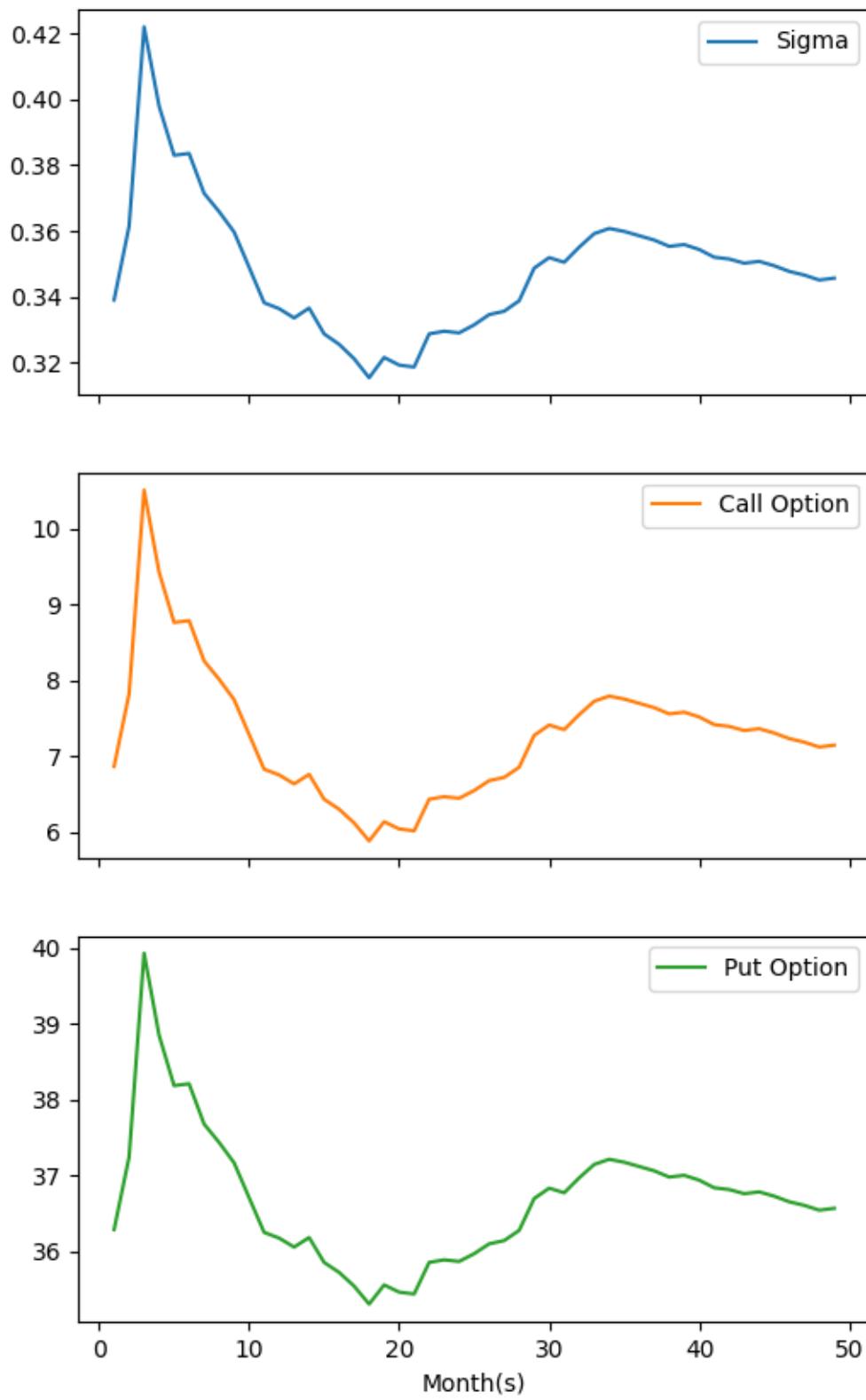
### Plot of TATAMOTORS (NSE) with A = 1.0



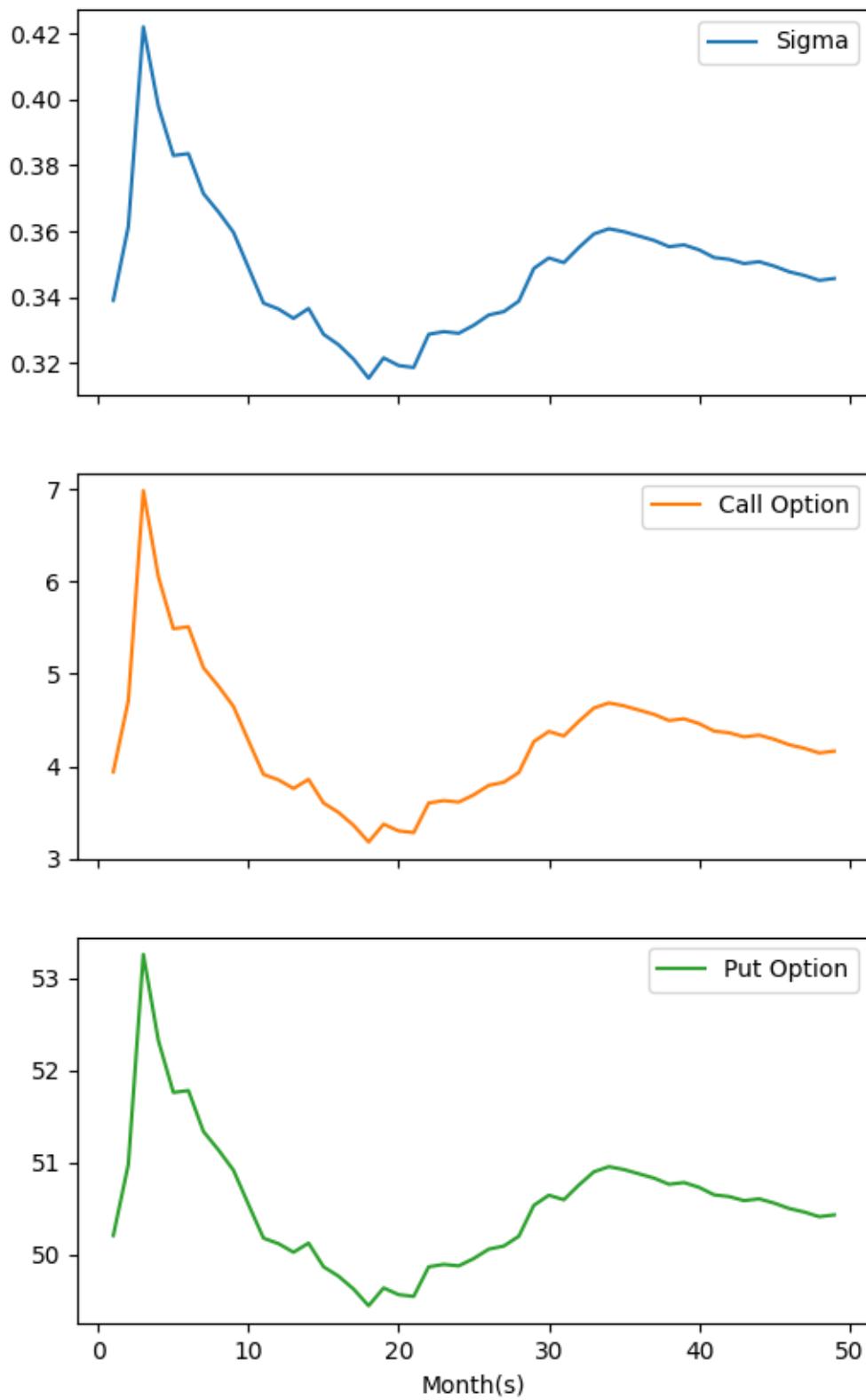
### Plot of TATAMOTORS (NSE) with A = 1.1



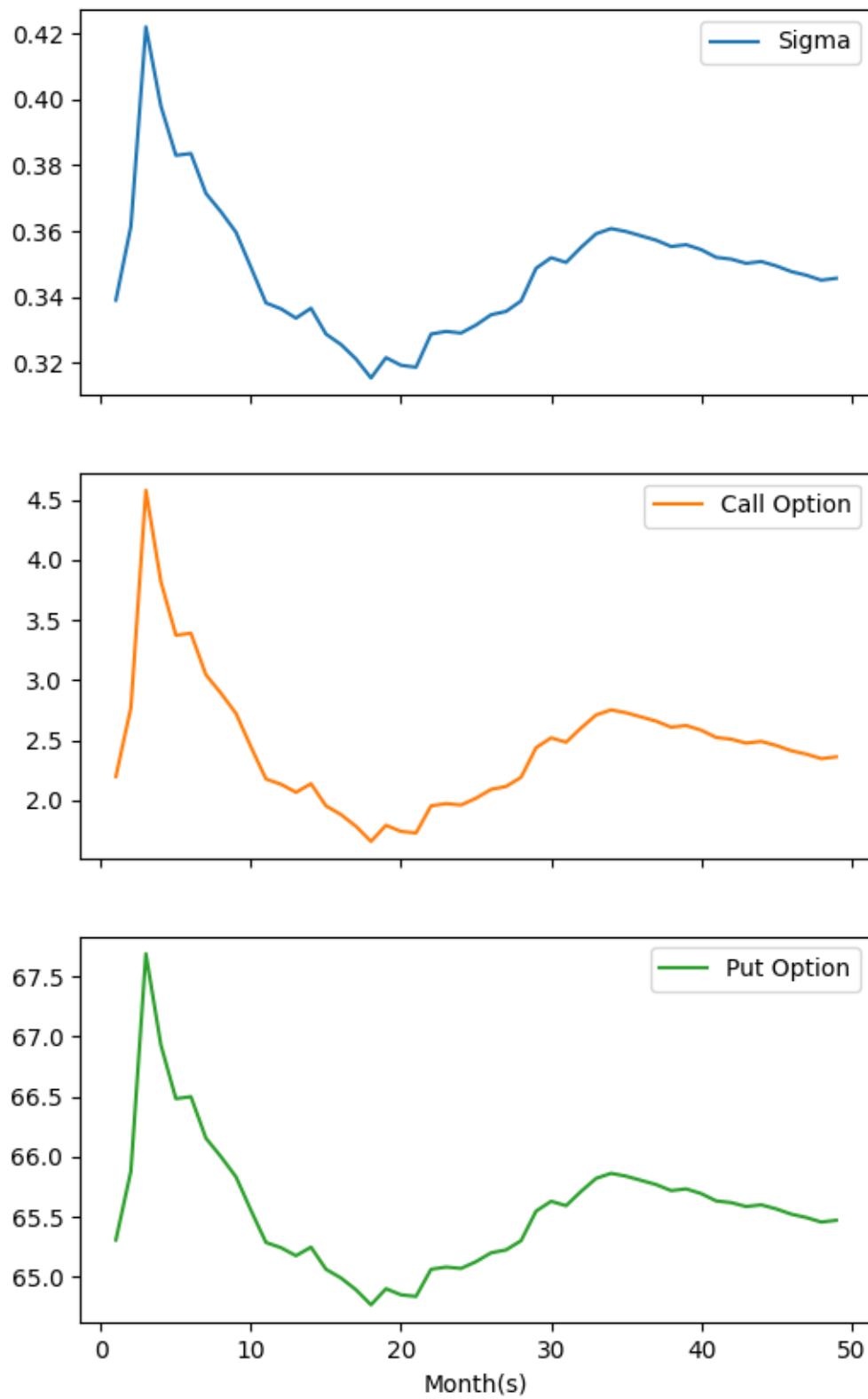
### Plot of TATAMOTORS (NSE) with A = 1.2



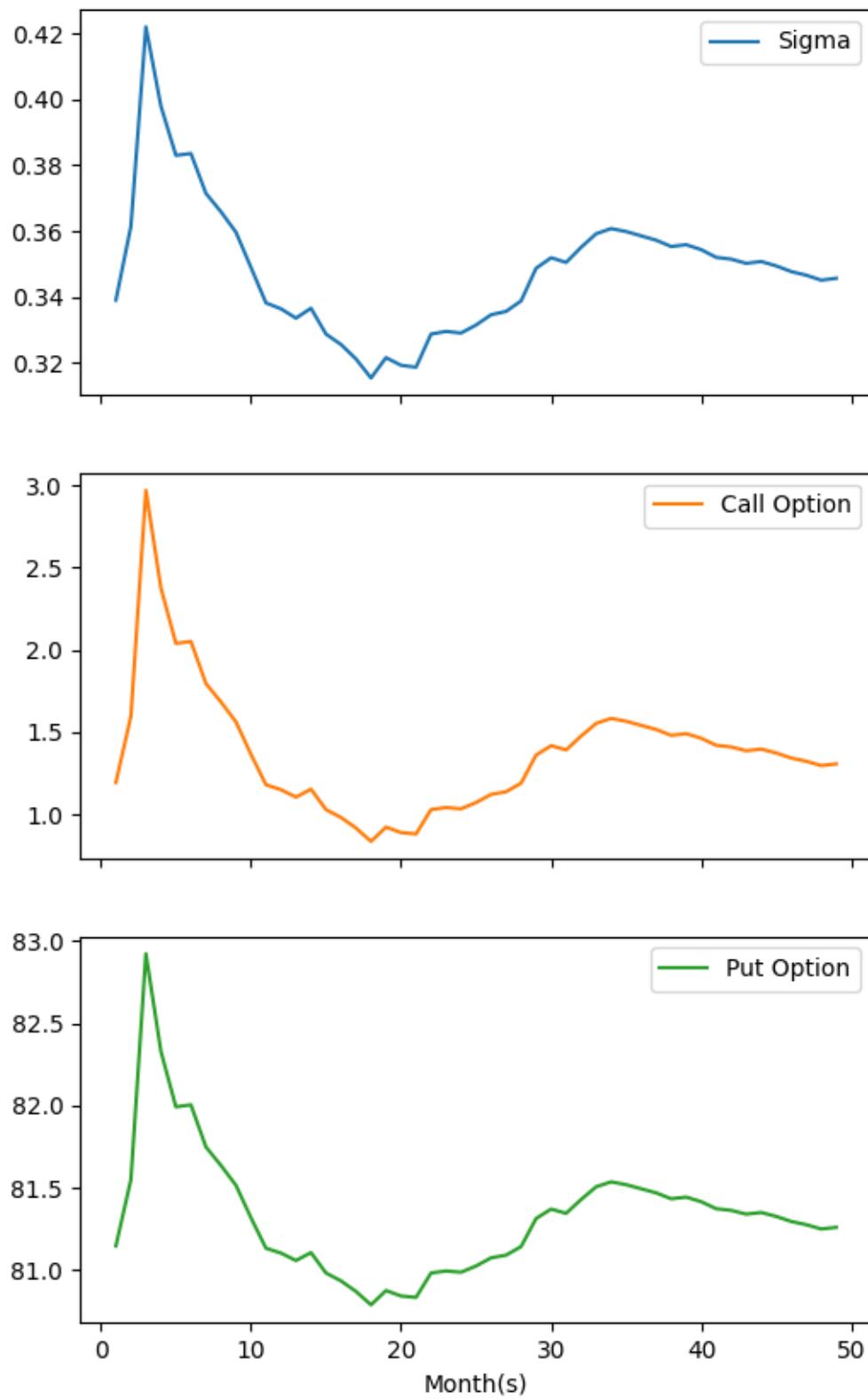
### Plot of TATAMOTORS (NSE) with A = 1.3



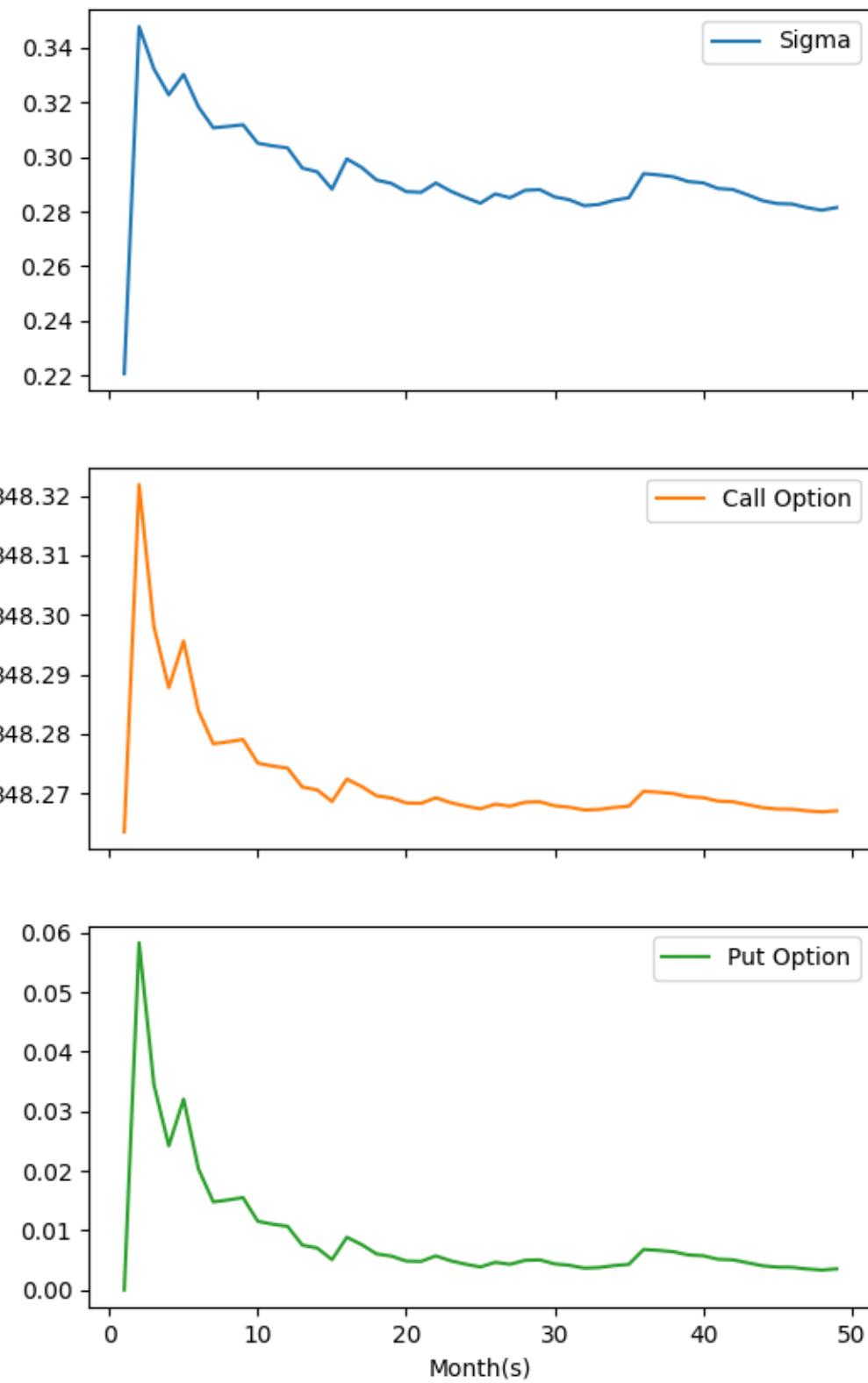
### Plot of TATAMOTORS (NSE) with $A = 1.4$



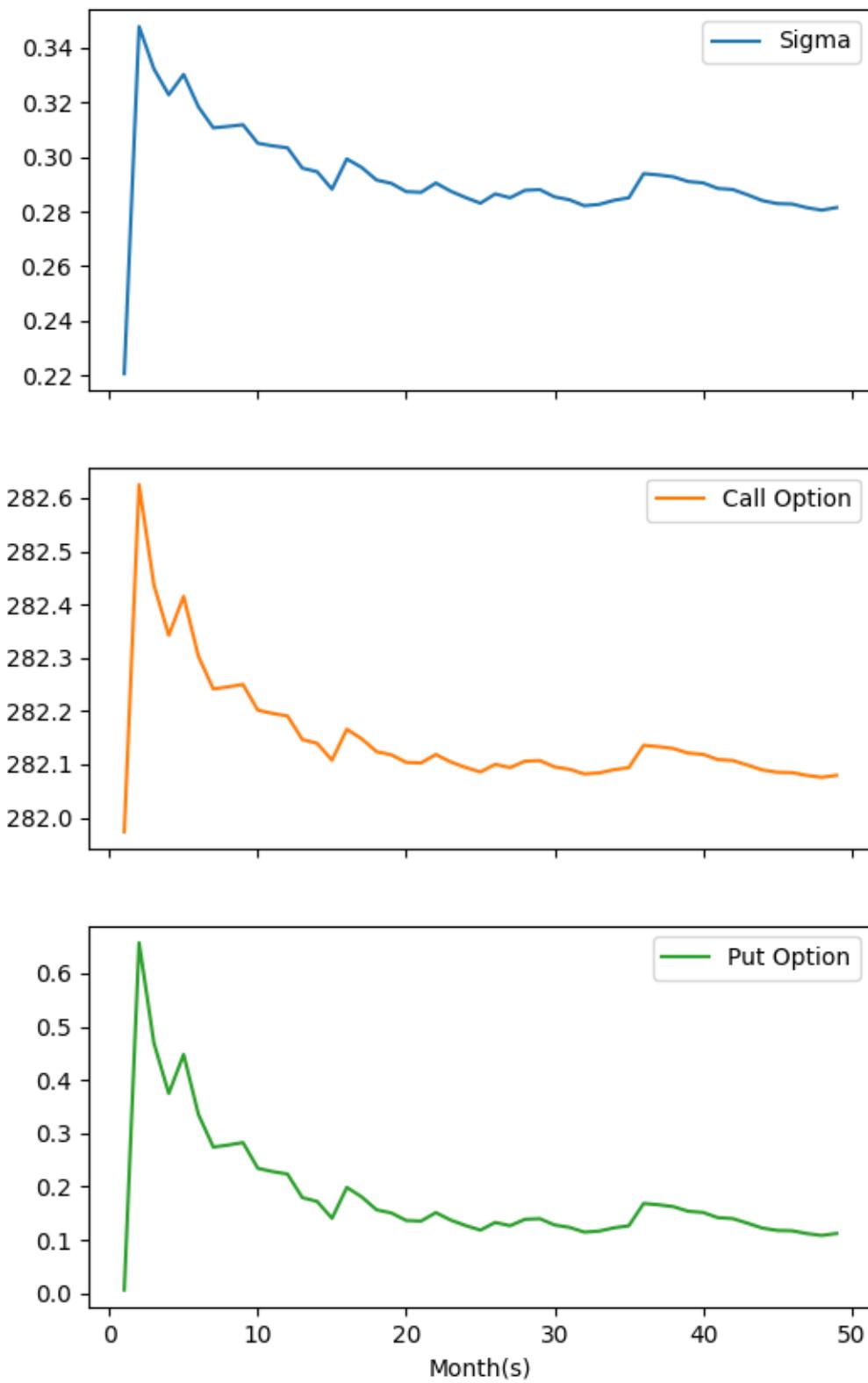
### Plot of TATAMOTORS (NSE) with $A = 1.5$



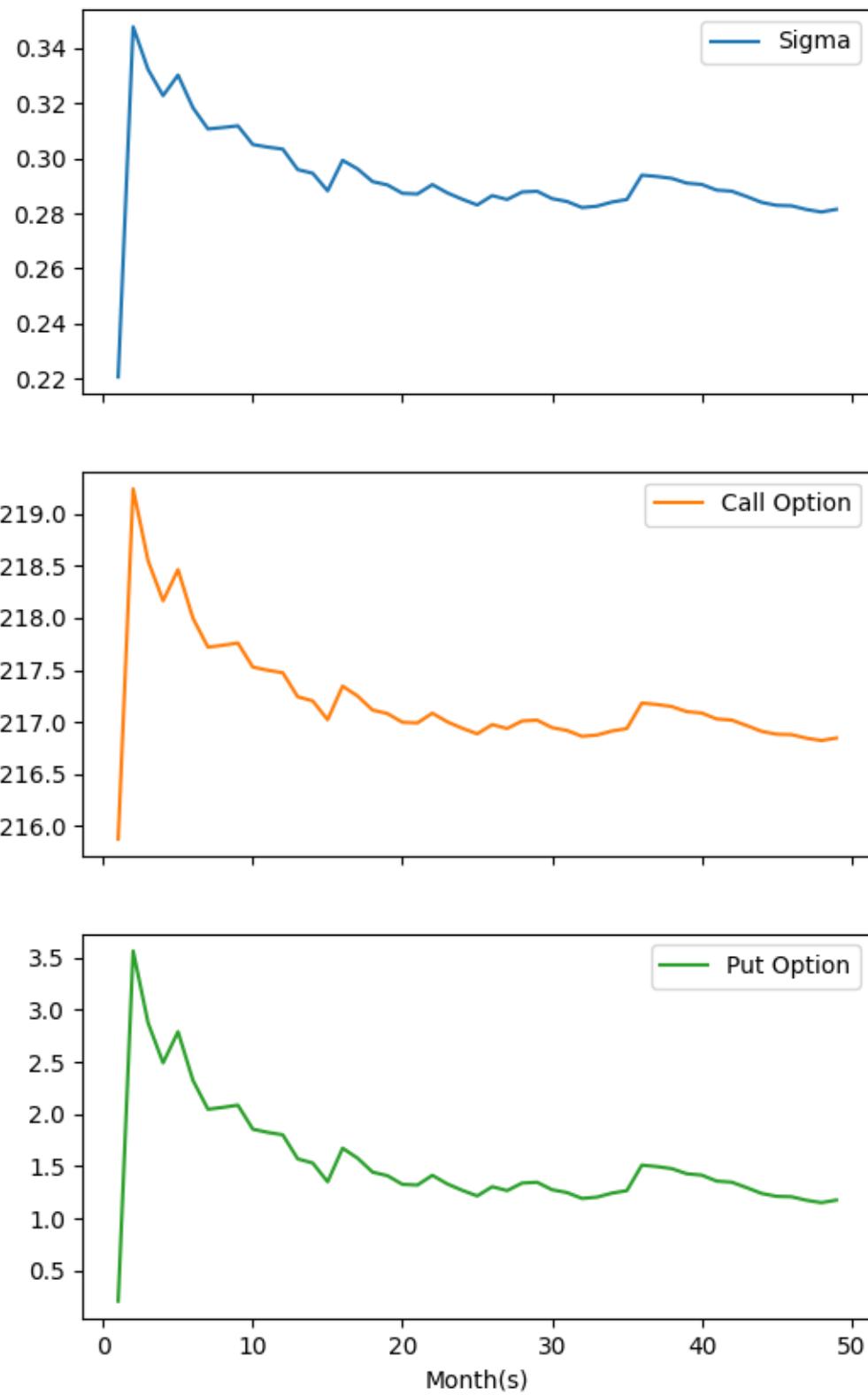
Plot of TECHM (NSE) with  $A = 0.5$



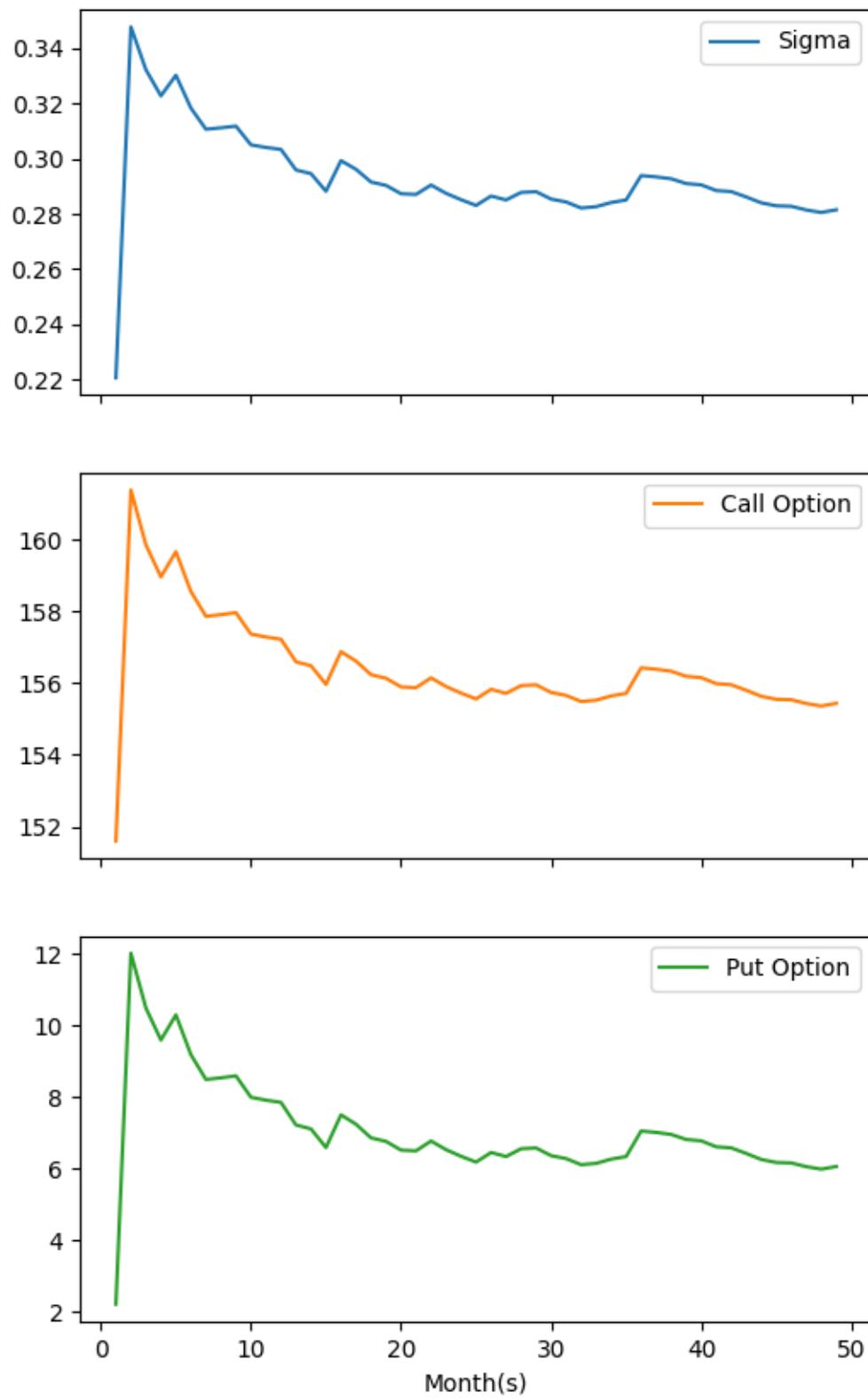
Plot of TECHM (NSE) with  $A = 0.6$



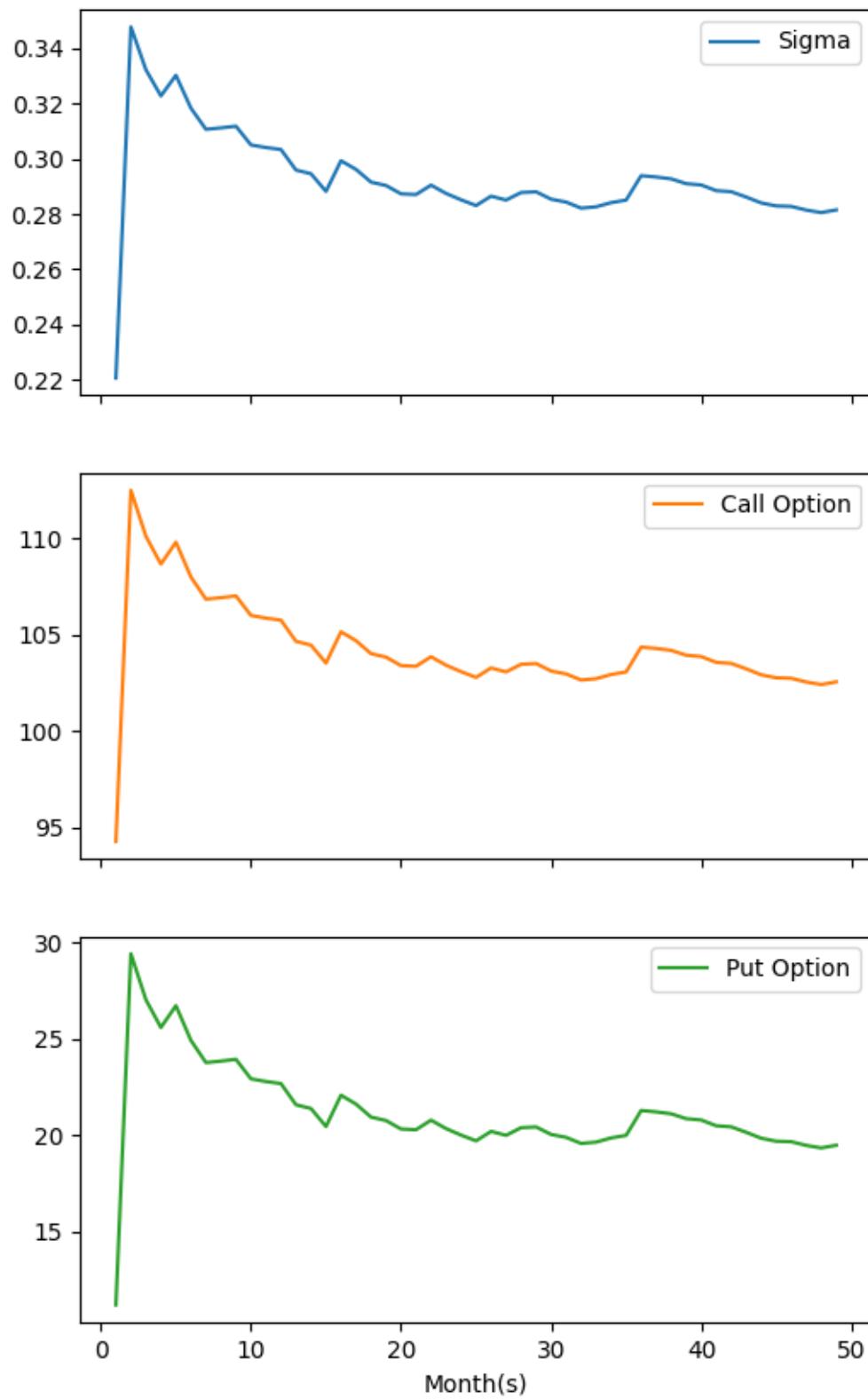
### Plot of TECHM (NSE) with A = 0.7



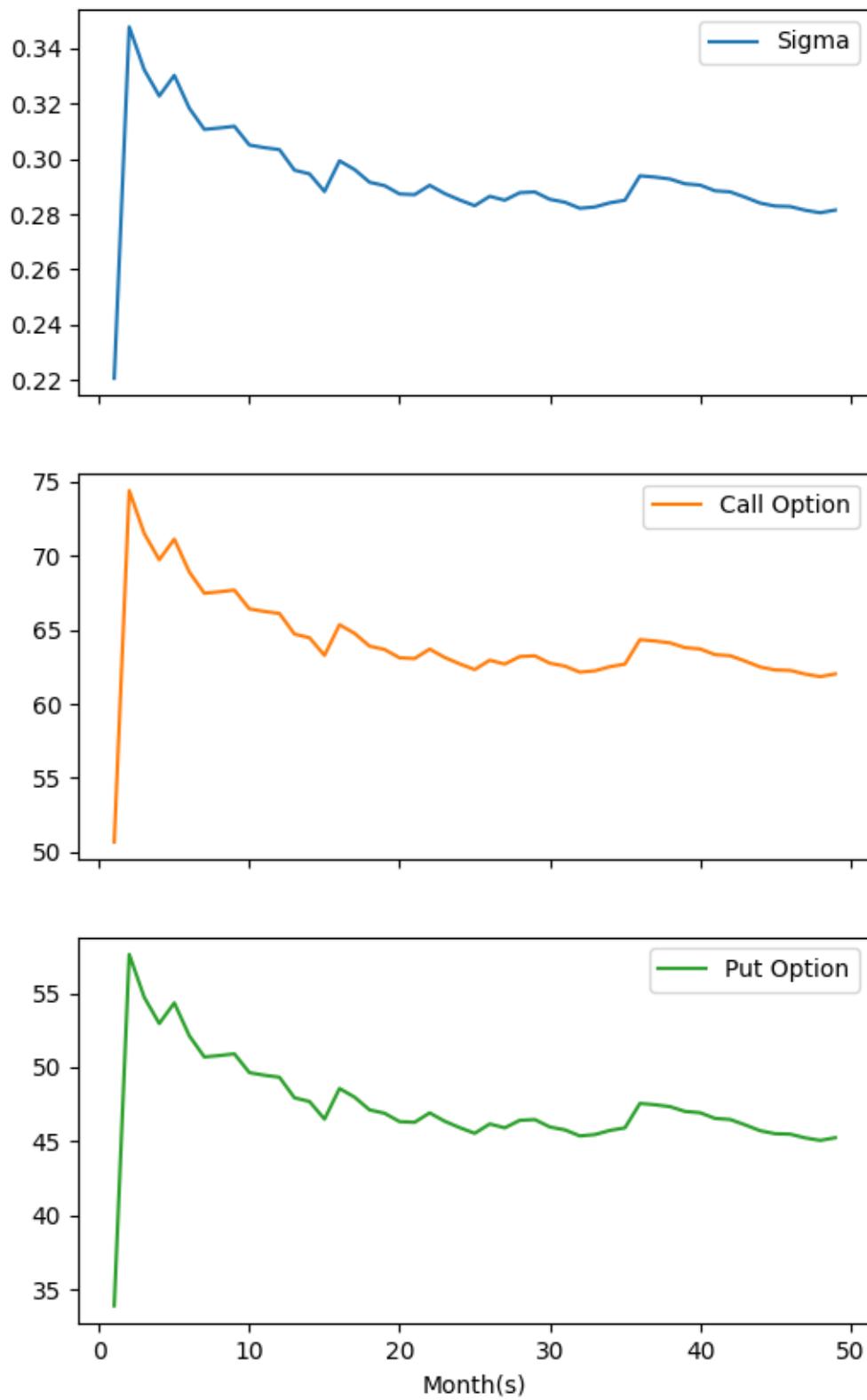
### Plot of TECHM (NSE) with $A = 0.8$



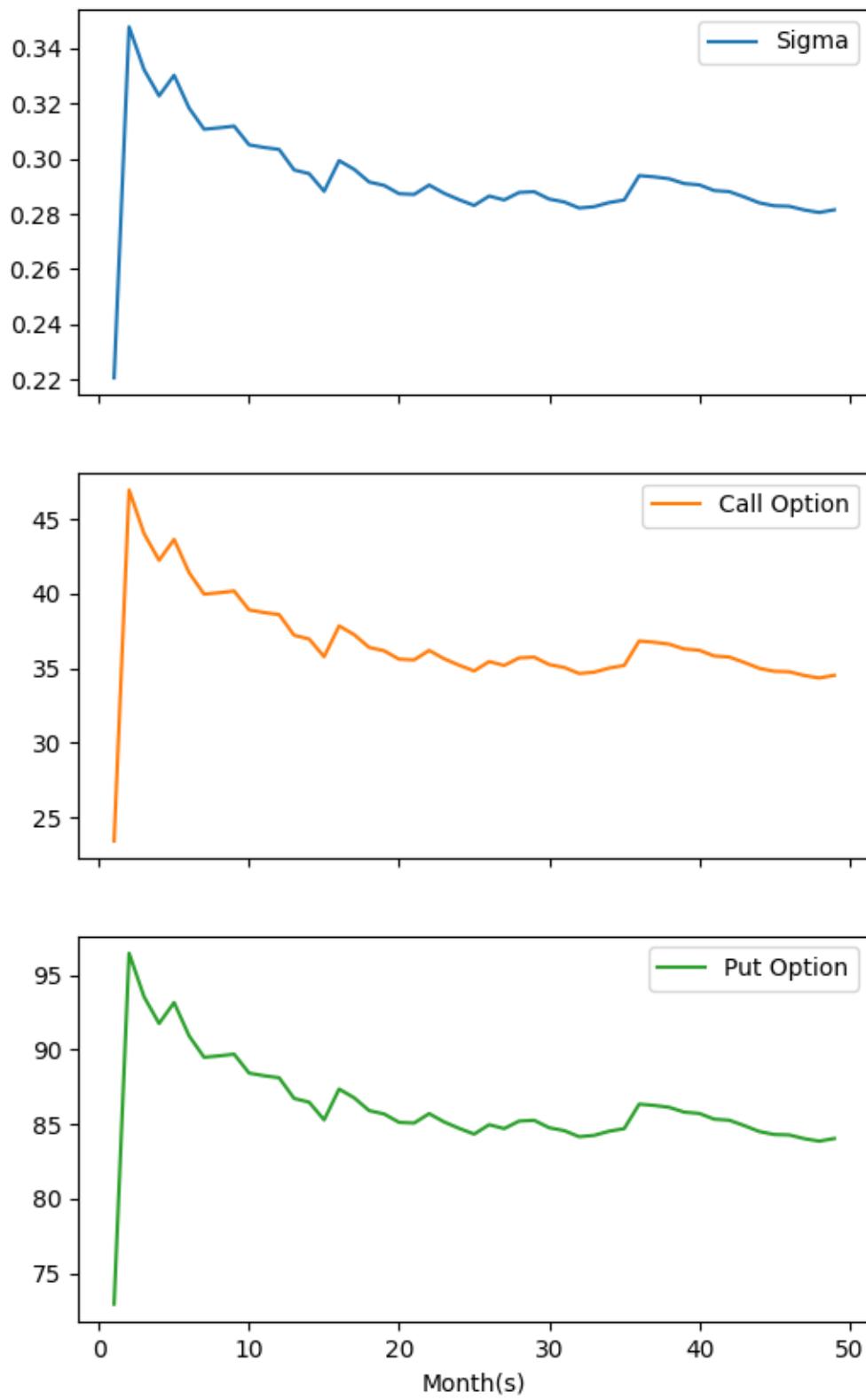
Plot of TECHM (NSE) with  $A = 0.9$



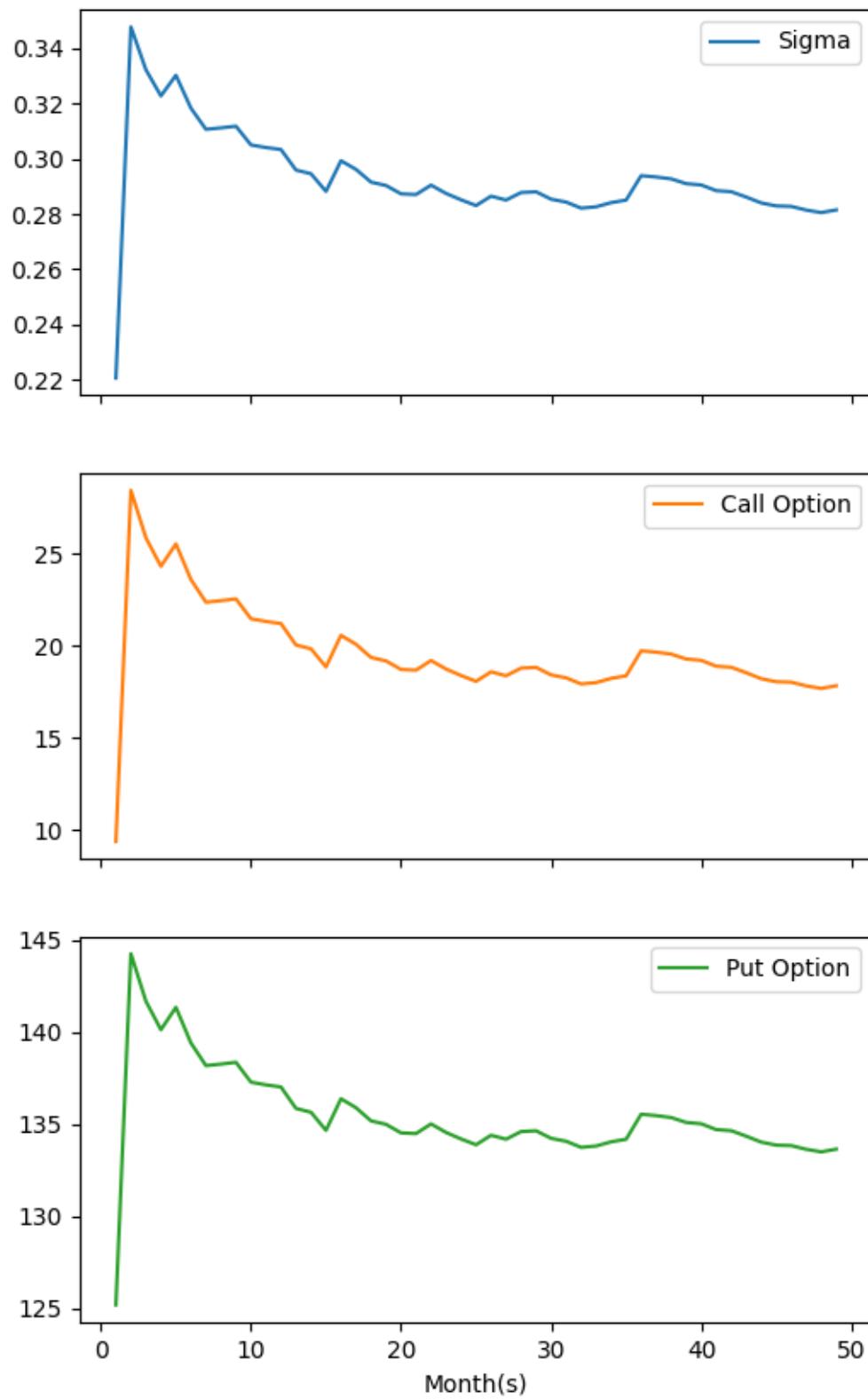
### Plot of TECHM (NSE) with A = 1.0



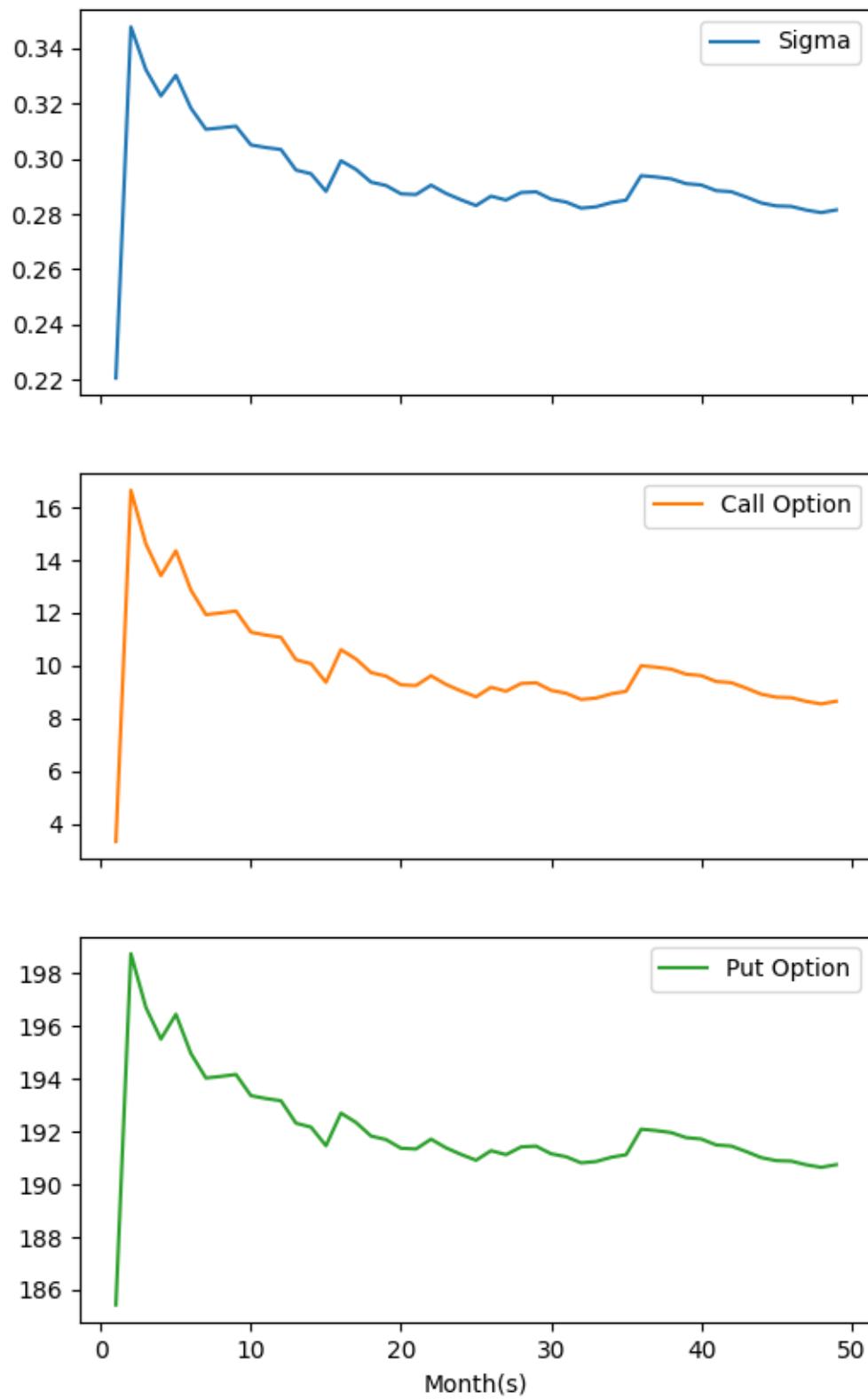
### Plot of TECHM (NSE) with $A = 1.1$



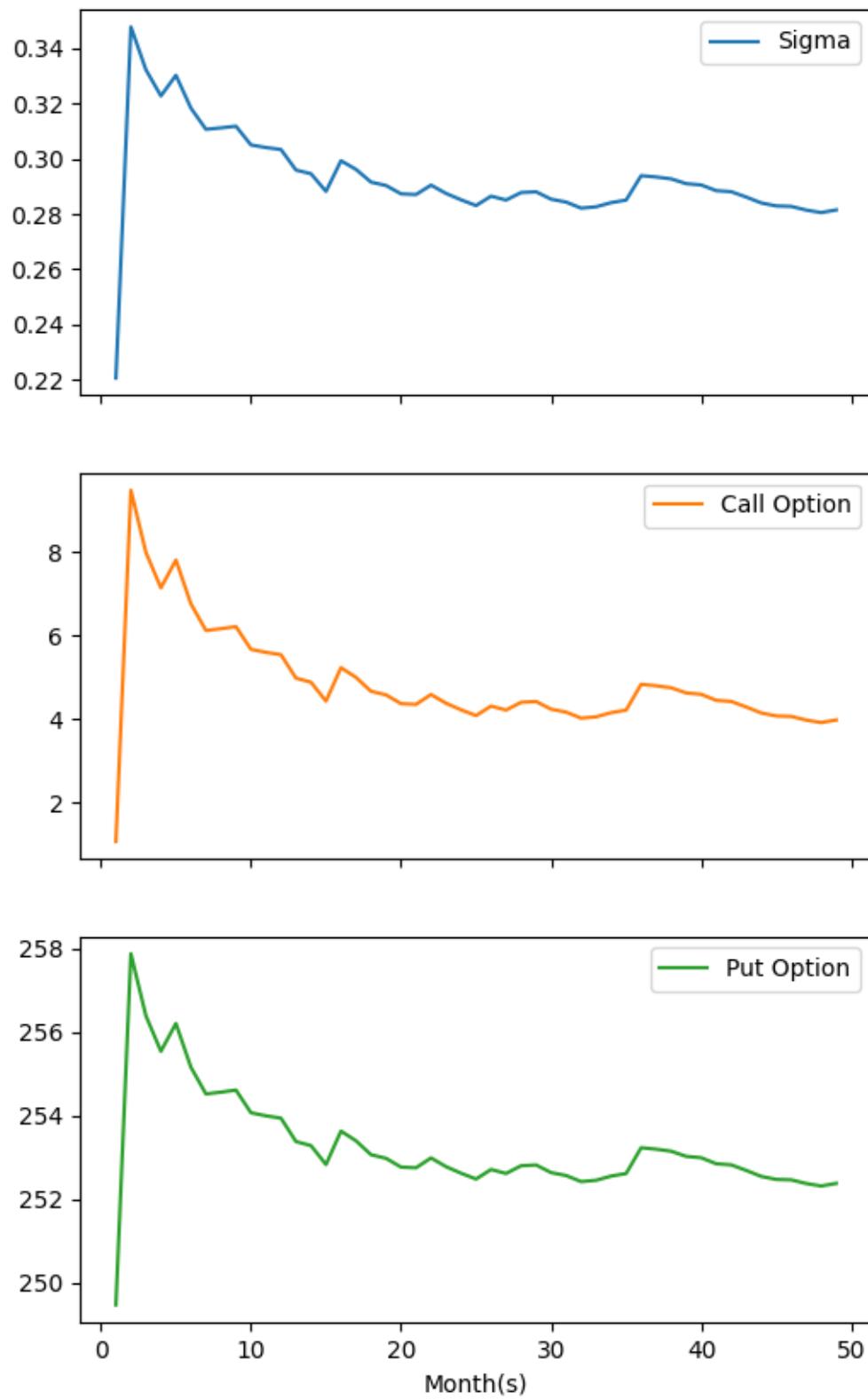
Plot of TECHM (NSE) with  $A = 1.2$



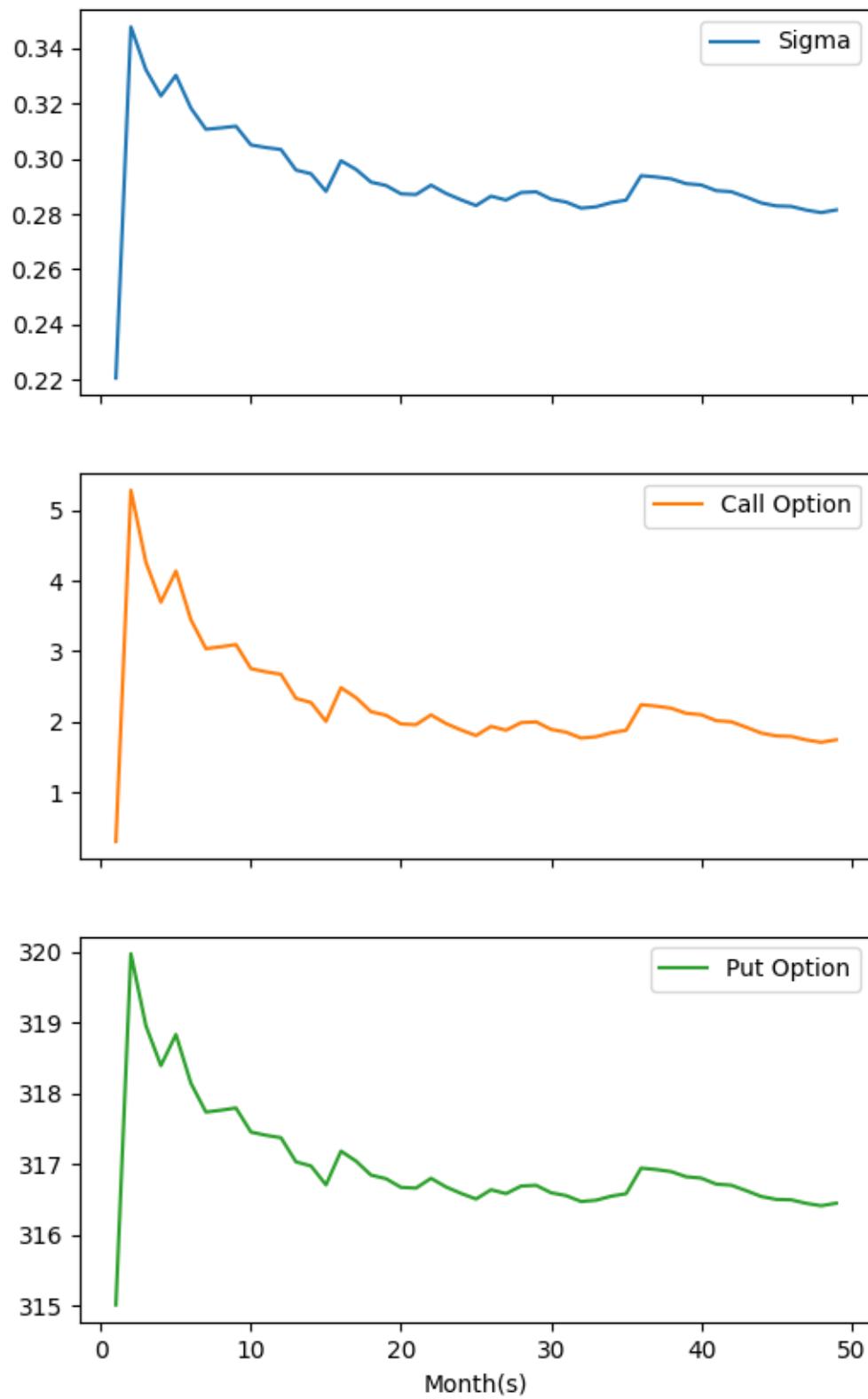
### Plot of TECHM (NSE) with $A = 1.3$



### Plot of TECHM (NSE) with $A = 1.4$

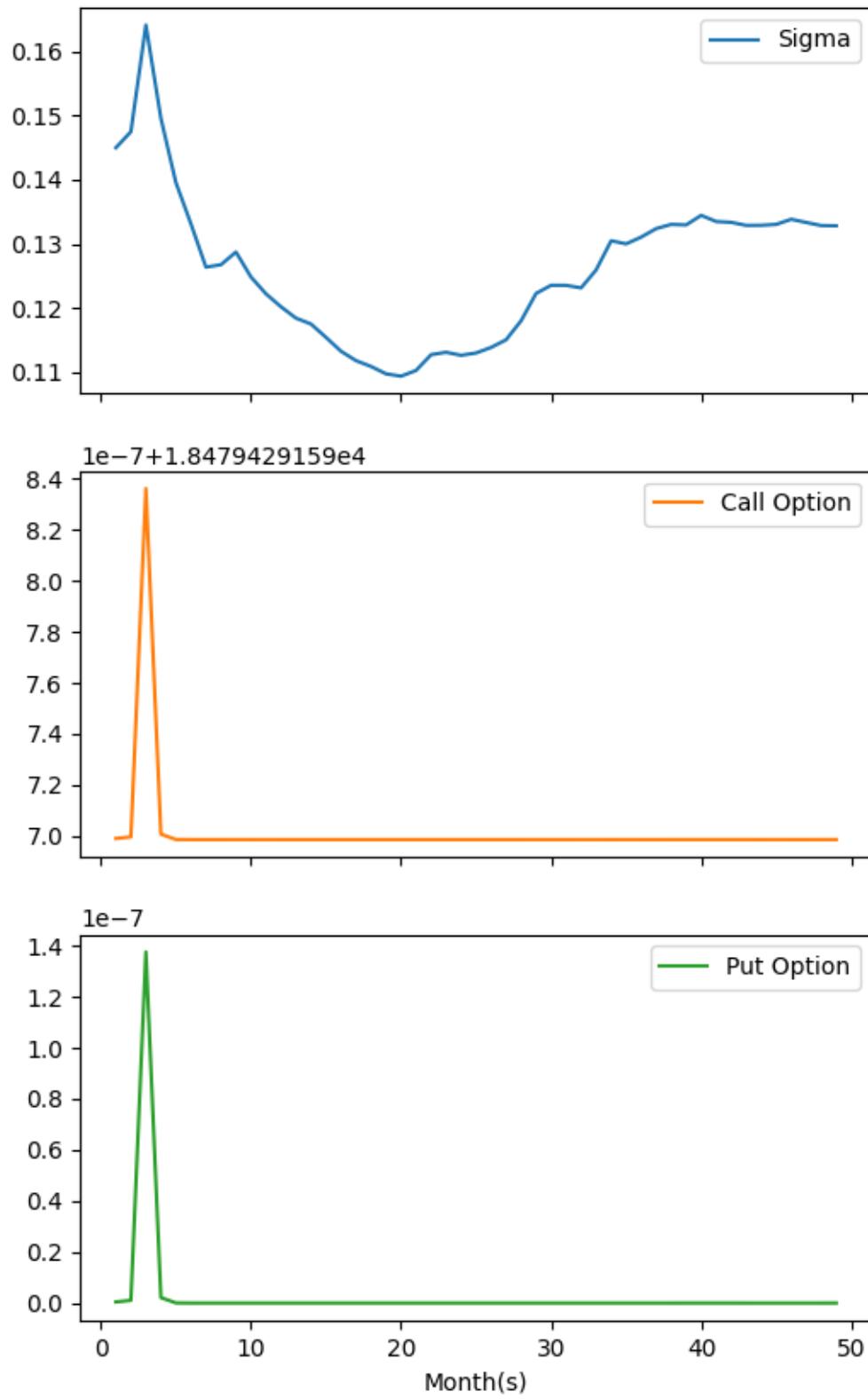


### Plot of TECHM (NSE) with $A = 1.5$

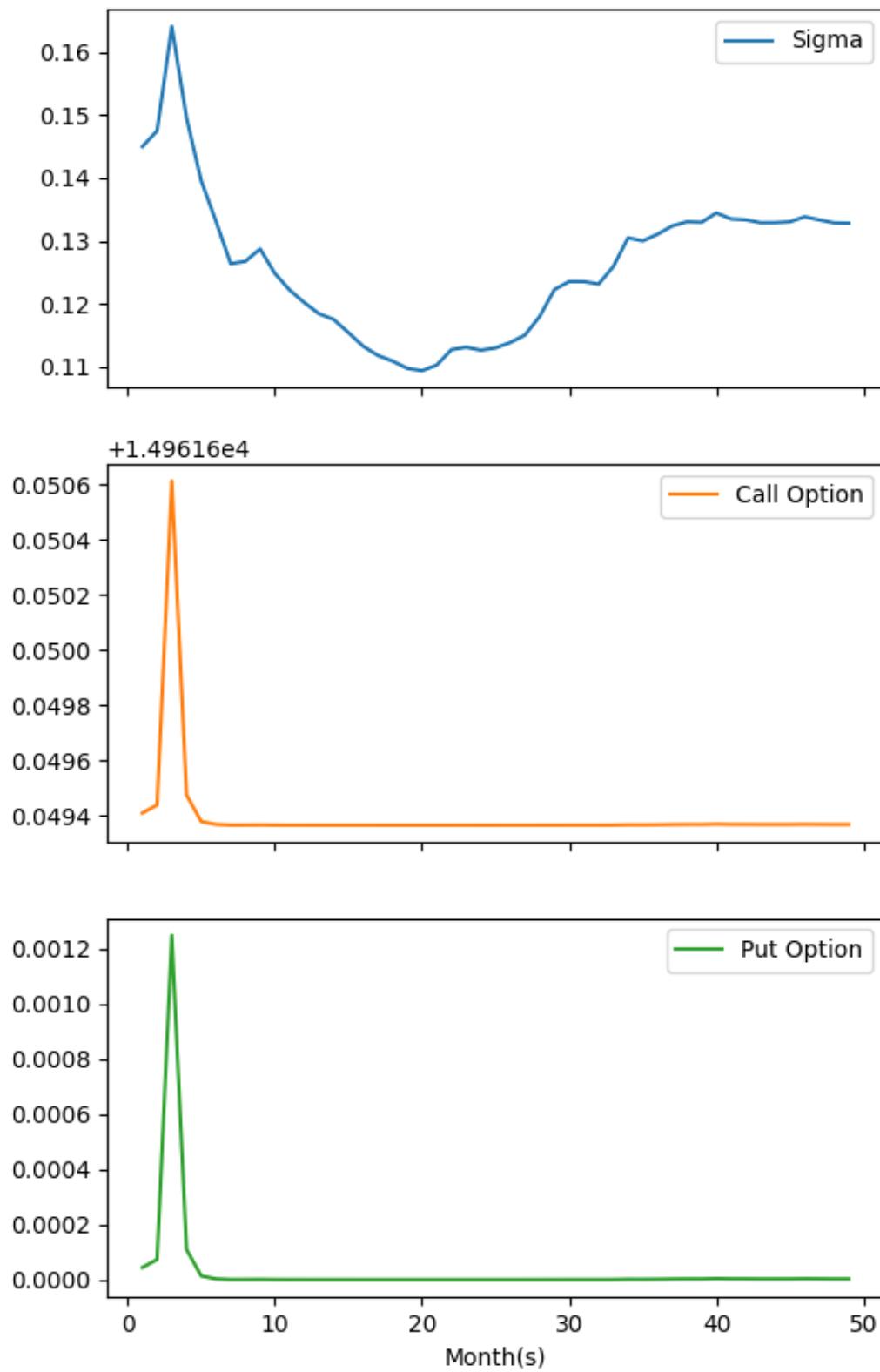


# **BSE Indices**

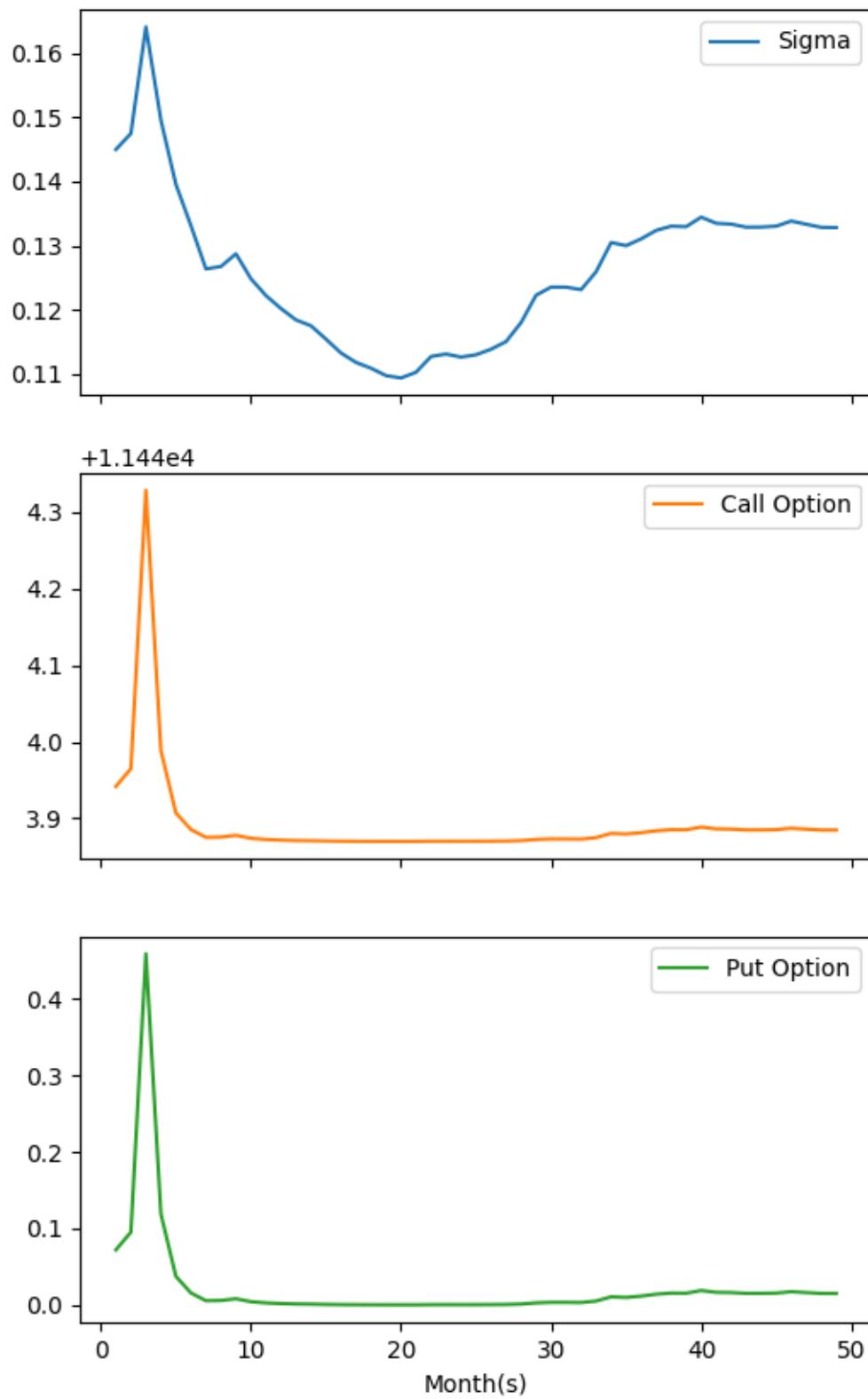
### Plot of BSE Index with $A = 0.5$



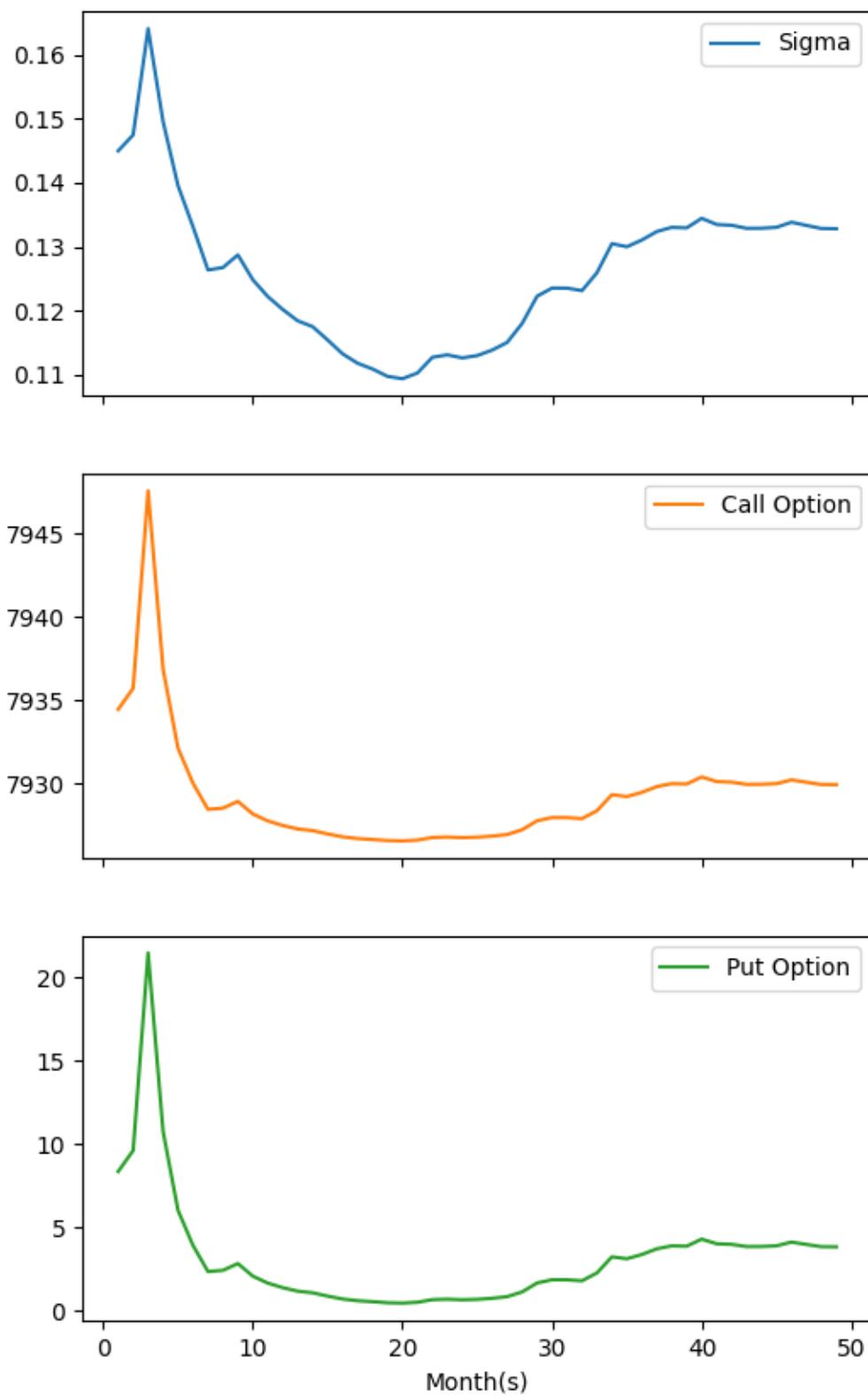
### Plot of BSE Index with A = 0.6



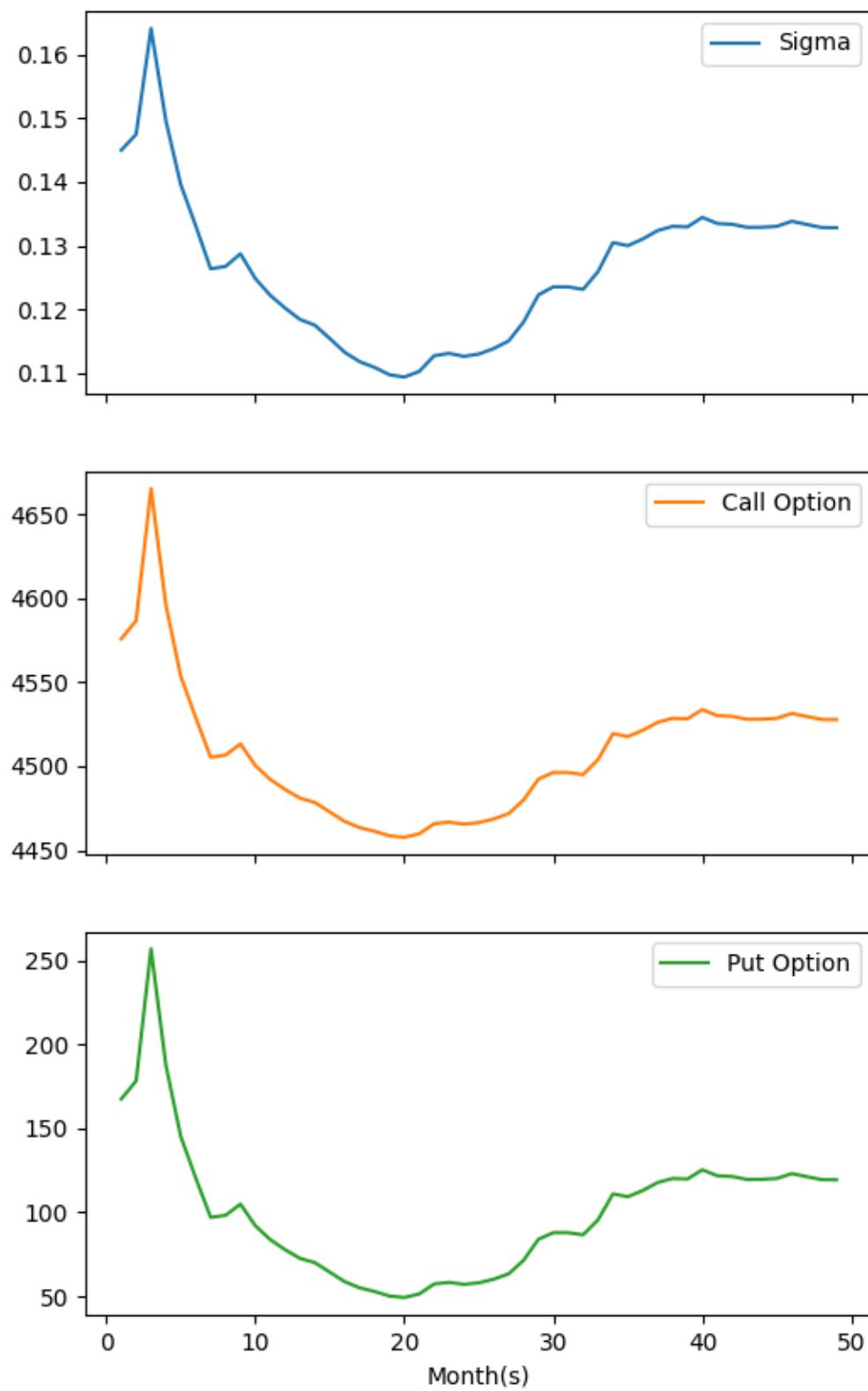
### Plot of BSE Index with A = 0.7



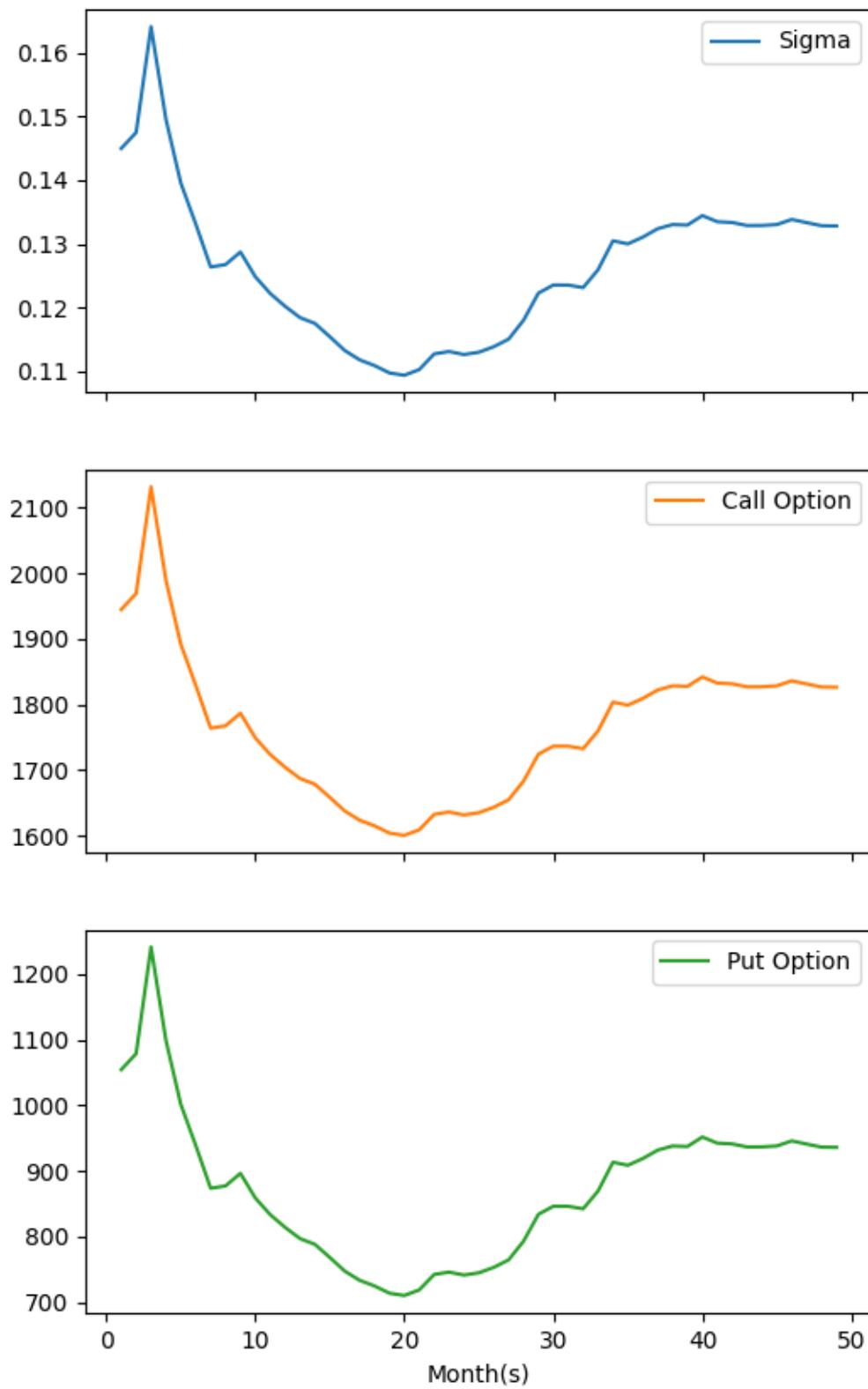
Plot of BSE Index with  $A = 0.8$



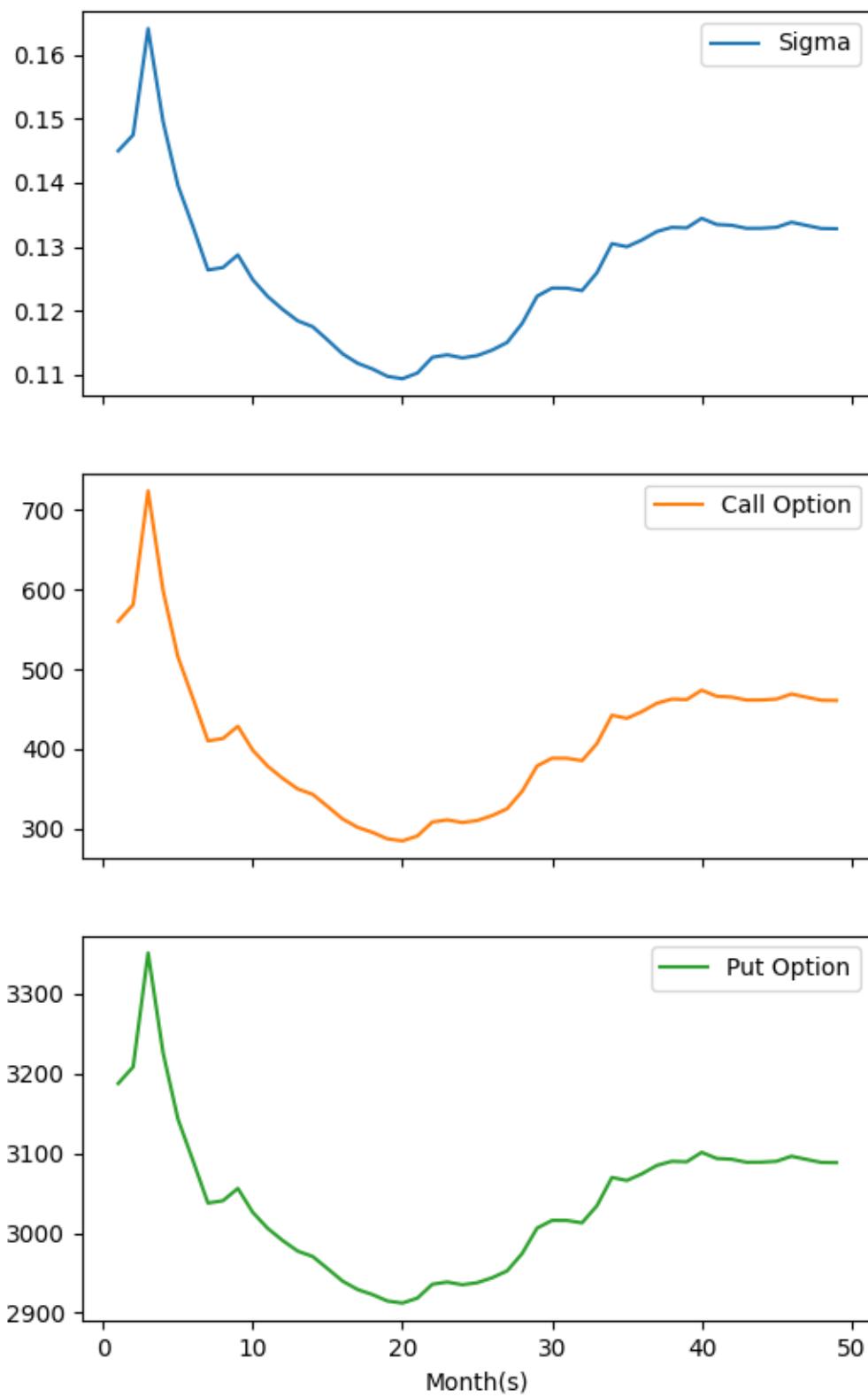
### Plot of BSE Index with $A = 0.9$



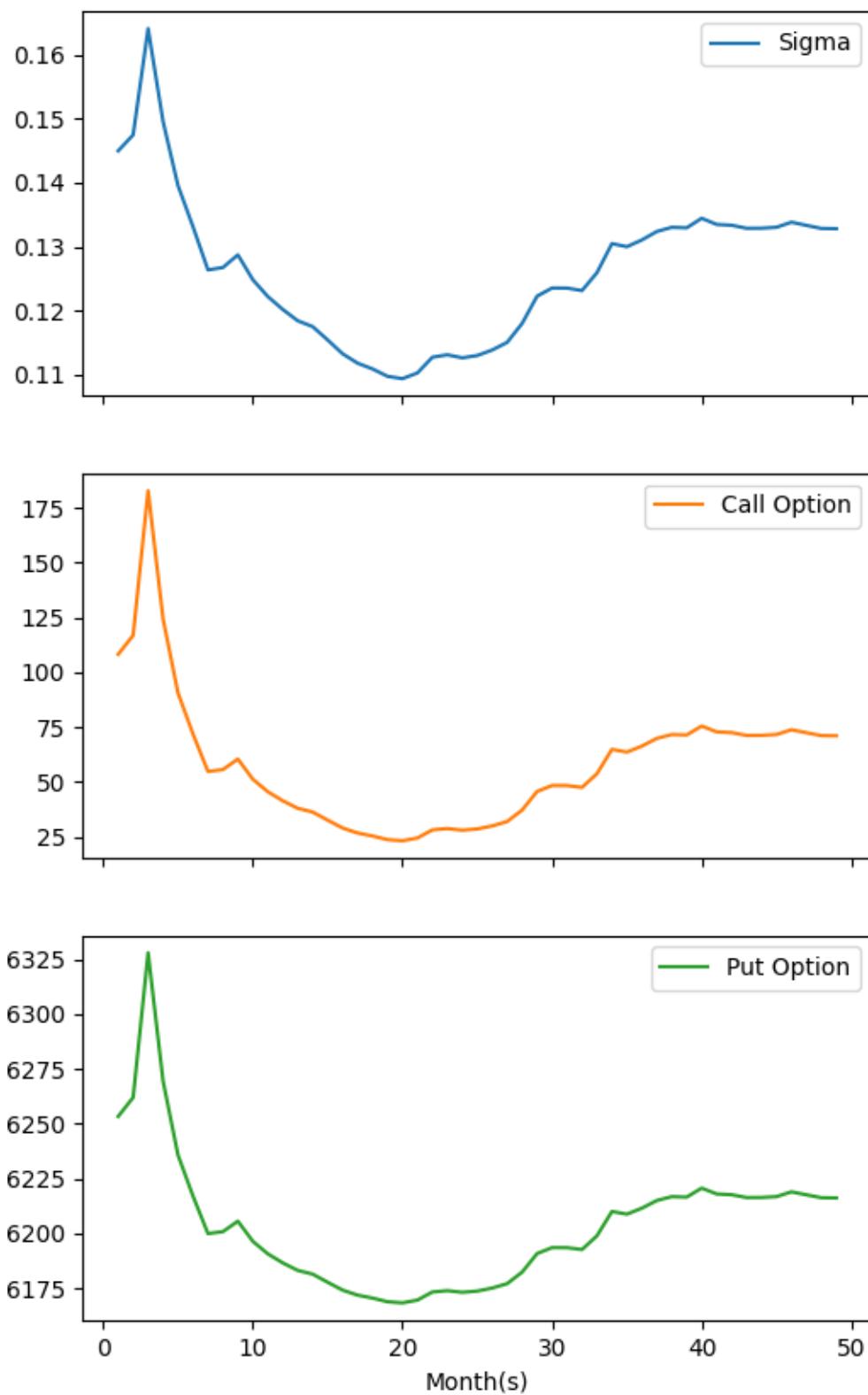
### Plot of BSE Index with $A = 1.0$



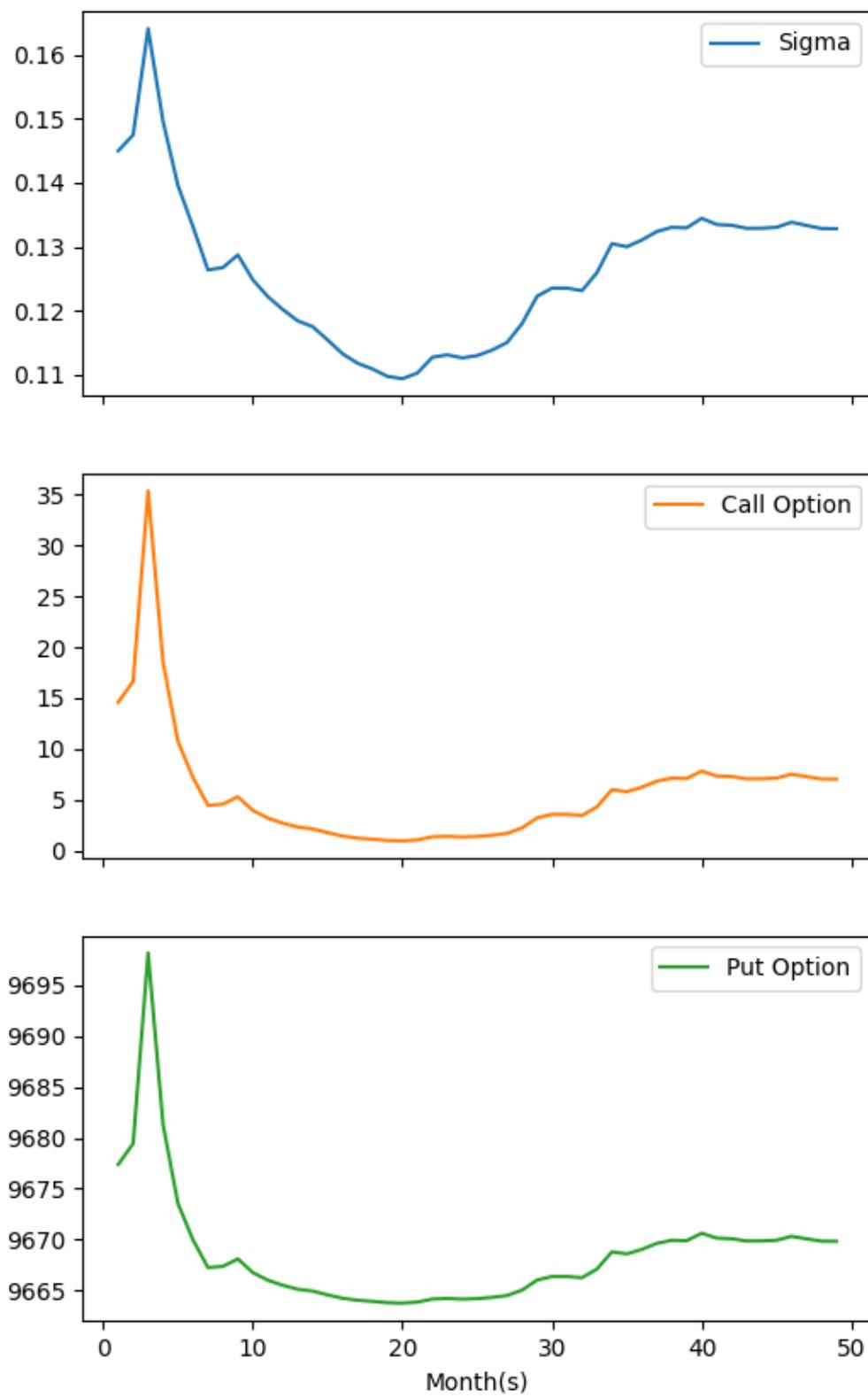
### Plot of BSE Index with $A = 1.1$



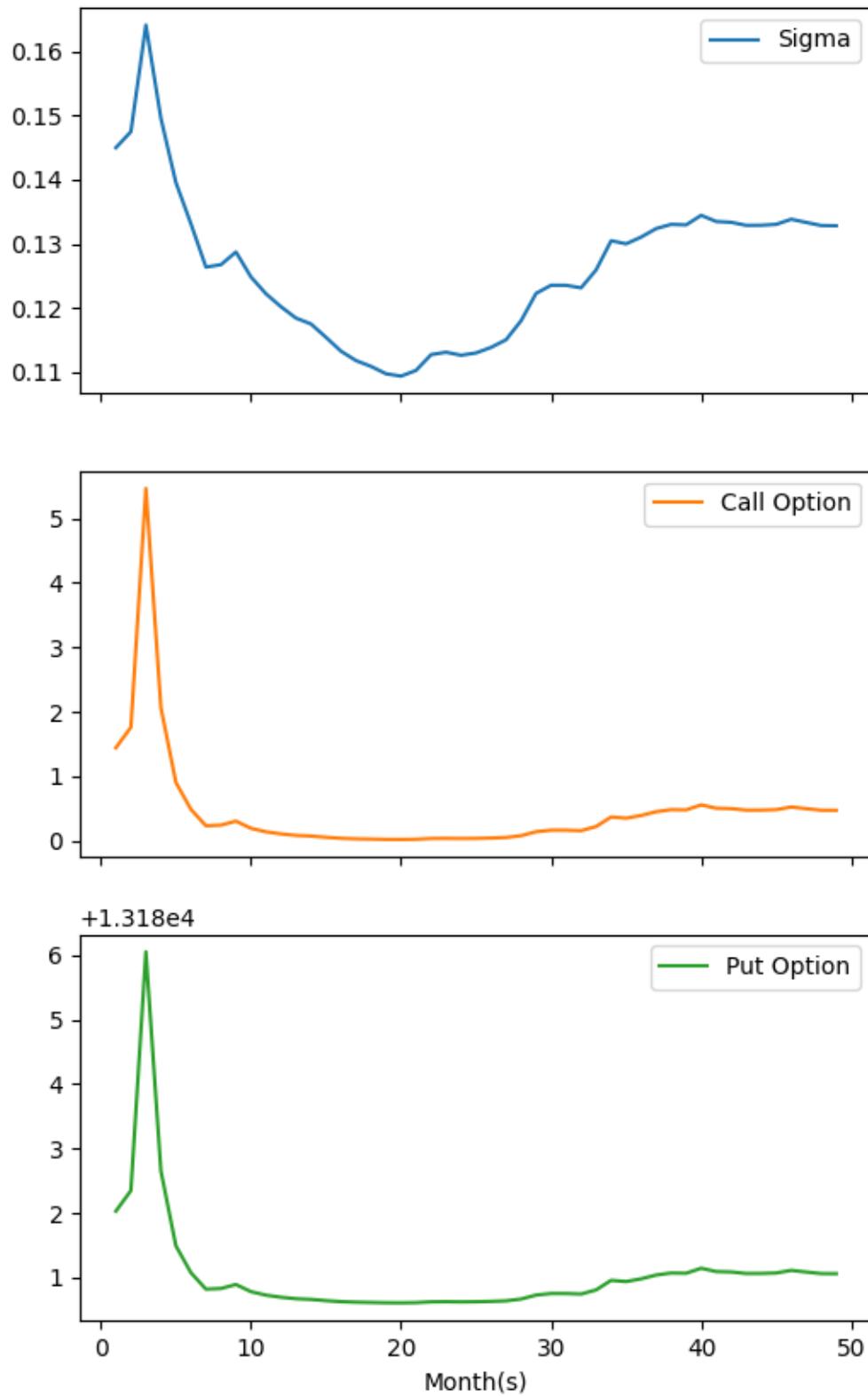
### Plot of BSE Index with $A = 1.2$



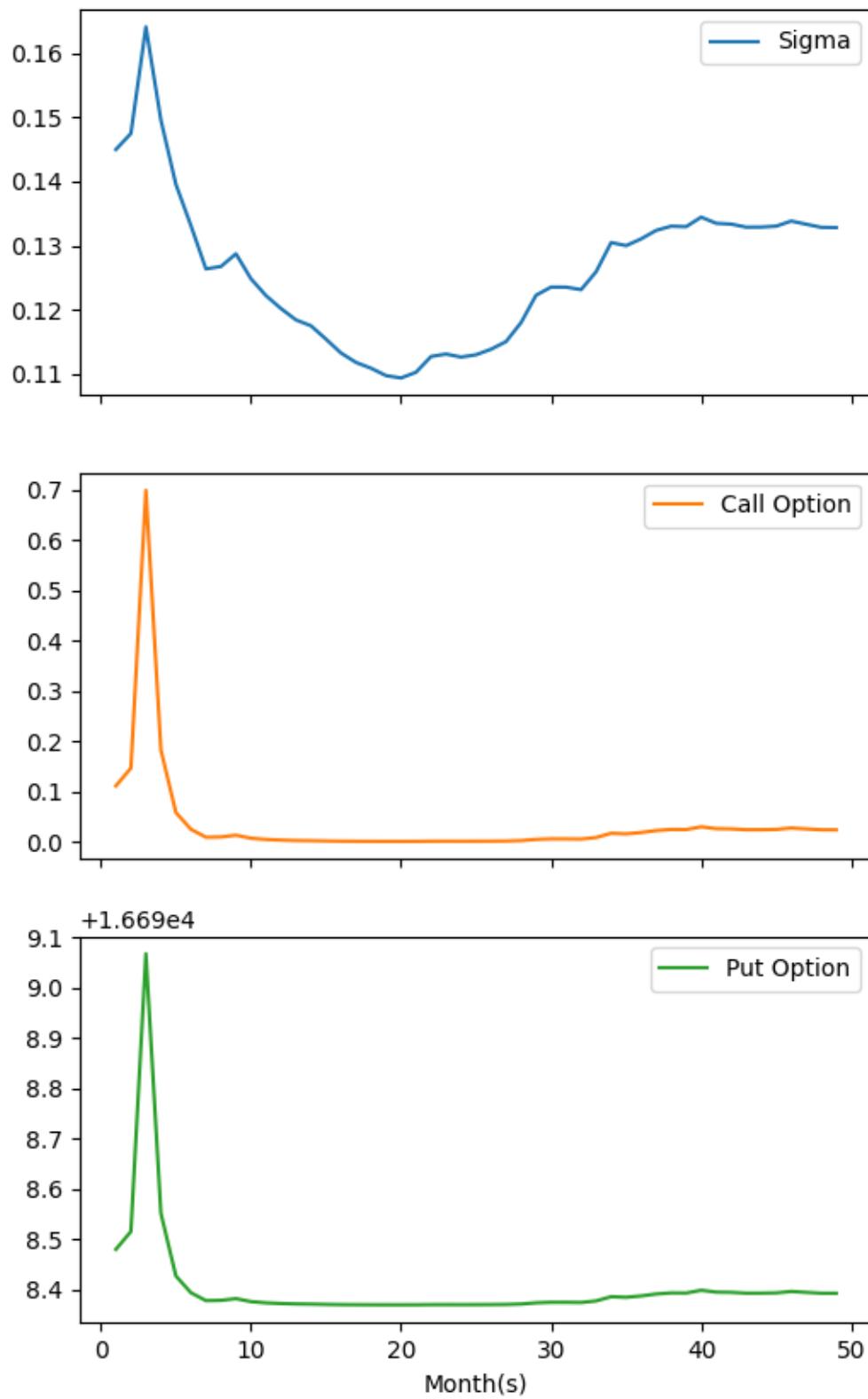
### Plot of BSE Index with $A = 1.3$



### Plot of BSE Index with $A = 1.4$

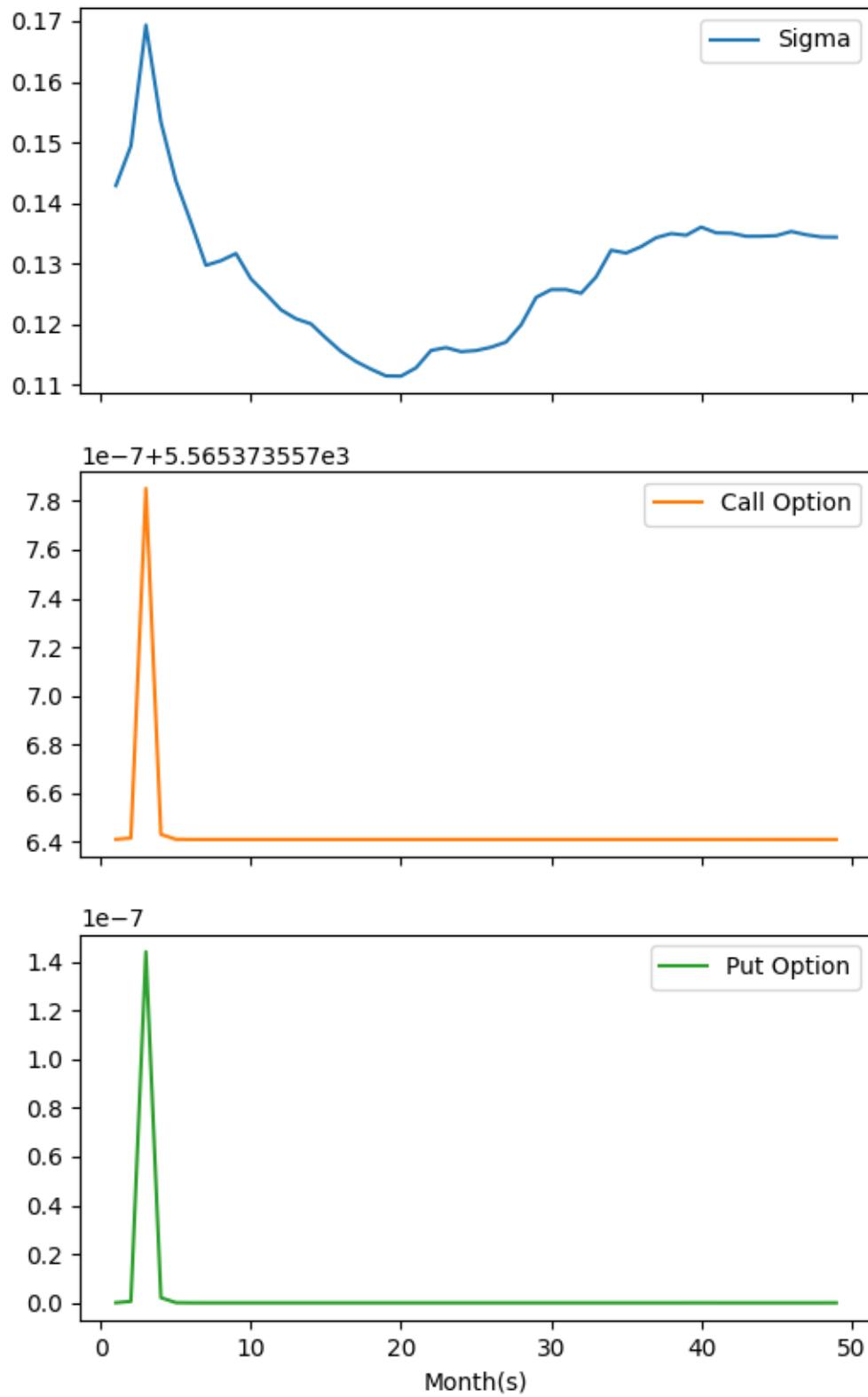


### Plot of BSE Index with A = 1.5

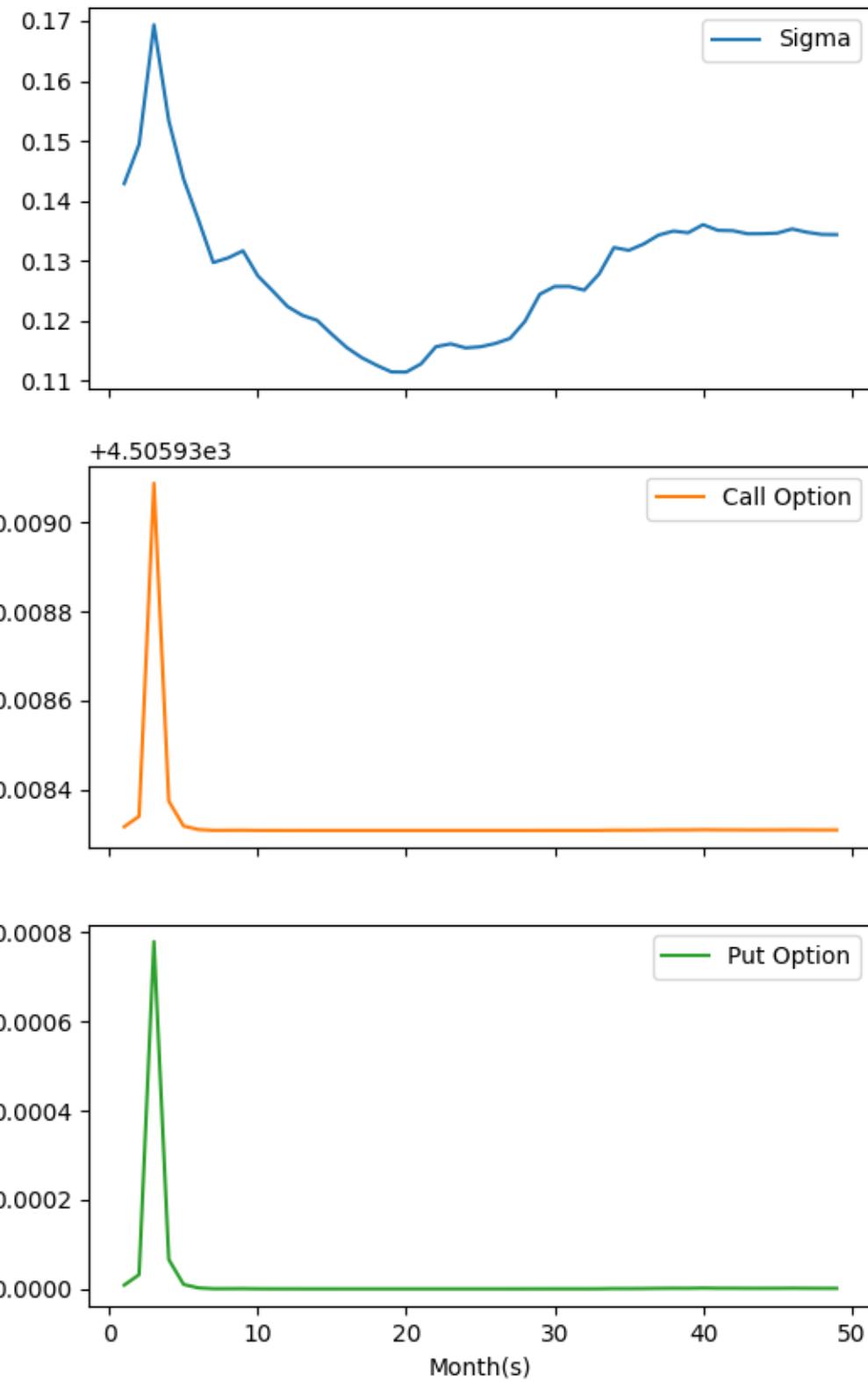


# NSE Indices

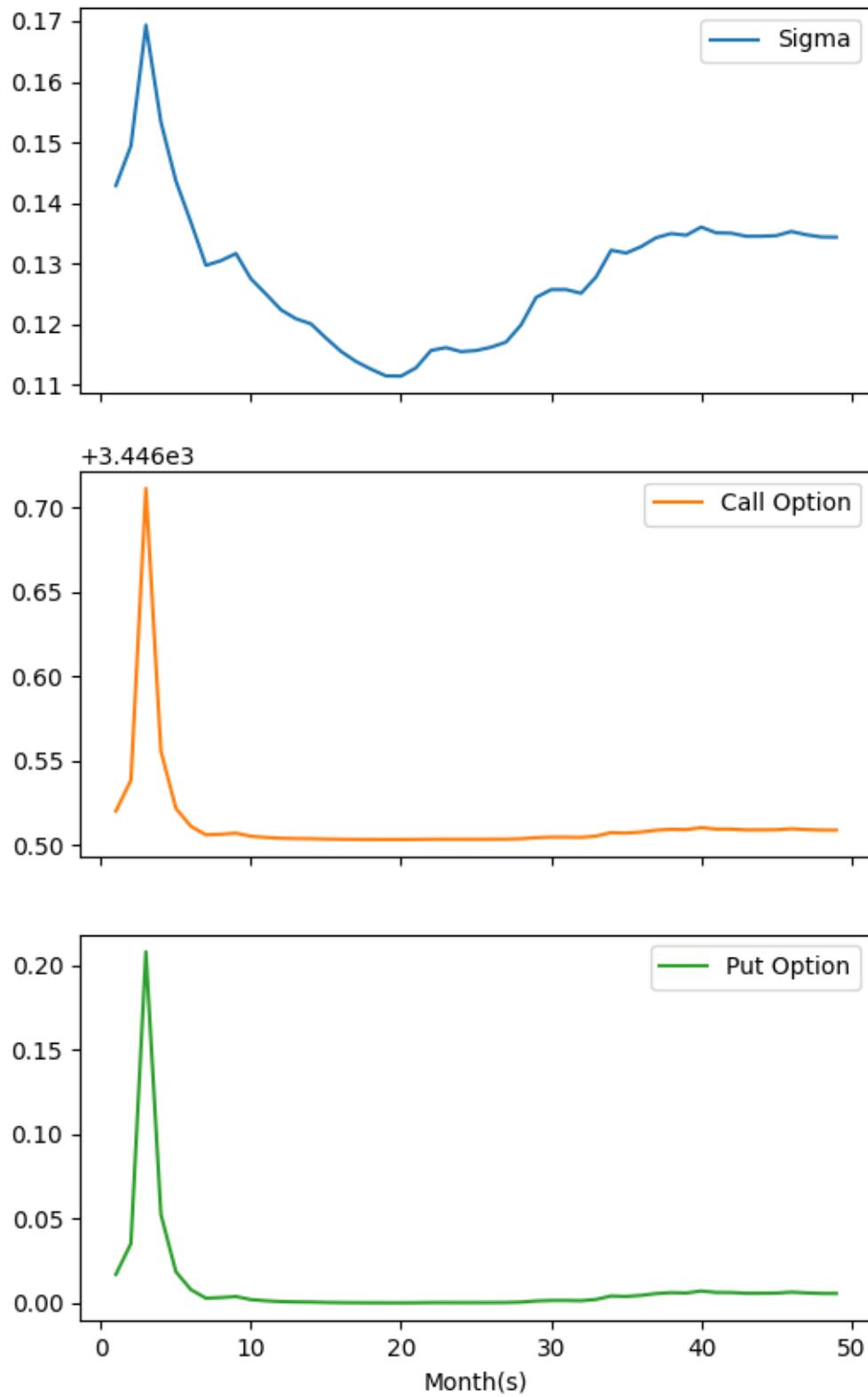
### Plot of NSE Index with $A = 0.5$



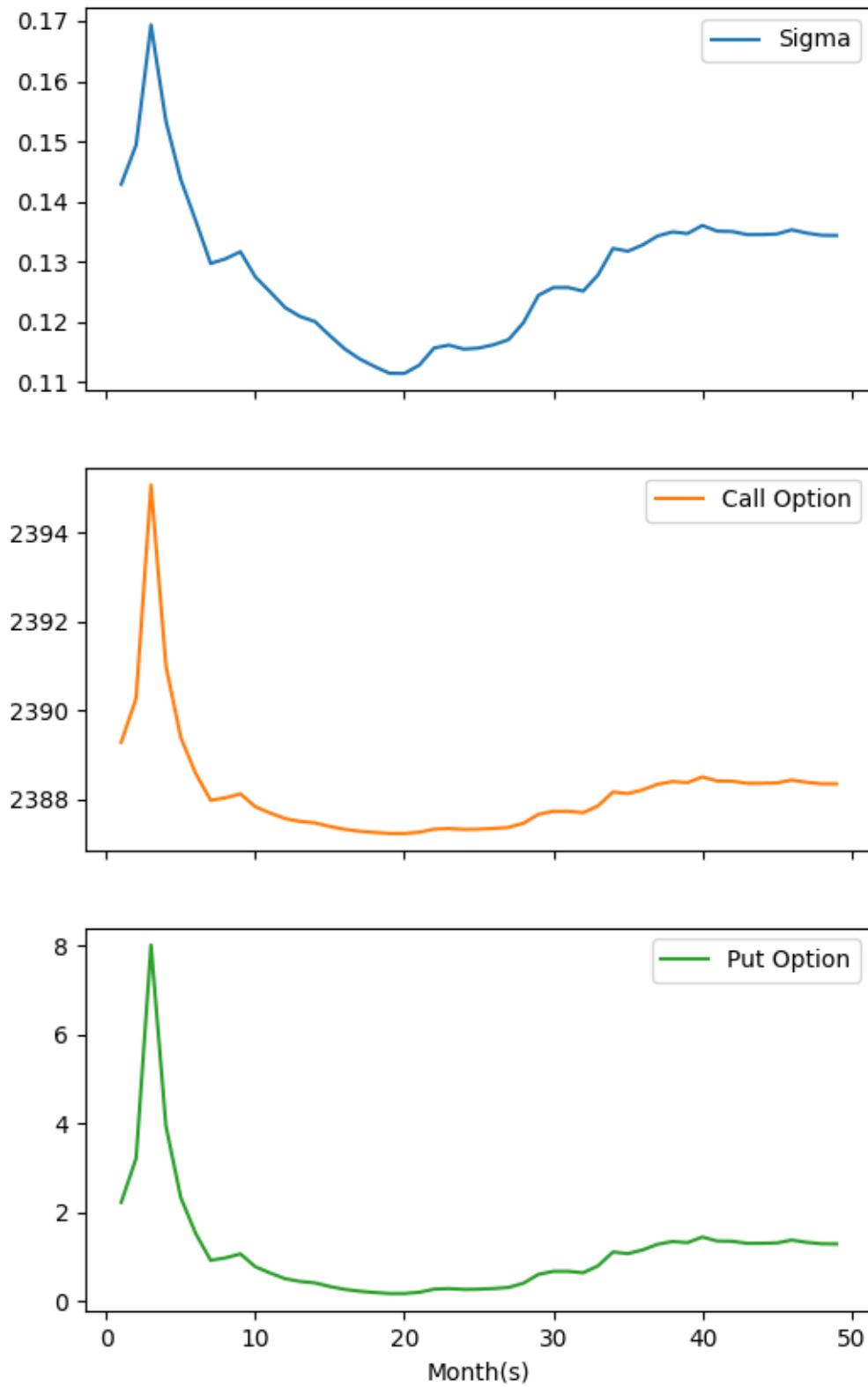
### Plot of NSE Index with A = 0.6



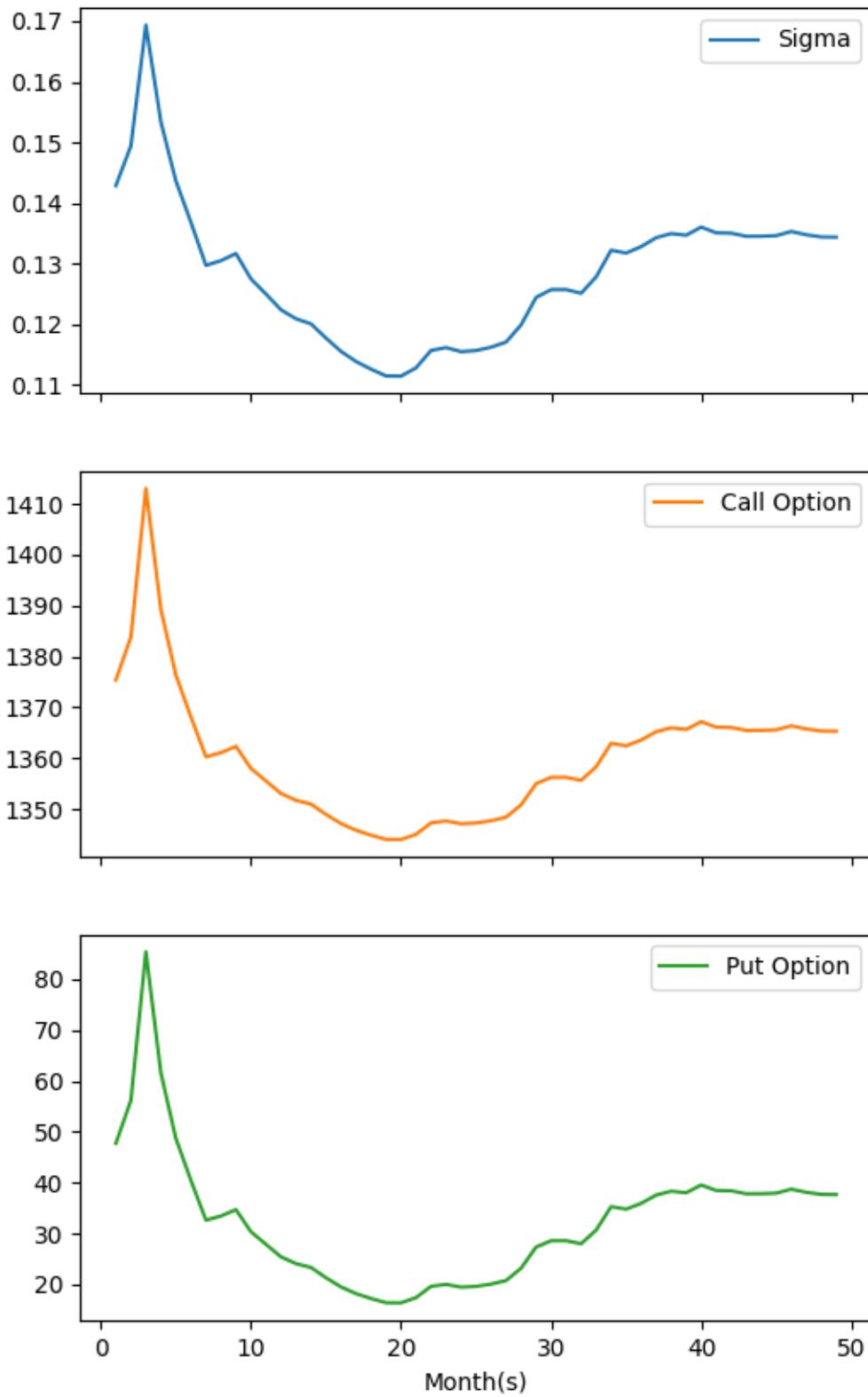
### Plot of NSE Index with A = 0.7



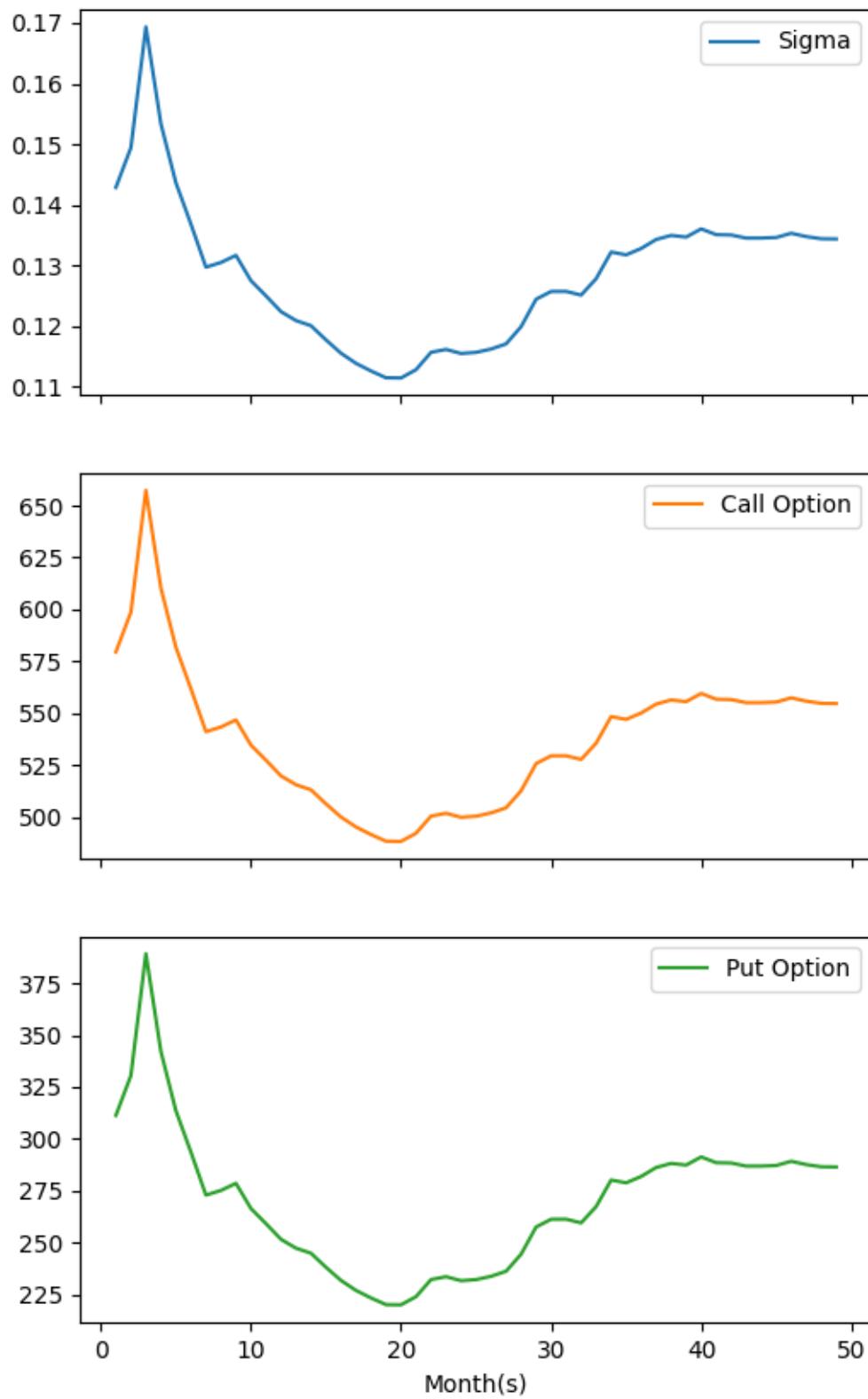
### Plot of NSE Index with $A = 0.8$



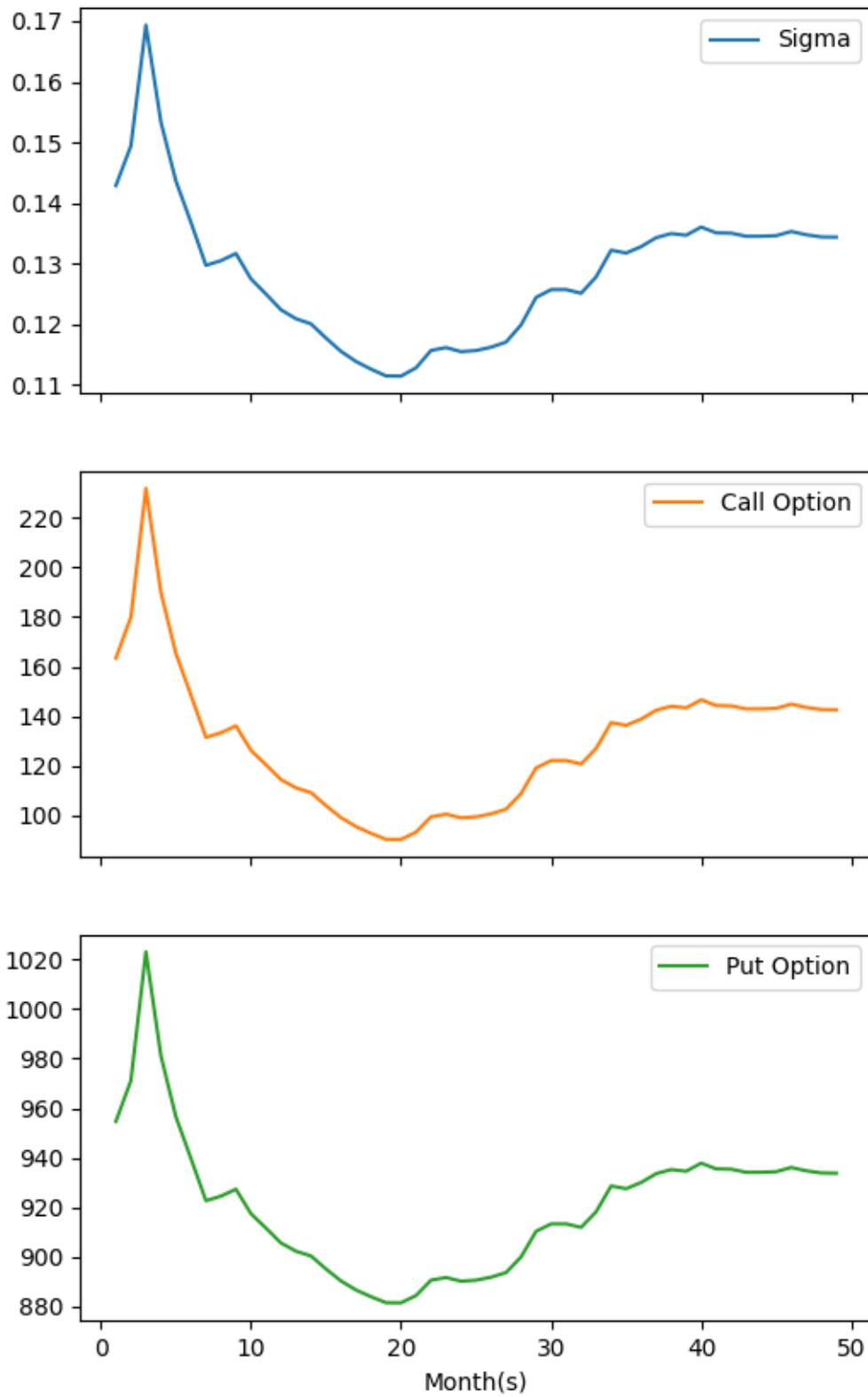
### Plot of NSE Index with $A = 0.9$



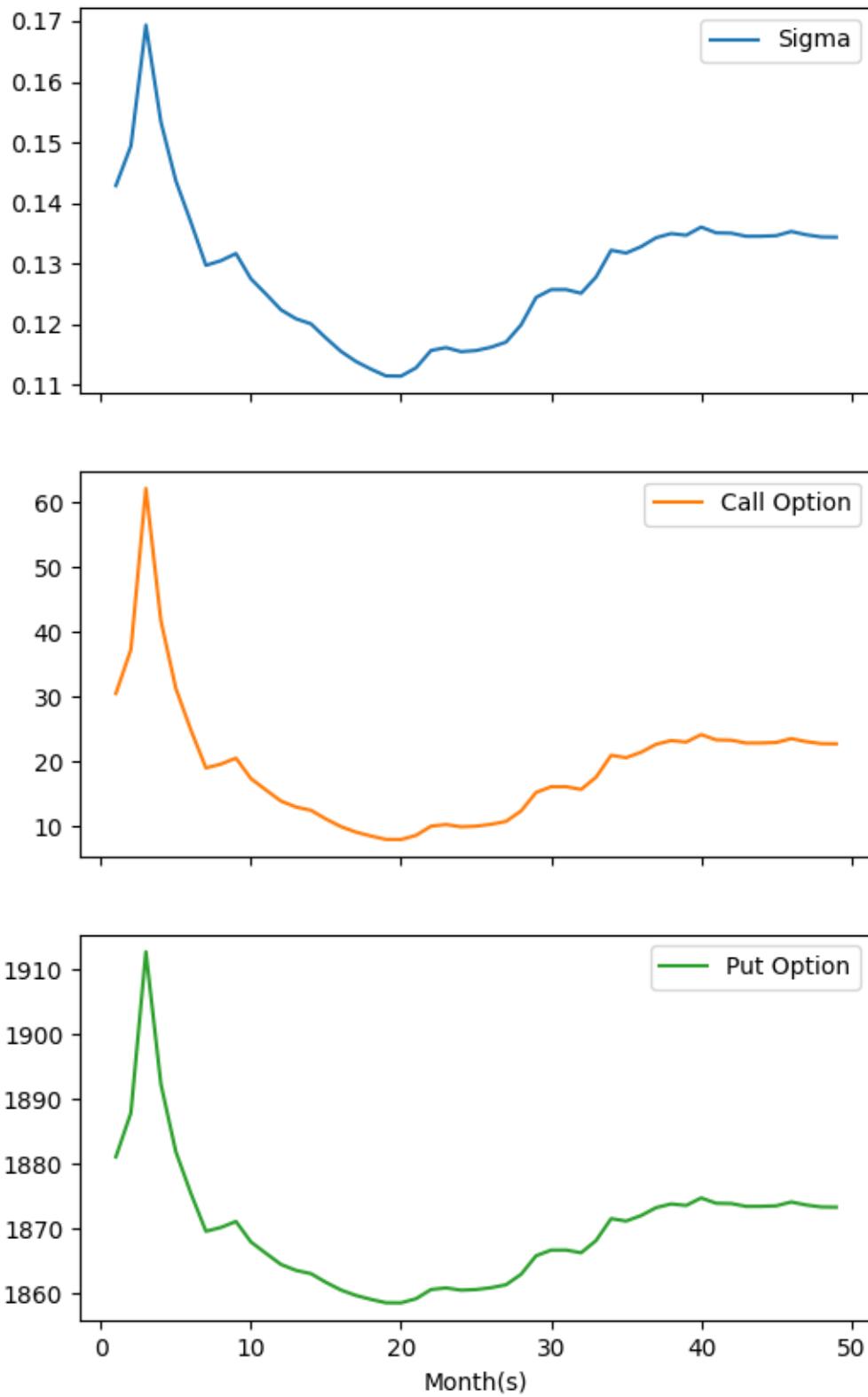
### Plot of NSE Index with A = 1.0



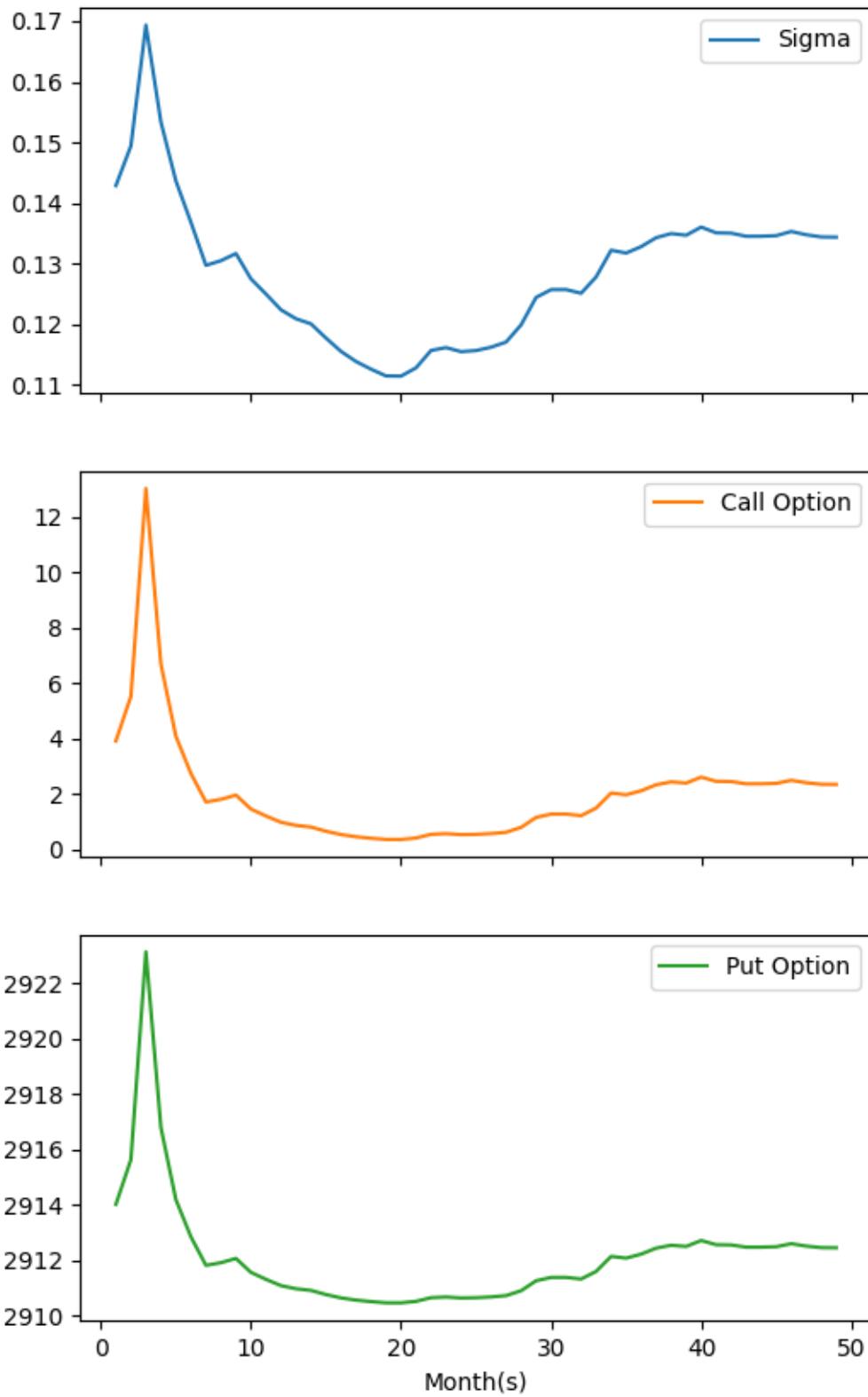
### Plot of NSE Index with $A = 1.1$



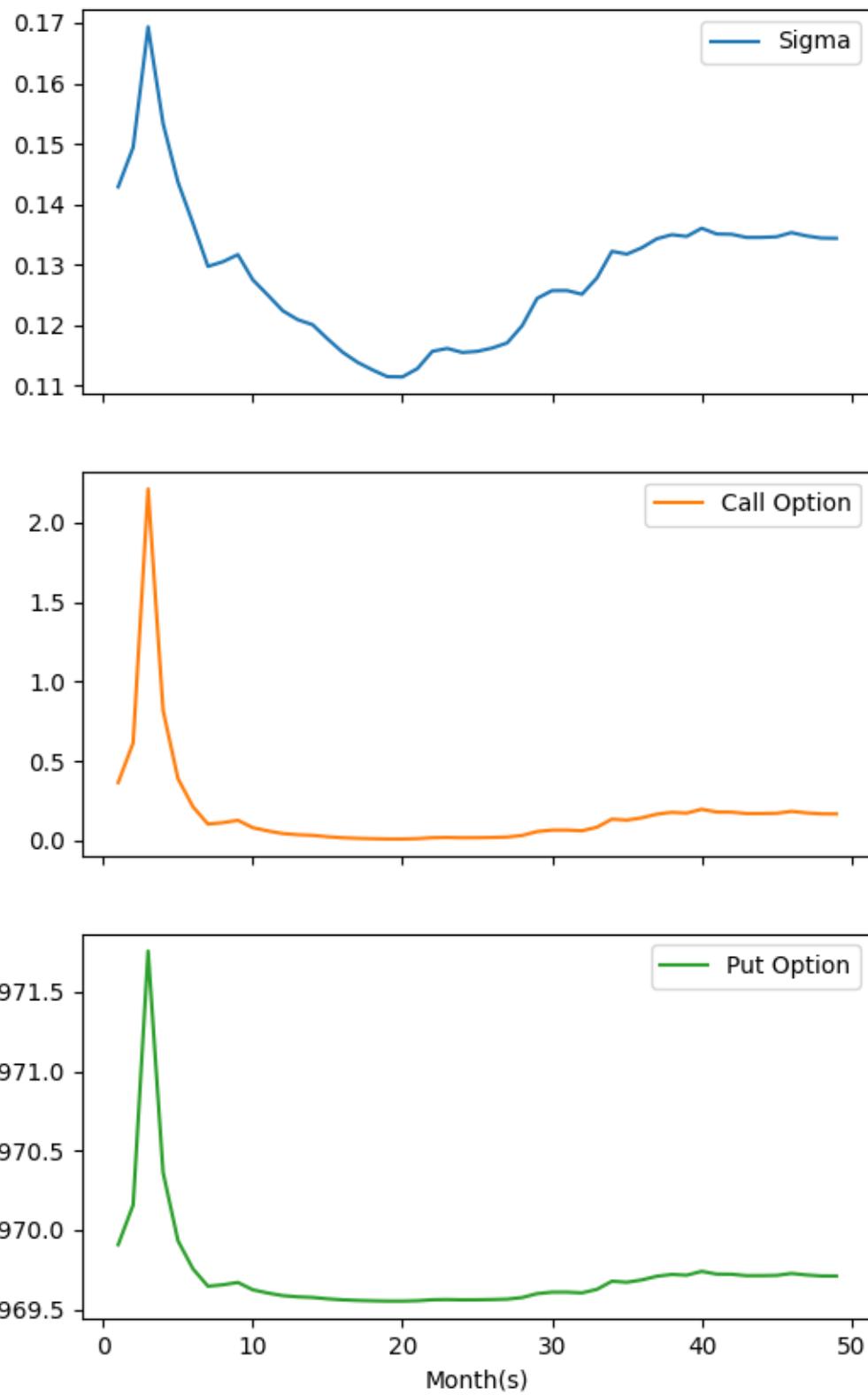
### Plot of NSE Index with $A = 1.2$



### Plot of NSE Index with $A = 1.3$



### Plot of NSE Index with $A = 1.4$



### Plot of NSE Index with $A = 1.5$

