QF600 – ASSET PRICING

Homework 5

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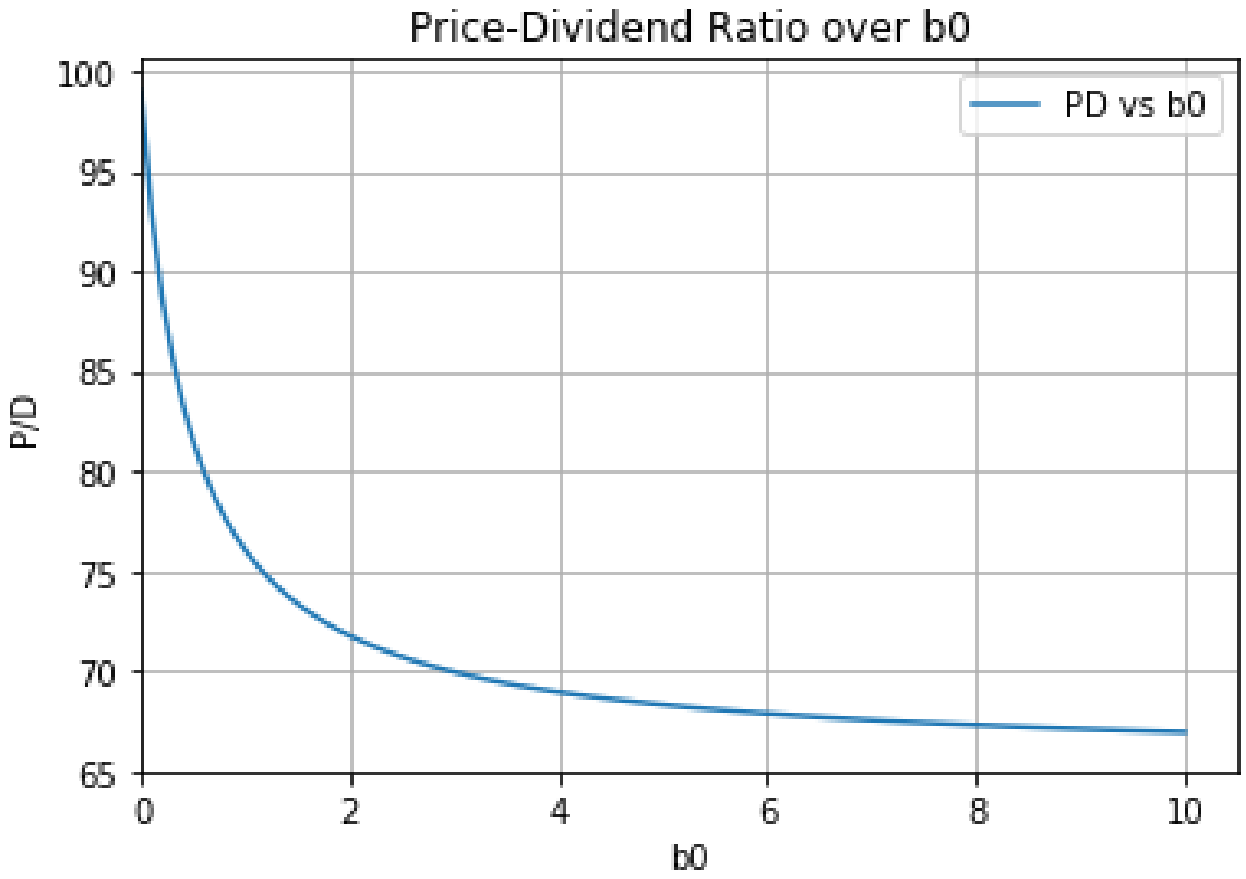
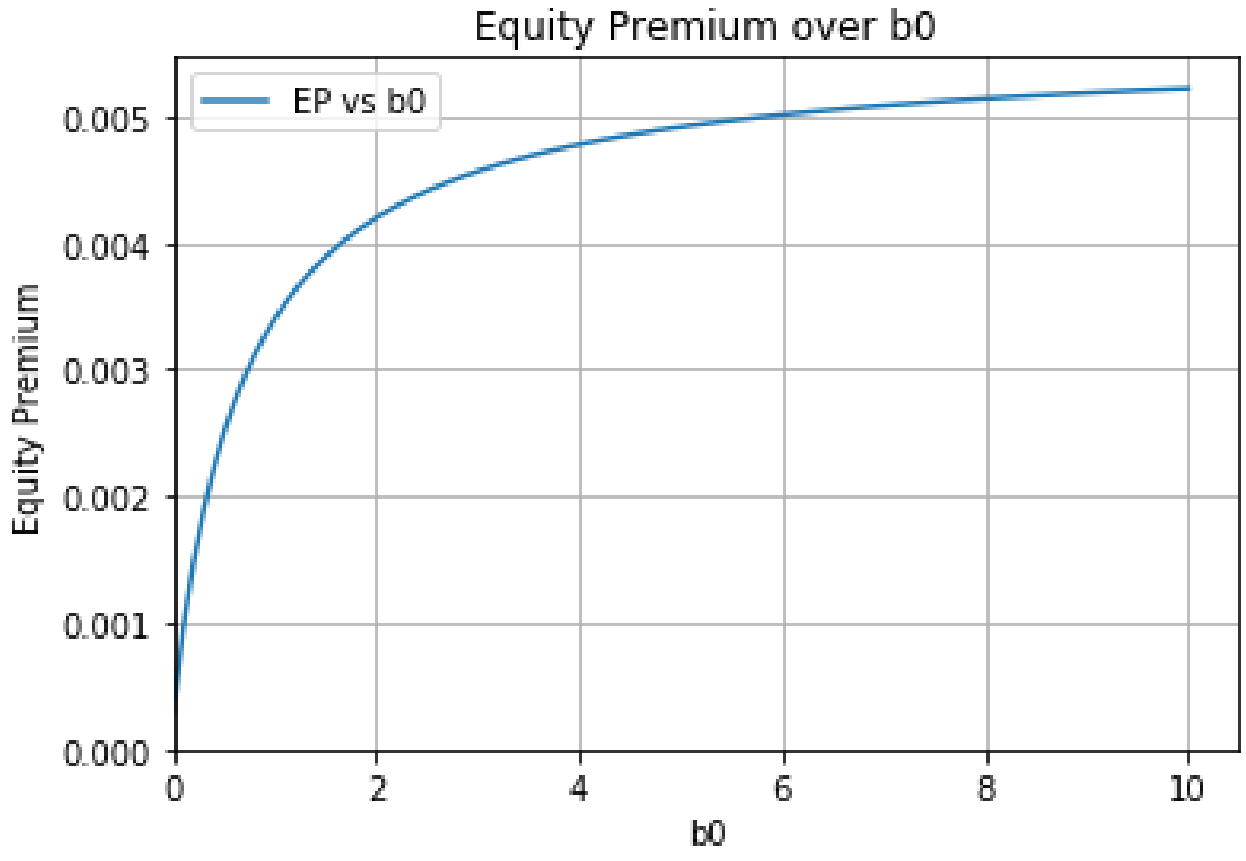
1.


Price-Dividend Ratio over b0
PD vs b0
P/D
b0
100
95
90
85
80
75
70
65
0
2
4
6
8
10

2.


Equity Premium over b0
EP vs b0
Equity Premium
b0
0.005
0.004
0.003
0.002
0.001
0.000
0
2
4
6
8
10

Investor utility function

Barberis, Huang and Santos (2001) incorporated concepts from the prospect theory (Kahneman and Tversky(1979)) into investor's utility function to better explain that investor's utlity is derived from both consumption, and recent financial gains or losses. The incorporation of prospect theory has led to the following assumptions in investor's utility:

1. Gains and losses are measured relative to reference level
2. Investors exhibit loss aversion, in which means that investors are more senstive to losses than gains of the same magnitude.

In this assignment, the reference rate is set to a risk-free rate of 1.0303%, and investors would only consider positive returns (i.e. gains) after subtraction from the reference rate. Else, the simulated returns, after subtraction from the reference rate, will be considered as twice the absolute amount as losses. This has resulted in a piece-wise linear function which indicates that investors utility is drastically penalised if they were to suffer losses ,and therefore exhibits that the investor's utility is twice as sensitive as to losses than to gains which is denoted by the lambda parameter.

b_0

b_0 acts as a scaling factor that determine gains or losses on the investors' utility in order to stay comparable to the magnitude of the consumption since this factor is multiplied with the marginal utlity of aggregate consumption, $b_t = b_0 \overline{C_t}^{-r}$ and must be greater than or equal to 0. In addition to that, b_0 helps to keep the prospect theory term in check as the size of the aggregate consumption changes.

Lambda

The parameter lambda scales the slope for the portion of utility curve function (i.e. for recent gains or losses) below the reference point to be much steeper in order to indicate the heightened level of investor's sensitivity towards losses than gains. Since investors are much more loss-averse in accordance to the prospect theory, the value of lambda should be greater than one, and the the scale of lambda should also positivity correlates with the investor's sensitivity for losses.

Codes

```
# -*- coding: utf-8 -*-
"""
Created on Tue Nov 20 01:11:47 2018

@author: Johnny

QF600 - Assignment 5
"""

import numpy as np
from scipy.optimize import fsolve,bisect
from matplotlib import pyplot as plt



#### Part 1: HJ Bound
epsilon = np.random.normal(0, 1, 10000)
cons_growth = np.exp(0.02+0.02*epsilon)
delta = 0.99
gamma=1
lambda_p=2
Rf = 1.0303

PD=[]
Rm=[]

b = np.linspace(0,10,100)

for b0 in b:
    x = bisect(lambda x: delta*b0*np.mean([x*c-Rf if (x*c>=Rf) else (2*(x*c-Rf)) for c in cons_growth]) + 0.99 * x - 1 , 1, 1.1)
    PD.append(1/(x-1))
    Rm.append(np.mean(x*cons_growth)-Rf)

plt.plot(b, PD , label = 'PD vs b0')
```

```
plt.title('Price-Dividend Ratio over b0')
plt.xlim(left=0)
plt.ylim(bottom=65)
plt.xlabel('b0')
plt.ylabel('P/D')
plt.legend()
plt.grid()
plt.savefig('PD_B0.jpeg', dpi=400)
plt.show()

plt.plot(b, Rm , label = 'EP vs b0')
plt.title('Equity Premium over b0')
plt.xlim(left=0)
plt.ylim(bottom=0)
plt.xlabel('b0')
plt.ylabel('Equity Premium')
plt.legend()
plt.grid()
plt.savefig('EP_B0.jpeg', dpi=400)
plt.show()
```