Mid term Exam for Financial Econometrics with Python

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Contents

1 Introduction

For the midterm assignment, we composed a group of 4 with Gavini Charles; Fournier Justin; Prat Paul and Blanc Mathieu. This document contains all the results of our assignment, including tables, figures, and calculations. It is composed by 1 parts, first, importing the good python libraries, then initialising variables to separate the differents datas (daily, monthly, ..., returns, logreturns,...)

2 Preliminary

2.1 AMAZON

The chosen stock is Amazon, because it is higly related in the current actuality. We are very interested in a major company such as Amazon, which has grown significantly over time. The ticker from yahoo finance is "***AMZN*** " on the Nasdaq stock exchange AMAZON on Yahoo Finance First, importing the Amazon stock with yfinance, then display the pandas table. We will import 25 years, 8 months and 25 days of data (from 1999-01-21 to 2024-10-16).

2.2 Data Table

The data printed here, is the preview of the Amazon stock extraction from yahoo fiannce:

Price Ticker Date	Adj Close AMZN	Close AMZN	High AMZN	Low AMZN	Open AMZN	Volume AMZN
1999-01-21 00:00:00+00:00	2.650000	2.650000	2.759375	2.314063	2.612500	940964000
1999-01-22 00:00:00+00:00	3.075000	3.075000	3.146875	2.468750	2.487500	875316000
1999-01-25 00:00:00+00:00	2.809375	2.809375	3.084375	2.750000	3.037500	546476000
1999-01-26 00:00:00+00:00	2.877344	2.877344	3.031250	2.765625	2.815625	490696000
1999-01-27 00:00:00+00:00	3.140625	3.140625	3.493750	3.000000	3.353125	700452000

Table 1: Preview of Amazon Stock Data from Yahoo Finance

2.3 Checking the 25 Years range condition

We have to check that the data is correctly displayed over a 25years range, hopefully, the introduction from Amazon is from january 1999, so it we should be able to find a 25 year range of data of the Amazon stock. To check that we can compute a python code to count the gaps and visualize the dates of gaps in order to see for any huge gap that would be problematic for analyzing data.

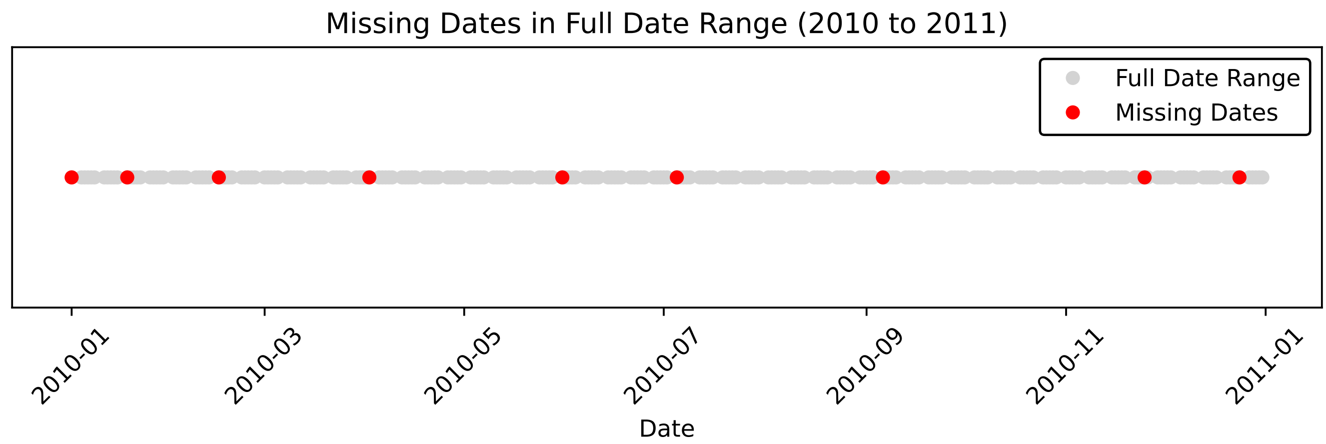

Figure 1: Missing Dates in Full Date Range (2010 to 2011)

We count less than 10 days of data gaps ponctually for one year over the 25-years range. Thus, the full data is still relevant to use for ou analysis of stilyzed facts.

3 First Results

3.1 Prices Evolutions

Then, ploting the prices evolution:

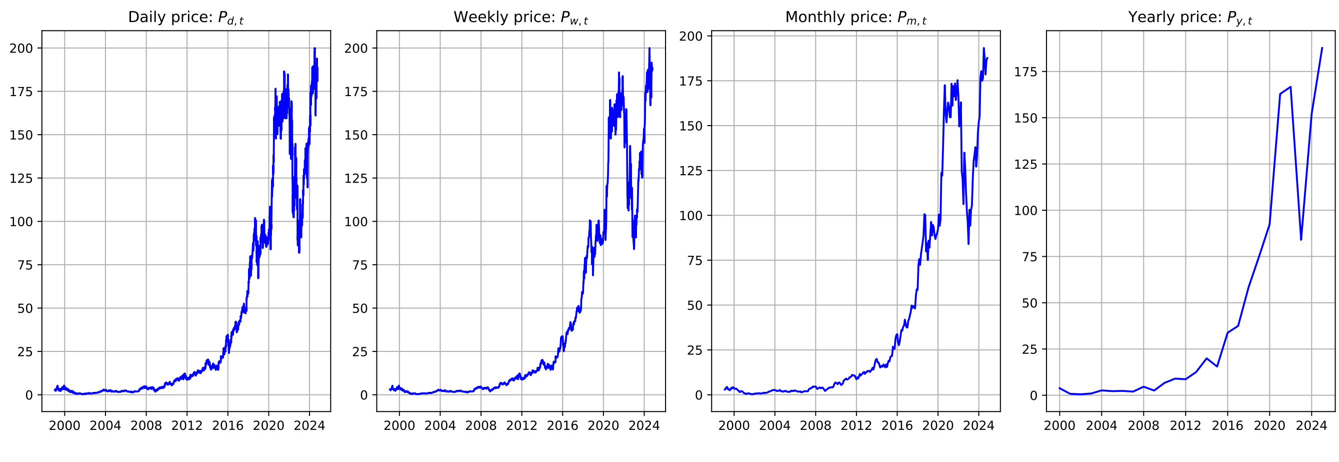

Figure 2: Prices over time by frequency

3.2 Calculating Returns

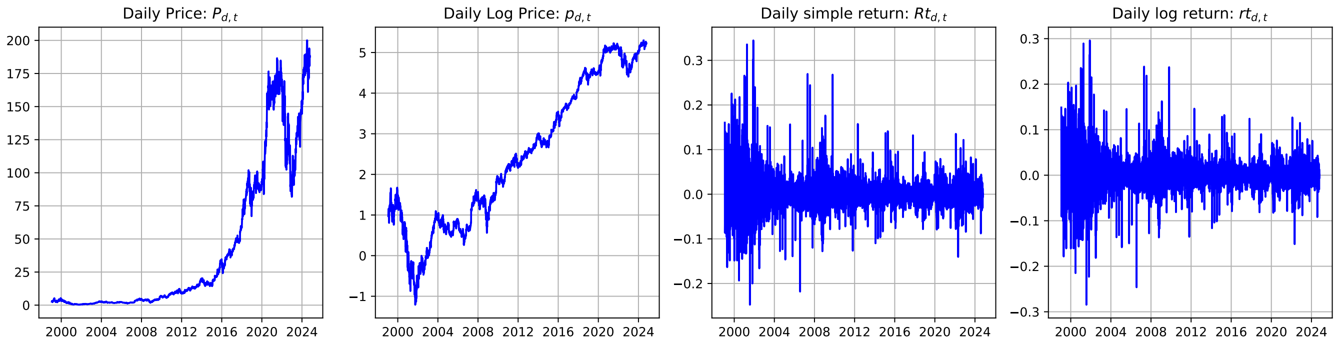

Figure 3: Prices, returns and log returns

3.3 Squared Returns

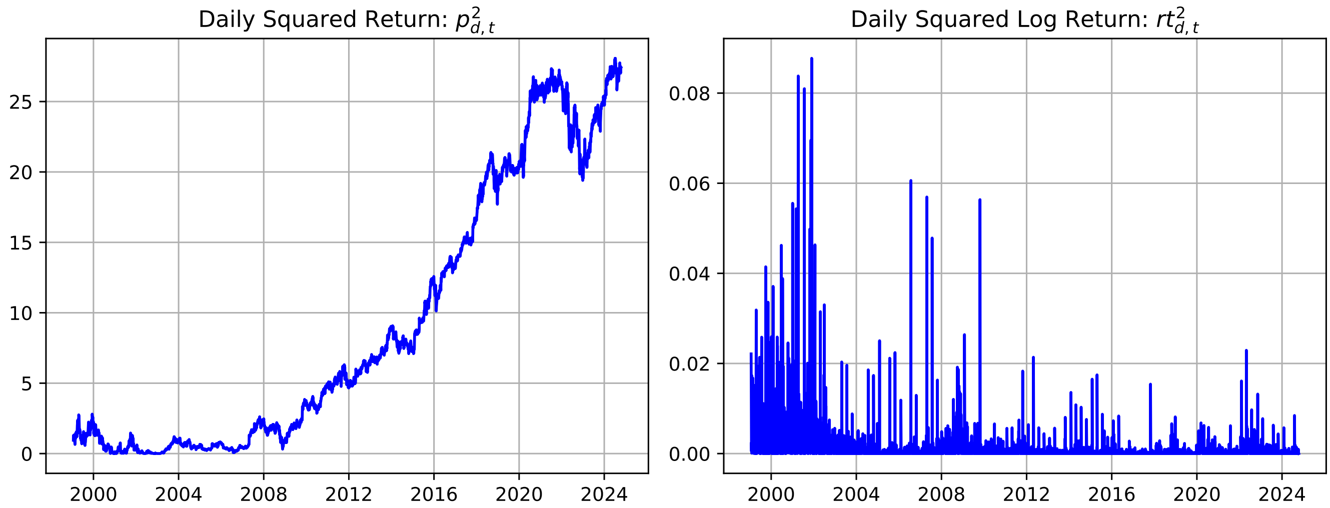

Figure 4: Squared daily returns and daily log returns

4 Amazon and the 8 Stylized Facts

4.0.1 Summary statistics

	daily	weekly	monthly	annual
Mean	0.06351	0.31014	1.32164	22.85692
St.Deviation	3.24131	6.76830	13.06275	45.28052
Diameter.C.I.Mean	0.07896	0.36213	1.45887	18.11598
Skewness	0.41992	0.05008	-0.45895	-0.15137
Kurtosis	11.15158	7.60655	2.59462	-0.64793
Excess.Kurtosis	8.15158	4.60655	-0.40538	-3.64793
Min	-28.45678	-38.51804	-53.02674	-68.54809
Quant5	-4.61051	-9.74288	-20.16713	-55.72274
Quant25	-1.25994	-2.64062	-4.98163	-7.23999
Median	0.04108	0.30519	2.09626	23.07665
Quant75	1.39659	3.40897	8.45973	55.96192
Quant95	4.47118	10.67416	20.90661	94.77653
Max	29.61811	56.11507	48.35221	102.44636
Jarque.Bera.stat	33735.75720	3235.87866	97.20696	0.51147
Jarque.Bera.pvalue.X100	0.00000	0.00000	0.00000	77.43487
Lillie.test.stat	0.10194	0.09591	0.08194	0.06494
Lillie.test.pvalue.X100	0.10000	0.10000	0.10000	99.00000
N.obs	6474.00000	1342.00000	308.00000	24.00000

Table 2: Summary statistics for the amazon stock

4.1 Prices are non-stationary

The first feature that will highlight non-stationarity of the prices is the comparison of p_t vs p_{t-1}.

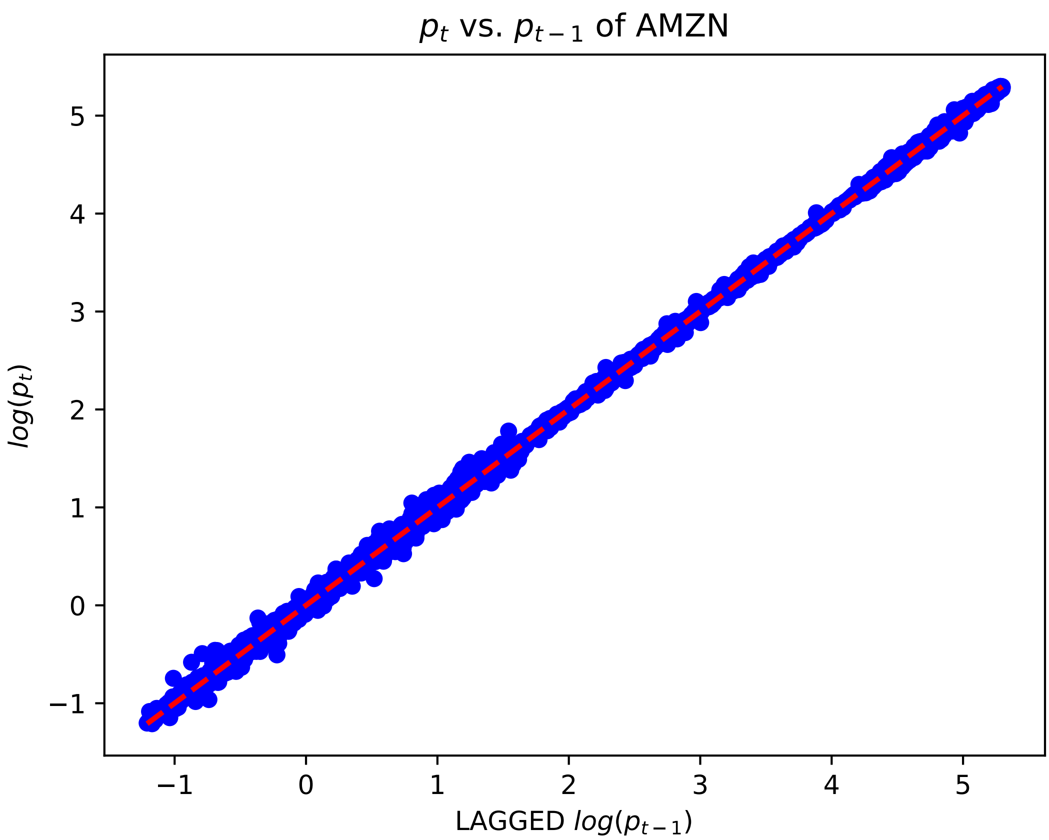

Figure 5: Comparison of $\log(p_t)$ vs $\log(p_{t-1})$

The graph in Figure 5 demonstrates this strong linear relationship, indicating that Amazon's prices at time t are highly dependent on those at $t-1$ and lack mean reversion, supporting the idea of non-stationarity.

Additionally, the empirical autocorrelation function (ACF) of Amazon's daily prices shows a slow decay, further suggesting non-stationarity, as shown in the next figure.

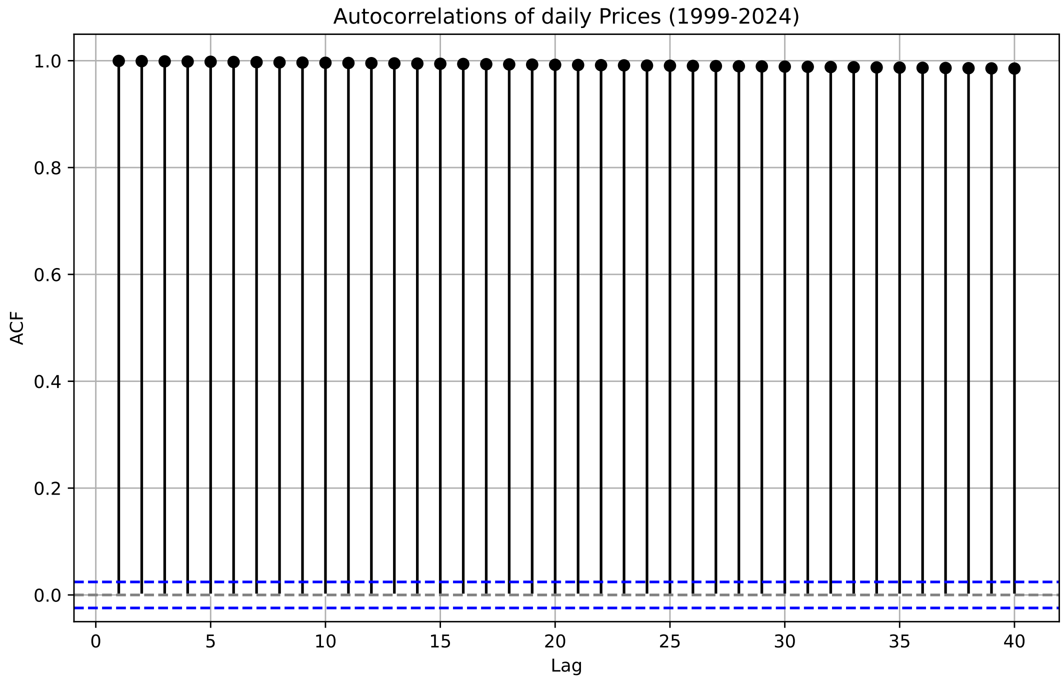

Figure 6: Autocorrelations of daily Prices (1999-2024)

4.2 Returns are stationary

4.3 Asymmetry

Stylized Fact 3: The distribution of returns is asymmetric and often negatively skewed, reflecting the fact that the downturns of financial markets are often much steeper than the recoveries. Investors tend to react more strongly to negative news than to positive news.

4.4 Heavy tails

4.5 Gaussianity

4.5.1 High frequency non-Gaussianity

As the result in Table 2 the skewness is positive for daily and monthly data [1] TODO add an article about amzn skewness. The 3^{rd} central moment is defined as $\mu_3 := E((X - m_1)^3)$. The skewness of r_t is defined as:

$$\text{Skew}(r_t) := E\left[\left(\frac{X - m_1}{\sigma}\right)^3\right] = \frac{\mu_3}{\sigma^3} = \frac{\mu_3}{\mu_2^{3/2}}.$$

In this case, and as emphasized in the 3^{rd} stylized fact, $\text{Skew}(r_t) > 0$, large realizations of X are more often larger than the mean μ. Skewness is thus used as a measure of asymmetry of the distribution $f_X(x)$. Therefore:
 $\text{Skew}(r_t) > 0$, so the distribution is said to be **right skewed**.
 $\text{Skew}(r_t) > 0$, then $\mu >$ median, where the median is the 50% quantile of the distribution.

4.5.2 Aggregational Gaussianity

4.6 Returns are not autocorrelated

4.7 Volatility clustering and long range dependence of squared returns

4.8 Leverage effect

A Appendix: Python Code

Below is the Python code used in this analysis.

```python
# Python code example
import numpy as np
import pandas as pd

def analyze_data(data):
    mean = np.mean(data)
    std_dev = np.std(data)
    return mean, std_dev

data = [1, 2, 3, 4, 5]
mean, std_dev = analyze_data(data)
print(f"Mean: {mean}, Standard Deviation: {std_dev}")
```

Listing 1: Python Code for Analysis

B To go further, CAPM pricing model

References

[1] John Doe and Jane Smith. An example article. *Journal of Examples*, 42(1):1–10, 2023.