FE 570 - Project 2
Team 10

Fall 2020

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Project

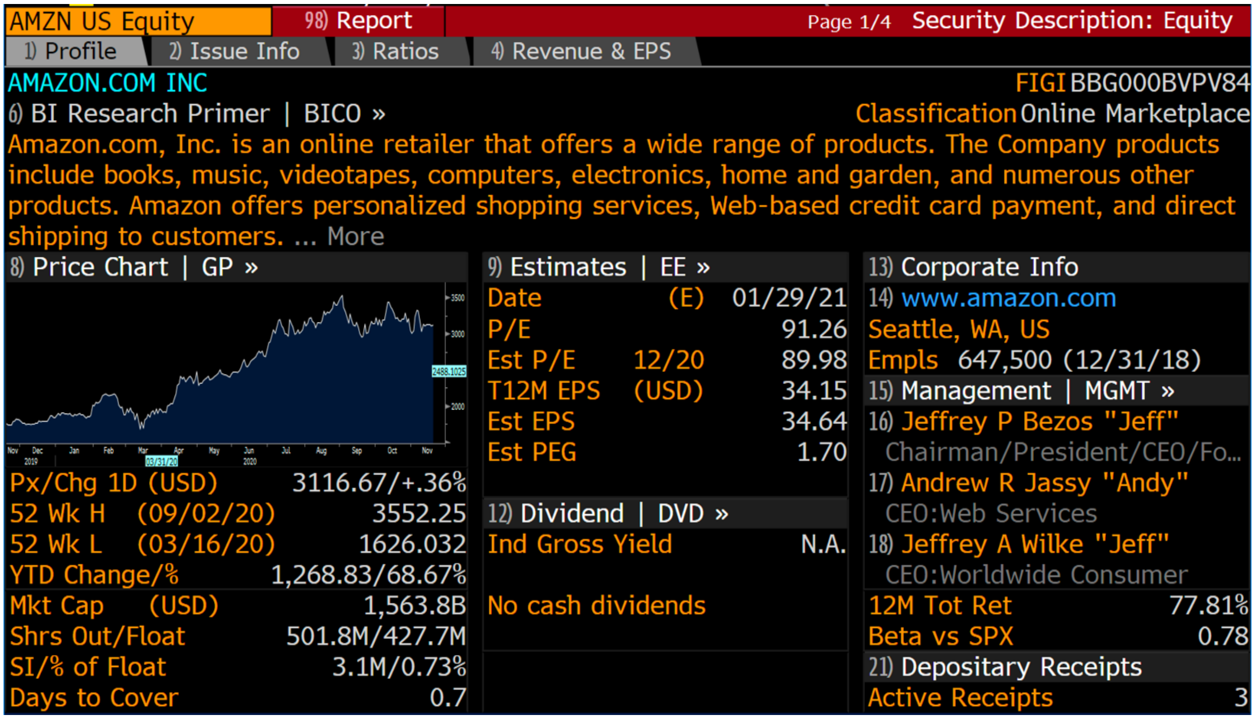
The project selected: “Download the trade and quote data for a stock of your choice for one day from Bloomberg, compute and compare the different liquidity measures discussed in class: bid-ask spread measure (Roll, Effective, Realized). Discuss the results.”

Project Objective

This project will compare different methods of measuring the liquidity of stocks during a day. The main bid-ask spread measures are : roll, effective and realized liquidity; I will use some knowledge learned through the classes and also some key books about microstructure and liquidity to discuss the results. I will present the theory and after that I will discuss my results.

The project scope will include only stock shares. I chose 5 stocks for the project: Amazon (ticker: AMZN), Apple (ticker: AAPL), Facebook (ticker: FB), United Airlines Holdings (ticker: UAL) and Tesla (ticker: TSLA).
In total I will get 5 different assets to analyze the data. These stocks were chosen because they are of well-known and reputable companies with high number of daily deals and are part of different business sectors as well.

1. **Amazon**



AMAZON.COM INC

FIGI BBG000BVPV84

Classification Online Marketplace

Amazon.com, Inc. is an online retailer that offers a wide range of products. The Company products include books, music, videotapes, computers, electronics, home and garden, and numerous other products. Amazon offers personalized shopping services, Web-based credit card payment, and direct shipping to customers. ... More

Px/Chg 1D (USD)	3116.67/+.36%
52 Wk H (09/02/20)	3552.25
52 Wk L (03/16/20)	1626.032
YTD Change/%	1,268.83/68.67%
Mkt Cap (USD)	1,563.8B
Shrs Out/Float	501.8M/427.7M
SI/% of Float	3.1M/0.73%
Days to Cover	0.7

Date	(E)	01/29/21
P/E		91.26
Est P/E	12/20	89.98
T12M EPS	(USD)	34.15
Est EPS		34.64
Est PEG		1.70

Ind Gross Yield	N.A.

No cash dividends

Seattle, WA, US

Empls 647,500 (12/31/18)

16) Jeffrey P Bezos "Jeff"
Chairman/President/CEO/Fo...

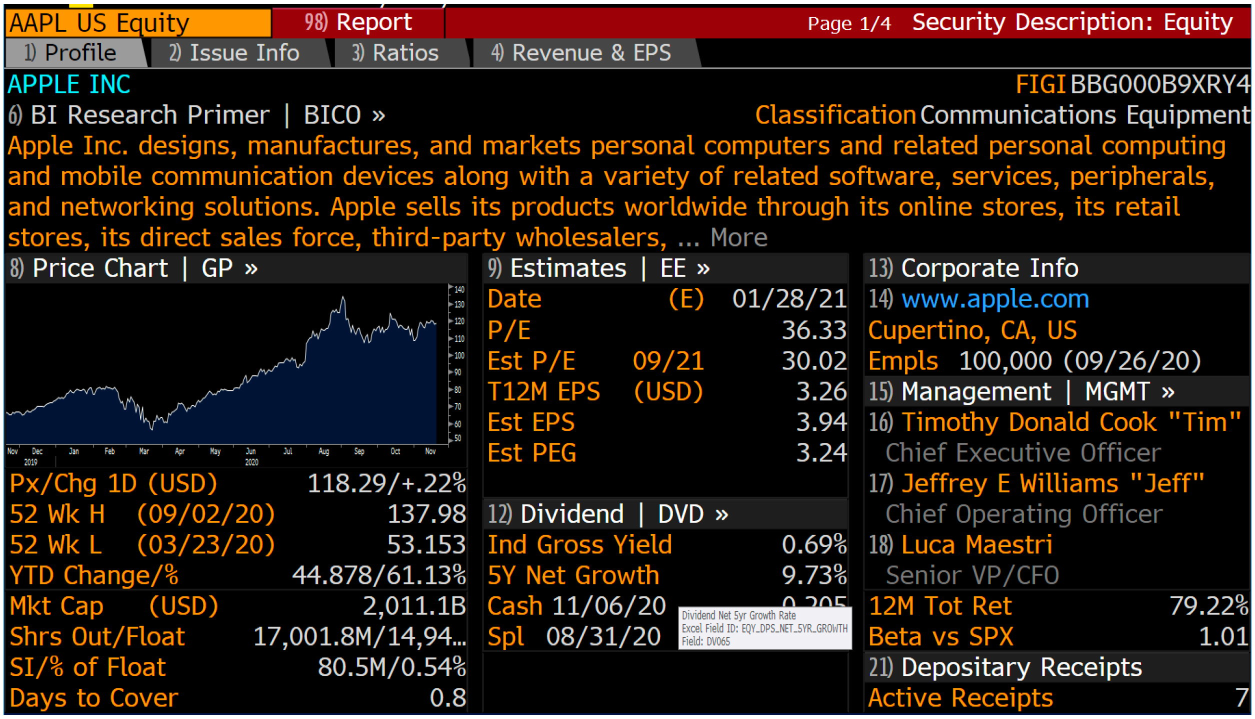
17) Andrew R Jassy "Andy"
CEO:Web Services

18) Jeffrey A Wilke "Jeff"
CEO:Worldwide Consumer

12M Tot Ret	77.81%
Beta vs SPX	0.78
Active Receipts	3

Figure 1: Amazon description, collected using Bloomberg

2. Apple



AAPL US Equity | 98) Report | Page 1/4 Security Description: Equity

1) Profile | 2) Issue Info | 3) Ratios | 4) Revenue & EPS

APPLE INC FIGI BBG000B9XRY4

6) BI Research Primer | BICO » Classification Communications Equipment

Apple Inc. designs, manufactures, and markets personal computers and related personal computing and mobile communication devices along with a variety of related software, services, peripherals, and networking solutions. Apple sells its products worldwide through its online stores, its retail stores, its direct sales force, third-party wholesalers, ... More

8) Price Chart | GP »

Px/Chg 1D (USD) 118.29/+.22%
52 Wk H (09/02/20) 137.98
52 Wk L (03/23/20) 53.153
YTD Change/% 44.878/61.13%
Mkt Cap (USD) 2,011.1B
Shrs Out/Float 17,001.8M/14,94...
SI/% of Float 80.5M/0.54%
Days to Cover 0.8

9) Estimates | EE »
Date (E) 01/28/21
P/E 36.33
Est P/E 09/21 30.02
T12M EPS (USD) 3.26
Est EPS 3.94
Est PEG 3.24

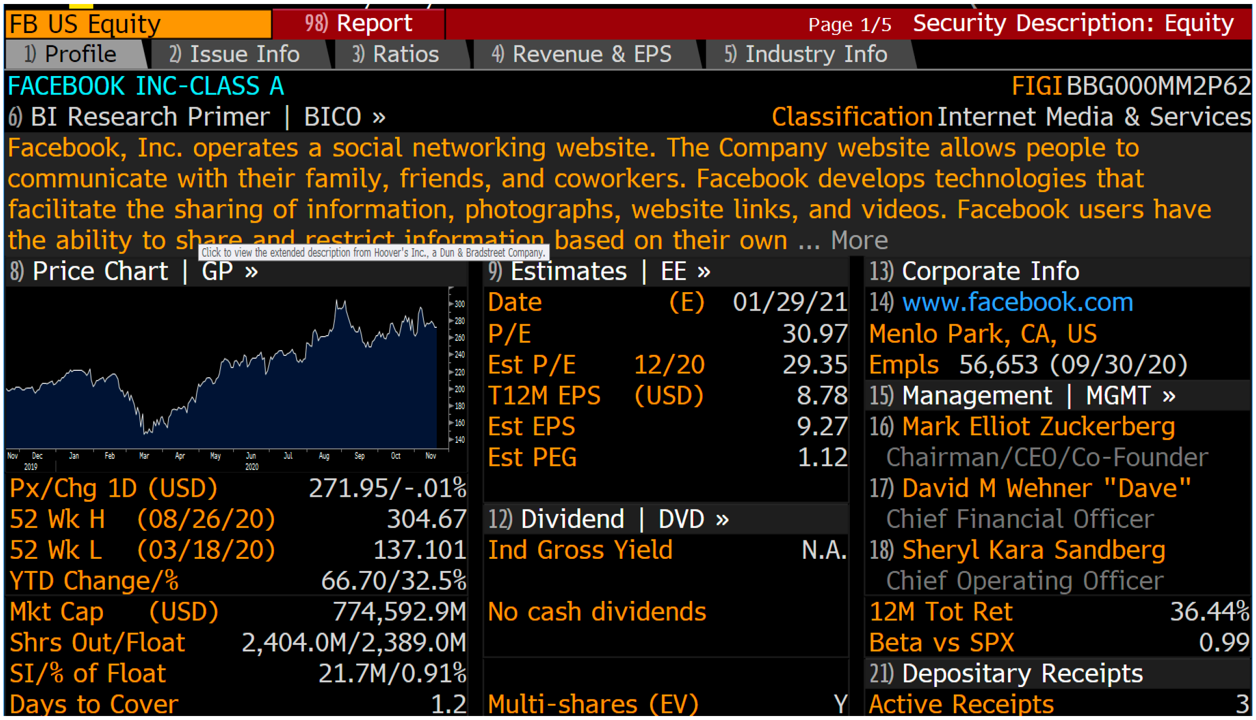
12) Dividend | DVD »
Ind Gross Yield 0.69%
5Y Net Growth 9.73%
Cash 11/06/20 0.205
Spl 08/31/20

Dividend Net 5yr Growth Rate
Excel Field ID: EQY_DPS_NET_5YR_GROWTH
Field: DV065

13) Corporate Info
14) www.apple.com
Cupertino, CA, US
Empls 100,000 (09/26/20)
15) Management | MGMT »
16) Timothy Donald Cook "Tim"
Chief Executive Officer
17) Jeffrey E Williams "Jeff"
Chief Operating Officer
18) Luca Maestri
Senior VP/CFO
12M Tot Ret 79.22%
Beta vs SPX 1.01
21) Depositary Receipts
Active Receipts 7

Figure 2: Apple description, collected using Bloomberg

3. Facebook



FB US Equity | 98) Report | Page 1/5 Security Description: Equity

1) Profile | 2) Issue Info | 3) Ratios | 4) Revenue & EPS | 5) Industry Info

FACEBOOK INC-CLASS A FIGI BBG000MM2P62

6) BI Research Primer | BICO » Classification Internet Media & Services

Facebook, Inc. operates a social networking website. The Company website allows people to communicate with their family, friends, and coworkers. Facebook develops technologies that facilitate the sharing of information, photographs, website links, and videos. Facebook users have the ability to share and restrict information based on their own ... More

Click to view the extended description from Hoover's Inc., a Dun & Bradstreet Company.

8) Price Chart | GP »

Px/Chg 1D (USD) 271.95/-.01%
52 Wk H (08/26/20) 304.67
52 Wk L (03/18/20) 137.101
YTD Change/% 66.70/32.5%
Mkt Cap (USD) 774,592.9M
Shrs Out/Float 2,404.0M/2,389.0M
SI/% of Float 21.7M/0.91%
Days to Cover 1.2

9) Estimates | EE »
Date (E) 01/29/21
P/E 30.97
Est P/E 12/20 29.35
T12M EPS (USD) 8.78
Est EPS 9.27
Est PEG 1.12

12) Dividend | DVD »
Ind Gross Yield N.A.

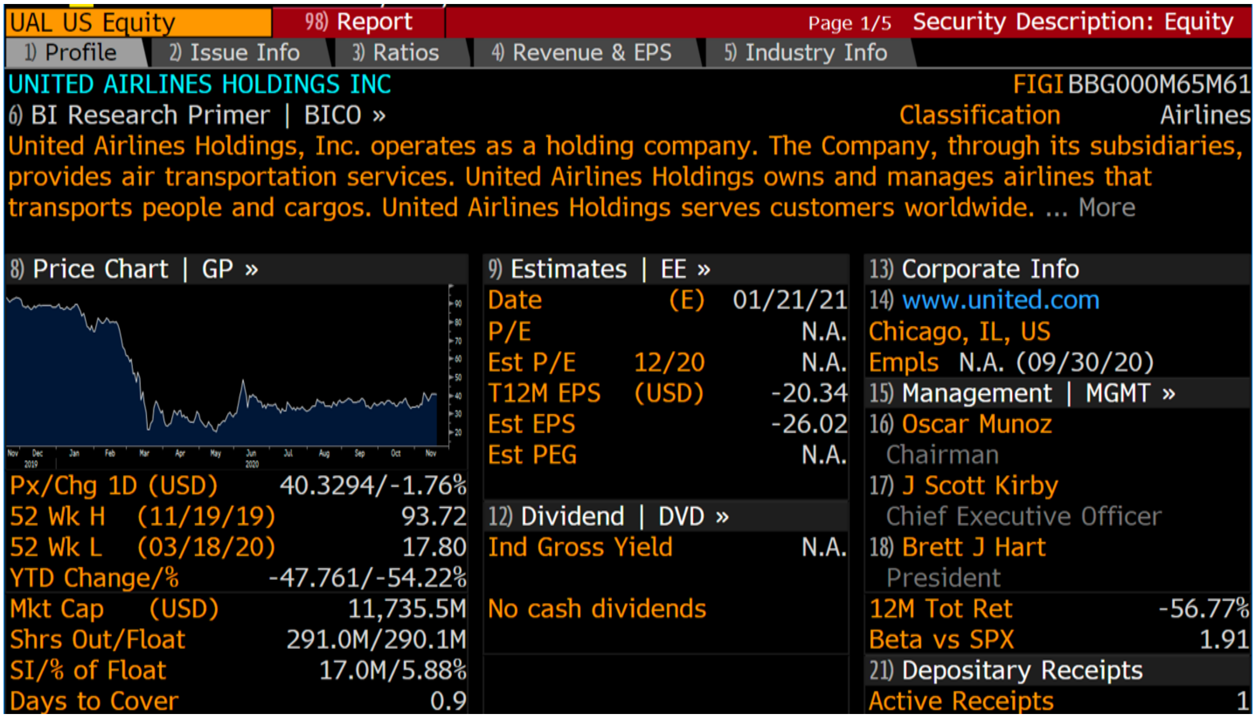
No cash dividends

Multi-shares (EV) Y

13) Corporate Info
14) www.facebook.com
Menlo Park, CA, US
Empls 56,653 (09/30/20)
15) Management | MGMT »
16) Mark Elliot Zuckerberg
Chairman/CEO/Co-Founder
17) David M Wehner "Dave"
Chief Financial Officer
18) Sheryl Kara Sandberg
Chief Operating Officer
12M Tot Ret 36.44%
Beta vs SPX 0.99
21) Depositary Receipts
Active Receipts 3

Figure 3: Facebook description, collected using Bloomberg

4. United Airline Holdings

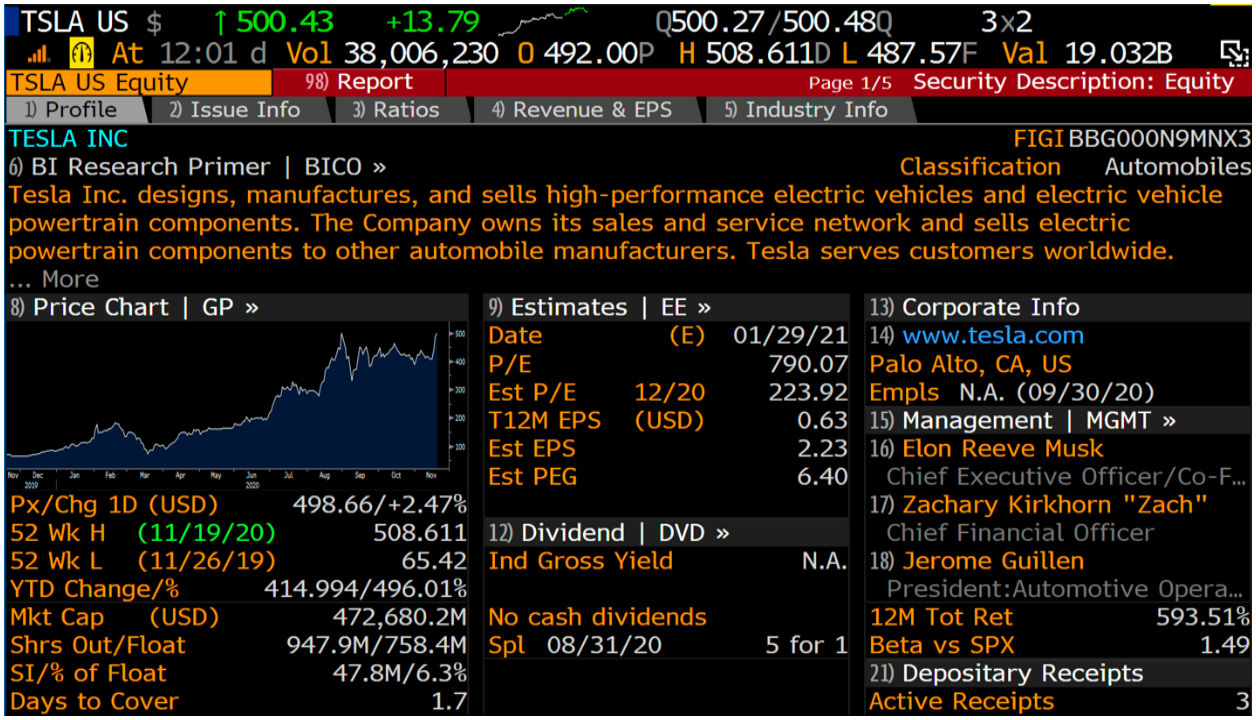


```
UAL US Equity          98) Report                         Page 1/5  Security Description: Equity
1) Profile   2) Issue Info   3) Ratios   4) Revenue & EPS   5) Industry Info
UNITED AIRLINES HOLDINGS INC                                              FIGI BBG000M65M61
6) BI Research Primer | BICO »                                   Classification     Airlines
United Airlines Holdings, Inc. operates as a holding company. The Company, through its subsidiaries,
provides air transportation services. United Airlines Holdings owns and manages airlines that
transports people and cargos. United Airlines Holdings serves customers worldwide. ... More

8) Price Chart | GP »              9) Estimates | EE »              13) Corporate Info
                                   Date            (E)  01/21/21    14) www.united.com
                                   P/E                       N.A.   Chicago, IL, US
                                   Est P/E     12/20         N.A.   Empls  N.A. (09/30/20)
                                   T12M EPS    (USD)       -20.34   15) Management | MGMT »
                                   Est EPS                 -26.02   16) Oscar Munoz
                                   Est PEG                   N.A.     Chairman
Px/Chg 1D (USD)    40.3294/-1.76%                                   17) J Scott Kirby
52 Wk H   (11/19/19)        93.72  12) Dividend | DVD »               Chief Executive Officer
52 Wk L   (03/18/20)        17.80  Ind Gross Yield           N.A.   18) Brett J Hart
YTD Change/%     -47.761/-54.22%                                      President
Mkt Cap     (USD)       11,735.5M  No cash dividends                12M Tot Ret           -56.77%
Shrs Out/Float      291.0M/290.1M                                   Beta vs SPX              1.91
SI/% of Float         17.0M/5.88%                                   21) Depositary Receipts
Days to Cover                 0.9                                   Active Receipts             1
```

Figure 4: United Airlines description, collected using Bloomberg

5. Tesla



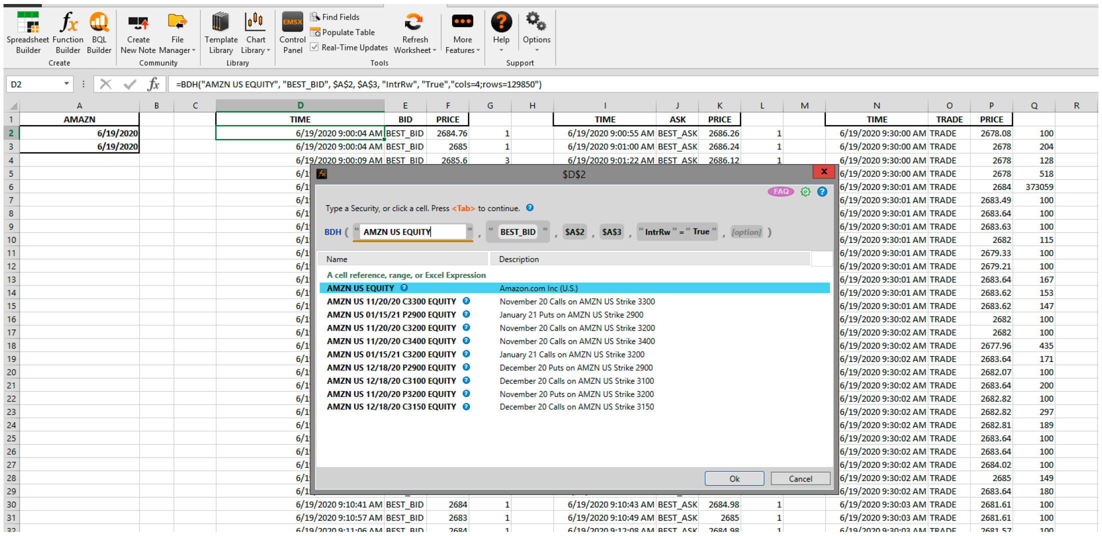
```
TSLA US $    ↑500.43   +13.79        Q500.27/500.48Q      3x2
     At 12:01 d  Vol 38,006,230  O 492.00P  H 508.611D L 487.57F  Val 19.032B
TSLA US Equity          98) Report                        Page 1/5  Security Description: Equity
1) Profile   2) Issue Info   3) Ratios   4) Revenue & EPS   5) Industry Info
TESLA INC                                                                 FIGI BBG000N9MNX3
6) BI Research Primer | BICO »                                   Classification  Automobiles
Tesla Inc. designs, manufactures, and sells high-performance electric vehicles and electric vehicle
powertrain components. The Company owns its sales and service network and sells electric
powertrain components to other automobile manufacturers. Tesla serves customers worldwide.
... More
8) Price Chart | GP »              9) Estimates | EE »              13) Corporate Info
                                   Date            (E)  01/29/21    14) www.tesla.com
                                   P/E                     790.07   Palo Alto, CA, US
                                   Est P/E     12/20       223.92   Empls  N.A. (09/30/20)
                                   T12M EPS    (USD)         0.63   15) Management | MGMT »
                                   Est EPS                   2.23   16) Elon Reeve Musk
                                   Est PEG                   6.40     Chief Executive Officer/Co-F...
Px/Chg 1D (USD)      498.66/+2.47%                                  17) Zachary Kirkhorn "Zach"
52 Wk H   (11/19/20)      508.611  12) Dividend | DVD »               Chief Financial Officer
52 Wk L   (11/26/19)        65.42  Ind Gross Yield           N.A.   18) Jerome Guillen
YTD Change/%      414.994/496.01%                                     President:Automotive Opera...
Mkt Cap     (USD)      472,680.2M  No cash dividends                12M Tot Ret           593.51%
Shrs Out/Float      947.9M/758.4M  Spl  08/31/20          5 for 1   Beta vs SPX              1.49
SI/% of Float          47.8M/6.3%                                   21) Depositary Receipts
Days to Cover                 1.7                                   Active Receipts             3
```

Figure 5: Tesla description, collected using Bloomberg

The initial idea is to price these Stock shares for at least 3 different days. I just selected a day with stock options expires in the market (Jun/19/2020), the election-day (Nov/03/2020) and the Veterans Day (Nov/11/2020). My goal is to analyze the data of these 3 different situations this year and hopefully I can find something interesting in my results. I carefully chose these different days for its uniqueness, which will help me highlight and analyze the difference in liquidity in each particular situation.

Bloomberg

To get the data I just used Bloomberg Terminal and some add-ins to extract all daily ticks.



=BDH("AMZN US EQUITY", "BEST_BID", A2, A3, "IntrRw", "True","cols=4;rows=129850")

D2

Type a Security, or click a cell. Press <Tab> to continue.

BDH (" AMZN US EQUITY " , " BEST_BID " , A2 , A3 , " IntrRw " = " True " , [option])

A cell reference, range, or Excel Expression

Name	Description
AMZN US EQUITY	Amazon.com Inc (U.S.)
AMZN US 11/20/20 C3300 EQUITY	November 20 Calls on AMZN US Strike 3300
AMZN US 01/15/21 P2900 EQUITY	January 21 Puts on AMZN US Strike 2900
AMZN US 11/20/20 C3200 EQUITY	November 20 Calls on AMZN US Strike 3200
AMZN US 11/20/20 C3400 EQUITY	November 20 Calls on AMZN US Strike 3400
AMZN US 01/15/21 C3200 EQUITY	January 21 Calls on AMZN US Strike 3200
AMZN US 12/18/20 P2900 EQUITY	December 20 Puts on AMZN US Strike 2900
AMZN US 12/18/20 C3100 EQUITY	December 20 Calls on AMZN US Strike 3100
AMZN US 11/20/20 P3200 EQUITY	November 20 Puts on AMZN US Strike 3200
AMZN US 12/18/20 C3150 EQUITY	December 20 Calls on AMZN US Strike 3150

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	AMAZN			TIME	BID	PRICE			TIME	ASK	PRICE			TIME	TRADE	PRICE	
2	6/19/2020			6/19/2020 9:00:04 AM	BEST_BID	2684.76	1		6/19/2020 9:00:55 AM	BEST_ASK	2686.26	1		6/19/2020 9:30:00 AM	TRADE	2678.08	100
3	6/19/2020			6/19/2020 9:00:04 AM	BEST_BID	2685	1		6/19/2020 9:01:00 AM	BEST_ASK	2686.24	1		6/19/2020 9:30:00 AM	TRADE	2678	204
4				6/19/2020 9:00:09 AM	BEST_BID	2685.6	3		6/19/2020 9:01:22 AM	BEST_ASK	2686.12	1		6/19/2020 9:30:00 AM	TRADE	2678	128
5				6/1										6/19/2020 9:30:00 AM	TRADE	2678	518
6				6/1										6/19/2020 9:30:01 AM	TRADE	2684	373059
7				6/1										6/19/2020 9:30:01 AM	TRADE	2683.49	100
8				6/1										6/19/2020 9:30:01 AM	TRADE	2683.64	100
9				6/1										6/19/2020 9:30:01 AM	TRADE	2683.63	100
10				6/1										6/19/2020 9:30:01 AM	TRADE	2682	115
11				6/1										6/19/2020 9:30:01 AM	TRADE	2679.33	100
12				6/1										6/19/2020 9:30:01 AM	TRADE	2679.21	100
13				6/1										6/19/2020 9:30:01 AM	TRADE	2683.64	167
14				6/1										6/19/2020 9:30:01 AM	TRADE	2683.62	153
15				6/1										6/19/2020 9:30:01 AM	TRADE	2683.62	147
16				6/1										6/19/2020 9:30:02 AM	TRADE	2682	100
17				6/1										6/19/2020 9:30:02 AM	TRADE	2682	100
18				6/1										6/19/2020 9:30:02 AM	TRADE	2677.96	435
19				6/1										6/19/2020 9:30:02 AM	TRADE	2683.64	171
20				6/1										6/19/2020 9:30:02 AM	TRADE	2682.07	100
21				6/1										6/19/2020 9:30:02 AM	TRADE	2683.64	200
22				6/1										6/19/2020 9:30:02 AM	TRADE	2682.82	100
23				6/1										6/19/2020 9:30:02 AM	TRADE	2682.82	297
24				6/1										6/19/2020 9:30:02 AM	TRADE	2682.81	189
25				6/1										6/19/2020 9:30:02 AM	TRADE	2683.64	100
26				6/1										6/19/2020 9:30:02 AM	TRADE	2683.64	100
27				6/1										6/19/2020 9:30:02 AM	TRADE	2684.02	100
28				6/1										6/19/2020 9:30:02 AM	TRADE	2685	149
29				6/1										6/19/2020 9:30:02 AM	TRADE	2683.64	180
30				6/19/2020 9:10:41 AM	BEST_BID	2684	1		6/19/2020 9:10:43 AM	BEST_ASK	2684.98	1		6/19/2020 9:30:03 AM	TRADE	2681.61	100
31				6/19/2020 9:10:57 AM	BEST_BID	2683	1		6/19/2020 9:10:49 AM	BEST_ASK	2685	1		6/19/2020 9:30:03 AM	TRADE	2681.61	100

Figure 6: Bloomberg API

To build the spreadsheet I just used the Function Builder/Spreadsheet Builder and then filled the fields with the necessary information.

Liquidity Measures

For this project we will analyze the data using 3 different liquidity measures: Effective Spread, Realized Spread and Roll Model. Below I will put a short definition provided by the professor during the classes.

- **Effective Spread:** signed difference of trade price and mid-price. This is a measure of actual trading costs. Also measure of the transaction's impact on price (aka "slippage").

- **Realized Spread:** Effective spread does not take into account price movements induced by trading. The realized spread adds a delay to the mid-price of ~ 5 min, allowing the price impact to be absorbed into prices.

- **Roll Model:** assumes uncorrelated trade signs. The Roll model could be used in situations where we do not have bid and ask data. If quote data are available, then the validity of the assumptions of the model can be tested.

Analysis Process

To analyze all the raw data, I first used Python code to clean the data. All the process is detailed described in the Appendix section (more than 40 pages).

So, after this data cleaning process, I started to use R code to calculate all the liquidity measures because is much easier using the high-frequency packages for this part of the job.

Analysis of Data

I truly believe the research is really valuable even if you cannot get the expected output, but on the other hand can point out the main pros/cons of the method. In this case I will start my analysis trying to explain about some noises in my results.

To analyze the data wasn't so easy as I expected when I just started this project. Couple problems started with the Data Collection for example. The problems just started in the first step of the project, the data extracted from Bloomberg appears in seconds, but for this project I was expecting to get data in the order of milliseconds at least. That's a big problem, because can compromise the most important results in this analysis. One of the problems for this case is, we have different bid/ask spreads and trades for the same time, but we just have this problem because the Bloomberg is just showing all the trades in order of seconds when all those trades are occurring in order of milliseconds.

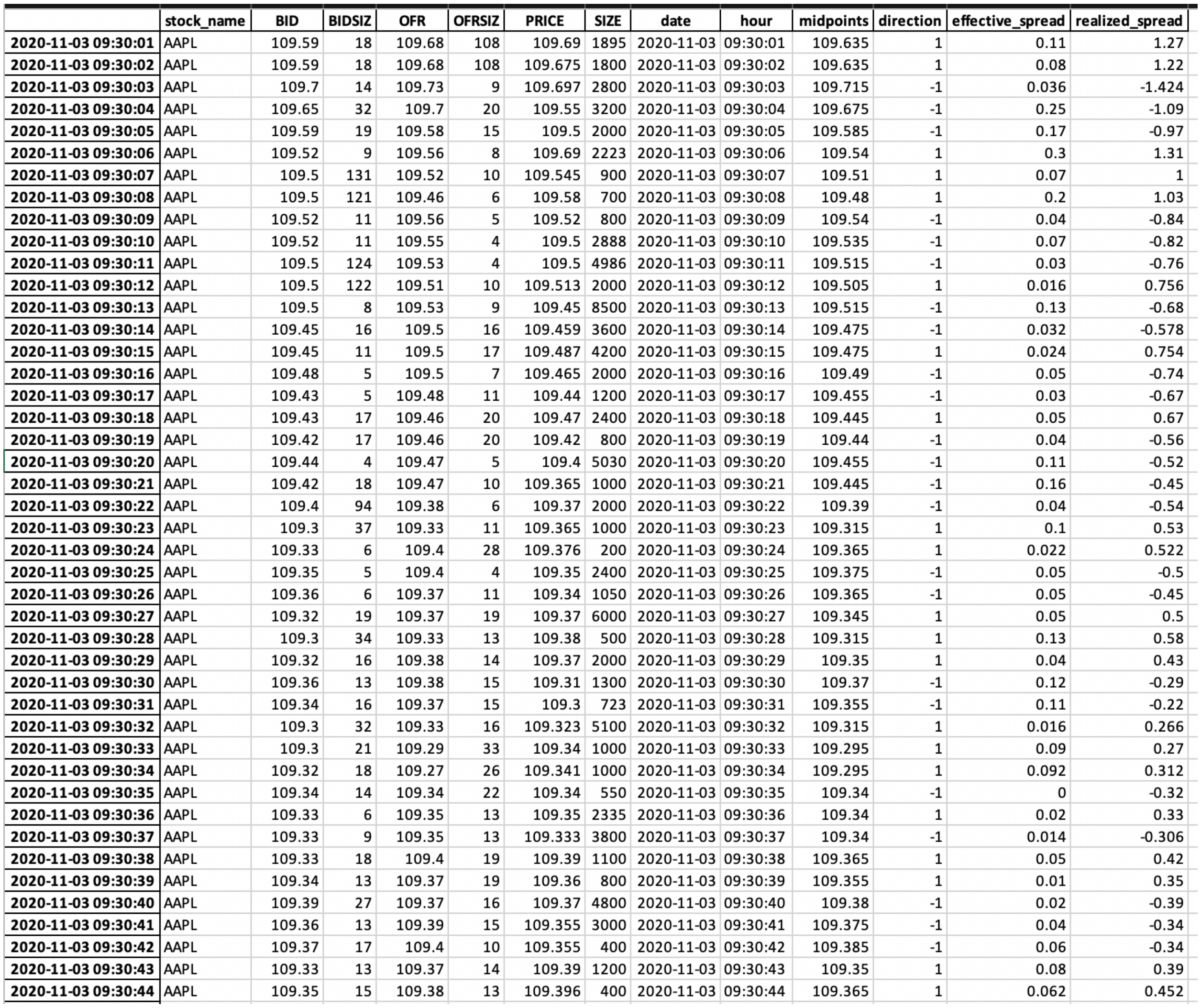
Another problem related with the data collection is about the delay between bid, ask and trades. For example, I had a lot of trades out of the bid/ask spread, that's not correct. I just saw this kind of results because exists some delays in the data. It's literally impossible to manage this kind of error, I had to delete some data of my results because doesn't make sense to analyze this kind of stuff.

Another intrinsic problem related with this Bloomberg data is related about the initial analysis. Once we start to analyze the data, we have to put couple trades in blocks (delay of data and mismatching of trades; data in seconds and not in milliseconds), so this kind of decision generated some noise in the final results. So, I basically did a tradeoff here, to be possible to analyze the data I lost a bit of accuracy in my final results, so once we start to look in the final numbers, we have to consider this kind of factor.

My initial idea was to analyze and compare 5 stocks in 3 different days. But, after all this data analysis, I just realized is very difficult to find some good results cross checking that stock analysis because part of the results will be hidden by all the noise explained above. So, I just decided to go ahead in this report with the APPL analysis, the other results will be in a excel file.

Results

Here I will present the Apple results for Nov-03-2020, the US election day.



	stock_name	BID	BIDSIZ	OFR	OFRSIZ	PRICE	SIZE	date	hour	midpoints	direction	effective_spread	realized_spread
2020-11-03 09:30:01	AAPL	109.59	18	109.68	108	109.69	1895	2020-11-03	09:30:01	109.635	1	0.11	1.27
2020-11-03 09:30:02	AAPL	109.59	18	109.68	108	109.675	1800	2020-11-03	09:30:02	109.635	1	0.08	1.22
2020-11-03 09:30:03	AAPL	109.7	14	109.73	9	109.697	2800	2020-11-03	09:30:03	109.715	-1	0.036	-1.424
2020-11-03 09:30:04	AAPL	109.65	32	109.7	20	109.55	3200	2020-11-03	09:30:04	109.675	-1	0.25	-1.09
2020-11-03 09:30:05	AAPL	109.59	19	109.58	15	109.5	2000	2020-11-03	09:30:05	109.585	-1	0.17	-0.97
2020-11-03 09:30:06	AAPL	109.52	9	109.56	8	109.69	2223	2020-11-03	09:30:06	109.54	1	0.3	1.31
2020-11-03 09:30:07	AAPL	109.5	131	109.52	10	109.545	900	2020-11-03	09:30:07	109.51	1	0.07	1
2020-11-03 09:30:08	AAPL	109.5	121	109.46	6	109.58	700	2020-11-03	09:30:08	109.48	1	0.2	1.03
2020-11-03 09:30:09	AAPL	109.52	11	109.56	5	109.52	800	2020-11-03	09:30:09	109.54	-1	0.04	-0.84
2020-11-03 09:30:10	AAPL	109.52	11	109.55	4	109.5	2888	2020-11-03	09:30:10	109.535	-1	0.07	-0.82
2020-11-03 09:30:11	AAPL	109.5	124	109.53	4	109.5	4986	2020-11-03	09:30:11	109.515	-1	0.03	-0.76
2020-11-03 09:30:12	AAPL	109.5	122	109.51	10	109.513	2000	2020-11-03	09:30:12	109.505	1	0.016	0.756
2020-11-03 09:30:13	AAPL	109.5	8	109.53	9	109.45	8500	2020-11-03	09:30:13	109.515	-1	0.13	-0.68
2020-11-03 09:30:14	AAPL	109.45	16	109.5	16	109.459	3600	2020-11-03	09:30:14	109.475	-1	0.032	-0.578
2020-11-03 09:30:15	AAPL	109.45	11	109.5	17	109.487	4200	2020-11-03	09:30:15	109.475	1	0.024	0.754
2020-11-03 09:30:16	AAPL	109.48	5	109.5	7	109.465	2000	2020-11-03	09:30:16	109.49	-1	0.05	-0.74
2020-11-03 09:30:17	AAPL	109.43	5	109.48	11	109.44	1200	2020-11-03	09:30:17	109.455	-1	0.03	-0.67
2020-11-03 09:30:18	AAPL	109.43	17	109.46	20	109.47	2400	2020-11-03	09:30:18	109.445	1	0.05	0.67
2020-11-03 09:30:19	AAPL	109.42	17	109.46	20	109.42	800	2020-11-03	09:30:19	109.44	-1	0.04	-0.56
2020-11-03 09:30:20	AAPL	109.44	4	109.47	5	109.4	5030	2020-11-03	09:30:20	109.455	-1	0.11	-0.52
2020-11-03 09:30:21	AAPL	109.42	18	109.47	10	109.365	1000	2020-11-03	09:30:21	109.445	-1	0.16	-0.45
2020-11-03 09:30:22	AAPL	109.4	94	109.38	6	109.37	2000	2020-11-03	09:30:22	109.39	-1	0.04	-0.54
2020-11-03 09:30:23	AAPL	109.3	37	109.33	11	109.365	1000	2020-11-03	09:30:23	109.315	1	0.1	0.53
2020-11-03 09:30:24	AAPL	109.33	6	109.4	28	109.376	200	2020-11-03	09:30:24	109.365	1	0.022	0.522
2020-11-03 09:30:25	AAPL	109.35	5	109.4	4	109.35	2400	2020-11-03	09:30:25	109.375	-1	0.05	-0.5
2020-11-03 09:30:26	AAPL	109.36	6	109.37	11	109.34	1050	2020-11-03	09:30:26	109.365	-1	0.05	-0.45
2020-11-03 09:30:27	AAPL	109.32	19	109.37	19	109.37	6000	2020-11-03	09:30:27	109.345	1	0.05	0.5
2020-11-03 09:30:28	AAPL	109.3	34	109.33	13	109.38	500	2020-11-03	09:30:28	109.315	1	0.13	0.58
2020-11-03 09:30:29	AAPL	109.32	16	109.38	14	109.37	2000	2020-11-03	09:30:29	109.35	1	0.04	0.43
2020-11-03 09:30:30	AAPL	109.36	13	109.38	15	109.31	1300	2020-11-03	09:30:30	109.37	-1	0.12	-0.29
2020-11-03 09:30:31	AAPL	109.34	16	109.37	15	109.3	723	2020-11-03	09:30:31	109.355	-1	0.11	-0.22
2020-11-03 09:30:32	AAPL	109.3	32	109.33	16	109.323	5100	2020-11-03	09:30:32	109.315	1	0.016	0.266
2020-11-03 09:30:33	AAPL	109.3	21	109.29	33	109.34	1000	2020-11-03	09:30:33	109.295	1	0.09	0.27
2020-11-03 09:30:34	AAPL	109.32	18	109.27	26	109.341	1000	2020-11-03	09:30:34	109.295	1	0.092	0.312
2020-11-03 09:30:35	AAPL	109.34	14	109.34	22	109.34	550	2020-11-03	09:30:35	109.34	-1	0	-0.32
2020-11-03 09:30:36	AAPL	109.33	6	109.35	13	109.35	2335	2020-11-03	09:30:36	109.34	1	0.02	0.33
2020-11-03 09:30:37	AAPL	109.33	9	109.35	13	109.333	3800	2020-11-03	09:30:37	109.34	-1	0.014	-0.306
2020-11-03 09:30:38	AAPL	109.33	18	109.4	19	109.39	1100	2020-11-03	09:30:38	109.365	1	0.05	0.42
2020-11-03 09:30:39	AAPL	109.34	13	109.37	19	109.36	800	2020-11-03	09:30:39	109.355	1	0.01	0.35
2020-11-03 09:30:40	AAPL	109.39	27	109.37	16	109.37	4800	2020-11-03	09:30:40	109.38	-1	0.02	-0.39
2020-11-03 09:30:41	AAPL	109.36	13	109.39	15	109.355	3000	2020-11-03	09:30:41	109.375	-1	0.04	-0.34
2020-11-03 09:30:42	AAPL	109.37	17	109.4	10	109.355	400	2020-11-03	09:30:42	109.385	-1	0.06	-0.34
2020-11-03 09:30:43	AAPL	109.33	13	109.37	14	109.39	1200	2020-11-03	09:30:43	109.35	1	0.08	0.39
2020-11-03 09:30:44	AAPL	109.35	15	109.38	13	109.396	400	2020-11-03	09:30:44	109.365	1	0.062	0.452

Table 1: Apple results

I just got bid-ask spread from the Roll model is 3.6 cents, which is very reasonable for this stock. Most of the time the bid-ask spread is pretty tight, so the 3.6 cents are in line with all the quotes. The good thing about this number, I just check analyzing the data.

The effective spread is really small, that means the transaction costs are not so big because, because you don't need to cross a massive spread to get your order done. The effective spread in this case is 2.39 cents, which is very small.

Another important result is the realized spread (that's important to tell us the direction of the trades). This result is a bit more trick to be analyzed. I got some negative and positive numbers here. In this case we have some hypothesis to understand those negative/positive numbers. This day analyzed was very volatile because was the election day, so seeing the trades changing the direction quickly is possible because we can have different players in the market looking to trade their positions before the official result comes out (especially all the techs had a decent move around the election day). Another possibility is about the block trades, so we are back to the same discussion as we have in the previous session, because of the fact the Bloomberg data is just coming in seconds (not in milliseconds), we had to aggregate a lot of trades do analyze the data. That being said this may confuse the trade direction and would count some block trades with opposite direction. That’s why is a bit trickier to analyze those results, we don’t know precisely if this trading signals are noise in the data or a lot of trades in different directions.

References:

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[3] Harris, Larry, 2003. *Trading & Exchanges : Market Microstructure for Practitioners*. Oxford University Press.a
[4] Foucault, Thierry and Marco Pagano. *Market Liquidity .* Oxford University Press.
[5] FE 570 classes (Dan Pirjol)

Appendix

Part 1 – Preprocess Stock Data

Part 2 – Find liquidities

Part 3 – Preprocess liquidity data