

Group 4 - Companion Document

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1 Introduction

This complementary document explores various factors of the analysis conducted by our group and explains the rationale behind certain charts (line, donut and diverging) and other tools (data transformation) used. Moreover, we critically analyse the plots produced and provide explanations for particular movements and changes observed.

2 Data Transformation

Figure 1 Short dataset

- Created a 'month' column for the convenience of plotting graphs
- Since we generated line charts by month, we only extracted the year and month
- We transformed the 'date' column to 'datetime' for simplicity of coding
- Used the 'groupby' function to generate the mean of every numerical value for each month, sector and country
- Transformed the 'month' column to a string type variable for the convenience of plotting the graph
- Separated France, Germany and UK data into different graphs
- Extracted unique sectors of the 2016 dataset
- Calculated percentage changes of the current price compared to the start of the year (2016) of each country and sector

$$PercentageChange = \frac{(CurrentPrice - OriginalPrice)}{(OriginalPrice)} \quad (1)$$

Figure 2 Long dataset

- Extracted the Year-Month-Date from the 'date' column and transformed it into 'datetime'
- Grouped 'country' and 'date' to calculate the average of share price of each month for each country
- Separated the dataset into 3 different dataframes with each containing the unique country (Germany, France or UK)
- Calculated percentage changes of the current price of each month compared to the start of the year (2014) of each country and sector

$$PercentageChange = \frac{(CurrentPrice - OriginalPrice)}{(OriginalPrice)} \quad (2)$$

Figure 3 and 4: Diverging Plots

- Extracted rows with the UK as a country
- Combined France and Germany, and set them to be a representation of the EU
- Extracted rows with the representative countries of the EU
- Applied the 'groupby' function to generate the mean of stock prices for respective dates and sectors

For all sectors, the following procedures and rationales were applied to the data: - Extracted rows with their respective sector - As for a given date and sector, stock prices are an average value and we saw no noticeable holistic fluctuation (from the previous illustration) between France, Germany, and UK companies' stock prices, pre-Brexit referendum; hence, we cherry picked stock prices from 3 given dates (2014-01-01, 2016-06-01 and 2019-12-01(%Y%m%d)) to analyse pre- and post-Brexit referendum UK stock performances relative to those of EU. In addition, this approach was strengthened by the fact that companies' performances in the UK and EU seemed to be affected by similar external factors, as perhaps the UK and EU have been tightly intergrated, reducing possible biasness. Unlike, for example, if applying this method to Thai companies' performances relative to the US in the Asian financial crisis era (1995), biasness would definitely materialize as external factors are confounding, and hence need to do a regression such as multiple linear regression to capture those noticeable confounding factors. - Then the repective growth of the UK and EU stock performances, per sector, was calculated:

$$GrowthRate = \frac{(Price_t - Price_i)}{(Price_i)} \quad (3)$$

where i stands for initial period and t is the end of the period 1. For pre-Brexit referendum, the initial period is 1st January 2014 and the ending period is 1st June 2016 2. For post-Brexit referendum, the initial period is 1st June 2016 and the ending period is 1st December 2018

- We then obtained growth rates, per sector, of the UK and EU companies, subsequently, we calculateed the relative performance of each sector, using the UK ones as a baseline:

$$RPuk_i = GrowthRate_{uki} - GrowthRate_{eui} \quad (4)$$

where i stands for a given sector 1. This can be done, as growth rates have no unit, but in percentage forms 2. RP is also a percentage form

- Next, we plotted relative performance graphs pre- and post- Brexit referendum
- For the post- Brexit referendum, we performed additonal statistical analysis to inspect which sector performed best and worst. This cannot be seen just by looking at the RP we plotted, as some sectors may have performed poorly or superiorly even before the referendum. Hence, we subtracted RP before the referendum with RP after:

$$RP'_{uki} = RP_{ukipos} - RP_{ukipre} \quad (5)$$

where pos stands for RP done using 1st June 2016 to 1st December 2018 period and pre stands for RP done using 1st January 2014 to 1st June 2016 period

- Hence, we obtained the sectors that experienced the biggest gain and the biggest loss, and marked them in the plot

Figure 5 and 6: Donut Charts For this section, we acknowledged that share prices alone would not tell the whole story; thus we implemented a donut chart to analyse assets held by each business sector of the British companies, in a percentage form. The following procedures and rationales applied to both of the donut charts: - Firstly, we separated assets to pre- and post-Brexit. As the assets varied on a yearly basis, we categorized the years 2014 to 2016 as pre-Brexit. Our reasoning was that assets were presumably illiquid, except perhaps the financial sector, and thus require time to adjust according to the referendum mid-2016. Consequently, the years 2017 and 2018 are categorized as post-Brexit years - We, then, summarized, for each sector, all assets and divided that by the number of years, thus obtaining average assets for a particular sector - Hence, we obtained average assets, for each sector, pre- and post- referendum, and we calculated percentage of assets controlled by one sector against all sectors:

$$pct_{it} = \frac{AvAsset_{it}}{(TotalAssets_t)} \quad (6)$$

where i indicates a particular sector and t denotes interested period 1. In this case, we have two interested periods: pre- and post- Brexit referendum

3 Graph Explanation

3.0.1 Figure 1: UK Share Price Percentage Change by Sector (Monthly, 2016)

Rationale: Line charts are extremely useful in showing trends of time series data. Since the range of the share price is different in each sector of the 'UK_short' dataset, we transformed the share price column to a percentage change column where the original price is the price of the first month of the year. As evident from Figure 1, Consumer Discretionary and Energy & Materials changed the most amongst the 6 unique sectors; we decided to highlight the 2 corresponding lines for these sectors while making other lines slightly more transparent. Since we are interested in Brexit, it was reasonable to indicate and visualize the exact date of the event, therefore, dots and information were emphasised on the date. Additionally, we were interested in the overall changes of the year, so plotting dots and information (percentage change at the end of the year) are demonstrated.

Analysis: The graph illustrated the short-term market performance of 6 sectors in the UK, indicated by percentage changes of share price from January 2016 to December 2016. By looking at the graph, on the Brexit date in June 2016, Consumer Discretionary increased by 11% while Energy & Materials decreased by 18%. In the end of 2016, Consumer Discretionary rose to another 10% while Energy & Materials maintained the same level.

3.0.2 Figure 2: UK, Germany and France Share Price Percentage Change (Monthly, 2014 - 2018)

Rationale of the selected line graph: To compare and contrast the overall performance of the 3 selected countries, using line graphs to illustrate the trends of percentage changes in share price of each country was extremely useful. As aforementioned, line graphs help us to quickly grasp the information both from start and end of a line in seconds, which then allow us to easily identify certain differences and/or similarities.

Analysis: The graph illustrated the long-term stock market performance of the UK, Germany and France, indicated by share price index, from 2014 to 2018. We observed an overall positive

trend for all 3 countries, which indicate the improvement in stock market performance since 2014. To fulfil our purpose of this visualization, we focused on comparing pre- and post-Brexit performance. For the UK, the percentage change fluctuates around 10% to 20% compared to the base year. However, the French and German stock market experienced a dramatic increase in share price since the Brexit referendum. A reason for this may be that UK company investors felt a sense of uncertainty towards future and tended to behave more conservatively in the UK market or may have shifted towards French or German stocks. Interestingly, after the stock market experienced positive trends in all 3 countries, particularly in the 3rd and 4th quarter of 2018, we see a strong negative trend in the stock market and a slowdown in the growth of stock price. This stock market trend might have been caused by the slowdown of the economic growth rate due to the end of monetary stimulus policy all across EU. This is certainly a matter that can be further investigated in future.

Another point to note is that we can say that if the UK never experienced the referendum, their share price would be around Germany's, 19% higher than its current price, mainly because prior to June 2016, the performance of Germany and the UK moved in a similar fashion, quite closely knit together.

3.0.3 Figure 3: Pre-Brexit UK Share Price Percentage Change Relative to EU (2014-2016)

Rationale: The reasoning behind using a diverging plot was to clearly illustrate performing and non-performing sectors of the British companies relative to those of the EU (Germany + France) ranging from January 2014 to June 2016 and their corresponding percentage changes. Share prices as percentage changes were specifically analyzed due to differing currencies.

Analysis: It seems from the given period, the UK Industrials sector was performing the worst at -20%, while the Utilities sector performed relatively best at +58%.

3.0.4 Figure 4: Post-Brexit UK Share Price Percentage Change Relative to EU (2016-2018)

Rationale: Same rationale as Figure 3, except Figure 4 looks at post-Brexit data.

Analysis: Regardless of the pre-Brexit comparison, Financial and Consumer Discretionary sectors performed best and worst, at +16% and -68% respectively. The Financial sector's performance was expected to fall, as predicted by our group, due to uncertainty causing investors to perhaps shift their stocks overseas or become more conservative - however, surprisingly, the stock price had actually increased. Conversely, the Consumer Discretionary sector performed more to our expectations since a lot of tourism and hospitality included in the sector had been hit hard. Compared with pre-Brexit performances, the Utilities sector's stock prices decreased the most, while the Energy and Materials sector topped all else, which is why they were highlighted.

3.0.5 Figure 5: Pre-Brexit UK Average Asset Distribution by Sector (2014-2016)

Rationale: The donut chart created intended to show assets controlled by each sector percentage-wise. However, the assets shown here were averaged from 2014 to 2016 to reduce possible noises. Due to their simplicity in structure, visually they are quite easy to understand at a glance, even for non-professional readers.

Analysis: It is clear that assets controlled by the Financial sector dominated, followed by Consumer Staples. In contrast, the rest are relatively similar. It is no surprise to see this kind of dominance, as London ranks 2nd in the Global Financial Centres Index (GFCI) 2020. Besides, the Industrial sector covered only 1.3% of the total, which makes perfect sense, as according to the provided data, France and Germany are the industrial power houses.

3.0.6 Figure 6: Post-Brexit UK Average Asset Distribution by Sector (2017-2018)

Rationale: Same rationale as Figure 5, but the assets shown here were averaged from 2017 to 2018 (post-Brexit).

Analysis: Compared to pre-Brexit, here we see a slight drop in the Financial sector, with a slight gain in Consumer Staples. This can be explained, as Colchester and Kowsmann (2019) reported, various financial firms have been moving assets to countries such as Germany since the referendum. Also, a surge in assets of the Consumer Staples sector can be explained as businesses and the government were stockpiling food (Raab, 2018, cited in Daneshkhu, 2018) to prepare for a no-deal scenario.

4 References

- Colchester, M. and Kowsmann, P., 2019. London'S Finance Industry Has Decided: Brexit Is Already A Reality. [online] WSJ. Available at: <https://www.wsj.com/articles/turmoil-over-brexit-spurs-a-costly-exit-of-assets-talent-from-london-11552318414> [Accessed 11 November 2020].
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