



BREXIT CALLING! AFTERMATH IN THE PHARMACEUTICAL INDUSTRY

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ABSTRACT

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This paper aims to examine the impact of the Brexit referendum on the financial performance of the pharmaceutical industry in the United Kingdom. We analyze daily data for the period 1/2000-10/2019, for the two largest British pharmaceutical firms, GlaxoSmithKline and AstraZeneca, as well as two European competitors, the Swiss Novartis and the German Bayer. We perform returns and volatility analysis, financial ratio analysis and regression analysis. Our empirical results are heterogeneous among firms, pinpointing strengths and weaknesses of the pharmaceutical firms. The Brexit decision has had a significant, positive effect on the stock returns of the two British firms, a negative effect for Bayer and no effect for Novartis, while lagged returns are significant only for the European firms. At least in the short-run, both British firms have gained considerably from the depreciation of the sterling and should aim to expand their overseas network and avoid prospective trade barriers and regulatory issues.

JEL Classification:

C12; C13; C2; G3; G4.

Contribution/Originality: This study contributes to the existing literature by examining the effect of the Brexit decision on a highly profitable sector, looking at the consequences from many different perspectives, employing various statistical techniques and focusing not only on the pharmaceutical companies in the United Kingdom, but their competitors as well.

1. INTRODUCTION

The United Kingdom European Union membership referendum, commonly known as the EU referendum or the Brexit referendum or the Brexit vote, took place on 23 June 2016 and resulted in 52% of the votes cast being in favor of leaving the EU. This Brexit vote undoubtedly had colossal ramifications for businesses across the United Kingdom (UK) industries, with an effect on growth, prosperity and trade and with uncertainty causing depressed economic performance, increased borrowing and decreased savings.

When the results of the Brexit vote were announced, the UK currency fell dramatically, but the FTSE 100 went up, demonstrating the benefit of a weak sterling to the companies in the UK's largest index. A sharp decrease was observed at the time of the referendum (June 2016), while in October 2016 sterling momentarily plunged to as low as \$1.15 (known as "flash crash"). Exchange rates, unemployment and consumer confidence are a few economically important parameters that influence the index with Brexit adding uncertainty to the frame. In three months when the FTSE 100 rose 10.4%, the pound fell 12.8% against the dollar. This can be attributed to the globality of the FTSE100: around 71% of revenues generated by FTSE 100 companies come from outside the UK. The inverse relationship between the UK currency and FTSE 100 can be seen for quite some time after the Brexit vote (Brett, 2017).

The UK economy has shown resilience since the referendum, thanks to the high performance of the services sector, especially those related to consumption (retail, catering, and entertainment). However, growth slowed to 1.7% in 2017, despite the favorable international economic environment (Partington, 2019).

The pharmaceutical industry accounts for a crucial part of the UK economy. Leaving the EU presents significant challenges to the stability of the industry in the UK. More specifically the prospective ramifications involve Marketing Authorizations, Quality and safety control, Pharmacovigilance, Clinical trials and Access to funding (NSF International, 2017). Pharmaceutical companies listed in the FTSE100 index will conform to repercussions that follow the regulatory processes and market authorization of medicines in the UK. Up to Brexit, UK companies had to follow EU medicines regulations; sanctioning the early licensing of certain products and providing quicker access compared to the UK's own procedures. The impact of Brexit will be highly dependent on the nature of the agreement between the two parts with the financial markets' loss of confidence in British institutions a highly probable outcome.

GlaxoSmithKline (GSK) and AstraZeneca (AZN) are two of the world's largest pharmaceutical companies, headquartered in the UK and listed in the London Stock Exchange. The announcement for Brexit, following the 2016 UK referendum, was a shock and has undoubtedly affected the financial performance of both pharmaceuticals preparing for every Brexit outcome.

The aim of this research is to explore how the UK's decision to exit the EU has impacted the financial performance of British Pharmaceutical companies. To the best of our knowledge, this is the first study on the effect of Brexit referendum on UK pharmaceutical stock prices. More specifically, the study aims are: (1) To evaluate the impact of the Brexit vote on the Pharmaceutical companies GSK and AZN. (2) To analyze the key financial ratios and volatility (stock price changes) before and after the 2016 Brexit referendum of these companies. (3) To describe the effect of 2016 Brexit referendum on their stock returns, testing if the result was immediately reflected in pharma stock prices. (4) To compare the performance of the two British companies with their competitors, Swiss NOVARTIS and German BAYER, during the same period.

2. THE BREXIT VOTE AND FINANCIAL UNCERTAINTY

Financial markets are characterized by volatility clustering due to uncertainty in the global economy (Tsangari, 2007). Price fluctuations reflect the changing outlook for the macroeconomic and microeconomic environment. Market volatility is positively associated with changes in inflation (through interest rates), industrial output growth and unemployment. At the same time the rise in interest rates reinforces the feeling of uncertainty. Generally the different phases of the economic cycle affect the level of profits and thereby cause fluctuations in the stock market. Stock price volatility is magnified by leverage while another factor that leads to increased volatility is the trading volume (Christie, 1982).

Incoming information, such as business deals (Mergers & Acquisitions (M&A)) or political events cause drastic changes in the supply and demand of stocks, thereby significantly changing their prices and increasing their volatility. As stated by Jorion and Goetzmann (1999) political events have caused market activity disturbances around the globe during the last century. Beaulieu, Cosset, and Essaddam (2006) concluded that the lack of certainty encircling a Canadian referendum outcome (political event) had an impact on stock returns for Quebec firms.

Among the greatest financial uncertainty shocks for the UK have been the dot-com crisis in 2002, the global financial crisis of 2008 and the Brexit vote (Redl, 2017). Financial instability for the UK began in September 2007 with the run on Northern Rock (nationalized in February 2008). In October 2008 the UK government had to bail out (£50bn bid) three major UK banks (Royal Bank of Scotland, Lloyds TSB and HBOS). These events led the UK to an economic plunge that led to austerity policies and generated a "direct line" to Brexit. In 2008, everything occurred rapidly. In 2016, Brexit unleashed an era of uncertainty, affecting companies and individual investors.

Brexit was a unique and momentous event, of an EU member voting to leave the union unprecedentedly. The Brexit vote has increased uncertainty, both political and economic. It was a global phenomenon that affected the international financial systems, predominantly the Foreign exchange market, which is the largest worldwide, involving the Euro and the British pound- the currencies closely engaged in the Brexit vote.

By the end of 2017 the economic cost of the Referendum was 1.3% of GDP with accumulating costs near £20 billion and an estimate of £60 billion by the end of 2018. Elevated policy uncertainty had an effect on investment and consumption (Born, Müller, Schularick, & Sedlacek, 2017). The projected growth rate of UK until early 2020 was revised downwards, due to the estimated decline in private investment, productivity and household expenditure, following the effects of the referendum (sterling depreciation and rising inflation).

Bloom et al. (2019a); Bloom et al. (2019b) quantitatively measured the level of uncertainty of British firms between 2016 and 2019, using the Brexit uncertainty index, showing how uncertainty increased after the referendum, had its highest level towards the end of 2018 and started to decrease after 2019. During the two-year period after the Brexit Referendum, around 40% of UK firms estimated that Brexit was a major originator of uncertainty for them. *The effect on British firms was dependent on the extent of linkage to Continental Europe. Investment increased by about 11% and productivity decreased around 2%-5% in the years 2016-2019* (Bloom et al., 2019a; Bloom et al., 2019b). Sattar, Hughes, and Marshall (2017) concluded that inward investments, a year on after the referendum, shifted due to unpredictability, in spite of the appeal of a weaker UK sterling. They point out that swiftly reconstructing a robust and attractive market will benefit the UK's future.

De Bondt and Thaler (1985) tested the tendency of people to “overreact” to unexpected and dramatic news events affects stock prices. Looking at the UK’s decision to leave the EU we can see the reason why markets repeatedly fail: the intrinsic human needs to feel in control. Major turmoil and volatility was caused in global financial markets as an immediate response to the referendum with an unforgettable lowest level (since 1985) for the British pound. An instantaneous economic hit occurred. Confidence fell and investment was hindered while interest rates dropped to 0.25% by the Bank of England. Two days after the Brexit announcement (24-25 June 2016) the FTSE 350 lost 7% of its value but mostly recovered by 30th of June with different companies having different experiences (Davies & Studnicka, 2018).

Shefrin and Statman (2000) concluded that investors are ruled by fear and greed when it comes to investing. CNNMoney’s Fear & Greed Index (CNNMoney, n.d) which tracks seven indicators of investor sentiment, deepened into “Fear mode” on 24th June 2016 (day after the referendum) after showing signs of “Extreme Greed” on Thursday 23rd of June 2016 (day of referendum) as investors expected that the no-Brexit vote would triumph. The VIX, a volatility measure that is designated as Wall Street’s fear indicator, took off more than 40% on 24th June 2016.

According to Szyszka (2013) “overconfidence” leads to misjudgment of risk. When a risk is underestimated, people tend to treat unlikely events as completely impossible and in contrast treat highly probable events as if they were certain. Stock prices are a good variable for capturing changes in investors’ expectations about future economic conditions (Beaudry & Portier, 2006). The Brexit referendum caused the stock market to react in such a way due to exchange rate fluctuations and investors’ beliefs of an economic downshift (Breinlich, Leromain, Novy, Sampson, & Usman, 2018).

According to the Efficient Market Hypothesis (EMH), financial markets are efficient and information (news) about stocks and securities spreads fast and is immediately reflected in stock prices, with tomorrow’s price change reflecting only tomorrow’s news and being independent of the price changes today (Fama, 1970; Malkiel, 1973). Information includes not only what is currently known about a stock, but also any future expectations. News, such as the Brexit referendum result, is not predictable, and thus, stock price changes are also unpredictable. In addition, the Random Walk Model tests the weak form market efficiency, if the value of the series tomorrow is its value today plus an unpredictable change. According to Schwert (2003) stock prices react in an efficient way to new information; good news causes stock prices to rise quickly– the test of market efficiency is what happens after the information becomes public (Shiller, 2003) recognized the importance of psychological factors and behavioral finance, which can address many market anomalies that EMH ignores. According to Shiller (2003) the EMH cannot explicate the excess volatility which is the most crucial market abnormality. In fact, behavioral finance shows that when it comes to risk and uncertainty, investors’ behavior deviates greatly from that of the “rational” investor (Hens & Meier, 2015). When making a decision most people are “myopic”, paying attention to the imminent future and dreading an instant loss most, eliminating more distant developments (Benartzi & Thaler, 1995; Benartzi. & Thaler, 1999; Kahneman & Tversky, 1979).

3. BREXIT AND THE PHARMACEUTICAL SECTOR IN UK

The performance of pharmaceutical firms depends on various factors, including the quality of the management team, the financial status of the firm, its profitability, stockholder return, strategy and prospects for growth (Beynon & Porter, 2000). The pharmaceutical industry involves product longevity. A new product thrives initially for a few years and can maintain positive growth rates for many years after launch. Markovitch, Steckel, and Yeung (2005) investigated the role of stock price variation in managerial decision-making using modern pharmaceutical companies as a reference group. They showed that pharmaceutical firms can successfully decipher stock market signals, by using success factors such as new product development and rigorous marketing, including brand building and promotion, concluding that stock market returns lead to changes in strategies.

The global financial crisis of 2008 negatively affected the pharmaceutical industry. Most companies had to scale down the majority of activities, especially on Research and Development (R&D). Big pharma companies had to focus on efficiency, cost-effectiveness, and productivity mostly through M&A. The pharmaceutical industry in general was quick to recover and grow positively to the economic slump during the 2008-2009 crisis. It can be argued that the earnings growth of pharmaceuticals is maintained even in recession periods: the demand for healthcare products does not drop and the sector seems to be untouched by economic cycles (Beynon & Porter, 2000). Pharmaceutical stocks are, in fact, attractive to investors, although their prices are higher compared to other firms.

The Brexit decision can potentially have consequences for many industries of the UK economy, especially for the pharmaceutical sector which is extremely regulated. The pharmaceutical industry of EU members is provided with the necessary scientific, regulatory and trade infrastructure – not many sectors of the economy are so closely interlinked with their European peers. The UK pharmaceutical industry will probably be at risk more than any other industry due to the complicated structure that relies on funds and research as well as ongoing regulations since it depends heavily on European harmonization (e.g. for transfer of raw materials and end-products to secure access to medicines across Europe). One of the biggest consequences of Brexit for the pharmaceutical industry is the relocation of the European Medicines Agency (EMA) from London to Amsterdam. As of spring of 2019 EMA has migrated to the Netherlands taking many of its employees, and most likely will impose changes to regulations for medicinal products developed and tested in the UK (European Medicines Agency, 2019).

The UK pharmaceutical industry is one of the most productive industries in UK, very high-yielding (turnover of £41.8 billion), contributing to 8.2% of UK exports (UK Parliament Publications, 2018). It involves a myriad of jobs (more than 700,000 employees) that deal with R&D, clinical trials, manufacturing and distribution, while the production of pharmaceuticals has contributed almost 10% of the UK's GDP and generated over £3 billion in trade surplus for 2015 (the year before the referendum) (European Federation of Pharmaceutical Industries and Associations, 2017). UK pharmaceutical exports to the EU market have increased by almost 30% over the last 10 years and promising future growth. In fact, the UK is the main location in Europe for venture financing of pharmaceutical companies, accounting for over a third of the total Venture Capital raised in the pharmaceutical sector in Europe (Kazzazi et al., 2017).

The UK's pharmaceutical sector has two huge players that rank amongst the top 15 world pharmaceutical companies (by revenue) and whose headquarters are UK-based: GlaxoSmithKline (GSK) with a revenue of \$40.99 billion (world's 6th largest pharmaceutical company according to Forbes as of 2019) and AstraZeneca (AZN) with a revenue \$22.09 billion (ranked 14th in 2018 by revenue) (AstraZeneca, n.d; GlaxoSmithKline, n.d). Their products include Over-The-Counter (OTC), branded and generic medicines for UK and global consumers. In addition, with bases in the UK some of the biggest global pharmaceutical companies have been selling their products to the European market taking advantage of the integration of the EU trade chain. McKee and Martin (2016) predict that, even if these companies do not relocate completely, it is unlikely that they would continue to invest in a UK separated from EU by a tangle of regulatory barriers.

The day after the decision to exit EU, stock markets plunged but pharmaceutical companies to a large extent avoided defeat. The share price of GSK actually did rise slightly on the 24th of June 2016. In times of economic trouble, pharmaceutical companies are considered a defensive investment; after all, pharmaceutical products are a necessity for most people. In addition, within the UK pharmaceutical industry a lot of companies (including GSK and AZN) earn much of their revenue in US dollars, so they would benefit, at least in the short run, from a falling sterling and increased export competitiveness, particularly for products produced in the UK and not requiring expensive inputs from abroad (Nicholls, 2016).

4. THE FOUR SAMPLE PHARMACEUTICAL COMPANIES UNDER STUDY

For the purpose of the current study we will examine the financial performance of the two largest UK pharmaceutical firms (GSK and AZN), which are listed in the London Stock Exchange, to represent the pharmaceutical sector of UK. For comparative purposes, we will additionally examine two European competitors, Novartis from Switzerland (non-EU firm), and Bayer from Germany (EU firm). We will focus on the effect of the Brexit vote on these four companies.

The largest UK pharmaceutical company, GlaxoSmithKline (GSK), has three main business divisions: Pharmaceuticals (60% of revenue), Consumer Healthcare, and Vaccines. GSK has more than 85 manufacturing sites in 36 countries. The firm's prime R&D facilities are located in Europe (UK, Spain, and Belgium), the United States and China. GSK is turning the focus of R&D towards fields that deal with the immune system, the employment of genetics, and funding in state-of-the-art technologies. According to GSK's approach to Brexit, the company will continue to adjust their plans and their expected financial impact as negotiations and regulations develop. Disruption is imminent in the short term, but over the longer term it is believed that Brexit will not have a material impact (GlaxoSmithKline, n.d). GSK has spent close to £70m on different measures including securing more warehouse space, building new laboratories for parallel product testing and shifting licenses to ensure their products can still be sold in the EU. A no-deal Brexit could add £50m a year in tariff costs for GSK (Kollewe & Scruton, 2019).

AstraZeneca (AZN) specializes in medicines designed for therapeutics of various ailments (cardiovascular, metabolic, neurological, GI, respiratory, oncological, and infections). It markets its products in over 100 countries, with European sales contributing towards 50% of total revenues. It manufactures products from about 30 sites in 18 countries. The company has R&D centers in the US, the UK, Sweden, Japan, China, and Poland. Like most large pharmaceutical companies, it has to withstand by developing new blockbusters despite patent expirations and increasing volume of generic competition. The firm has made an effort to strengthen its industry position ahead of patent expirations by focusing on building up its late-stage drug development pipeline through internal R&D, acquisitions, and collaborations (AstraZeneca, n.d). AZN has frozen all UK manufacturing investments the last two years. Fears of the UK becoming "an isolated island" were expressed by the company's chairman, Leif Johansson (Kollewe & Scruton, 2019).

Novartis (NOVN) has headquarters in Basel, Switzerland, and it is a global player of pharmaceuticals and vaccines. Novartis possesses 15 blockbuster drugs, with annual revenue of more than \$1 billion per year. In 2018, it sold its 36.5% portion owned in a consumer health care joint venture with GSK, for about £9.2 billion, in order to focus on such fields as gene therapy and oncology. It also announced plans to sell parts of Sandoz; in 2019 it spun off its eye care unit. Novartis continued its restructuring by exiting its antibiotic research activities and, later, ending 90 drug programs. It plans to focus on a smaller number of drugs that it feels could have a major impact. Novartis is a major supplier to the UK's Healthcare system importing 120million packs of medicines to the UK from the continent each year. The pharma giant issued a Brexit statement for the UK operations in January 2019, stressing the fact that the UK government should minimize disruption to the supply of medicines and that a no-deal Brexit would be 'hugely impactful' for patients (Novartis, n.d).

The German company Bayer (BAYN) generates around half its revenue from its Pharmaceutical operation, manufacturing prescription products, especially for women's health care and cardiology, and specialty therapeutics in the areas of oncology, hematology, and ophthalmology. Its Consumer Health division manufactures OTC products while its Crop Science division acquired agrochemical company Monsanto in mid-2018 for \$66 billion. Most of Bayer's core manufacturing facilities are in Germany and the US and comprises about 240 consolidated companies operating in 80 countries around the world. During 2019 Bayer sold its global prescription dermatology business to Danish firm Leo Pharma. The company also sold its veterinary unit for \$7.6 billion and agreed to sell its sun-care brand and its foot care business, in order to concentrate on its nucleus units; Pharmaceuticals, Consumer Health, and Crop Science. Bayer's political position on Brexit is 'Maximizing Economic Integration' as far as the future relationship of the UK and the EU are concerned. The company states that Bayer's core interests lie in maintaining a strong UK R&D base, as well as barrier-free access to the UK market (Bayer, n.d).

5. METHODS

The data for the study were obtained from various sources, including Yahoo! Finance, Hoover's Company Profiles (Hoovers, n.d) and the four pharmaceutical firms' official financial statements and annual records (AstraZeneca Plc, 2019; Bayer, 2019; GlaxoSmithKline Plc, 2019; Novartis, 2019). The data cover the period 3/1/2000-22/10/2019 for all firms, subject to availability.

We will analyze (1) the pharmaceutical firms' financial performance before and after the 2016 Brexit referendum, using financial ratio analysis, (2) the returns and volatility of stock prices of the four pharmaceutical firms and (3) the effect of the 2016 Brexit referendum on the stock market returns using regression analysis.

5.1. Financial Ratio Analysis

The financial performance of a company is important to stockowners, investors and financial managers. Financial ratios assist in the investors' evaluation of pharmaceutical companies. In this study, we examine key financial metrics and ratios that the pharmaceutical industry uses as benchmarks.

1) Liquidity ratios. With high R&D costs, pharmaceutical firms must successfully control their high extent of debt and guarantee sufficient liquidity levels. Such ratios are:

$$\text{Current Ratio} = \text{Current Assets} / \text{Current Liabilities}$$

$$\text{Quick Ratio} = (\text{Current Assets} - \text{Inventory}) / \text{Current Liabilities}$$

2) Debt ratios. For a pharmaceutical company to be viable and profitable its debt obligations must be successfully managed:

$$\text{Debt-Equity Ratio} = \text{Total Liabilities} / \text{Total Equity}$$

3) Profitability/ Growth ratios. Pharmaceutical firms after launching new medicines need to produce and trade them. On that account investors are interested in profitability ratios:

$$\text{Net profit margin (NPM)} = \text{Net income} / \text{Sales}$$

$$\text{Earnings per share (EPS)} = (\text{Net Income} - \text{Preferred Dividends}) / \text{Average Common Shares Outstanding}$$

$$\text{Return on Equity (ROE)} = \text{Net Income} / \text{Stockholders' Equity}$$

$$\text{Return on Capital Employed (ROCE)} = \text{EBIT} / \text{Capital Employed. Capital Employed} = \text{Total Assets} - \text{Current Liabilities.}$$

4) Market ratios. They are barometers of a company's long-term growth and upcoming performance expectations:

$$\text{Price-Earnings Ratio (P/E)} = \text{Market Price per Share} / \text{Earnings per Share.}$$

5.2. Return and Volatility Analysis

We will follow a two-stage analysis: In stage 1, we will examine the volatility of stock prices of the two UK pharmaceutical firms. There exist several measures of volatility, but we will consider the one reported in Rogers and Satchell (1991) and Rogers, Satchell, and Yoon (1994) as it includes all ranges of prices at a specific trading day, representing risk. Specifically, daily volatility of prices is calculated from high, low, open, and closing prices as follows:

$$\text{Var} = [\ln(\text{High}) - \ln(\text{Open})][\ln(\text{High}) - \ln(\text{Close})] + [\ln(\text{Low}) - \ln(\text{Open})][\ln(\text{Low}) - \ln(\text{Close})] \quad (1)$$

In stage 2, we will compute the returns of daily closing prices of UK pharma firms using the formula:

$$\text{Return}_t = \ln(\text{Price}_t) - \ln(\text{Price}_{t-1}) \quad (2)$$

Return_t denotes the daily return on day t; Price_t is the daily closing price on day t; and Price_{t-1} is the lagged value (previous day) closing price.

To test the effect of Brexit referendum on the stock market returns of the pharmaceutical firms, we will consider linear regression analysis. We will test the impact of the pre-Brexit, Brexit, and after-Brexit referendum result on the UK pharmaceutical stock returns. More specifically, we will test the model:

$$\text{Return}_t = \alpha + \beta D_{\text{pre-Brexit}} + \gamma D_{\text{Brexit}} + \delta D_{\text{after-Brexit}} + z \text{Return}_{t-1} + u_t \quad (3)$$

In the model Equation 3 we have three dummy variables:

$$D_{\text{pre-Brexit}} = 1 \text{ for the period before the Brexit referendum result (before 24/6/2016);}$$

$$= 0 \text{ otherwise.}$$

$$D_{\text{after-Brexit}} = 1 \text{ for the period after the Brexit referendum result (after 24/6/2016);}$$

$$= 0 \text{ otherwise.}$$

$$D_{\text{Brexit}} = 1 \text{ for the day of Brexit referendum result (24/6/2016);}$$

=0 otherwise.

We also include in Equation 3 the lagged value of Return (Return_{t-1}) in line with the non-synchronous trading effect and tests of the random walk model.

A variable is considered significant if the corresponding p-value is less than the level of significance, α , 5%.

All the data analyses are performed using Microsoft Excel and EViews software.

6. RESULTS

Table 1 shows the financial performance of the two UK pharmaceutical firms under study (GSK, AZN), for the period before and after the Brexit vote (2014–2018) and a comparison with key financial ratios of the two competitors (NOVN, BAYN).

Table-1. Key financial ratios for the four pharmaceutical firms, for the years 2014–2018.

| Company | Financial ratio | 2014 | 2015 | 2016 | 2017 | 2018 |
|---------|-----------------------|----------|----------|---------|---------|----------|
| GSK | Net Income (\$ M) | 4280.62 | 12484.77 | 1121.94 | 2066.86 | 4629.43 |
| | Net Profit Margin (%) | 11.98 | 35.21 | 3.27 | 5.08 | 11.76 |
| | Current Ratio | 1.10 | 1.24 | 0.88 | 0.60 | 0.75 |
| | Quick Ratio | 0.66 | 0.84 | 0.56 | 0.36 | 0.45 |
| | ROE (%) | 48.95 | 179.63 | 29.24 | 290.15 | 168.83 |
| | ROCE (%) | 13.37 | 28.09 | 6.59 | 14.24 | 15.62 |
| | Reported EPS growth | -0.49 | 2.04 | -0.89 | 0.67 | 1.35 |
| AZN | Net Income (\$ M) | 1233.00 | 2825.00 | 3499.00 | 3001.00 | 2155.00 |
| | Net Profit Margin (%) | 4.65 | 11.43 | 15.21 | 13.36 | 9.76 |
| | Current Ratio | 0.96 | 1.08 | 0.87 | 0.80 | 0.96 |
| | Quick Ratio | 0.82 | 0.90 | 0.68 | 0.57 | 0.68 |
| | ROE (%) | 5.76 | 14.82 | 20.99 | 20.13 | 15.71 |
| | ROCE (%) | 4.26 | 7.83 | 8.95 | 6.26 | 6.29 |
| | Reported EPS growth | -0.52 | 1.28 | 0.24 | -0.14 | -0.28 |
| NOVN | Net Income (\$ M) | 10210.00 | 17783.00 | 6712.00 | 7703.00 | 12611.00 |
| | Net Profit Margin (%) | 19.04 | 35.29 | 13.58 | 13.56 | 23.72 |
| | ROE (%) | 14.07 | 24.06 | 8.84 | 10.34 | 16.51 |
| BAYN | Net Income (\$ M) | 4164.30 | 4490.18 | 4773.86 | 8787.53 | 1917.02 |
| | Net Profit Margin (%) | 8.11 | 8.87 | 9.69 | 20.95 | 4.28 |
| | ROE (%) | 16.78 | 18.53 | 16.60 | 21.85 | 4.10 |

Source: Hoovers.com; (AstraZeneca Plc, 2019; Bayer, 2019; GlaxoSmithKline Plc, 2019; Novartis, 2019).

We can see that for GSK, Net income and Net profit margin reduced significantly from 2015 to 2016, as well as ROE and ROCE. The year 2015 was very successful for GSK, but the end of 2016, after the Brexit vote, found GSK with a 3.27% Profit Margin and a negative EPS growth. However, GSK had a steady profitability and growth in years after the Brexit vote, as can be seen in 2017 and 2018. A phenomenal ROE of 168% is noted for the year 2018, much higher than any of the other pharmaceutical firms of the study.

Regarding the financial performance of AZN, there was a steady growth in net income and financial ratios from 2014 to 2016, where the year 2016 (which includes the period right after the Brexit vote) showed the best financials (Net income, NPM, ROE, ROCE) for the company. A decline appears in the years after the Brexit vote, 2017–2018, including a negative EPS growth. Comparing AZN with GSK, in terms of short term liquidity, their current and quick ratios are similar.

Regarding NOVN, 2015 was a profitable year, while the firm's net profit margin dropped by the end of 2016, after the Brexit vote, from 35.3% to 13.6%, together with the other financial ratios (ROE dropped from 24.1% to 8.8%). An increase of the company's net income, NPM and ROE appears by 2018. Comparing NOVN with GSK and AZN for 2018, we can see that the NPM of NOVN is much higher (23.7% compared with 11.8% and 9.8% respectively).

BAYN had a steady increase until 2018, but by the end of the year there was a sharp decrease in net income and financial ratios (ROE dropped from 21.9% in 2017 to 4.1% in 2018, much lower than the other three firms).

Table 2 shows descriptive statistics of the daily returns for all the pharmaceutical firms of the study, for the period 1/2000–10/2019.

Table-2. Descriptives for the daily returns of the four pharmaceutical firms (1/2000–10/2019).

| Descriptives | GSK Return | AZN Return | BAYN Return | NOVN return |
|--------------|------------|------------|-------------|-------------|
| Mean | 0.000229 | 0.000193 | 6.29E-05 | 9.28E-05 |
| Median | 0.000 | 0.000 | 0.000 | 0.000 |
| Maximum | 0.188 | 0.134 | 0.330 | 0.113 |
| Minimum | -0.139 | -0.167 | -0.194 | -0.099 |
| Std. Dev. | 0.015 | 0.016 | 0.020 | 0.013 |

| | | | | |
|-------------|-----------|-----------|------------|----------|
| Skewness | 0.133 | -0.278 | 0.742 | -0.063 |
| Kurtosis | 9.365 | 11.651 | 25.353 | 9.324 |
| Jarque-Bera | 13605.850 | 15823.480 | 105936.800 | 8255.821 |
| p-value | p<0.001 | p<0.001 | p<0.001 | p<0.001 |

The highest mean return for the period 2000-2019 appears for GSK, with a low standard deviation. We have a positive skewness for GSK and BAYN, implying a long right tail in the distribution of daily returns, whereas the values of kurtosis are all higher than 3. The Jarque-Bera test rejects normality at the 5% level for all pharmaceutical firms under study.

Next we will examine graphically the distribution of daily returns, as well as the volatility of the pharmaceutical stock prices for the period 2000-2019 (as calculated using Equations 1 and 2).

Figure 1 shows the time-series plot of daily stock returns for all four companies.

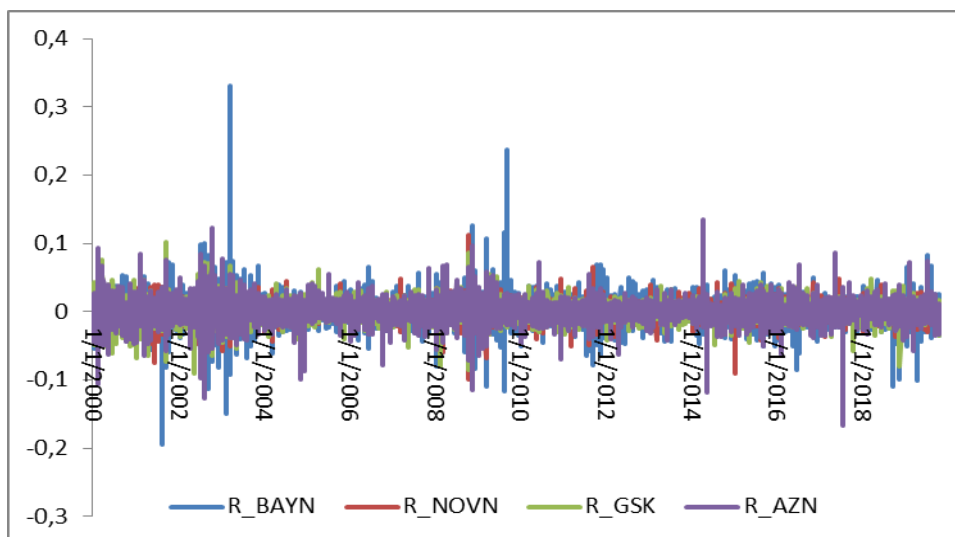


Figure-1. Daily Returns of GSK, AZN, BAYN and NOVN for the period 1/2000-10/2019.

We can see that the daily returns of the four stocks are at similar levels, with some exceptions such as the returns of BAYN during 2003 and 2009, as well as the returns of AZN during 2014 and the lowest return in 2017, the year after the Brexit vote.

Figure 2 shows the daily volatility of the stock prices of the four pharmaceutical firms, for the period 1/2000-2019.

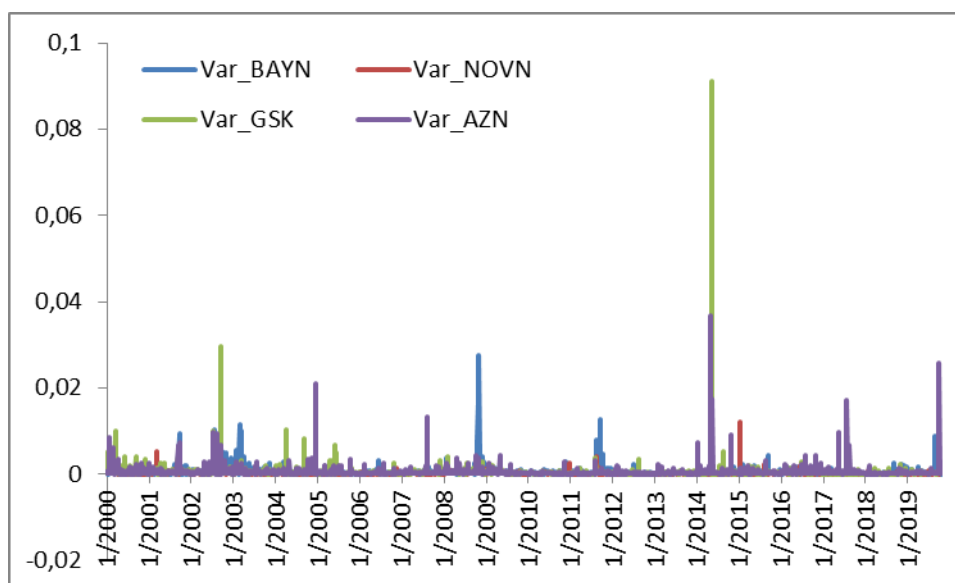


Figure-2. Daily Volatility of stock prices of GSK, AZN, BAYN and NOVN for the period 1/2000-10/2019.

NOVN appears to have the lowest levels of risk and volatility clustering, with an increase in risk during 2015, while GSK and AZN have similar levels of variability. GSK has the highest level of volatility in 2014 and 2002, while AZN has increased volatility in 2002-2003 and 2017-2018 and end of 2019, which are the years after the

Brexit announcement. BAYN has increased risk after the financial crisis of 2008, but its volatility appears to be high also during 2019.

Finally, we examine the impact of the Brexit referendum result on the daily returns of the four pharmaceutical firms, using regression analysis. Table 3 shows the regression results for all firms, for the period 3/1/2000-22/10/2019.

Table-3. Regression analysis for the impact of Brexit vote on the daily returns of the four pharmaceutical firms under study (2000-2019).

| Company | Variable | Beta | t-statistic | p |
|---------|-----------------------|-----------|-------------|--------|
| 1. GSK | RETURN _{t-1} | -0.018 | -1.300 | 0.194 |
| | D_pre Brexit | -4.93E-05 | -0.223 | 0.824 |
| | D_Brexit | 0.036 | 2.544 | 0.011* |
| | D_after Brexit | 0.000 | 0.271 | 0.786 |
| 2. AZN | RETURN _{t-1} | 0.018 | 1.319 | 0.187 |
| | D_pre Brexit | 9.59E-05 | 0.378 | 0.705 |
| | D_Brexit | 0.033 | 2.037 | 0.042* |
| | D_after Brexit | 0.001 | 1.075 | 0.282 |
| 3. NOVN | RETURN _{t-1} | 0.038 | 2.641 | 0.008* |
| | D_pre Brexit | 3.50E-05 | 0.174 | 0.862 |
| | D_Brexit | -0.016 | -1.231 | 0.218 |
| | D_after Brexit | 0.000 | 0.651 | 0.515 |
| 4. BAYN | RETURN _{t-1} | -0.028 | -1.997 | 0.046* |
| | D_pre Brexit | 0.000 | 0.531 | 0.595 |
| | D_Brexit | -0.061 | -2.989 | 0.003* |
| | D_after Brexit | -0.000 | -0.494 | 0.621 |

The regression results show that for GSK and AZN there is a positive, statistically significant effect of the Brexit referendum on stock returns. In addition, we can see that for their competitors, there is a negative, statistically significant effect for BAYN, while for NOVN there is no statistically significant effect of Brexit on stock returns. Finally, the lagged values of returns are statistically significant only for the two European firms, NOVN and BAYN.

It is noted that, as expected, the values of Rsquare are small in all cases (around 0.002), showing that other factors significantly affect the daily returns (outside the focus of the study), while the Durbin-Watson statistic is for all the cases equal to 2, indicating that there is no autocorrelation problem.

7. CONCLUSIONS

Brexit is undoubtedly a highly significant and unprecedented event. Our findings shed light on how the Brexit referendum had an impact on the British pharmaceutical industry. More specifically, we examined the financial performance of the largest British pharmaceutical firms, London Stock Exchange listed GlaxoSmithKline and AstraZeneca, pre- and post-Brexit vote. For a comparability analysis in strategies and performance, we also examined two of their European competitors, the Swiss Novartis and the German Bayer.

Our results indicate the strengths and weaknesses of all firms and enable us to make suggestions for maximization of financial performance and improvement of profitability.

The statistical analysis showed that the Brexit vote had a significant, positive effect on the stocks of the two British pharmaceutical firms, GSK and AZN. Looking at the financial ratios, it appears that the effect was reflected in a different way in the two firms, albeit both firms, at least in the short-run have benefited by the depreciation of the British pound.

GSK has consistently increased its revenue over the past few years and has successful financial indicators after the Brexit vote. The year before the Brexit vote, 2015, had been very successful for GSK with a net income growth. This was the year when GSK acquired the Vaccines and Consumer Health divisions of Novartis, and trading its oncology division to Novartis. However, the end of 2016, the period after the Brexit vote, found GSK with a Net Profit Margin dropping from 35.2% in 2015 to 3.27% in 2016, a drastic drop in ROE and ROCE and a negative EPS growth. GSK, being a substantial exporter, kept afloat after Brexit because of new drug sales and obtaining currency gains from a falling British pound. The study shows an impressive increase in the company's ROE, in the years after the Brexit vote. ROE is an important indicator for pharmaceutical firms, considering the fact that they have to pay out enormous sums of capital to launch their products to market and need to have an efficient management the effective utilization of capital to be profitable.

Despite the 2016 referendum result, GSK invested £275 million at three manufacturing locations in Britain, proving its confidence that the UK remains an attractive place for manufacturing medicines, with expert employees and relatively low tax rates (GlaxoSmithKline, n.d). Based on more information from the company's official website, the joint venture with Novartis in 2018 contributed to the vote of confidence from investors, while in 2019, GSK also acquired the US-based oncology pharma company Tesaro in a £4 billion deal. In 2018 GSK outperforms NOVN with a Price/Earnings ratio of 39.87% compared to 14.91%, an indication for the firm's better prospects for long term growth. In 2019, it also completed a landmark deal with Pfizer, merging their consumer healthcare

businesses. The new business is a global leader in OTC products, with a market share of around 7%. (GlaxoSmithKline, n.d).

AZN similarly has been shown in our paper to be positively affected by the Brexit vote. Looking at the financials of AZN, we can see that AZN had a steady increase in Net income from 2014 till 2016, where the end of 2016, the period right after the Brexit vote found the company in a very successful phase (highest values of net income, NPM, ROE and ROCE). A slowdown, however, appears in 2017-2018. It is noted that AZN has a revenue growth during the last year, supported by the launch of new medicines and further progress on its pipeline, with several approvals. The slightly higher levels of volatility that have been shown in our study could be related to a rise in AZN's net debt: the firm's quick and current ratios had a sharp decline in 2007 (around the 2008 financial crisis) and its debt to equity ratio has been increasing ever since. A comparison of AZN and GSK for the year 2018 with additional ratios, shows that AZN has a higher Gross Profit Margin for 2018 (77.66% compared to 66.77%), as well as a higher Price/Sales ratio (4.40% compared to 2.45%), indicating better prospects for long term growth. According to the official website of the company, AZN has stockpiling and moved products from the UK to Continental distribution sites to minimize distance from customers on Brexit day (AstraZeneca, n.d).

NOVN, a Swiss pharmaceutical company has proven that although EU regulations do not apply, the firm can thrive and be successful. Our statistical analysis showed that there was no significant effect of Brexit on stock returns. NOVN's current and quick ratios do seem to be increasing post 2008 financial crisis with a sharp decrease in 2010 (probably due to the \$40 billion acquisition of Alcon- the world's largest eye-care company) and steady figures since then. The year 2015 was a profitable year, but the firm's profit margin and ROE dropped in 2016. There was a steady increase in net income by 2018 (Novartis, n.d). Switzerland, not an EU member, can be given as an example of a flourishing and profitable pharmaceutical industry, although the uncertainty lies whether the EU states will permit analogous benefits for the UK.

On the contrary, our results showed that for the German BAYN there is was a significant, negative effect of the Brexit referendum on stock returns. The financial performance of the company, however, shows a steady increase in net income from 2010 till 2018. The sharp decrease occurred in 2018, with a plunge of the net income, ROE (from 21.85% to 4.10%), as well as ROCE, perhaps due to the multi-billion, high-risk acquisition of the agrochemical Monsanto. The majority of European pharmaceutical companies have been using financial services supplied mainly by the UK and hold foreign currency to oversee their enterprises when operating in more than one market. Thus, for the non-UK based pharmaceutical firms it might become pricier to guarantee financial services or even access to such services, should Brexit restrict the offering of financial services to them.

In an attempt to test the weak-form market efficiency and a random walk pattern, our statistical results additionally indicated that lagged returns were significant for NOVN and BAYN, but not significant for AZN and GSK. Based on the random walk model, if returns are random and unpredictable, the pharmaceutical market processes information (news) efficiently and incorporates it into prices immediately (Malkiel, 1973; Schwert, 2003).

Hashemian-Rahaghi, Cheng, and Farnaz (2017) showed that the production efficiency and financial performance of pharmaceutical companies over 2011-2015 (years after the 2008 financial crisis and before the Brexit referendum) varied. For example, BAYN performed better than its competitor Merck, NOVN was below its competitor Swiss company Roche, GSK needed to lower their substantial dependence on debt financing and the financial performance of AZN was below the industry average. It can be seen that the results of the present study also indicate heterogeneity among the pharmaceutical companies under study, for the period before and after the Brexit referendum, with mixed findings, although a positive effect appears to exist, at least in the short-run, for both British firms.

The research-based pharmaceutical sector has always been facing challenges, such as additional regulatory obstacles and R&D costs. In fact, the industry has been severely hit by the fiscal austerity measures introduced by governments across Europe since 2010 (European Federation of Pharmaceutical Industries and Associations, 2019). After Brexit, the UK will be faced with revised trade duties and import tariffs. Inflicted tariffs on pharmaceutical firms will determine profitability and can revive the debate concerning strategic relocation of HR and manufacturing facilities. Since 2017 NOVN, GSK and AZN have been part of the trend of divestment of non-core business segments. Pharmaceutical companies are able to cut costs and streamline operations by restructuring, continually re-evaluating their pipelines and discontinuing programs with unfavorable risk-benefit profiles.

Albeit the fact that a compromised economic environment can hinder growth forecasts for any industry, there is a stability of demand for products that promote health (Kazzazi et al., 2017). The pharmaceutical industry has reduced mortality by achieving substantial advancements in patient well-being. Pharmaceutical companies will continue to have a good financial performance, especially due to the fact that populations are ageing (Papastavrou et al., 2011). Ageing populations involve myriads of ailments and increased health care costs. In addition, when new viruses emerge, consumers and investors tend to invest into vaccine developing firms. In light of the recent coronavirus pandemic, the US pledged more than 1 billion dollars to AZN to help the University of Oxford make the COVID-19 vaccine, while on June 13, AZN reached an agreement with Europe's Inclusive Vaccines Alliance to supply up to 400 million doses of the vaccine, with deliveries starting by the end of 2020 (Lauerman & Ring, 2020; London Stock Exchange, 2020). The research partnership between the UK and EU or US, to attract international investment is essential. The UK will have to maintain funding levels for science and promote UK academics through research programs. Pharmaceutical companies will have to ensure that product quality and regulatory criteria will take the lead role so as to create safe and trusted products.

Our findings indicate that the UK's currency weakness has given some short term benefits to the British pharmaceutical companies that export their products. However, in the long run Brexit will create material uncertainties for regulation, supply chain, packaging and manufacturing. Brexit repercussions offer opportunities for pharmaceutical companies to expand to countries as far as manufacturing and distribution is concerned, to avoid trade barriers and build ties with other countries. Pharmaceutical products require at least a decade of R&D and high-scale investments to introduce the products to markets. This considerable *initial* outlay needs firm regulatory and economic conditions together with sustainable degrees of foreseeability. Any extended phase of uncertainty after Brexit will influence the companies' inclination to invest locally. GSK is already focusing on the US market, aspiring to gain six new drug approvals in 2020 (GlaxoSmithKline, n.d). Having taken a risk-diffusing modus operandi to Brexit, GSK has paid particular attention to expanding its overseas supply network to prepare them for regulatory issues. AZN is similarly focusing on opportunities outside the EU, preparing to build a new global R&D base in Shanghai, together with an artificial innovation center (AstraZeneca, n.d). Brexit involves financial uncertainty. An increase in volatility as a consequence should be expected, but it is also expected that its impact will reduce gradually in the long run. The real impact on financial markets and the pharmaceutical sector more specifically, will be evaluated in the post-Brexit period, in the years to come.

The competitiveness of the pharmaceutical sector forces companies to pursue top financial performances by focusing on constructive decision-making and imposing strategies stemming from quantitative analysis. Financial ratios are also vital regarding pharmaceutical companies, especially those related to debt and profitability. Therefore, our findings have practical implications for financial managers, policy makers and investors dealing with the pharmaceutical industry.

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