Explaining EU's Oil Dependency Through the Response of the Portuguese Sector Indexes to Brent Oil Prices Fluctuations

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Abstract

This paper looks at the extent to which the Portuguese stock market at a sector level is sensitive to Brent crude oil price changes over the period of 2000-2020, focusing particularly on endogenous structural breaks in the relationship between the two variables. The empirical results from this paper indicate that the sensitivity of Portuguese sectors to Brent crude oil price changes is rather limited, with only 4 statistically significant periods highlighted. The early 2000s period is one where a statistical significant sensitivity is not detected in any sector, however transitioning into the second decade, we see a slight increase in sensitivity. This sensitivity, interestingly, differs from that reported for Spain, as it was primarily negative, suggesting that for the Portuguese stock market aggregate demand-side oil price shocks induced by real economic activity, don't play a major role. Thus suggesting and strengthening Catalão-Lopes et al. (2015) argument that neither global supply shocks, global demand shocks or precautionary demand shocks affect Portuguese stock market returns. Instead, it is Portugal's import situation that is responsible for the statistically significant sensitivity reported. Therefore, highlighting that the path to minimizing oil exposure risk for the Portuguese economy is to address its importer status.

1 Introduction

With the exception of Norway, Russia and Azerbaijan, European countries are in general heavily dependent on oil imports. In fact according to a recent study by Cambridge econometrics (2016) “The European Union relies on foreign companies to supply 80% of its oil imports”. The OEC (2020) aso notes that, Portugal's crude petroleum importation is responsible for 6.39% ($5.75B) of its total $89.9B exports, whilst it only exports $21.9M of crude petroleum or 0.03% of its exports ("Portugal (PRT) Exports, Imports, And Trade Partners", 2020). These figures make Portugal a net importer of petroleum, by a very large margin. Situations, like the ones observed in Portugal, are the norm in the EU, as countries are reliant on countries like Saudi Arabia, Russia, Iraq, United States, Canada, and the United Arab Emirates. According to Wang, “the response of stock prices differ depending on the net position of a country” as well as “the cause of oil price change” and “the importance of oil to the economy” (Wang. 2012). While, there is a general consensus within the economics community that oil prices do play a major role in the economic activity of all countries, the direction of the impact is less agreed upon. “Since the stock market acts as a barometer of the economy, oil prices are also likely to play a major role in the behaviour of stock prices” (Moya-Martínez et al., 2014). There are two central mechanisms in the explanation of why oil prices are seen as a driver of stock market prices: both Miller and Ratti (2009), and Mohanty et al. (2011) refer to this idea of the discount rate. They argue that oil prices are sensitive to inflationary/deflationary pressures: i.e., a fall in oil prices may signal deflationary pressures, which may cause central banks to respond by decreasing interest rates, which lead to a positive performance of the stock markets. The second mechanism focuses on oil as a key input in the production process of most firms. Increasing oil prices will therefore translate into increasing production costs, which negatively impacts profits and tends to lower stock market prices (Apergis et al., 2009; Arouri et al., 2010; Sadorsky, 1999). If we combine both mechanisms, the hypothesis would be that increasing oil prices would negatively affect sector stocks that are net oil importing and positively affect those that are net exporting. There are several factors that can contribute to the oil price sensitivity of a particular sector: whether the sector is a "net producer or consumer of oil, its degree of dependence on oil, its ability to transfer oil price shocks to consumers or its extent of hedging activity." (Moya-Martinez et al., 2014). It may be important to note that in this study all sectors are net-importing and so is the country that they operate in.

There is no doubt that the last twenty years have seen a reasonably large flow of research on the sensitivity of stock market prices to oil price fluctuations. However, as Smyth (2018) observes "the sheer volume of research on the interaction between oil markets and stock markets has meant that we have lost track of the key findings from the literature" (Smyth. 2018). Furthermore, the results themselves have been quite contradictory as Aloui et al. (2012), Broadstock et al. (2012) and Filis et al. (2019) argue. These contradictions as argued by Moya-Martinez et al. (2014) are potentially due to "stock market and oil price bubbles, geopolitical instability, corporate hedging activity" and the 2008-09 global financial crisis. Park argues that "there is little evidence of asymmetric effects on real stock returns of positive and negative oil price shocks for oil-importing European countries" (Park. 2008) and therefore we will dive into the Portuguese markets—more specifically its sector indexes—to try and find out for ourselves. In this study, we will be using Brent Crude oil Prices, where Brent is the international benchmark price used by OPEC. This study aims to regain what Smyth (2018) argues we have lost, by focusing on a country in particular that has received less exposure in this area of research, Portugal. We employ the methodology of Moya-Martínez et al. (2014) to understand the sensitivity of sectors of the Portuguese stock market to changes in oil prices, while taking in consideration endogenously determined structural breaks. The point of structural-break analysis tends to be overlooked in the literature, and is incredibly important to avoid what Moya-Martinez et al. (2014) calls “inaccurate inferences about the oil-stock market link”.

Moya-Martinez et al. (2014) were the first to study the “stability of the relationship between oil prices and equity markets" with the application of “the test for multiple structural breaks developed by Bai and Perron (1998, 2003)”, and our work applies their approach to the Portuguse stock market. Our study contributes to the literature as it is the first study that focuses on the sensitivity of Portuguese sectors to oil price changes, and in so doing, extends the prior work of, — (Catalao et al., 2015) who studied oil-dependence of the PSI20 index and did not isolate the dependence of sectors within the index. Moreover, by being an open market non-producing economy that has an extremely high external dependency, 82.3% in 2008 according to (DGEG, 2010) . In fact according to the European Environmental agency, “ Every oil crisis exposes the vulnerability of the Portuguese economy. Even though it has decreased recently, oil still plays a leading role in the supply structure (52 % in 2008).” (EEA. 2010). Since 2008 Portugal has made significant strides in growing its renewable sector and has seen a further fall in its oil dependency, to 45.1% in 2014 (Nunes, 2018) and 43.8% in 2016 (Worldometer, 2016). However, even with the fall in oil dependency, oil is still far the main energy source in Portugal (e.g., 43.8% for oil, 27% for hydroelectric). Taking this information into consideration one could argue that Portugal is highly vulnerable to oil price shocks, and so would be an ideal nation to study the sensitivity of its sectors to oil price changes.

The objective of this study is to provide more data on the subject by illuminating the dependence of particular sectors and thus provide the Portuguese government with more empirical evidence to support the transition to a green Portuguese economy, and thus transitioning into an analysis of how the EU's—Portugal in particular—transition to renewable energy affect Portuguese dependence on oil, generate more or less jobs, save on imports, and most importantly protect the economy and several dependent sectors from heightened volatile oil markets.

The paper is structured as follows: Section 2 focuses on the literature of stock market sensitivity to oil price shocks. Section 3 goes over the empirical methodology and Section 4 the data description. Section 5 discusses the empirical results and section 6 concludes.

2 Literature Review

The study of the stock market's sensitivity to oil price shocks is not something new. Ever since the first modern oil crisis of the 1970s, economists have focused on the effects oil shocks had on the real economy. (Cuñado et al., 2005; Hamilton, 1983; Jiménez-Rodríguez and Sánchez, 2005). Later literature focused on the stock market and its sensitivity to price shocks, with Jones and Kaul (1996) and Sadorsky (1999) both being pioneers in the field. Jones and Kaul's found that oil price shocks negatively impacted equity markets in the US, UK, Canada, and Japan for the post-WWII period. Sadorsky looked at the correlation between oil prices (both Crude and Brent) and the US stock markets, "results from a vector autoregression show that oil prices and oil price volatility both play important roles in affecting real stock returns. There is evidence that oil price dynamics have changed. After 1986, oil price movements explain a larger fraction of the forecast error variance in real stock returns than do interest rates. There is also evidence that oil price volatility shocks have asymmetric effects on the economy." (Sadorsky.

1999). Although Jones and Kaul's methodology revolved around a cash-flow dividend valuation (CFDV) model, Sadorksy's methodology utilized a vector autoregressive (VAR) model. The literature on this issue explores a plethora of models: VAR, CFDV, vector error correction model (VECM), wavelet analysis, GARCH-type models and even cointegration techniques. (Moya-Martinez et al., 2014)

Since Jones and Kaul (1996) and Sadorsky (1999), the literature has increased considerably, and the relationship between stock market prices and oil price changes in several countries has been examined in some detail. However, the results seem to also vary extensively. For example, Sadorksy (1999), Park and Ratti (2008), and Miller and Ratti (2009) findings depict a negative stock market price sensitivity to oil price changes. On the other hand, Zhu et al. (2011), Arouri and Rault (2012), Papapetrou (2001), and Li et al. (2012) find a positive stock market price sensitivity to oil price changes. Finally, Huang et al. (1996), Apergis et al. (2009), Catalão et al. (2018) findings depict neither a positive or negative stock market price sensitivity to oil price changes but instead claim that the stock market returns they study are unaffected by both global demand and supply shocks as well as precautionary demand shocks. A comparable more recent study, Ono (2011), looked at "oil price shocks and stock markets in BRICs" over 1999 to 2009. "The results suggest that whereas real stock returns positively respond to some of the oil price indicators with statistical significance for China, India and Russia, those of Brazil do not show any significant responses. In addition, statistically significant asymmetric effects of oil price increases and decreases are observed in India. The analysis of variance decomposition shows that the contribution of oil price shocks to volatility in real stock returns is relatively large and statistically significant for China and Russia.". Similarly, Papapetrou (2001) found that "oil prices are important in explaining stock price movements' in Greece'. The empirical evidence from the study made it clear that oil prices are important in explaining stock price movements in Greece. Whilst, a second study—the one which we base our methodology on—which examines "the sensitivity of the Spanish stock market at the industry level to movements in oil prices over the period 1993–2010" concluded that "the degree of oil price exposure of Spanish industries is rather limited, although significant differences are found across industries. The oil price sensitivity was very weak in the 1990s, a period of fairly stable and low oil prices. Instead, the link between crude oil and stock prices seems to have increased during the 2000s, becoming primarily positive." (Moya-Martinez et al., 2014). This increase depicts the importance of demand- side oil price shocks in the sensitivity of the stock market.

On another note, Greece, and Spain in particular have a very similar economy to that of Portugal—on a larger scale albeit—Liapsis et al. (2013), they were denominated alongside Italy the PIGS of the 2008 financial crisis for a reason. This similarity between economies potentially suggests that a similar trend to that of Spain could be found for the Portuguese markets. Further reinforcing Martinez's view, Apergis's study investigates the explicit structural shocks of oil price changes and their subsequent effect on "stock-market returns in a sample of eight countries — Australia, Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States." (Apergis et al., 2009). Interestingly, like Martinez, Apergis observes "that international stock market returns do not respond in a large way to oil market shocks. That is, the significant effects that exist prove small in magnitude". Once again highlighting the divergence of scholars on the matter.

Moreover, the literature does attempt to explain the reason for such discrepancies in the results: Sadorsky (1999), Park and Ratti (2008), and Arouri and Nguyen (2010), argue that oil-importing countries will have a negative stock market price sensitivity to oil price shocks, at the same time (Jiménez-Rodríguez and Sánchez, 2005; Nandha and Faff, 2008) argue on the same lines that oil-exporting countries will exhibit a positive stock market price sensitivity to oil price shocks. This is also described in the two oil price mechanisms we described in the introduction as movers of the stock market, and further reinforced by the explanation provided by Moya-Martinez et al. (2014): "Thus, precautionary demand–side oil price shocks that reflect concerns about future oil supply shortfalls generally have a negative impact on stock markets. However, supply–side oil price shocks due to a reduction of crude oil availability do not significantly influence the linkage between the two markets. Finally, aggregate demand-side oil price shocks which correspond to unexpected changes in the demand for crude oil driven by fluctuations in the global business cycle tend to have a persistent positive effect on stock prices. This occurs because oil and stock markets react similarly to shifts in expectations regarding future economic activity." However, it seems that data does not seem to conform perfectly to these mechanisms and as shown above the variance we see on whether oil price shocks have a statistically significant impact on the prices of a particular national stock market is a trend that is seen throughout the literature, and serves to highlight the complexity of the theory behind it, with regards to the role played by both demand side and supply side shocks. It's this idea that for some countries, the effect is visible and quite large and for others it seems that there is no correlation whatsoever. This is in a sense what makes studying this topic and focusing on Portugal in particular, extremely interesting, one doesn't really know what to expect. It is therefore in this atmosphere of uncertainty that the study aims to build upon, attempting to find whether or not one can argue that in fact oil prices play a major role in Portuguese stock market prices, isolating each sector index. In a sense, we are asking the same question Moya-Martinez et al. (2014) asks in their study but translating it into the smaller of the two Iberian economies.

So far the majority of the studies mentioned focus on the sensitivity of the overall market returns of a particular country in response to oil price shocks. For example, in the Portuguese case in particular, the only study that attempts to address our theme is from 2015, as Catalão-Lopes et al. (2015) focuses on the broader market returns without isolating particular sectors, and concludes that "none of the three types of oil price shocks addressed— global supply shocks, global demand shock for all industry commodities and precautionary demand shocks—affect Portuguese stock market returns." (Catalao et al., 2015). However our aim is to focus on particular sector returns sensitivity to that of oil price shocks. To further strengthen the literature on the correlation between oil prices and the different productive sector indexes, we can look at Arouri's study in 2011, which claimed that "the strength of this association varies greatly across sectors. Moreover, for some sectors we find strong evidence of asymmetry in the reaction of stock returns to changes in the price of oil." (Arouri, 2011). This idea was further reinforced by Scholtens' study which focuses on investigating "the impact of oil price shocks at the industry level in the Euro area for the period 1983–2007.". Scholtens used "different oil price specifications" with "multivariate regression to investigate how 38 different industries respond to oil price shocks, and concluded that there is a large asymmetry to industries' responses to oil price increases and decreases (Scholtens, 2011). This substantial differentiation between industries is to be expected, those with more reliance on oil and oil derivatives will undoubtedly be more affected by the oil prices. Elyasiani et al. (2011) study on oil price shocks effects on thirteen US sectors, further strengthens this idea. The overarching similarities is that there are substantial differences between sectors regarding their sensitivity/exposure to oil price changes. Theoretically, industries where oil inputs play a significant role in the production process will benefit from negative oil price shocks (decreases); whilst those that generate revenue from oil and oil related products will be harmed by negative oil price shocks. (Boyer and Filion, 2007; El-Sharif et al., 2005).

The data trend highlights that "crude oil and petroleum products account for one third of gross inland energy consumption in the EU", and although there has been a decrease in the domestic energy demand, "crude oil extraction in the EU has fallen at a faster rate. This has led to an increased dependency on oil imports. As of 2014, the EU relied on imports for 88% of its crude oil supply" (Cambridge Econometrics. 2016) and since then that number has only increased to 94.6% in 2018. With Portugal being the European country with the largest oil import dependency of 104.2%. "Overall, the EU's dependency on crude oil and refined fuel imports is high and rising. Moreover, much of this oil comes from geo politically unstable regions. This makes the European economy, particularly the transport sector, vulnerable to supply and price shocks." (Cambridge. 2016). The numbers above highlight the inherent european exposure to supply risk for the Portuguese economy. As a Portuguese myself I not only find this to be an extremely interesting topic but also a patriotic study, highlighting the danger and impact that oil prices have on the Portuguese oil-importing economy and how a move away from oil in the long-run could eliminate or at least heavily reduce such risk. Currently the EC (European Commission) "has put in place some measures to reduce these risks and improve Europe's energy security. The Oil Stocks Directive, for example, requires EU Member States to hold stocks of oil to reduce the effects of supply shortages. However, in the longer term, there is a need to reduce use of petroleum products in order to reduce exposure to security of supply risk as well as demand side shocks; and would also at the same time have the added benefit of helping to meet the global climate change commitments.

3 Empirical Methodology

Like Moya Martinez et al. (2014) our examination of the sensitivity of sector stock returns to oil price changes employed the multifactor market model:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \gamma_i \Delta OIL_t + \lambda_i \Delta I_t + \varepsilon_{it} \quad (1)$$

where R_{it} denotes the return on the stock index of the ith sector in period t, R_{mt} the return on the market portfolio, ΔOIL_t the change in oil prices (in \$), ΔI_t the changes in interest rate, and ε_{it} is a random error term.[1]

Each coefficient has its own meaning, α_i simply represents the intercept of the regression. Whilst, β_i, is the coefficient of the return on the market portfolio and represents the sensitivity of R_{it} (the return on the stock index of the ith sector in period) to changes in the return on the market portfolio across t. Following the same rationale, γ_i is the coefficient of the change in oil prices, and represents the sensitivity of R_{it} to changes in oil prices, λ_i is the coefficient of the change in interest rates and represents the sensitivity of R_{it} to changes in interest rate. Our regression model includes the market return, R_{mt} in order "to control for the macroeconomic factors that affect stock returns and are correlated with oil price changes" (Moya-Martinez et al., 2014). This in turn reduces omitted variable bias (OVB). Interest rate changes are also included in the model for a similar reason. Several studies have shown that Portuguese firms are highly leveraged. Ferrão (2012), for example, observed that Portuguese firms, on average, have presented one of the lowest Shareholder's Equity Ratios in the EU over the last decade. Moreover, according to Boletim Estatístico of Banco de Portugal (2014), the average Debt-to-GDP ratio, over the last 8

[1] For examples of the use of this approach in related settings, see Faff and Brailsford (1999), Boyer and Filion (2007) and Nandha and Faff (2008).

years, stood at 159.6%, one of the highest values among European countries.``. Since then even with the economic adjustment programme that took place in Portugal in 2011, and led to a "smooth deleveraging process occurring in the nonfinancial business sector, however, less visible for large firms.", the fact is that to this day "Portuguese firms are still more leveraged than their European peers", and more importantly to our study "high corporate debt levels are transversal across industries.", (Limão et al., 2016). Brushing to the side Bernake and Campbell's (1988) point that "industries with relatively high average values of financial leverage face higher bankruptcy events, deeper recessions and slower recoveries", high levels of interest rate exposure will play a large role in explaining variations in the stock market prices and subsequent sectors.

Moya-Martinez argues, and I agree, that "given the significant milestones that have occurred in financial and oil markets over the last two decades, it is advisable to analyze the existence of structural breaks in the link between oil price changes and industry stock returns.". Something that only Moya-Martinez has explored in the literature and that is replicated in this study. The multiple structural break test created by Bai and Perron (1998, 2003) was utilized. Bai and Perron test enables us to test for several structural breaks at particular dates within the linear model. The technical details for the procedure can be found in Bai and Perron (1998,2003). By applying the multiple structural break test on our multifactor model we devise the following multivariate regression with m breaks and m+1 sub sampled time periods:

$$R_{it} = \alpha_{ij} + \beta_{ij} R_{mt} + \gamma_{ij} \Delta OIL_t + \lambda_{ij} \Delta I_t + \varepsilon_{it} \quad t = T_{j-1} + 1, \ldots, T_j \tag{2}$$

Here we see that the breakpoints are represented by j and are treated by the regression model as being unknown. In order to make sure all sub-sample periods are recorded in the model, $T_0 = 0$ and $T_{m+1} = T$, where T represents the total sample size.

Moya-Martinez et al. (2014) explains how Bai and Perron "design three different test statistics to identify the number of breaks. First, the supFT (k) is a supF-type test of the null hypothesis of no structural breaks (m = 0) versus the alternative of an arbitrary number of breaks k (m = k). Second, the double maximum tests (denoted by UDmax and WDmax) allow us to test the null of no breaks against the alternative of an unknown number of breaks given some upper bound M. Third, the supFT (l + 1|l) test is a sequential test of the null of l breaks versus the alternative of l + 1 breaks.". Summarizing this information, Bai and Perron create the conditions necessary to be able to estimate the number of structural break points in the time series that minimizes the sum of squared residuals for all sector time series. In this study in particular we utilized Bai and Perron's (2003) recommendation and utilized the Bayesian Information Criterion (BIC) in order to decide on the number of structural breaks to be utilized— the "m" with the lowest BIC value is the one that minimizes the sum squared residuals and thus gives us the ideal number of breakpoints for the particular sector time series, as shown by Liu et al. (1997). The method was repeated for all 8 sector time series yielding the results shown in Section 5. We tested for both homoscedasticity (Breusch-Pagan test) and for autocorrelation (Durbin-Watson test). Since we are dealing with time series datasets, it was no surprise that we ran into heteroskedasticity and autocorrelation issues, which we then managed through the use of Newey-West HAC robust standard errors analysis in our OLS regressions.

4 Data Description

We examined the oil price exposure of Portuguese industries over the period January 2000 to December 2020. Our starting date of January 2000 was chosen because that is the earliest time for which the PSI20 sector indexes were available. We attempted to create our own value-weighted industry stock indices to mimic those of Moya-Martinez et al. (2014) but due to the lack of information regarding the particular method utilized by them the decision was made to use the PSI20 sector indices made available to us by the EuroNext (2020) database. To validate our approach, we obtained Spanish indices of the Madrid Stock Exchange from the Bolsa de Madrid (2020) and applied them to our methodology. Our Spanish results and those of Moya-Martinez were very similar, thus indicating that the approach that we would subsequently use to study Portugal was valid. Moya-Martinez et al. (2015) covered 14 sectors, but Portugal, being a smaller economy, had concrete data for only 8 sectors: Consumer Goods, Consumer Services, Basic Materials, Industrials, Financials, Technology, Telecommunications, and Utilities. Similarly to Moya-Martinez who used the Indice General de la Bolsa de Madrid as a proxy to the market portfolio, we used the PSI20 index as a proxy to the Portuguese market portfolio which was the broadest Portuguese market index. As mentioned above both our market return data as well as our sector index data was retrieved from the Euronext database, which is the equivalent of the Portuguese stock exchange.

Regarding the data harvesting itself, the study once again follows Moya-Martinez et al. (2014), who themselves followed Mohanty et al. (2011), Arouri et al. (2012), and Broadstock et al. (2012), among others. All of these studies utilized weekly sector index returns in their time series. Our study used weekly closing returns from January 2000 - December 2020; there were 1095 observations. The weekly prices for our sector indexes came from the EuroNext database as mentioned above, where they provide us with the closing sector index price on Wednesday. This is done in order to minimize the weekend effect (Keim and Stannbourg, 1984) and (French, 1980) — "the persistently negative returns for Monday are caused by some weekend effect". Furthermore the EuroNext database also adjusts its values for dividends and splits. According to Moya-Martinez et al. (2014), weekly returns were chosen over daily or monthly returns for several reasons: “Firstly, weekly data are preferred over daily data because sometimes the market may take a while to interpret the effects of changes in economic variables such as oil prices on asset prices. Weekly data also significantly reduce the problems of non- synchronous trading bias for less actively traded stocks and too much noise associated with higher frequency data. Secondly, compared to monthly data the weekly frequency provides a number of observations large enough to yield more reliable results.”

For the oil variable we used Brent crude oil prices (USD), collected from the US Energy Information Administration (EIA, 2020). Brent crude oil was chosen as it is the international benchmark price used by OPEC.

Of the possible interest rates, we used the rates associated with the 10-year Portuguese Treasury bonds. We obtained the data from the investing.com database. According to Moya-Martinez et al. (2014), “This choice has become a standard in the literature (Ballester et al., 2011; Elyasiani and Mansur, 1998; Hirtle, 1997). Long-term interest rates incorporate market expectations about future prospects for the economy and largely determine the cost of borrowed funds. Thus, long-term rates presumably will have a significant influence on firms' investment activity and profitability and, hence, on their stock market performance”.

To calculate the returns from the market, sector, and oil prices, we, like Moya-Martinez et al. (2014), utilized a logarithmic difference on the weekly values. For the changes in the interest rate we utilized the first difference of two consecutive observations on the 10-year bond yields.

Descriptive statistics for the data are shown in Table 1. Interestingly, like with the Moya-Martinez study, the standard deviation (SD) for oil price changes is larger than 6/8 of our sector indexes. However for both Financial Services and Technology we see the sectors SD being higher than that of the oil price changes, showing that although oil prices are highly volatile these two sector indexes appear to show an even higher volatility. The Jarque–Bera (JB) statistic for all variables is statistically significant at the 1% level; and therefore we reject the null hypothesis of normality in all sectors, as well as at the market level, oil price changes and interest rate changes data. Furthermore the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests also highlight a statistical significance at the 1% level for all variables suggesting that all variables are stationary at the 1% level.

Table 1

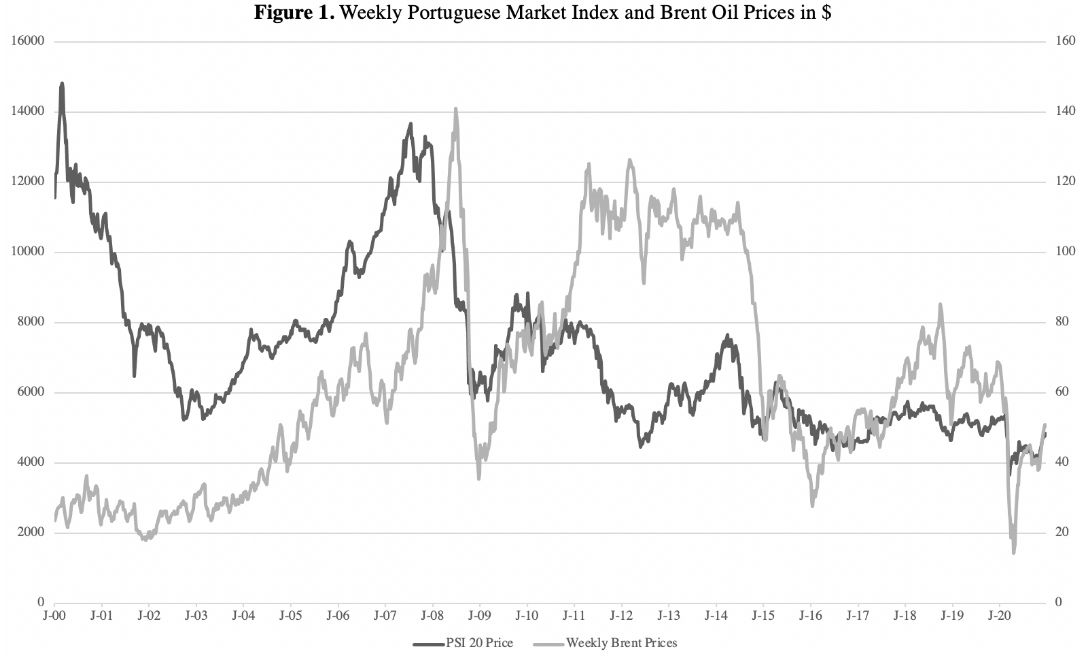
Descriptive statistics for sector and market returns, oil price changes, and interest rate changes.

Returns and Risk Factors	Mean	Median	Min.	Max.	Std. dev.	Skewness	Kurtosis	JB statistic	ADF statistic	PP statistic
Consumer goods	0.001652	-0.000036	-0.174263	0.166304	0.029458	0.1769	6.8147	669.64 ***	-10.14 ***	-1142.60 ***
Consumer Services	0.001440	0.001069	-0.222660	0.268967	0.034093	0.1633	11.9967	3697.80 ***	-11.33 ***	-1255.20 ***
Basic Resources	0.002149	0.001886	-0.206376	0.271868	0.032059	0.2960	10.9916	2929.80 ***	-9.81 ***	-1141.30 ***
Industrials	0.000851	0.000997	-0.227661	0.323244	0.037467	0.3636	13.3884	4947.90 ***	-9.72 ***	-1105.80 ***
Financial Services	-0.001912	-0.000079	-0.291920	0.543047	0.048542	1.0813	21.6574	16095.00 ***	-9.77 ***	-1166.10 ***
Technology	0.000053	-0.001578	-0.288033	1.024108	0.055367	6.7845	119.0612	622979.00 ***	-12.22 ***	-1075.70 ***
Telecommunications	-0.000901	-0.001032	-0.253457	0.269472	0.039706	0.1385	8.8975	1590.40 ***	-9.94 ***	-1088.10 ***
Utilities	0.002083	0.002833	-0.203487	0.298510	0.033572	0.0692	12.1793	3845.20 ***	-10.28 ***	-1152.50 ***
Market Portfolio	-0.000403	0.000882	-0.185923	0.164917	0.027665	-0.7136	8.6756	1562.60 ***	-10.00 ***	-1129.80 ***
Oil Price changes	0.001856	0.003614	-0.334911	0.382405	0.047824	-0.1320	12.0982	3779.90 ***	-10.35 ***	-805.37 ***
Interest rate changes	-0.000052	-0.000120	-0.017540	0.021200	0.002542	0.2615	21.9704	16432.00 ***	-8.11 ***	-875.78 ***

Notes: The table above depicts the descriptive statistics of all 8 weekly sector index returns as well as overall market returns, oil price changes and interest rate changes for the period January 2000 - December 2020. The descriptive statistics include the Mean, Median, Minimum, Maximum, Standard Deviation, skewness, Kurtosis, JB statistic, ADF statistic and PP statistic. Note also that the JB statistic denotes the Jarque-Bera test for normality, whilst the ADF (Augmented Dickeyt-Fuller) test and the PP (Phillips-Perron) test are both unit root tests. As per usual. *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

The time series for both the Brent oil prices and the weekly Portuguese market index for the time period of January 2000 to December 2020 are shown in Figure 1. A visual comparison of the movement of the two time series yields interesting results. It appears that from mid 2003 to late 2007 the two time series appeared to move together. Prior to this we see a relatively large fall of Brent crude oil prices. After this early 2000s fall we see a gradual increase of the Brent Crude oil prices fueled by “the geopolitical tensions in the Middle East, growing demand of crude oil mainly from China and India, active speculation in oil markets, and depreciation of the US dollar, reaching another double peak between June 2007 and June 2008.” (Moya-Martinez et al., 2014). The Portuguese stock market became positive from the end of 2002 up to mid 2008, with the 2006-08 period being quite strong. We also witness large falls in both time series representative of the 2008 financial crisis. The subsequent years saw a rise in Brent Crude oil prices fueled by expectations that the recovery from the financial crisis would lead to increases in the demand for Brent crude oil consumption. However since that recovery the trend has been one of decreasing oil prices up until 2020, with a much smaller visible matching movement between the Portuguese market index and the Brent oil prices. In 2020, there was a large drop in the worldwide demand for oil due to the COVID-19 pandemic closing businesses and restricting travel. The oil price war between Russia and Saudi Arabia in March further contributed to the fall. A potential explanation for why post 2008 financial crisis, the Portuguese stock market appears to move in a different direction from oil prices is the Portuguese economic crisis of 2010-2014 which marked an international bailout programme as well as intense austerity measures. It was only in 2014 after 3 years of recession that the Portugese economy posted positive economic growth (Pordata. 2018).

Figure 1. Weekly Portuguese Market Index and Brent Oil Prices in $



5 Empirical Results

5.1 Testing for structural breaks

Table 2
Optimal number of structural breaks, estimated break dates and confidence intervals.

Sector	Breaks	Break dates	95% Confidence Interval
Consumer Goods	4	September 2005	[July 2005 - November 2005]
		October 2010	[October 2010 - November 2010]
		June 2013	[May 2013 - June 2013]
		July 2016	[July 2016 - August 2016]
Consumer Services	4	December 2004	[November 2004 - January 2005]
		November 2009	[October 2009 - December 2010]
		December 2012	[December 2012 - January 2013]
		February 2016	[February 2016 - March 2016]
Basic Resources	4	January 2006	[December 2005 - January 2006]
		October 2010	[July 2010 - November 2010]
		January 2014	[December 2013 - January 2014]
		February 2017	[January 2017 - February 2017]
Industrials	4	September 2005	[August 2005 - September 2005]
		October 2008	[October 2008 - December 2008]
		December 2011	[November 2011 - February 2012]
		August 2015	[July 2015 - August 2015]
Financial Services	4	May 2005	[March 2005 - May 2005]
		July 2008	[June 2008 - July 2008]
		August 2011	[August 2011 - September 2011]
		October 2014	[October 2014 - October 2014]
Technology	3	February 2003	[January 2003 - February 2003]
		September 2007	[September 2007 - October 2007]
		November 2010	[November 2010 - December 2010]
Telecommunications	3	February 2006	[January 2006 - March 2006]
		August 2011	[July 2011 - October 2011]
		October 2014	[September 2014 - October 2014]
Utilities	4	February 2006	[January 2006 - February 2006]
		February 2010	[January 2010 - March 2010]
		February 2014	[February 2014 -February 2014]
		November 2017	[September 2017 - November 2017]

Notes: The optimal number of breaks is selected with the structural break methodology proposed by Bai and Perron (2003). The number of structural breaks is detected by the BIC information criteria. The last column shows the 95% confidence interval for each break date.

The results of our structural-break analysis are shown in Table 2. The statistical significance of the breaks at the 5% level indicate that all 8 sectors under analysis have at least 3 structural breaks, with six of the eight sectors having 4 structural breaks. The main finding from Table 2 is that unlike with the Moya-Martinez paper we don't see "notable discrepancies among industries concerning the number of breaks". We see four breaks for all sectors other than technology, and telecommunications where we see three breaks.

In Table 2 the break date estimates are together with their 95% confidence intervals. Much like with the Moya-Martinez study, the breakpoints are not identical in all sectors, however there are some similarities between sectors. For example, the first and major structural break is shared by several sectors (Consumer Goods, Consumer Services, Basic Resources, Industrials, Financials, Telecommunications, and Utilities), is the late 2004 and early 2006 period. This break may be associated with the effects of the formation of an oil price bubble in late 2003, "which was fueled by factors such as the booming demand for crude oil from China and India, massive speculation in oil future markets, and increasing geopolitical risks associated with the US invasion of Iraq." (Moya-Martinez et al., 2014). Interestingly, Moya-Martinez et al. (2014) also highlights this break as one of his fundamental breaks. A second common structural break emerges in three sectors (Financial Services, Industrials and Technology) between the first quarter of 2007 and the latter half of 2008. The structural break can be explained by the 2008 financial crisis, and interestingly, other than the technology sector we see that the financial services and industrials sectors are both sectors that were highly involved in the Portuguese housing bubble (Pereira et al. 2020) and subsequent housing market crash which was "triggered by the global financial crisis arising from the US subprime mortgage market, led to the stock market collapse of real estate and construction firms, which later would spread to European financial institutions due to their great real estate exposure risk. Meanwhile, oil prices dropped around 79% in five months since their record peak in July 2008 due to the tremendous plunge in oil demand resulting from sharply declining global economic activity and the large-scale withdrawal of speculative positions from oil future markets." (Moya-Martinez et al., 2014). This structural break point is also seen in Moya-Martinez et al. (2012), as well as Li et al. (2012) in his analysis of the sensitivity of the Chinese stock market on changes in oil prices. A third common structural break is the late 2010 to early 2014 period which covers all sectors in the study. This was the period of the Portuguese financial crisis which was part of a wider downturn in the Portuguese economy. A fourth common break is the 2016-17 period which marks the end of the Portuguese economic crisis. We see all expect industrials and financial services have breaks in this period (partially because they have breaks in late 2014-15, where they transition away from the Potruguese economic crisis), technology also doesn't depict this change, neither does telecommunication.

5.2 Regression results

Table 3

Results for the multivariate regression model

Sector	Sub-samples	Breaks	Intercept	Market Return	Oil price chs.	Interest rate chs.	Adjusted R2
Consumer goods	January 2000 - September 2005	4	-0.001	0.393 ***	0.037	0.181	0.128
	September 2005 - October 2010		0.002	-0.536	-0.039	3.839	
	October 2010 - June 2013		0.002	-0.720 ***	0.001	-1.281	
	June 2013 - July 2016		0.009 ***	-0.498	-0.163 **	-0.136	
	July 2017 - December 2020		0.003	-0.181 *	-0.004	0.445	
Consumer Services	January 2000 - December 2004	4	0.002	1.025 ***	0.096	-2.890 *	0.420
	December 2004 - November 2009		-0.003	-1.104	-0.223 *	6.234	
	November 2009 - December 2012		0.000	-1.856	-0.060	5.048	
	December 2012 - February 2016		-0.002	-1.208	-0.223	6.407 *	
	February 2016 - December 2020		-0.003	-1.246	-0.271 **	5.558	
Basic Resources	January 2000 - January 2006	4	0.002 *	0.302 ***	-0.021	-0.606	0.333
	January 2006 - October 2010		-0.002	-0.288	0.075	0.846	
	October 2010 - January 2014		0.000	-0.032 **	0.056	1.247	
	January 2014 - February 2017		0.001	0.103 ***	0.063	0.047	
	February 2017 - December 2020		-0.004	0.577 ***	0.110 *	3.481	
Industrials	January 2000 - September 2005	4	0.003	0.546 **	0.087	-1.231	0.434
	September 2005 - October 2008		-0.003	-0.219	-0.247 *	5.849	
	October 2008 - December 2011		-0.006	0.003	-0.163	3.076	
	December 2011 - August 2015		-0.005	-0.495	-0.154	2.714	
	August 2015 - December 2020		-0.005	-0.011 *	-0.138	3.749	
Financial Services	January 2000 - May 2005	4	0.001	0.578 ***	-0.025	0.948	0.613
	May 2005 - July 2008		-0.002	-0.073 ***	0.050	-1.421	
	July 2008 - August 2011		-0.003	0.311 *	-0.039	-2.537	
	August 2011 - October 2014		-0.004	0.679 ***	-0.119	-2.601	
	October 2014 - December 2020		-0.004	0.142 ***	0.159	-0.691	
Technology	January 2000 - February 2003	3	0.006	1.806 ***	0.031	-5.471	0.192
	February 2003 - September 2007		-0.014	-2.840 *	-0.065	11.194	
	September 2007 - November 2010		-0.012	-2.683	-0.166	11.906	
	November 2010 - December 2020		-0.011	-3.301 **	-0.001	10.126	
Telecommunications	January 2000 - February 2006	3	0.001	1.334 ***	0.005	0.990	0.395
	February 2006 - August 2011		0.002	-2.005 **	-0.024	-4.537	
	August 2011 - October 2014		-0.005	-1.628 **	-0.119	-2.703	
	October 2014 - December 2020		-0.004	-2.068 ***	0.010	-1.674	
Utilities	January 2000 - February 2006	4	0.001	0.729 ***	-0.068	-1.336	0.545
	February 2006 - February 2010		-0.001	-0.385 *	0.134	0.727	
	February 2010 - February 2014		-0.002	-0.609	0.162	2.426	
	February 2014 - November 2017		-0.001	-0.669	0.082	0.009	
	November 2017 - December 2020		0.002	-0.747	0.162	-2.857	

Notes: The table depicts the OLS regression results of the multivariable model in Eq. (2) for each sector subsample based on the breakpoints identified by the test of Bai and Perron (1998, 2003). Also the standard errors of the estimated coefficients are corrected for autocorrelation and heteroscedasticity with the Newey–West procedure. As usual, *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Taking into consideration the structural breaks identified in Section 5.1 we applied our multivariate model depicted in Eq. (2) to the sub-samples of each sector time series and obtained the regression results shown in Table 3. As shown in this Table, the adjusted R^2 values for the eight industries range between 0.128 (Consumer Goods) and 0.613 (Financial Services)—here the results are similar to Moya-Martinez— and are reasonably high as well for Industrials, Consumer Services, and Utilities. Interestingly, our results differ from those of Moya-Martinez et al. (2014) who found a CAPM-like explanatory power of the market return in explaining the variability of equity returns. Even within the same sector we see changes in positive negative and no sensitivity throughout the different periods. The Basic Materials sector for example, witnesses a positive sensitivity with statistical significance at 1% in the first subperiod, then a relatively negative sensitivity with statistical significance of 5% in the third sub period and then back to positive sensitivity with statistical significance at 1% for the remaining two sub periods.

As for the sector's sensitivity to oil price changes, much like with the Moya-Martinez et al. (2014) results, we see very limited sector sensitivity to oil price changes in the Portuguese stock market. Our results are consistent with similar studies on other nations: (Apergis, 2009; El-Sharif et al., 2005; Li et al., 2012; Papapetrou, 2001, Scholtens, 2012). Furthermore, the sensitivity of the sector indexes to oil price changes varies strongly in relation to both the sector and the subsample under analysis.

Our analysis also reveals that the Financial Services, Technology, Telecommunications and Utilities sectors have no statistically significant sensitivity to oil price shocks. These results are not that surprising if we are to look at the requirements of oil in each sector, which appear to be relatively small, they are not oil-intensive sectors, as Moya-Martines puts it. On the other hand, we see that for at least one subsample, the Consumer Goods, Consumer Services, Basic

Materials and industrials sectors all display a statistically significant sensitivity to oil price shocks at both the 5% and 10% level.

The case study of the Financial Services sector is interesting in particular. Although our results depict that it's sensitivity to oil price shocks is not statistically significant at 1%, 5% and 10% level, Moya-Martinez's results argue that there is a "significant negative sensitivity to the oil price factor over the period from April 1997 to March 2008." Our results highlight a nonsignificant negative sensitivity in the first subsample (January 2000 - May 2005), a nonsignificant positive sensitivity in the second sub sample (May 2005 - July 2008), and once again a nonsignificant negative sensitivity for the third subsample (July 2008 - August 2011). Moya-Martinez supports his results of the negative sensitivity of financial services sector to oil price changes by provisioning through different mechanisms: Firstly, that of McSweeney and Worthington (2008) who argue that when oil prices are increasing investors will tend to sell their less risky assets (bank stocks and purchase riskier assets such as energy stocks in order to benefit from the increases in oil prices, the selling of the bank's stocks logically negatively affects the stock prices of the banks and leads to this negative sensitivity. The second mechanism is given by Faff and Brailsford (1999) who argue that increases in oil prices will lead to an increase in the production costs of several of the bank's customers (firms reliant on oil for production), which will hurt the profitability of such firms. If the bank's customers' profitability gets harmed, the bank will also be negatively affected by this, and their volume and profitability will also decrease, negatively affecting its stock price and once again depicting the sector's negative sensitivity to oil prices. We see this sensitivity once again depicted in Arouri (2011) who strengthens the first demand side mechanism we have highlighted in remarking "that the negative influence of oil price changes on the financial industry takes place mainly through demand–side effects. Thus, higher oil prices have a detrimental effect on consumer and investor confidence and demand for financial products.”. Potentially an explanation for the lack of oil price sensitivity of the Portuguese Financial Services sector could lie in either the more risk-averse Portuguese investors or the lack of oil-reliant firms for production.

Of the four sectors that have a statistically significant sensitivity to oil price changes, industrial and Basic Materials both stand out. A significant negative relationship is observed for the period September 2005 - October 2008 for the Industrials sector, whereas a significant positive link has been found for basic resources for the subsample time period of February 2017 - December 2020. A potential explanation for the latter can lie in the combination of the demand side shock caused by the COVID-19 Pandemic and the supply-side shock caused by the Russia-Saudi Arabia oil price war. The geo-political issue culminated in a 65% quarterly fall in the price of oil, with Brent falling 24% in the first two weeks of March and oil futures trading in the negative. (Worland, 2020). This huge drop in oil prices could potentially have benefited a sector that is relatively oil-intensive. Looking at the industrial sector, the statistically significant negative sensitivity to oil price changes, is quite puzzling. If we look at Moya-Martinez’s results, from November 2004 onwards we see a significantly positive link between oil price changes and the sector of his that is most similar to our industrial sector (other than Moya-Martinez’s actual industrials sector). He argues with a certain logic that the “housing boom clearly benefited construction [industrial] firms and coexisted with a growing global demand for oil, especially since 2004, driving the prices of both construction stocks and crude oil up to record levels. Likewise, the burst of the real estate bubble from the end of 2007 and the subsequent collapse of stock prices of construction [industrial] companies coincided with the slump of oil prices during the second half of 2008, which was caused by the devastating contraction in oil demand resulting from the worldwide recession. In short, construction stocks and crude oil have moved together over the last years, thereby giving rise to a positive correlation between their prices." (Moya-Martinez et al., 2014). On the other hand the negative sensitivity of the Portuguese industrial sector can be explained by the fact that whilst the industrial sector includes construction within its definition it is more broad and describes any business that manufactures goods. Therefore, looking through this perspective: as the industrial sector coexisted with the rising oil prices driven by the growing global demand of oil (Filis et al. (2011))—" the rising demand of crude oil derived from the industrialization of countries such as China and India during the period 2006 until mid-2008"—the overall Portuguese industrials sector suffered from the increases in oil prices due to its oil-intensive production. After the slump of oil prices during the second half of 2008 due to another demand side oil price shock generated from the international financial crisis of 2008, the Portuguese industrial sector highly benefited from the low oil prices to drastically reduce their oil-related production costs and so the stock prices of these firms benefited. Therefore, overall the negative sensitivity to oil price changes is not surprising when regarding the industrials sector. And in fact although Moya-Martinez's construction sector depicts an opposite sensitivity to Portugal's industrials sector, his industrials sector strongly reinforces our findings: "Industrials exhibit a significant oil price sensitivity, in both cases negative indicating that oil price rises had a detrimental impact on the stock prices of firms in these industries." (Moya-Martinez et al., 2014)

From 2009 to 2015 it appears that oil price changes have had very little effect on Portuguese sectors, suggesting a relatively stable period for oil prices, which is backed by the data (EIA, 2020)—consistent growth up to 2012, and then a plateau of sorts up to 2015. It is only consumer goods that exhibit a statistically significant oil price sensitivity, a negative one, in this period (June 2013 - July 2016) indicating that oil price increases negatively affect the stock prices of the consumer goods sector. The explanation to this may lie in the mechanism described above, where we assume that the firms in the sector have their production highly reliant on oil (be it in the production, transportation or packaging of products, which involves crude oil as an energy source as well as a mode of plastic production via crude oil refinery, which is also an essential material for consumer goods production).

Interestingly, unlike Moya-Martinez who found predominantly positive sensitivity to oil price changes in his sectors in the 2000s, the majority of the statistically significant results in our study show a negative sensitivity to oil price shocks by the Portuguese sectors: Consumer goods, Consumer Services and Industrials, with only the Basic Materials sector highlighting a positive sensitivity. So, even though Moya-Martinez et al. (2014) argues that "this significant positive exposure, contrary to the negative expected effect of oil price hikes on the equity market of a heavily oil-dependent country like Spain, may be explained by the fact that most of the oil price shocks in the 2000s have been driven primarily by global real economic activity:" and have therefore moved in tandem with the stock market in both directions. Thus, suggesting that "aggregate demand-side oil price shocks originating from global business cycle's fluctuations have had a greater influence on the oil price–equity returns relationship than Spain's oil importer status." We argue the opposite, that for Portugal, the demand side oil price shocks that originated from the global business cycle fluctuations—worldwide interest rate cut in 2000 leading to a construction boom (positive oil price shock); China and India's [2006-08] industrialization (positive oil price shock); international financial crisis of 2008 (negative oil price shock); International COVID-19 crisis of 2020 (negative oil price shock)—have had less of an influence on the stock market prices of Portuguese sectors tha Portugal's status as an oil importing country.

Once again this strongly reinforces the argument made by Catalão et al. (2015) who states "that none of the three types of oil price shocks addressed – global supply shocks, global demand shocks for all industrial commodities and precautionary demand shocks – affect Portuguese stock market returns."

Our interest rates results also differ from those of Moya-Martinez et al. (2014), who found the Consumer Services sector to be effectively insensitive to interest rates. By contrast, we found the Consumer Services sector to be the only sector with a statistically significant sensitivity to interest rate changes, with a negative statistically significant sensitivity in the first subsample period (January 2000 - December 2004) and a positive statistically significant sensitivity in the fourth subsample period (December 2012 - February 2016). In a way the results contradict both economic theory as well as the reality of Portugal as an economy whose firms are highly sensitive to interest rate changes (Limão et al., 2016). However, they depict a interest rate exposure of Portuguese firms that interestingly is remarkably low, and with only a slight statistical significance of negative sensitivity in the first period suggesting that the Portuguese firms of consumer services are on average positively affected by falling interest rates, and in the later period with a positive statistical significant sensitivity where they are negatively affected by falling interest rates as the sensitivity becomes positive. It must be kept in mind that this only goes for the consumer services sector, and the explanation for why we don't see a statistically significant sensitivity for other sectors for the period of our study might be related to an argument that Moya-Martinez puts forward: "in scenarios of low and relatively stable interest rates, such as the 2000s, the correlation between interest rates and stock returns substantially declines and could even be positive. This evidence is in accordance with prior research in the Spanish case (Ferrer et al., 2010; Jareño, 2008)." (Moya-Martinez et al., 2014). Although there isn't much literature for Portugese firms on this, Moya Martinez provides a viable explanation for the Spanish markets.

6 Concluding remarks

This study investigates the oil price sensitivity of Portuguese sectors for the period January 2000 to December 2020. The main results indicate that the sensitivity of the Portuguese stock market and its sectors to oil price changes is rather limited, albeit the sensitivity does vary depending on the sector: the argument can be made that the sensitivity of the Financial Services, Technology, Telecommunications and Utilities is not statistically significant, whilst the Consumer Goods, Consumer Services, Basic Materials, and Industrial sectors demonstrate a statistically significant sensitivity to oil price changes, at the 5% level for basic resources and industrials, and 10% for Consumer Goods and Services. The latter having one subsample at 5% and one at 10%. The discrepancy in results follows the results of prior studies in the field: (Moya-Martinez et al., 2014; Arouri et al., 2010; Scholtens, 2012; Papapetrou, 2001; Elyasiani et al., 2011). The heterogeneous results for the different sector indexes highlight the fact that an analysis on an overall market level like the one seen in Catalao et al. (2015) may hide important effects that are only applicable to certain sectors. This is clearly exemplified by the comparison of the results from this study and that of Catalao et al. (2015); where no statistically significant sensitivity to oil price changes is highlighted. However, in our study we see that there is a statistically significant sensitivity to oil price changes at the 10 and 5% level for four different sectors (Consumer goods, Consumer Services, Basic Materials and Industrials). Catalao et al. (2015) broader Portuguese stock market analysis combines this significant sector sensitivity under the broader umbrella of the entire PSI20 stock market index and, as a result, found no statistically significant sensitivity.

Another factor that further reinforces the relatively weak sensitivity of Portuguese sectors on oil price changes is the fact that only one of the four sectors that displayed statistically significant sensitivity to oil price changes, displayed it in one or more sub-sample time periods. That of Consumer Services, which disapled a statistically significant negative sensitivity to oil price changes in the period of December 2004 - November 2009 and February 2016 - December 2020. The maintenance of the negative sensitivity for Consumer goods as well as the lack of other statistically significant sectors with more than one subsample, suggests that direction of the Portuguese sector exposure even if very small has not undergone significant changes—It is however important to note that the sample of sectors with a statistically significant sensitivity is too small to make this argument compelling, but nonetheless an interesting point to raise. Overarchingly, this point of stagnant modifications in the direction of the oil price exposure in the different Portuguese sectors, goes against the findings in Moya-Martinez et al. (2014) who argues that "the oil price exposure has undergone substantial changes in recent years for a wide group of industries. This changing pattern may be put down to the influence of several major events such as the Asian and Russian financial crisis of 1998, the oil price bubble from mid-2003 or the recent global financial crisis, which hit Spain very hard causing the burst of the real estate bubble and a profound economic downturn." (Moya-Martines et al., 2014).

Overall, the 2000s for the Portuguese economy and its different sectors was as previously mentioned one where the oil price sensitivity is relatively low, which counters the idea of Moya-Martinez et al. (2014) who states that "the link between oil prices and industry returns seems to have intensified during the 2000s, a period characterized by higher and more volatile oil prices, and has become mainly positive since then."; further challenged by the act that our dataset highlights four statistically significant subsamples and three of them display a negative sensitivity to oil price shocks, the opposite of what Moya-Martinez argues, which reinforces what was stated in section 6, that for Portugal, the demand side oil price shocks that originated from the global business cycle fluctuations have had less of an influence on the stock market prices of Portuguese sectors than does Portugal's status as an oil importing country. Another really interesting argument for why Portugal displays a relatively smaller sensitivity to oil price changes than that of Spain in Moya-Martinez's et al. (2014) study is that whilst this study occurs in the time span of 2000 to 2020, the Spanish study occurs in the timespan of 1993 to 2010. Despite the fact that they intersect for the last decade of the Spanish period, the first seven years of the Spanish study are done under conditions of much higher external dependency on energy and oil in particular, than those seen in this study and the 2000s of the Spanish study, as both countries were global leaders in the transition towards renewable energy with the turning of the century. Moreover, for the Portuguese sectors in the 2000s, it appears that interest rate risk unexplainably does not pose the same statistical sensitivity that we see in the Spanish paper.

In conclusion, a lot can be drawn from this study. For example, "investors and portfolio managers, the disparity in oil price exposure across industries can be used to identify potential sector-based hedging opportunities and to make optimal portfolio allocation decisions." (Moya-Martinez et al. 2014). Furthermore, firms can look at their particular sector sensitivity to oil price changes and act accordingly regarding their risk management strategy. And finally and most importantly, policy makers can look at this paper and understand the effect that oil price shocks have on different sectors and act accordingly to attempt to minimize the shocks through a plethora of strategies, including but not limited to developing better energetic investment and consumption strategies regarding particular sectors and the Portuguese economy as a whole.

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