COLEGIO UNIVERSITARIO DE ESTUDIOS FINANCIEROS

### GRADO EN ADE BILINGÜE

### Trabajo de Fin de GRADO



## ANÁLISIS DE DATOS FINANCIEROS

## ENERGÍAS DE PORTUGAL (EDP)



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### 0. Note to the reader

This final degree project is merely informative, so this information should not be taken as a basis to make investments decisions. The information used to prepare this project has been obtained from sources considered reliable. This document can help the reader discover more about the company analysed and the Portuguese energy sector as a whole, as well as the econometric model proposed to explain the factors that influence the price changes in the price of EDP.



### 1. Introduction

### 1.1 Purpose of the project

The main purpose of this project is to carry out an analysis of Energías De Portugal (EDP) and the evolution of its stock price in previous years, with the objective of calculating the profitability of the stock and comparing it with the rest of the companies listed in the Portuguese market and finally, calculating the volatility of our chosen stock.

This analysis is divided in the following order: First, there is the company's overview, based on its history, what do they do, the services they offer, the most relevant facts that have affected the company from the year 2000, analysis of the financial statements and a brief comment of their shareholder structure. Then there is an explanation of the sector in which EDP operates, how the company is positioned against its competitors, and the amount of market share it has. Then there is a description of how the data has been obtained, a resume of the main changes in the stock price throughout the last years, and a statistical-descriptive analysis of those changes and compare them with the market. Additionally, a series of questions will be formulated in order to explain with more details the profitability and risk of the asset during the period, and they will be answered with hypothesis contrasts. Then a CAPM (Capital Asset Pricing Model) will be made with the estimated model. The project ends with the conclusions of the study made around the company, followed by the bibliography and the appendix.

To sum up, the final purpose of this project is not only to collect and analyse all the information needed to explain the evolution of the company and its stock price and make a recommendation whether to invest on it or not, but to learn about the relationship between all the agents in the market, and use this knowledge in the future.



### 2. Description of the company

### 2.1 Company's history

EDP was founded in 1976 through the merger of thirteen companies that had been previously nationalized in 1975, and was known as "Electricidade de Portugal". As it was a State-owned company, it was responsible for the modernization of the network, the distribution map planning of the national electric park, and the establishment of a single tariff scheme to customers.

In the mid-1980s the EDP distribution network was covering 97% of the territory of Portugal and claimed 80% of the low-voltage power supply. In 1991, the Portuguese Government changed the legal status from public company to Corporation. In 1994, a deep restructuring took place, and the outcome was the foundation of the EDP group. In 1996 EDP makes its first international acquisition in Brazil. In 1997 the privatization phase started, placing the Portuguese government a 30% of the firm's capital in the stock market. In 2001 EDP acquired an important share of the Spanish company Hidrocantábrico, and at the end of 2011 a Chinese state-owned electric company acquired a 21,35% of the firm previously owned by the Portuguese Government for €2.7 Billion.

### 2.2 What do they do?

EDP ranks amongst Europe's major electricity operators, as well as being one of Portugal's largest business groups.

The EDP Group's activities are centred on the generation and distribution of electric power, as well as the information technologies areas. In addition, the group's business includes complementary and related areas, such as water, gas, engineering, laboratory testing, vocational training and real estate management.

The Value Chain of EDP is divided in three main stages:

 Generation: EDP generates electricity from <u>renewable sources</u> such as water, wind and sun, and from <u>non-renewable sources</u> – mostly coal, natural gas, nuclear and cogeneration. The company is the largest electricity generator in Portugal, the third in the Iberian Peninsula and the fifth largest private group in Brazil. In the



wind energy market, EDP Renováveis is one of the leading global players. At the end of 2017, EDP had 26,753 MW of installed capacity. Because of climate change and the global agreements signed to combat such changes, renewable sources have been gaining ground in recent decades and are also the sources most commonly used by EDP.

- Distribution: The energy they produce is delivered to the transmission network and then channelled into the distribution network. EDP operates in three electricity distribution markets, Portugal, Spain and Brazil, having distributed, in 2017, 78,788 GWh, through a network with more than 246 thousand km. In Portugal, the company operates throughout all the country. In Spain, EDP operates in some autonomous communities, especially in the Asturias region. EDP's electricity distribution strategy is focused on the implementation of smart networks and related services, in order to meet future challenges and become an electricity distribution benchmark.
- **Supply:** Once the energy gets to the supply point, it is sold by the supplier. Commercialization is the activity closest to the customer end of the electricity value chain. It is responsible for our relationship with end consumers. In Iberia, electricity and gas supply is liberalized and consumers have the right to freely choose their supplier. EDP is present in the electricity supply activity in Portugal, Spain and Brazil, having more than 9.8 million customers in those geographies. In the gas sector, this presence is only in Iberia, where EDP has 1.5 million customers.

Apart from generating, distributing and supplying energy to Portugal, Spain and Brazil; EDP is a specialist in Energy Consulting, where it supplies strategic counselling and technical assistance, by sharing best practices and the technical quality associated with the EDP Group. Experts from the Group are directly involved in these projects, with range from hydroelectric generation to smart distribution networks.

The projects are usually funded by various multilateral entities, such as the European Investment Bank, the World Bank and Cooperation Agencies.



Here below is a table which reflects the breakdown of the EBITDA expected for EDP to achieve in 2018, and can give us a quick overview on how the income of the company is distributed (in  $Mn \in$ ):

	2018		
EBITDA	New	Old	% chg
Generation Iberia	829	855	-3.1%
Networks	653	653	0.0%
Brazil	613	591	3.7%
EDPR	1,309	1,287	1.7%
Other	10	10	NM
Total	3,413	3,397	0.5%

Figure 1: EDP 2018 expected EBITDA breakdown.

Source: Morgan Stanley Research estimates.

### 2.3 Main events from 2000-2018

In November 1999, the Portuguese conglomerate Sonae, one of EDP's largest customers, began buying its power from the Spanish utility Endesa. Nevertheless, EDP moved ahead with growth and diversification. The Onitelecom (new telecom unit created in 1999) unit became fully operational in 2000, as international and long-distance fixed-line services were liberalized that January. Although the unit lost money in its first two years of operation, it acquired 589,000 voice and 372,000 internet customers by the end of 2001. EDP also bought a 14 percent stake in the Portuguese oil and gas utility GALP early in 2000.

The government, which had held just over half of EDP since 1999, reduced its share further in October 2000 with the EUR 1.6 billion sale of an 18 percent stake, but it was very wary of relinquishing too much control over Portugal's electricity system; so despite its minority holding, it retained a "golden share" that gave it veto power over major policy decisions.

In 2001 EDP ended its strategic alliance with Iberdrola in response to rumors that Iberdrola might merge with its larger competitor Endesa. In December 2001 EDP reached an agreement with a German utilities company, under which EDP had a controlling 40% and EnBW 35% of Hidrocantábrico, with two Spanish financial institutions holding the remaining shares. Results in 2001 showed a drop in net profit to EUR 451 million, due to losses in the telecom unit.



As EDP entered 2002, it faced the challenge of holding its market share in a sector where small and medium-sized companies started to be allowed to buy from other electricity suppliers. While actively pursuing acquisitions and opportunities for diversification, EDP also needed to concentrate on its core business of electricity generation. The company announced its intention to cut costs over the next four years as the Iberian electricity market became increasingly integrated.

In November 2009, EDP sold one of his Brazilians subsidiaries "Energias Do Brasil" for  $\in$ 170 million. In July 2010, EDP acquired a controlling stake on the Spanish company "Naturgas" for  $\in$ 614 million. In July 2011, EDP sold another stake of "Energias Do Brazil" for  $\in$ 340 million, keeping finally with a 51% stake of the company.

In December 2011, a huge event took place, that was the entrance in the shareholder structure of the company by China Tree Gorges. This Chinese State-owned electric company bought a 21,35% stake owned by the Portuguese government for €2.7 Billion.

In May 2015, EDP acquired a 50% stake of Pecem (Brazil) for €88 million. In January 2016 EDP acquired gas distribution assets from Repsol in Spain for an EV of €116 million. In April 2016, EDP sold a 49% equity shareholding and outstanding shareholders loans in a portfolio of fully-owned wind onshore assets in Spain, Portugal, Belgium and France for a total consideration of €550 million, in accordance to EDP Renováveis asset rotation strategy. In July 2017, EDP sold the 100% of Naturgas for €2.591 million. In October of the same year, EDP sold his subsidiary of Gas in Portugal to the competition for €536 million, in order of the company's strategy of reducing their net financial debt.

The last and very remarkable event has been the takeover bid on May 2018, by the main shareholder, China Three Gorges to take control of the company, offering a 5% premium on the stock. The total value of the offer was of €9.070 Billion, excluding the 23% stake in hands of China Three Gorges.

### 2.4 Analysis of Financial Statements

So far there is no annual report of 2018, as they are normally updated by the very end of march, so I am going to do the analysis of the Financial Statements of 2017 compared to the ones of 2016.

At first glance, both the Income Statement and the Balance Sheet shows that it has been



a great year, a year of growth and reduction of the group's financial debt.

As it is shown in Figure 2, the Income Statement main highlights are the greater increase in cost of energy sales than in total revenues, the huge increase in other income (the energy consultant business and revenues from divestments) and the increase in the EBITDA and Net Income of the company. The increase of the EBITDA is mainly due to the divestments the company has done along the year (the 100% of Naturgas and his gas subsidiary in Portugal); this is called an inorganic growth, because if this sales wouldn't have happened, the EBITDA would have decreased, in line with the Gross Profit that this year has decreased a 6%.

Million of Euros	2017	2016	4Q17vs4Q16 (%)
Revenues from energy sales and service and other	15.745,987	14.595,164	7,88%
Cost of energy sales and other	-10.354,909	-8.857,132	16,91%
Gross profit	5.391,078	5.738,032	-6,05%
Other income	1.036,999	427,314	142,68%
Supplies and services	-990,553	-947,874	4,50%
Personnel costs and employee benefits	-680,833	-660,616	3,06%
Other expenses	-766,762	-797,549	-3,86%
EBITDA	3.989,929	3.759,307	6,13%
Provisions	3,627	15,076	-75,94%
Amortisation and impairment	-1.675,659	-1.510,304	10,95%
EBIT	2.317,897	2.264,079	2,38%
Financial income	439,636	899,323	-51,11%
Financial expenses	-1.248,089	-1.790,803	-30,31%
Share of net profit in joint ventures and associates	11,521	-22,062	152,22%
Profit before income tax and CESE	1.520,985	1.350,537	12,62%
Income tax expense	-10,394	-88,796	-88,29%
Extraordinary contribution to the energy sector (CESE)	-69,246	-61,630	12,36%
Net profit for the period	1.441,435	1.200,111	20,11%
Earnings per share - €	0,31	0,26	19,23%

*Figure 2: EDP Income Statement* 

Source: EDP website, Own Elaboration, Excel.



From the asset-side of the Balance Sheet shown in Figure 3 there are very few comments to make. The long-term debtors have increased by 16% (+€400mn), the goodwill has decreased by 35% (-€1.180mn), and the cash and equivalents has increased by 58% (+€900mn). These three outcomes are all really positive for the future of the company.

The equity of the firm has remained stable, and the movements in the liabilities-side of the Balance Sheet comes entirely from the current liabilities. The short-term financial debt has decreased by 42%(-€1.022mn) and the current tax liabilities have also decreased by 41% (-€390mn).

Millions of Euros	2017	2016	4Q17vs4Q16 (%)
Assets			
Property, plant and equipment	22.730,615	24.193,736	-6%
Intangible assets	4.747,360	5.128,544	-7%
Goodwill	2.232,668	3.414,852	-35%
Investment in joint ventures and associates	843,082	820,565	3%
Available for sale investments	124,016	165,044	-25%
Investment property	39,199	31,219	26%
Deferrred tax assets	808,521	904,412	-11%
Debtors and other assets from commercial activities	2.839,379	2.448,442	16%
Other debtors and other assets	518,772	437,028	19%
Non-Current tax assets	60,793	32,241	89%
Collateral deposits associated to financial debt	34,874	31,936	9%
Total Non-Current Assets	34.979,279	37.608,019	-7%
Inventories	265,775	316,577	-16%
Debtors and other assets from commercial activities	3.325,730	3.207,613	4%
Other debtors and other assets	304,628	354,316	-14%
Current tax assets	520,500	494,504	5%
Financial assets at fair value through profit or loss	37,544	9,567	292%
Collateral deposits associated to financial debt	10,381	20,095	-48%
Cash and cash equivalence	2.400,077	1.521,253	58%
Assets held for trade	231,135	551,802	-58%
Total Current Assets	7.095,770	6.475,727	10%
Total Assets	42.075,049	44.083,746	-5%

Figure 3: EDP Balance Sheet (Asset side)

Source: EDP website, Own Elaboration, Excel.



Equity			
Share Capital	3.656,538	3.656,538	0%
Treasury stock	-62,957	-63,528	-1%
Share premium	503,923	503,923	0%
Reserves and retained earnings	4.335,265	4.348,793	0%
Consolidated net profit attributable to equity holder	1.113,169	960,561	16%
Non-controlling interests	3.934,322	4.330,085	-9%
Total Equity	13.480,260	13.736,372	-2%
Liabilities			
Financial debt	15.469,636	15.550,273	-1%
Employee benefits	1.198,362	1.410,136	-15%
Provisions	726,771	637,613	14%
Deferred tax liabilities	466,532	722,401	-35%
Institutional partnerships in USA	2.163,722	2.339,425	-8%
Trade and other liabilities from commercial activities	1.343,171	1.293,133	4%
Other liabilities and other payables	874,984	761,101	15%
Non-current tax liabilities	91,551	68,156	34%
Total Non-Current Liabilities	22.334,729	22.782,238	-2%
Financial debt	1.448,129	2.476,403	-42%
Employee benefits	323,891	316,709	2%
Provisions	26,058	33,879	-23%
Hydrological correction account	1,574	1,574	0%
Trade and other liabilities from commercial activities	3.498,131	3.362,421	4%
Other liabilities and other payables	284,140	345,032	-18%
Current tax liabilities	563,456	953,264	-41%
Liabilities held for sale	114,681	75,854	51%
Total Current Liabilities	6.260,060	7.565,136	-17%
Total Liabilities	28.594,789	30.347,374	-6%
Total Equity and Liabilities	42.075,049	44.083,746	-5%

Figure 4: EDP Balance Sheet (Equity & Liabilities side)

Source: EDP website, Own Elaboration, Excel.

### **2.5 Shareholder Structure**

As the Figure 5 illustrates, the EDP's shareholder structure is very simple. There is no



investor with half or more of the voting rights, so it is a company with a Free float of 2.19bn shares, and as there are 3.66bn shares outstanding, leading to a 60% of Free Float.

The principal shareholder is China Three Gorges, a Chinese State-owned electric company who owns 23,27% of the capital. But this percentage added to the one that has the second shareholder, CNIC, a Chinese State-owned international investment fund, a 4,98% of EDP capital, the **28,25% of EDP's capital is in hands of the People's Republic of China.** 



Figure 5: EDP Shareholder Structure.

Source: EDP website, Own Elaboration, Excel.

### 3. Sector Analysis

The energy dependence (ED) is a parameter that characterizes the extent to which an economy relies upon imports to meet its energy needs. The indicator is calculated as net imports of primary energy (i.e., (IMP) importations minus exportations (EXP)) divided by the sum of gross inland energy consumption (GIC) plus international maritime bunkers (IMB).<sup>1</sup>

<sup>&</sup>lt;sup>1</sup> Energies Review-MDPI. "An overview of the Portuguese Energy Sector and perspectives for power-to-gas implementation".



Portugal had the seventh highest energy dependence among the European Union in 2015. This data shows how dependant of energy Portugal is. Here below on Figure 6 are shown the different types of source of energy that are available in Portugal, and their consuming percentage in the country.



Figure 6: Source of Energy in Portugal.

The figure above explains very clearly how the country has changed their energy consumption throughout the years. The most remarkable change is the huge decrease of use of petroleum/oil. Renewable energies have increased from a 10% in 2000 to a 20% in 2017. Coal has remained stable, and the natural gas has also experienced a huge increase.

In October 2005, the Portuguese government approved the new National Energy Strategy substituting the one from 2003. This agreement took place mainly to pursue the following four objectives: the liberalisation of the fuel, gas and electricity markets; growth of renewable energy supply; an efficient and environmentally public supply of energy and the creation of a competitive structural framework.

Source: DGEG (Direçao General de Energía e Geología), Own Elaboration, Excel.



The energy policies before mentioned have made Portugal one of the top energy producers in Europe, specially in terms of renewable power producers. Data collected from governments, statistics, and research articles shows that renewables and natural gas assumed a growing importance in the Portuguese energy sector along time, while oil followed an opposite trend, as it is reflected on Figure 6.

In terms of companies and market share, there are four main competitors in the energy industry: GALP, EDP, REN (Redes Energéticas Nacionais) and EDPR (a spin-off of EDP exclusively dedicated to renewable energy, where the matrix still owns an 83%). GALP is not really a direct competitor, as their core business is completely different. They explore, process and refine oil all around the world, and don't put the same weight on distribution and supplying as EDP does, besides that they don't treat with as much type of energies as EDP does.



Figure 7: Stock Price Evolution of EDP main competitors (2007-2019).

### Source: Thomson Reuters.

The Figure above shows the stock prices of EDP main competitors from 2007 until today. I chose on Thomson Reuters to start this chart on 2007 because REN started trading in 2007, and EDPR in 2008. The orange colour corresponds to EDP, the purple one to



Naturgy, green one to Iberdrola, blue to EDPR and red to REN. The five equities are correlated, as the five of them fall down from 2008 until 2012, then recover to approximately the levels pre-crisis, and from 2014 until today the have moved very collateral.

### 4. Statistical – Descriptive Analysis

### 4.1 Variation of the stock price

Before analysing the logarithm variation rates of the company and the PSI 20, I would like to start with a quick overview of the evolution of the EDP stock price in the past 18 years, and compare it with the evolution of the Portuguese market, the PSI20, as it is shown in Figure 8 and 9.

At the end of February 2000 the stock reached 4,0€, and after 3 really bad performing years, the stock reached historic lows in February 2003.

This historic low has a great number of reasons: the first and most important one was the 18% stake of the company sold by the Portuguese Government for 1.6\$ Billion. In 2001 EDP finished his strategic alliances with Iberdrola, and acquired a 40% stake of HidroCantábrico. And another great reason of this historic low was the decision of the government that allowed small and medium-sized companies to buy from other electricity suppliers, reducing the company market share.



Figure 8: Evolution of EDP Stock Price.



### Source: Bloomberg, Own Elaboration, Excel

From this point until the start of the world crisis in the end of 2007, the stock price grew an impressive 171%, reaching historic highs at 4,61 $\in$ . Then the company faced a 5-year period of downslope, from that historic high in November 2007 until the start of the recovery of the stock in May 2012. And finally from the summer of 2014 until today, the stock has been moving very collateral, with a roof in 3,60 $\in$  and floor in 2,70 $\in$ .

The Figure 9 shows the comparison between the stock price of EDP compared to the PSI 20, the Portuguese Index.



Figure 9: Evolution of EDP Stock Price vs PSI20.

### Source: Bloomberg, Own Elaboration, Excel

We can easily spot that both assets maintained a perfect correlation since the beginning of the data, until the beginning of 2014 where that correlation clearly finishes, and EDP starts to outperform the national Index until today.







Figure 10: Inter – Annual logarithm variation rate.

Source: Bloomberg, Own Elaboration, Eviews.

The figure above shows the inter – annual logarithm variation rate of EDP and the Portuguese Index, which means the variation the asset suffers from one month with respect to the same one from last year. Both graphs move the same way practically the entire 10 years, with just a couple of highlights such as the effect of the world crisis of 2008 had more impact on the PSI20, but in fact the recovery from that point was more remarkable in the PSI20.

### 4.3 Inter – Monthly variation rate

In the Figure 11 we can observe the inter – monthly logarithm variation rate of EDP and the PSI20, which is a similar way of analysing the variation rate that the one in point 4.1, but in this case the variation of the asset is calculated by the difference of one month





minus the month before, instead of the exact month from last year.

Figure 11: Inter – Monthly logarithm variation rate.

Source: Bloomberg, Own Elaboration, Eviews.

While Figure 10 made it difficult to determine which asset varied the most, in this scenario of inter – monthly logarithm variation rate we can confirm that both assets are perfectly correlated, but the stock of EDP has had more significant variations, particularly in the drop of 2012 (China Three Gorges acquires big stake of the company to the Portuguese Government) and 2017 (because of the issue of \$1.000.000.000 in corporate debt).

### 4.4 Histograms

Now I will proceed to analyse two histograms of the relative variation of the EDP stock price and the Portuguese Index, the PSI20. This is used to see the frequency of the variation of the asset, and help us know if it follows a normal distribution or not.



The Figure 12 shows the histogram of the relative variation of the EDP stock. The variables follow a quite perfect normal distribution, being the mean and median 0% of variation. The variable has a symmetric coefficient, maybe with a small number of observations located more on the right hand-side than in the left.



Figure 12: Frequency Histogram of EDP stock variation rates.

Source: Bloomberg, Own Elaboration, Eviews.

Now I will project on Figure 13 the same histogram but aimed to the frequency of the variation rates of the Portuguese market, the PSI20.

It also follows a normal distribution, but in this case the Jarque-Bera is not 48, it is of 16, which means...

The standard deviation confirms what we saw in points 4.2 and 4.3, that the EDP stock has more deviation than the Portuguese market. In the previous figure there was a small number of observations located more on the right side, but in this case is the opposite, allocating more observations on the left tail.





Figure 13: Frequency Histogram of PSI20 variation rates. Source: Bloomberg, Own Elaboration, Eviews.

### 5. Hypothesis Testing and Analysis

With the approach of an hypothesis test, we are trying to analyse in more detail the information of the behaviour of the data. "The principle of parsimony establishes that hypotheses must always be stated in the simplest way possible" (TFG Guide, 2017), and therefore determine if the null hypothesis should be accepted or not.

Here below I will start by making a summarized table with the questions I will formulate later on, the decision that will be taken based on the hypothesis contrast, the implication of this decision, and the annex where the hypothesis contrast will be located at the end of the project.

The first two questions are one of the main purposes of this project, and it is to determine if the company we have selected, in this case EDP, is more profitable or more volatile than the national index, in this case the Portuguese PSI20. I found the third question very interesting to analyse in an econometric way, as we could then scientifically know if the huge change of shareholders the company suffered on 2011 affected the profitability of the EDP stock.



Question	Decision	Implication	Annex
Has been the profitabi- lity of the stock of EDP equal to the PSI20 in the last 18 years?	Accept Ho. P-va- lue of 0,44	Accepting the null hypothesis confirms that EDP has been equal, but with a more thorough analysis we can con- firm that the EDP stock has been slightly more profitable.	1 (Page 35)
Which yields have been more volatile in the last 18 years, the ones from EDP or the PSI20?	P-value of 0,057. Reject Ho under special circum- stances.	With this P-value we should accept Ho, but with a 10% significance reject it. The decision was made regarding the standard-deviations, being higher the one from EDP.	2 (Page 35)
How has affected the change of shareholder's majority to the EDP share profitability?			3 (Page 36)

Figure 14: Questions to do the hypothesis contrasts with.

Source: Own Elaboration, Excel.

# 5.1 Has been the profitability of the stock of EDP equal to the PSI20 in the last 18 years?

The best way to answer this question is by formulating an hypothesis contrast, where the null hypothesis (Ho) is that the yield of EDP has been equal than the PSI20, while the alternative hypothesis (H1) is that the yield has been different than the Portuguese index.

 $H_0: \overline{x} EDP - \overline{x}PSI20 = 0$  $H_1: \overline{x} EDP - \overline{x}PSI20 \neq 0$ 

In this case we can't reject Ho, so we accept it. As it is shown in the Annex 1, we got a p-value of 0,44 and as we are testing with a 5% level of significance, we can't reject Ho. It is true that the profitability of the EDP stock has been very similar to the Portuguese index, but there is a slight difference between both, being the mean of the return on EDP stock -0,0037, and the one from the PSI20, -0,42. Both are really poor results, but we can confirm that the EDP stock has been slightly more profitable than the PSI20 index.



## 5.2 Which yields have been more volatile in the last 18 years, the ones from EDP or the PSI20?

We will make another hypothesis contrast to answer this question. In this case, the null hypothesis (Ho) is that EDP has the same volatility than the Portuguese index, and the alternative hypothesis (H1) is that the volatility of EDP is different than the Portuguese index.

H<sub>0</sub>:  $\$^2$  EDP =  $\$^2$ PSI20 H<sub>1</sub>:  $\$^2$  EDP  $\neq$   $\$^2$ PSI20

This case is more complex than the previous one, as the p-value of this contrast of variances is 0,057; meaning that we can't reject Ho with a 5% level of significance, but we can reject it with a 10% level of significance. As it is shown in the Annex 2, the standard deviation of EDP is 0,738 higher than PSI20, so we can conclude that with a very slightly difference, EDP is more volatile than the Portuguese index.

# 5.3 How has affected the change of shareholder's majority to the EDP share profitability?

This question is referring to the huge change the company experienced on its shareholding the 22<sup>nd</sup> of December, 2011. On this date the Portuguese government sold a 21,35% stake of the company to China Three Gorges, a Chinese State-owned electric company. This was an historic event, taking into account that 23 years before the company was a (Portuguese) public monopoly.

To answer this question, we will make a new hypothesis contrast, where the null hypothesis (Ho) is that the yield of the EDP stock was the same when the Portuguese government was the major shareholder (2000-2011) than when the Chinese were the referent shareholders (2012-2018), and the alternative hypothesis (H1) is that the yield was different in that same period.

CÓMO ESCRIBO LA Hº Y LA H1?? SI PONGO Hº ES IGUAL LA RENTABILIDAD EN AMBOS PERIODOS Y H1 DISTINTA, ME



## SALDRÍA DE ACEPTAR Hº (0,58), CUANDO ABAJO SE DEMUES-TRA QUE SON DISTINTAS Y QUE ES MAYOR LA DEL 2º PERI-ODO (0,28)!!!

t-test Satterthwaite-Welch t-test* Anova F-test Welch F-test*		225 165.2197 (1, 225) (1, 165.22)	-0.545606 -0.536621 0.297686 0.287962	0.5859 0.5923 0.5859 0.5923				
*Test allows fo	or unequal cell v	/ariances						
Analysis of Var	riance							
Source of Varia	ation	df	Sum of Sq.	Mean Sq.				
Between Within		1 225	11.45664 8659.278	11.45664 38.48568				
Total		226	8670.735	38.36608				
Category Statis	Category Statistics							
DCRISIS 0 1 All	Count 143 84 227	Mean -0.175894 0.289407 -0.003712	Std. Dev. 6.053871 6.451925 6.194036	Std. Err. of Mean 0.506250 0.703963 0.411113				

### 6. CAPM Model

Through the CAPM model, which stands for Capital Asset Pricing Model, the risk of the EDP stock and the PSI20 Index will be analysed and compared. To achieve this, a detailed analysis is carried out through a model in the statistical program Eviews, following the indications of the Manual "Modelo CAPM, 2019".

To develop this this model, the following mathematic formula is used:

$$R_{\rm A} = R_{\rm F} + \beta (R_{\rm M} - R_{\rm F})$$

Where:

- R<sub>A</sub> : expected rate of return of EDP.
- $R_F$ : expected rate of return of the 10Y Portuguese Bond.
- R<sub>M</sub>: expected rate of return of the PSI20.



Therefore the econometric model is represented in a way that:

$$(R_A - R_F)_t = \alpha + \beta (R_M - R_F)_t + \varepsilon_t$$

Where:

- $(R_A R_F)_t$ : dependent variable, will be the share premium of EDP.
- $(R_M R_F)_t$ : explanatory variable, will be the market (PSI20) premium.
- $\alpha$  : coefficient that measures the asset (EDP) profitability.
- β : coefficient that measures the variation of the profitability of the asset when the market faces movements in its profitability.
- $\varepsilon_t$  : residuals of the model.

### 6.1 Descriptive analysis of the data.

The purpose of this section is to build a model and project it in a graph. This model is about comparing both the asset and market premium. The model has been calculated using the historic share prices of EDP and the Portuguese Index PSI20, which have been extracted from Bloomberg, and the data used for the Risk Free asset has been extracted from Investing.

The Eviews programme transforms the share prices into monthly variation rates, and then creates two series of premiums respect the Risk Free asset (10Y Portuguese Bond).



Figure 15: Stock premium & Market premium.

Source: Bloomberg & Investing, Own Elaboration, Eviews.



Watching the figure 15, we can see that the premiums of the EDP stock and the PSI20 index are very correlated along time, and with not enough data to confirm which is more volatile.

### 6.2 Estimation by OLS (Ordinary Least Squares)

The econometric model we want to estimate is the following one:

EDP Premium  $t = \alpha + \beta * PSI20$  Premium  $t + \varepsilon_t$ 

Where:

- EDP Premium  $_t$ : surplus of the stock profitability over the 10Y Portuguese Bond.
- $\alpha$  : coefficient that measures the stock profitability.
- $\beta$ \*PSI20 Premium: surplus of market profitability over the 10Y Portuguese Bond.
- *ɛt* : residuals of the model.

Introducing this data in the econometric model of Eviews, we obtain a CAPM model estimation by OLS (Ordinary Least Squares), which is shown below.

Dependent Variable: PEDP Method: Least Squares Date: 03/09/19 Time: 20:47 Sample (adjusted): 2000M02 2018M12 Included observations: 227 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C PPSI20	0.251940 0.795985	0.297767 0.053832	0.846099 14.78648	0.3984 0.0000
R-squared Adjusted R-squared S.E. of regression Sum squared resid Log likelihood F-statistic Prob(F-statistic)	0.492832 0.490578 4.436161 4427.893 -659.2768 218.6401 0.000000	Mean depende S.D. depender Akaike info crit Schwarz criteri Hannan-Quinr Durbin-Watsor	ent var nt var terion ion n criter. n stat	-0.404567 6.215391 5.826227 5.856403 5.838404 2.263934

Figure 16: CAPM Model Estimation by OLS (Ordinary Least Squares).

Source: Bloomberg & Investing, Own Elaboration, Eviews.



Our CAPM Model has an alpha that it is not significant due to the high p-value it has (0,39), and implicitly says that our asset is not subject to exogenous interferences, and only to movements in the market. The beta is 0,79 meaning that apparently the stock is less risky than the index, as if for example the market increases or decreases in 100bp, the EDP stock will only increase or decrease in 79bp, but we will need more studies of this model to confirm this fact.



### **6.2.1 OLS Residuals Analysis**

Figure 17: OLS Residuals Analysis.

### Source: Own Elaboration, Eviews.

Apparently there is no special circumstance that makes the residuals move in an estrange way, moving randomly along 0, and between the range of +-10%. We will need more tests and studies about these residuals to estimate if they follow a normal distribution or not.

### **6.2.2** Normality Analysis

It must be analysed if the residuals follow a normal distribution. To check this, we use the statistic Jarque-Bera on this hypothesis contrast:



H<sub>0</sub>: residuals follow a normal distribution.

H1: residuals doesn't follow a normal distribution.



Figure 18: Normality Analysis, Histogram.

Source: Own Elaboration, Eviews.

The statistic Jarque-Bera is 1,41; but the real important number here is the p-value (0,49) and as it is much higher than the 5% level of significance, we can't reject the null hypothesis, and we accept that residuals follow a normal distribution

### 6.2.3 Heteroskedasticity analysis

The heteroskedasticity measures if the residuals of the model have the same variance or not. To solve this doubt, we do the White Test which consists of the following two variables:

H<sub>0</sub>: residuals have the same variance.

H1: residuals have different variance.



The Figure below shows the White Test done in Eviews.

### Heteroskedasticity Test: White

F-statistic	10.98636	Prob. F(2,224)	0.0000
Obs*R-squared	20.27789	Prob. Chi-Square(2)	0.0000
Scaled explained SS	23.22016	Prob. Chi-Square(2)	0.0000

Test Equation: Dependent Variable: RESID^2 Method: Least Squares Date: 03/10/19 Time: 20:12 Sample: 2000M02 2018M12 Included observations: 227

Figure 19: White Contrast (Heteroskedasticity).

Source: Own Elaboration, Eviews.

If the p-value is above 0,05; means that the variance is constant and then there would be homocedasticity, and if the p-value is below 0,05; the variances are not constant and by the way there would be heteroskedasticity. Our model gives a p-value of exactly 0, meaning that the variances of the residuals are not constant and appearing the heteroskedasticity.

Whit that p-value it seems that there is autocorrelation, but to be more sure about this fact, I am going to do the Breusch-Godfrey Test, where the null hypothesis (Ho) is that there is no autocorrelation, and the alternative hypothesis (H1) is that there is autocorrelation. in two possible scenarios: in the last 2 months and in the last 12 months.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.573209	Prob. F(2,223)	0.0786
Obs*R-squared	5.120557	Prob. Chi-Square(2)	0.0773

Test Equation: Dependent Variable: RESID Method: Least Squares Date: 03/21/19 Time: 19:44 Sample: 2000M02 2018M12 Included observations: 227 Presample missing value lagged residuals set to zero.



Figure 20: Breusch-Godfrey Test for the last 2 months.

Source: Own Elaboration, Eviews.

For this scenario of the last 2 months, there is a p-value of 0,07. As it is very near to the 5% level of significance we could have doubts whether to accept Ho or not, so I am going to do the Breushc-Godfrey Test again but for the previous 12 months.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic Obs*R-squared	1.969553	Prob. F(12,213) Prob. Chi-Square(12)	0.0283
Obs IC-squareu	22.07233	TTOD. CHI-Diquare(12)	0.0000

Test Equation: Dependent Variable: RESID Method: Least Squares Date: 03/21/19 Time: 19:45 Sample: 2000M02 2018M12 Included observations: 227 Presample missing value lagged residuals set to zero.

Figure 21: Breusch-Godfrey Test for the last 12 months.

Source: Own Elaboration, Eviews.

This test for the last 12 months shows a p-value of 0,02; so we must reject the null hypothesis, confirming that there is strict autocorrelation.

### 7. Newey – West Estimation and Hypothesis Contrast

The Newey – West method allows us to consistently estimate the variance and covariance matrix of the OLS estimators in the presence of heteroskedasticity and / or autocorrelation problems, so that the Wald statistic and the conventional t statistic are suitable instruments for statistical inference.

If we compare the Newey – West estimation results (Figure 22) with the OLS estimation results (Figure 16), it is observed that the estimation of the coefficients are the same, but the standard deviations, statistical t and p-values have varied slightly while being now estimated consistently.



#### Dependent Variable: PEDP Method: Least Squares Date: 03/10/19 Time: 20:28 Sample (adjusted): 2000M02 2018M12 Included observations: 227 after adjustments HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C PPSI20	0.251940 0.795985	0.279731 0.068954	0.900652 11.54371	0.3687 0.0000
R-squared Adjusted R-squared S.E. of regression Sum squared resid Log likelihood F-statistic Prob(F-statistic) Prob(Wald F-statistic)	0.492832 0.490578 4.436161 4427.893 -659.2768 218.6401 0.000000 0.000000	Mean depend S.D. depende Akaike info cri Schwarz criter Hannan-Quin Durbin-Watso Wald F-statist	ent var nt var terion ion n criter. n stat ic	-0.404567 6.215391 5.826227 5.856403 5.838404 2.263934 133.2573

Figure 22: CAPM model estimation by the Newey-West Method.

Source: Own Elaboration, Eviews.

Now with the results given by the CAPM model estimation by the Newey –West Method on Figure 22 we can again made several hypothesis contrast.

### 7.1 Hypothesis Contrast

### 7.1.1 Does my asset have the same risk as the Portuguese Index?

To answer this question an hypothesis contrast is required, where the null hypothesis (Ho) will be that the risk of EDP and the PSI20 are the same, and the alternative hypothesis (H1) that they have different risk.

H<sub>0</sub>: PPSI20 = 1 H<sub>1</sub>: PPSI20  $\neq$  1



As it is shown on Figure 18 the PPSI20 has a coefficient of 0.79 with a p-value of exactly 0, meaning that we must reject the null hypothesis, accepting the alternative one that says that the two assets have different risk. Concretely, the EDP stock is less risky than the PSI20 index, as if the market increases or decreases in 100bp, the EDP stock will only increase or decrease in 79bp. This information confirms what we saw from the study of the model by the OLS method, in the Figure 14, that the beta was  $\neq$  1, and being the EDP stock less risky as well.

## 7.1.2 ¿Has the EDP stock premium been affected by exogenous factors?

We need to make another hypothesis contrast, where in this case de null hypothesis (Ho) will be that the stock premium hasn't been affected by exogenous factors, and the alternative hypothesis (H1) that it has been affected by those factors.

$$H_0: \alpha = 0$$
$$H_1: \alpha \neq 0$$

In this case the Figure 18 shows that the  $\alpha$  is equal to 0.25 with a p-value of 0.36, so we then can't reject the null hypothesis, accepting that the EDP stock premium has not been affected by exogenous factors. This confirms all the previous studies where the data confirmed that the stock has nearly perfect correlation with the Portuguese Index.

### 8. Conclusions

Energías de Portugal (EDP) is an energetic company with near half a century of history. It remained as a state-owned company since foundation until 1997, where the Portuguese Government placed 30% of the firm's capital on the stock market. The share capital stayed more or less unchanged since the entry in 2011 of a Chinese state-owned energetic company with a 21% stake. This same company made a takeover bid in May 2018, but up until now hasn't been accepted.

The main purpose of this project was to study the profitability and volatility of the EDP stock, and compare it with the national index, the PSI20. To achieve this, it has required



a great number of calculations, estimations and analysis of different data drawn mainly from Bloomberg. This data has been later projected on the statistic programme Eviews10, which has helped us manipulate and interpret it.

After a thorough analysis, we can conclude that the EDP share has been slightly more profitable along the years of our study (2000-2018), essentially our stock has obtained a mean of profitability in this 18 years of -0,0037% with a standard deviation of 6,19 while the Portuguese Index has obtained a main of profitability of -0,42% with a standard deviation of 5,45. Just with this data we can affirm that both results are very poor, and that the stock of EDP is not the preferred one to be invested in for long periods of time, even though it can give good returns in specifics point of time.

Concerning volatility, an hypothesis contrast has been made to know which was more volatile, the EDP stock or the PSI20. The p-value given was of 0,057; so with a 5% level of significance we should accept the null hypothesis, and with a 10% level of significance we should reject it. As it was between both parameters, the standard deviations of both assets finally answered the question. The EDP share has been slightly more volatile (+0,738) than the index.

We have estimated the CAPM model by OLS to keep consolidating the results we got from the statistic-descriptive analysis. Our estimated model has given an  $\alpha$  of 0.29 with a p-value of 0.39 meaning that it has no relevance on the model and that the EDP stock is not affected by exogenous factors. The estimated model has also given an  $\beta$  of 0.79 with a p-value of exactly 0, meaning that the stock is less risky than the index, as if the market increases or decreases in 100bp, the EDP stock will only increase or decrease in 79bp.

We studied the residuals of the estimated model by graphing them, subjecting them to hypothesis contrast to check the p-value of the statistic Jarque-Bera, heteroskedasticity (White-Contrast) test and the Breusch-Godfrey test. The outcome of all this tests has been that the residuals follow a normal distribution and that both variables of the estimated model have autocorrelation, confirming the previous studies.

To sum up, I would recommend to buy EDP shares as it is an European leader on the energy sector, more profitable and less risky than the Portuguese Index, the PSI20; but with a time constraint, as it has been proofed that for long periods of time the profitability of the stock is nearly 0, but reaching yields of 20% at specific points in time.



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### 11.Annex

### Annex 1. ¿Has been the profitability of the stock of EDP equal to the PSI20 in the

#### last 10 years?

Test for Equality of Means Be Date: 03/19/19 Time: 13:11 Sample: 2000M01 2018M12 Included observations: 228	etween Series		
Method	df	Value	Probability
t-test Satterthwaite-Welch t-test* Anova F-test Welch F-test* *Test allows for unequal cell Analysis of Variance	452 444.9228 (1, 452) (1, 444.923) I variances	0.766972 0.766972 0.588246 0.588246	0.4435 0.4435 0.4435 0.4435
Source of Variation	df	Sum of Sq.	Mean Sq.
Between Within	1 452	20.04108 15399.29	20.04108 34.06922
Total	453	15419.33	34.03825

Source: Own Elaboration, Eviews.

## Annex 2. ¿Which yields have been more volatile in the last 10 years, the ones from EDP or the PSI20?

Test for Equality of Variances Between Series Date: 03/19/19 Time: 13:48 Sample: 2000M01 2018M12 Included observations: 228

Method	df	Value	Probability
F-test Siegel-Tukey Bartlett Levene Brown-Forsythe	(226, 226) 1 (1, 452) (1, 452)	1.288648 1.408656 3.615804 2.412441 2.335323	0.0572 0.1589 0.0572 0.1211 0.1272

#### Category Statistics

			Mean Abs.	Mean Abs.	Mean Tukey-
Variable	Count	Std. Dev.	Mean Diff.	Median Diff.	Siegel Rank
REDP	227	6.194036	4.701214	4.692167	218.8238
RPSI20	227	5.456405	4.149467	4.147610	236.1762
All	454	5.834231	4.425341	4.419888	227.5000

Bartlett weighted standard deviation: 5.836884

Source: Own Elaboration, Eviews.



## Annex 3. ¿How has affected the change of shareholder's majority to the EDP stock profitability?

t-test Satterthwaite-Welch t-test* Anova F-test Welch F-test*		225 165.2197 (1, 225) (1, 165.22)	-0.545606 -0.536621 0.297686 0.287962	0.5859 0.5923 0.5859 0.5923
*Test allows fo	or unequal cell v	/ariances		
Analysis of Va	riance			
Source of Varia	ation	df	Sum of Sq.	Mean Sq.
Between Within		1 225	11.45664 8659.278	11.45664 38.48568
Total		226	8670.735	38.36608
Category Stati	stics			
DCRISIS 0 1 All	Count 143 84 227	Mean -0.175894 0.289407 -0.003712	Std. Dev. 6.053871 6.451925 6.194036	Std. Err. of Mean 0.506250 0.703963 0.411113

Source: Own Elaboration, Eviews.