Work Project, presented as part of the requirements for the Award of a Master's degree in Finance from the Nova School of Business and Economics.

FINANCIAL RISK MANAGEMENT AT GALP: ASSESSING MARKET EXPOSURES OF AN INTEGRATED OIL & GAS COMPAN

LUISA ANN-MARIE KLOTH

Work project carried out under the supervision of:
Fernando Anjos

01/03/2025

Abstract

This thesis examines the financial risk management practices of Galp, a leading integrated oil and gas company. It quantifies market exposure to key variables and explores their interactive effects before assessing the effectiveness of the company's current hedging strategies. Leveraging these insights - along with Galp's Two-Year Cash Flow at Risk (EUR 376m), obtained through a separately developed proprietary Cash Flow at Risk model - this study proposes a gasoline-based collar hedging strategy. The recommended approach is shown to mitigate cash flow volatility cost-effectively, ensuring sufficient liquidity for strategic investments and dividend payments, thereby enhancing Galp´s financial resilience.

Keywords

Risk Management, Financial Risk Management, Hedging, Simulations, Oil and Gas Industry

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

Contents

Introduction

In today's global and highly dynamic business environment, effective risk management is essential for ensuring long-term stability and corporate performance.

Organizations face a range of risks that can significantly impact profitability and operational sustainability. Among these, financial - specifically market risks - can be effectively managed using financial instruments, particularly derivatives. Exposure to fluctuations in commodity prices, exchange rates, and interest rate variability can be mitigated through hedging strategies. Hedging involves taking an opposing position in a related asset to offset potential losses from an existing position. The advantages and disadvantages of this strategy are well-documented in both academic literature and empirical research. While corporate hedging is widely practiced, controversy remains over the optimal approach to risk management and its effectiveness in creating additional value for shareholders.

The capital-intensive nature of exploration and development projects, along with ongoing shifts like the energy transition that fundamentally redefine the industry, make stable revenue generation crucial. Long-term competitiveness depends on maintaining sufficient cash flow to support both traditional operations and investments in emerging energy sectors.

This thesis focuses on Galp, the leading Portuguese-origin energy company with global operations. Their integrated business model spans the entire energy value chain, from exploration and production to refining and distribution of oil and gas, exposing the company to market risks at multiple stages and highlighting the potential for effective financial risk management strategies. Given the capital-intensive nature of business operation, and ambitions to support mankind through sustainable energy, Galp requires access to significant funding.

Oil and gas markets have faced substantial price volatility in recent years, driven by geopolitical tensions, supply disruptions, and fluctuations in economic activity, leading to frequent supply and demand imbalances. Global demand for energy plummeted in 2020 due to the Covid-19 pandemic, causing prices to fall to historic lows, but has since rebounded in most regions. Similarly, Russia's invasion of Ukraine disrupted supply chains, causing market prices to surge globally, though particularly in Europe.

The outlook for energy markets remains uncertain, influenced by various economic and political factors that affect global energy demand, consumer preferences, and supply availability. Key themes expected to shape the near- to medium-term future include the impact of political developments such as Trump's election sweep, the behaviour of OPEC+ countries, the evolution of conflicts in the Middle East, and the growing need to transition towards renewable energy sources, driven by government regulations and technological advancements.

Galp needs to forecast and prepare appropriate responses to the evolving challenges impacting the company, particularly those related to market exposure and cash flow sensitivity. Accordingly, this field lab provides in-depth analysis of Galp´s market risk exposures and its current financial risk management practices. A Cash Flow at Risk model is used to develop a hedging strategy recommendation aligned with firm-level financial policies and corporate strategy, providing a comprehensive managerial perspective.

Four key segments will ensure a suitable structure which facilitates comprehension and chronological delivery. Accordingly, the methodology is introduced first, followed by a review of the literature and relevant empirical studies, before progressing to the diagnostic and prescriptive sections.

Methodology

Firstly, a systematic literature review is conducted, synthesizing existing academic and empirical research on hedging strategies, relevant financial instruments, and common financial risk management practices.

Secondly, the diagnostic phase utilizes both qualitative and quantitative methods to assess Galp's market exposures and their corresponding impacts. To provide contextual depth, two expert interviews were conducted with employees from Galp’s LNG Trading and Risk Management Departments. These interviews offer valuable insights into the company’s risk governance structure and help interpret the findings. The analysis begins with an evaluation of Galp’s exposures, focusing on their severity and potential for hedging, based on the company’s business model. Key market risk factors are identified and defined through relevant proxy indicators. Using simple linear and multiple regression analyses, this section quantifies the sensitivities of Galp’s critical financial metrics -such as Ebitda, capex, and debt - to market variables. Subsequently, natural hedging within Galp's value chain is examined, with a focus on the implications of business model diversification and the offsetting relationships between input and output linkages. Next, market variable volatility is calculated and compared with the extent of exposure to determine the importance of risk factors for cash flow stability and to guide hedging prioritization. Finally, Galp’s financial risk management practices are assessed and compared to expectations based on the industry benchmark and the identified exposures. This includes consolidating insights from Galp’s annual reports, calculating a proxy hedge ratio, and conducting a cash flow impact analysis to evaluate the effectiveness of the company’s current risk management strategies.

Thirdly, the final component of this research adopts a prescriptive approach, focusing on identifying actionable insights to optimize Galp’s financial risk management strategy.

Leveraging insights obtained through a separately developed, proprietary Cash Flow at Risk (CFaR) model, and the established relationships between market exposures and Galp's cash flows, a cost-effective collar hedging strategy is proposed. This strategy ensures Galp can meet its discretionary cash flow needs even in adverse market conditions.

Literature Review

The Role of Financial Risk Management in Enhancing Firm Value

Financial risk management, central to corporate strategy and governance, seeks to minimize disruptive events that could hinder investment strategies or performance (Froot, Scharfstein, and Stein 1993; Stulz 1996; Fisher and Kumar 2010). It involves managing market risks - such as fluctuations in foreign exchange rates, interest rates, and commodity prices - using operational adjustments or financial instruments. Corporate hedging, a key component of this strategy, aims to reduce exposure to adverse price movements, typically through derivatives linked to underlying assets like commodities (Kolb and Overdahl 2003). Unlike speculation, which seeks to profit from market movements, hedging manages existing exposure, reducing sensitivity to price changes while limiting potential gains (Guay and Kothari 2003; Fama 1970).

Modigliani and Miller's foundational theories in corporate finance argue that in perfect markets - free from information asymmetry, taxes, or transaction costs - risk management, like capital structure, does not affect firm value, as investors can manage risk through diversification at no cost (Modigliani and Miller 1958; Froot, Scharfstein, and Stein 1993; Haushalter 2005). In such markets, market risk exposures, such as interest rate, currency, and commodity risks, would not influence a diversified portfolio (Stulz 1996). However, real-world market imperfections, such as information asymmetries and transaction costs, justify the need for corporate risk management.

The Agency Problem: Financial risk management aligns shareholder and managerial interests by addressing risk aversion and mitigating the principal-agent problem. Hedging allows risk-averse managers, whose wealth is tied to the firm's stock performance, to reduce exposure to financial volatility (Stulz and Smith 1985; Stulz 1996; Duffie 1995; Tufano 1996). This alignment incentivizes decisions that protect firm value, as managers' financial interests are linked to the company's health. In the oil and gas sector, where commodity price fluctuations cause revenue volatility, effective risk management reduces uncertainty and supports informed long-term decision-making.

The Cost of Financial Distress: Hedging reduces cash flow variability, maintaining liquidity, and decreasing default risk (Stulz 1996; Froot, Scharfstein, and Stein 1993; Stulz and Smith 1985). While hedging minor earnings variability may not benefit shareholders due to portfolio diversification, hedging major risks that increase distress probability benefits both shareholders and creditors. Financial distress, even without bankruptcy, incurs indirect costs, such as reduced sales or reinvestment, eroding firm value (Haushalter 2005). Effective hedging strategies help oil and gas firms reduce cash flow volatility, mitigate liquidity issues, lower default risk, and protect firm value.

The Underinvestment Problem: Stable free cash flow supports corporate investment, reduces reliance on costly external funds, and mitigates the underinvestment problem (Froot, Scharfstein, and Stein 1993). Hedging reduces earnings variability, enabling reinvestment in long-term value-generating projects (Bessembinder 1991). Underinvestment, particularly in high-debt situations, can lead to missed growth opportunities, as equity holders avoid investments benefiting creditors, harming firm value and competitiveness (Hennessy, Levy, and Whited 2007). In the oil and gas sector, where significant capital expenditure is essential, hedging ensures stable cash flows, providing liquidity for long-term projects and strategic investments, such as renewable energy or new exploration, even during market volatility, thus enhancing competitiveness.

The Capital Structure and Cost of Debt: Hedging can reduce external funding costs by minimizing transaction costs and information asymmetries. Firms with valuable growth opportunities, who typically prefer the use of internal funds due to lower capital costs, may access external capital at more attractive rates (Ahn et al. 2003). Additionally, risk management influences capital structure by balancing debt and equity. While debt offers tax advantages, it also introduces fixed obligations, increasing financial risk. Hedging mitigates volatility, bankruptcy risk, and information asymmetries, enabling firms to access cheaper debt and take on more leverage with reduced distress risk (Chen and King 2014). By addressing the trade-off between debt's tax benefits and bankruptcy costs, hedging supports the trade-off theory of capital structure, enhancing firm value (Stulz 1996; Leland 1998; Ross 1997). In the capital-intensive oil and gas industry, effective hedging helps manage debt obligations, stabilize financing costs, and maintain access to capital for new projects, while minimizing financial distress risk.

Empirical Evidence on Hedging and Firm Value

This section examines empirical research, with a particular focus on the Oil & Gas sector. It compares these findings to the expectations outlined earlier, providing a benchmark for understanding the effectiveness, and suitability, of Galp's approach to hedging.

Empirical evidence indicates that an effective hedging program can reduce stock price volatility, with some studies suggesting a positive impact on firm value, although the findings on this relationship remain mixed (Jin and Jorion 2006; Allayannis and Weston 2001; Li, Visaltanachoti, and Luo 2014). The optimal approach to financial risk management is recognized to depend on factors such as company size, industry, and specific risk exposures

(Allayannis and Weston 2001; Culp and Miller 1995; Guay and Kothari 2003; The Wharton School 1994). Research generally suggests that hedging against commodity price fluctuations can enhance firm value by reducing sensitivity to risk exposure. In addition to market risk, studies emphasize that a firm's revenues are significantly influenced by the variability in production volumes (Haushalter 2000; Jin and Jorion 2006; Allayannis and Weston 2001). This is particularly relevant as demand in oil-dependent sectors is highly sensitive to oil price fluctuations (Hamilton 2009). Without hedging, rising prices passed on to consumers can reduce demand for oil and refined products, leading to decreased production, lower revenues, and a drop in stock prices (Basher, Haug, and Sadorsky 2018). The anticipated relationship between management compensation and hedging, designed to align principal-agent interests, is not directly supported by evidence from the oil and gas sector (Haushalter D. 2005; Haushalter G. 2000). However, levered oil and gas companies tend to hedge more frequently to mitigate financial distress, which aligns with theoretical expectations that hedging reduces bankruptcy costs (Haushalter 2002; Haushalter 2005). Analysis indicates that firms often adopt a "selective" rather than "full cover" approach to hedging, seeking to leverage informational advantages to determine their hedge ratios (Stulz 1996). High implementation and maintenance costs of derivatives further discourage full hedging, particularly for smaller firms (Brown 2001). While classical theory suggests smaller firms ought to hedge more to mitigate financial distress risk, Rampini and Viswanathan (2010) argue that financial constraints limit hedging activities, as smaller, financially constrained firms lack the capital and collateral necessary for (effective) risk management. The the extent of hedging is positively correlated with firm size, with studies revealing that oil and gas companies, on average, hedge only approximately 33% of next-year production(Jin and Jorion 2006, 903;Haushalter 2005).

<u>Hedging Instrument Choice and Strategic Considerations in the Oil & Gas Industry</u>

In the oil and gas industry, selecting the appropriate hedging instruments and their mix is particularly challenging due to high commodity price volatility, fluctuating revenue streams, and the variety of available contracts. Given the absence of a universally accepted hedging framework, companies must tailor their approach to specific goals and prevailing market conditions (Froot, Scharfstein, and Stein 1993; Adam 2005).

Risk managers typically choose between linear derivatives - such as futures, forwards, and swaps - and non-linear derivatives, like options, often combining both to achieve effective risk management (Schulte, Nicholson, and Lambert 2022). Linear derivatives stabilize cash flows cost-effectively, particularly in volatile markets, but carry the risk of over/under hedging if actual exposures deviate significantly from forecasts (Adam and Fernando 2006). Options, on the other hand, provide flexibility for an upfront premium, enabling firms to manage uncertain exposures while retaining the ability to capitalize on favourable price movements. This flexibility is particularly valuable in the oil and gas sector, where price volatility and production uncertainty are significant concerns. Options allow firms to manage downside risks while preserving upside potential, supporting capital preservation for essential investments in exploration or infrastructure (Froot, Scharfstein, and Stein 1993). Particularly, in cases where production levels and market prices are negatively correlated, options offer a more suitable hedging solution (Gay, Nam, and Turac 2002). However, the significant costs associated with non-linear derivatives mean that larger, financially stable firms are more likely to utilize them, as they can better absorb these expenses (Geczy et al. 1997).

Section 1: Diagnostic Analysis

Introduction to Galp

Galp Energia SA is a leading Portuguese energy company operating across the entire energy value chain, structured into four core segments. Upstream Operations focus on global oil and natural gas exploration and production. The Industrial & Midstream (I&M) division covers oil refining and trading activities. The Commercial segment manages the sale of refined oil products, natural gas, and electricity to end customers. Lastly, the Renewables & New Business segment drives Galp's expansion into renewable energy, aligning with its transition to low-carbon solutions. While Galp's oil exploration operations are global, its refining, retailing, and electricity sales are largely concentrated in Europe, particularly Iberia. This geographic concentration shapes risk assessment and hedging strategies, necessitating careful selection of benchmarks, proxies, and financial instruments (Galp 2023, 34–66).

Overview of Key Risk Factors

Galp faces five primary risk factors: commodity price, foreign exchange, interest rate, liquidity and insurance, and credit risks, each with varying levels of relevance and mitigation potential through risk management (Galp 2023, 286). Commodity price risk is the most significant for Galp, given its reliance on oil and gas operations. The company faces positive exposure from exploration and production and negative exposure from input costs in refining and trading. Effective management of these opposing exposures requires evaluation of natural hedges that offset risks across its business units. Liquidity and insurance risk are closely linked to commodity price fluctuations, which affect operating cash flow and capital availability for strategic investments. As the insurance market for oil and gas assets declines and lending to the sector decreases, mostly in response to the energy transition (Rickman et al., 2024), maintaining stable cash flows through effective hedging becomes crucial for mitigating these risks. Foreign exchange (FX) risk is of moderate significance for Galp, as its operating margin is sensitive to fluctuations in the US Dollar, with transactions largely in USD while financial reporting is in Euros. FX risk is influenced by oil and natural gas price fluctuations, which determine cash flow exposure. However, this risk is secondary to commodity risk, which has a more direct impact on revenue and costs. Interest rate risk is a moderate concern for Galp, primarily due to its debt profile. Preference is given to floating-rate (57%), medium- to long-term (86%) debt in form of bonds issuance and loans (Galp 2024b). Therefore, rising interest rates increase borrowing costs, creating negative exposure for the company. Credit and counterparty risk is moderate, stemming from potential defaults in Galp's financial and commercial transactions, particularly related to trade and receivables. While this risk is less volatile, it tends to rise during economic downturns. However, due to its lower relevance to the core business and the difficulty in quantifying this exposure, it will not be included in the exposure analysis.

Assessing Market Exposures of an Integrated Oil and Gas Company

This section examines Galp's sensitivity to market exposures, emphasizing their economic significance and potential adverse impacts. The analysis seeks to strengthen the case for financial risk management, providing valuable insights into the suitability of Galp's current hedging program and identifying areas for improvement.

The analysis focuses on commodity, FX, and interest rate risks, which are pivotal to Galp's operations and manageable through financial instruments. Utilizing 18 quarters of time series data (Q2 2020–Q3 2024; "the period"), the study conducts linear and multivariate regressions to assess Galp's performance sensitivity. The longest reliable time series data available is used, considering that Galp changed its segmental reporting in 2020, which is also reflected in the availability of quarterly BBG data. However, the methodology effectively captures short- to medium-term trends and minimizes noise often linked to high-frequency data Statistical significance is assessed, and confirmed, at the 5% level unless otherwise specified.

Independent Variables - Market Exposures

Variables were carefully chosen to align with Galp's production focus, operational footprint, and euro-based reporting framework. Accordingly, proxies reflect the primary market-based revenue and cost drivers. For the Upstream unit, market prices of produced commodities were selected. Brent crude is chosen as it is Galp's preferred benchmark given alignment in quality and operational context. For natural gas, the significant regional price basis led to the selection of Dutch TTF, reflecting the company's sales concentration in continental Europe (Galp 2023). Both indicators were obtained from Galp's quarterly report supplements (Galp 2020; Galp 2022b; Galp 2024a). For the Industrial & Midstream (I&M) segment, selecting appropriate proxies is more complex due to its diverse operations. After analysing profit drivers - particularly refining margins and Galp's refined product portfolio - oil product spreads over Brent crude are identified as the most suitable indicators of market exposure, complementing the first two variables. As Galp does not directly report this data, refined product spreads are sourced from Repsol's quarterly reporting supplements (Repsol 2020; Repsol 2021a; 2021b; Repsol 2022a; 2022b; Repsol 2023a; 2023b; Repsol 2024a; 2024b). The Commercial segment's reported exposures include crude oil, natural gas, and refined product spreads, as well as electricity prices. Particularly, the latter is also relevant to the Renewables segment. Since Galp's end user sales are strongly concentrated in Iberia (Galp 2023, 59), the Iberian pool price is chosen as the most relevant proxy for electricity exposure, and sourced through Galp´s report supplements (Galp 2020; Galp 2022b; Galp 2024a). Across segments, FX risk is captured using the EUR/USD currency pair, given its dominant role in Galp's revenue and cost streams and is obtained through Galp´s quarterly report supplements (Galp 2020; Galp 2022b; Galp 2024a). Interest rate sensitivity is assessed through short-term Euribor (3-month) and long-term European bond yields (10-year) to account for impacts on operational financing, and long-term project funding (FRED 2024, European Central Bank 2024).

The identified exposures indicate strong correlations (Figure 1). This raises concerns about multicollinearity, which distorts regression results by obscuring individual effects of independent variables. To make an informed decision, variance inflation factors (VIFs) are calculated (Figure 1). VIFs, a common tool for detecting multicollinearity, measure how much a regression coefficient's variance is inflated due to correlations with other predictors.

Correlation Matrix

	Dated Brent	Dutch TTF natural gas	Gasoline vs Brent	Diesel vs Brent	Iberian Electricity	EUR:USD	Long Term Interest Rate	Short Term Interest Rate
Dated Brent	1.00							
Dutch TTF natural gas price	0.69	1.00						
Gasoline vs Brent	0.75	0.36	1.00					
Diesel vs Brent	0.76	0.67	0.74	1.00				
Iberian Electricity	0.69	0.73	0.32	0.39	1.00			
EUR:USD	(0.58)	(0.58)	(0.63)	(0.88)	(0.22)	1.00		
Long Term Interest Rates	0.61	0.25	0.76	0.74	0.02	(0.82)	1.00	
Short Term Interest Rate	0.30	(0.16)	0.51	0.37	(0.30)	(0.54)	0.88	1.00
Variance Inflation Factors	11.93	7.33	5.26	11.84	4.96	14.38	70.14	34.22

Figure 1. Market Variable Correlation Matrix and Variance Inflation Factors

Multicollinearity (VIF >5) of independent variables poses a challenge reducing reliability of estimated predictor coefficients and their statistically significance. However, Multicollinearity does not inherently reduce the overall explanatory power (R-square) of the model. Since excluding correlated variables - critical Ebitda drivers across Galp's business segments - or combining predictors would overlook their individual relevance, a stepwise regression with forward selection is employed. This method iteratively includes predictors based on statistical significance and their contribution to the model, ensuring coefficient integrity is maximized. The final set of independent variables is summarized in Figure 2 below.

Independant (Market) Variables

	Unit	Exposure Type	Source
Brent Crude	($/bbl)	Commodity	Galp
Dutch TTF natural gas	(€/MWh)	Commodity	Galp
Diesel vs Brent spread	($/bbl)	Commodity Spread	Repsol
Gasoline vs Brent spread	($/bbl)	Commodity Spread	Repsol
Iberian Electricity	(€/MWh)	Commodity	Galp
EUR:USD	($/€)	FX	Galp
Euribor (3m)	(%)	Interest Rate	ECB
Europe (10y)	(%)	Interest Rate	FRED

Figure 2. Overview Independent (Market) Variables including Unit and Source

<u>Dependent Variables - Financial Metrics Galp</u>

A comprehensive evaluation of sensitivity to market exposure focuses on operational performance and financial health, excluding shareholder value (e.g., stock returns) as these reflect investor sentiment and long-term outlook rather than direct, manageable impacts.

The primary objective of financial risk management is to stabilize operating cash flow, mitigating risks related to underinvestment, agency costs, and financial distress. Ebitda is the key metric here, as it reflects core operational profitability. Specifically, Galp's reported Replacement Cost Adjusted (RCA) Ebitda is preferred over IFRS Ebitda because it adjusts for fluctuating commodity prices through replacement cost accounting, offering a clearer view of market-driven impacts. The chosen approach to assess sensitivity to market prices is well-suited, since the majority of Ebitda variability could not be linked to operational exposures. Across business segments, key output indicators were regressed on the relevant eight independent variables. Findings for individual operational indicators exhibit none, to comparatively low, sensitivity to market variables at conventional significance levels. Given that Ebitda contributions come from four, diversified segments, the findings suggest that Ebitda variability is primarily driven by market prices rather than output differences (Overview and Findings enclosed in the Appendix: Figure 13 and Figure 14).

While metrics like capex and debt levels are also considered, they serve a supplementary role, helping to understand the links between market conditions, Galp's investment decisions, and financial structure.

Note: The available data pertains to a company actively engaged in risk management. Galp primarily uses non-designated hedges, which reflect real-time market impacts and performance volatility. Designated cash flow hedges, though minimal (e.g., specific electricity positions in 2021–2022 and natural gas in 2023), align gains and losses with the timing of hedged items, potentially buffering observable price fluctuations (Galp 2023, 278; Galp 2022, 303). Consequently, cash flow hedging may lead to (over) underestimation of market sensitivity in the analysis. Corrective adjustments for realized derivative impacts were deemed infeasible due to annual reporting of derivatives, whereas the dataset operates on a quarterly basis.

Financial Metrics Regression: Expectations and Results

This section establishes expectations based on Galp's business model, followed by an analysis of the findings, and notable observations, derived from the stepwise regression approach.

Ebitda Sensitivity

Market sensitivity expectations for Ebitda are closely tied to the contributions of Galp's business units. Supplementary analysis suggests heightened commodity risk exposure, where a concentration in oil sensitivity, is anticipated to result in FX risk. Upstream is the dominant driver of Ebitda, stably contributing an average of 73% over the period (Figure 3, left-hand side). This emphasises Galp's strong dependence on exploration for cash flow generation. Galp's production mix reinforces a notion of exposure concentration, with oil accounting for 89% of upstream production compared to 11% for natural gas (Figure 3, right-hand side).

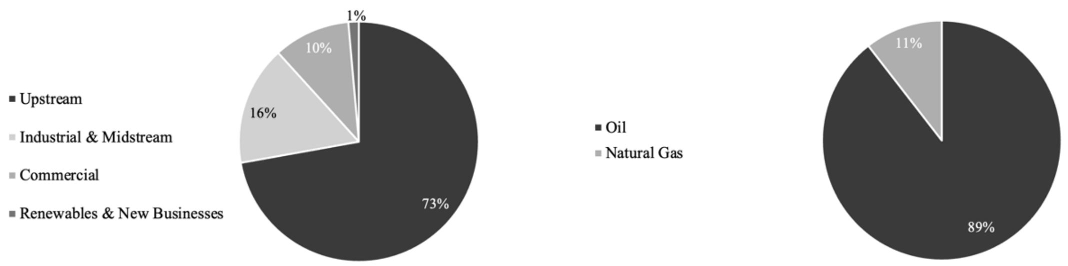

Figure 3. Ebitda Contribution/Segment; Upstream Production Mix, 2020-2024 Period, Bloomberg (2024a)

The I&M and Commercial segments, given lower exhibited contribution to Ebitda, suggest having exposures to which Galp, at company level, is less sensitive (specifically spreads and electricity). While lower segment contribution is one element, these units also rely more on margins for profit generation and are therefore expected to be able to offset cost pressures by (partially) passing them on.

The Natural Gas and Liquefied Natural Gas (LNG) trading unit, part of midstream operations, influences Galp's net natural gas exposure. Understanding its impact requires examining Galp's sourcing strategy; 80–90% of natural gas is secured through long-term contracts (up to 20 years) with fixed pricing indexed to benchmarks like Brent, Henry Hub, or TTF (Galp, 2023, 296 -

297; Franco, 2024). The effect of long-term contracts is similar to that of financial instruments like forwards and futures, therefore, also carrying similar risks, including quantity and basis risks, which can affect Ebitda especially in response to market volatility. Interest rates are not expected to directly influence Ebitda, as it is a metric calculated before interest expenses.

(€m) Ebitda						
Regression Results						
Intercept	0.4	(46.2)	(171.1)	1442.1	369.3	456.1
Dated Brent price (USD/bbl)	8.0	10.3	13.3	12.0	-	-
Dutch TTF natural gas price (EUR/MWh)	(1.2)	-	(2.0)	(2.5)	-	-
Gasoline vs Brent spread (USD/bbl)	11.9	-	-	-	22.7	-
Diesel vs Brent spread (USD/bbl)	-	-	-	-	-	12.9
Iberian baseload pool price (EUR/MWh)	-	-	-	-	-	-
Exchange rate EUR:USD	-	-	-	(1334.1)	-	-
Short Term Interest Rates (3m Euribor)	-	-	-	-	-	-
Long Term Interest Rates (10y Europe)	-	-	-	-	-	-
R Square	0.94	0.78	0.85	0.91	0.82	0.64
Significance F	9.92E-09	1.11E-06	5.90E-07	1.12E-07	2.22E-07	7.47E-05
N (Quarters)	18	18	18	18	18	18

Figure 4. Ebitda Regression Results, best-fit model highlighted in grey

The findings align with expectations, with the best-fit model showing that crude oil, natural gas, and gasoline spreads explain 94% of Ebitda variability (Figure 4). Commodity sensitivity, as expected, is deeply engrained in Galp's business model, with exposure to individual market risks captured through the stepwise approach. Brent crude prices are the primary driver of Ebitda variation, explaining 78% of its variance (Figure 4). This underscores the significant impact of oil price fluctuations, such as the COVID-19 price drop, on Galp's cash flow availability. Including natural gas prices increases explanatory power to 85%, emphasizing the upstream segment's dominance (Figure 4). While oil prices positively influence Ebitda, the unexpected negative relationship with natural gas prices suggests offsetting exposures, as detailed in the Natural Hedging section. Gasoline spreads exhibited unexpectedly high sensitivity, with a simple linear regression yielding the highest single variable R-squared value of 82% (Figure 4). This is notable since the I&M unit contributes less to Ebitda and diesel dominates Galp's refined product portfolio (Galp, 2021, p. 68;Figure 3). Gasoline spreads likely better explain Ebitda variability due to their highly positive correlation with Brent crude during the study period (75%) (Figure 1). Acting as a proxy for other refined products like diesel or jet fuel, gasoline spreads likely have enhanced explanatory power. The high coefficient is attributable to the spread reflecting Galp's refining profitability rather than a commodity price.

Despite its exclusion from the best-fit model, FX exposure sensitivity warrants attention. When analysed with oil and natural gas (R-squared = 91%), it shows that a stronger euro reduces USD-denominated revenues compressing revenue margins as expected (Figure 4). The high EUR/USD exchange rate coefficient (-1334.08) reflects Ebitda response to a one-unit increase, but in practice, exchange rate changes are typically smaller, which should be considered in assessing FX vulnerability. Overall, the findings highlight Galp’s additional market exposure as a euro-reporting company in a dollar-denominated market.

The remaining variables show limited explanatory power or relevance. Interest rates, particularly long-term rates (R-squared = 60%), likely reflect the broader impact of higher commodity prices rather than a direct link to Ebitda (Appendix: Figure 15). In contrast, electricity prices have low relevance to Ebitda (R-squared = 21%, significant at the 90% confidence level; Appendix: Figure 15).

Capex Sensitivity

Galp’s capital-intensive nature is evident in its average allocation of 37% of Ebitda to capex (Appendix: Figure 16). While all segments require significant funding, the emerging Renewables segment highlights the need for stable Ebitda in key segments, given the disparities between cash flow generation and capital requirements. Despite accounting for 24% of capex, the Renewables unit generates only 1% of Ebitda (Figure 3 and Figure 5).

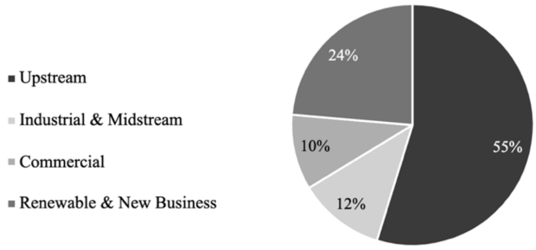

Figure 5. Capex Contribution/Segment, 2020-2024 period, Bloomberg (2024a)

While capex is indirectly linked to market risks through operational cash flow, it is crucial to assess any direct connection to market conditions. If investment is sensitive to market risk, two scenarios could arise: either hedging becomes less critical, as non-obligatory financial needs decline during volatile periods, or it emphasizes the need for hedging if Galp's investment capacity is reduced. However, regression results indicate limited sensitivity to market volatility, with only a weak positive relationship to commodity prices. Natural gas prices are the only statistically significant factor, explaining 22% of capex variability (Figure 6). None of the other key Ebitda exposures show a significant relationship (Figure 6).

(€m) Capex					
Regression Results					
Intercept	211.7	179.7	256.1	236.9	257.9
Dated Brent price (USD/bbl)	-	*1.1	-	-	-
Dutch TTF natural gas price (EUR/MWh)	1.0	-	-	-	-
Gasoline vs Brent spread (USD/bbl)	-	-	*0.6	-	-
Diesel vs Brent spread (USD/bbl)	-	-	-	-	-
Iberian baseload pool price (EUR/MWh)	-	-	-	-	-
Exchange rate EUR:USD	-	-	-	-	-
Short Term Interest Rates (3m Euribor)	-	-	-	-	*678.8
Long Term Interest Rates (10y Europe)	-	-	-	*1646.9	-
R Square	0.223	0.055	0.004	0.050	0.017
Significance F	4.80E-02	3.49E-01	8.11E-01	3.70E-01	6.06E-01
N (Quarters)	18	18	18	18.0	18.0

*Not Signficant at any Conventional Level

Figure 6. Capex Regression Results, best-fit model highlighted in grey

Natural gas prices exhibit a positive relationship with capex, unlike with Ebitda. This disconnect is evident when regressing capex on Ebitda, which does not establish a causal link at conventional significance level (Appendix: Figure 17). This suggests that investment decisions are driven by long-term strategic goals, not short-term market fluctuations. Therefore, findings highlight the importance of hedging to stabilize cash flow, ensuring sufficient capital is available for long-term, capital-intensive projects during market volatility.

Debt Sensitivity

Non-obligatory financial needs, like capex or dividends, can be funded through operating profit or, in the absence of sufficient cash flow, through debt. Rising commodity prices are expected to reduce borrowing by increasing Ebitda (Figure 4). However, findings deviate in the case of natural gas prices, which show a positive relationship with debt. A detailed review of Galp's financial statements revealed that rising natural gas prices led to an increase in working capital, primarily due to margin calls on derivatives. The resulting cash flow strain necessitated an increase in short-term debt (Galp 2021, 92). This linkage is explored further in the section on the existing hedging program. At this stage however, findings underscore Galp's vulnerability to market exposure and highlight its reliance on short-term borrowing during liquidity crunches, which can arise in the absence of effective revenue-stabilising measures.

It should be noted that lower short-term interest rates, remain the primary influence of debt levels, better suited than long-term rates, explaining 78% instead of 41% of debt variability (Figure 7). This is relevant given Galp's floating-rate debt profile and implies reduced servicing costs which make borrowing more attractive. Together with natural gas prices, interest rates explain 90% of debt variability in the period (Figure 7).

(€m) Debt				
Regression Results				
Intercept	3093.9	3683.7	4022.3	2175.4
Dated Brent price (USD/bbl)	-	-	-	-
Dutch TTF natural gas price (EUR/MWh)	10.2	-	-	14.0
Gasoline vs Brent spread (USD/bbl)	-	-	-	-
Diesel vs Brent spread (USD/bbl)	-	-	-	-
Iberian baseload pool price (EUR/MWh)	-	-	-	-
Exchange rate EUR:USD	-	-	-	-
Short Term Interest Rates (3m Euribor)	**(565.4)	**(603.6)	-	-
Long Term Interest Rates (10y Europe)	-	-	**(614.4)	-
R Square	0.90	0.78	0.41	0.23
Significance F	3.10E-08	1.28E-06	4.45E-03	4.17E-02
N (Quarters)	18	18	18	18

**Interest Rates in %

Figure 7. Debt Regression Results, best-fit model highlighted in grey

Aggregated View - Natural Hedging at Galp?

Galp’s integrated business model requires the assessing of natural hedging, as its segments have varying market risk sensitivities. Analysis, requires combining qualitative insights with quantitative analysis, regressing each segment’s Ebitda on market exposures, and comparing sensitivities to Total Ebitda to identify interactive effects.

(€m) Ebitda

Regression Results	*Total*	*Upstream*	*I&M*	*Commercial*	*Renewables*
Intercept	0.4	(30.0)	628.2	68.6	11.0
Dated Brent price (USD/bbl)	8.0	7.5	-	-	-
Dutch TTF natural gas price (EUR/MWh)	(1.2)	-	(1.4)	-	-
Gasoline vs Brent spread (USD/bbl)	11.9	-	11.2	*1.16	-
Diesel vs Brent spread (USD/bbl)	-	-	-	*(0.43)	-
Iberian baseload pool price (EUR/MWh)	-	-	-	*(0.03)	*0.007
Exchange rate EUR:USD	-	-	(556.6)	-	-
Short Term Interest Rates (3m Euribor)	-	-	-	-	-
Long Term Interest Rates (10y Europe)	-	-	-	-	-
R Square	0.94	0.89	0.92	0.17	0.00055
Significance F	9.92E-09	5.61E-09	7.85E-08	4.50E-01	9.26E-01
N (Quarters)	18	18	18	18	18

* Not Significant at any Conventional Level

Figure 8. Ebitda Regression Results, best-fit models highlighted in grey

Galp’s integrated business model yields valuable diversification effects as Total Ebitda is influenced by various market exposures (Figure 8). This is also evident in the inability to establish a common factor model for Galp's business units at statistically significant levels; even ones including single market exposure variables. While such a model would facilitate quantifying offsetting effects through Ebitda-weighted coefficients, the operational differences highlight the potential for natural insurance across Galp's operations. Particularly, the Commercial and Renewables segments demonstrated no statistically significant sensitivity to the market variables considered. Regression models for factors where sensitivity was anticipated but could not be established, are included for reference in Figure 8.

Diversification serves as a natural hedge against market risk, as shocks to one exposure do not uniformly impact all segments, thus protecting operational cash flow from single-variable risks. This is particularly evident in the Renewables and Commercial segments, which generate more stable cash flows despite market volatility. However, the protective effect may be limited, as commodity/ energy product volatility tends to spread, and exposures are related (*Figure* 1).

Natural hedging, in the form of reduced total exposure sensitivity through input-output linkages, appears limited, as Total Ebitda sensitivity exceeds that of individual segments (Figure 8 and Figure 18). However, a more nuanced perspective arises when considering business model specifics. Given that the Commercial and Renewables segments showed no sensitivity, the analysis is focused on interactions between the Upstream and I&M segments.

Net Commodity Exposure

Interaction effects between upstream and downstream operations are anticipated, as the same commodities are first explored and then refined and traded. The best-fit model for Total Ebitda shows positive crude oil exposure and negative natural gas exposure, indicating opposing sensitivities when compared with Upstream's exposure (Figure 8). As expected, Upstream Ebitda is strongly correlated with crude oil prices (R-squared = 89%), reflecting the oil-dominant production. Natural gas shows a weaker, positive correlation (R-squared = 41%), but lacks statistical significance in the best-fit model (Appendix: Figure 18). In the I&M segment, oil is an input cost, but price pass-through reduces sensitivity. A linear regression with Brent crude shows a low positive coefficient (R-squared = 21%, 90% significance), likely due to the 75% correlation between crude and refined oil product spreads, which capture profitability by comparing output value to input costs (Figure 1 and Figure 18). Galp's negative net exposure to natural gas suggests a corresponding negative exposure in the I&M segment. Linear regressions do not reveal significant negative coefficients (Appendix: Figure 18), however, anticipated sensitivity materializes when oil product spreads are included in the model, suggesting conditional effects (interactions) between the key variables of the segment (Figure 8). Extensive operational and financial analysis, indicates that this negative effect stems from mismatches in buying and selling prices, linked to Galp's long-term contracts indexed to benchmarks like Brent, Henry Hub, and Dutch TTF (Franco 2024). Three factors contribute to the negative Ebitda impact of the I&M segment. First, basis risk arises from the widening gap between Dutch TTF and Iberian gas prices, which may reduce profitability since most of Galp's natural gas is sold in Iberia (Appendix: Figure 19; Galp 2022, 64). Second, sourcing mismatches occur during European natural gas shortages, where Galp is forced to purchase higher-priced spot market gas to cover pre-sold commitments which negatively impacts I&M Ebitda (Galp 2022, 62). Third, rising operating costs occur as increasing natural gas prices raise the costs of refining activities, with Galp relying on gas for energy-intensive processes. When internal volume shortfalls happen, Galp is required to purchase additional gas from the spot market at higher prices, elevating operating costs and reducing segment Ebitda (Galp 2022, 56).

Findings indicate that while Galp benefits from natural hedging within its value chain - where positive commodity exposure in the upstream segment partially offsets pressures in the I&M segment - this offsetting was limited during the analysed period due to factors like basis risk and unexpected volatility affecting volume availability.

Note: Segment sensitivity to market variables may not be fully captured by the selected proxies, potentially limiting the accuracy of Galp's net market risk assessment. This is because segments often manage crude oil or natural gas of varying qualities, and using a single benchmark may not fully capture actual Ebitda sensitivity to market risk.

Net FX Exposure

Ebitda sensitivity to FX market risk is primarily influenced by Galp's connections to the crude oil and refined oil product markets. Simple linear regressions show that both the upstream segment, which sells into dollar-denominated markets, and the midstream segment, with dollar-denominated costs and revenues, are negatively affected by EUR/USD fluctuations due to euro-based reporting (Appendix: Figure 18). For the I&M segment, findings indicate that dollar-denominated revenues exceed costs yielding negative segment exposure; without this misalignment, offsets within the segment would lower net sensitivity. However, this discrepancy between inflows and outflows leads to net exposure aggregation across segments, increasing overall FX sensitivity (Figure 8 and *Figure* 4).

The Impact of Market Exposure Volatility

Volatility amplifies risk by increasing the likelihood of (significant) disruptions, even with lower exposure. To address this, annualized volatility indicators for each market variable were calculated using the 2020-2024 data. To align with FX and commodity (Exposure Type), the gasoline and diesel asset return volatility is presented instead of spread volatility. As for interest rates, volatility is calculated based on the annualized standard deviation of quarterly differences in rates, as opposed to using returns (Figure 9).

(%) Market Variable Volatility	
Dated Brent price (USD/bbl)	39.4%
Dutch TTF natural gas price (EUR/MWh)	98.8%
Gasoline (USD/bbl)	44.2%
Diesel (USD/bbl)	40.6%
Iberian baseload pool price (EUR/MWh)	96.6%
Exchange rate EUR:USD	6.0%
Long Term Interest Rates (10y Europe)	0.7%
Short Term Interest Rates (3m Euribor)	0.9%

Figure 9. Annualized Volatility of Market Variables 2020-2024 Period

The findings show that Galp's primary exposures, particularly commodity risk, are also the most volatile during the analysed period (Figure 9). This higher likelihood and potential severity of impact highlight the need for Galp to prioritize mitigating exposure sensitivity through hedging to minimize its effect on Ebitda. The economic rationale for prioritizing hedging of these market variables is clear when compared to exposures less central to Galp's operations, such as FX and interest rate risk, which exhibit significantly lower volatility (Figure 9).

Note: Volatility not only emphasizes the need for hedging but also raises protection costs, as higher volatility increases the price of financial derivatives due to greater price swings. This creates a trade-off for companies like Galp, which must balance the cost of derivatives with the potential economic impact of volatility.

The Case for Hedging at Galp: Key Takeaways

Ebitda variation at Galp is primarily driven by market sensitivity in the Upstream and I&M segments, particularly influenced by commodity price volatility, such as oil and gasoline spreads. The upstream segment's reliance on dollar-denominated revenue, along with negative FX exposure in I&M, leaves Galp vulnerable to euro appreciation. High volatility in key market exposures increases the risk of cash flow disruptions. While natural hedging offers some reduction in net exposure, no significant offsets for individual market variables were found during the period analysed. However, Galp benefits from its integrated business model, which provides natural protection through diversification.

Given its capital-intensive nature, stabilizing Ebitda as a main cash flow contributor can prove essential for meeting substantial capex requirements, especially in the Renewables unit, which receives a significant portion of funding for long-term strategic priorities. This, along with other discretionary financial needs such as dividends or share buybacks, underscores the need for stable Ebitda generation. To address these challenges, minimizing Ebitda sensitivity to market variables through effective risk management, is critical. Stabilizing cash flows in key segments, especially those exposed to volatility, will help Galp fund strategic investments, remain competitive, and avoid liquidity issues, reducing reliance on costly external debt.

Financial Risk Management at Galp

This chapter critically evaluates Galp's financial risk management programme. Insights are obtained through the consolidation of annual reports, the calculation of a proxy hedge ratio, and an evaluation of the hedging impact on Galp's financial performance and liquidity.

Galp employs a multifaceted strategy to mitigate market sensitivity, aiming to protect cash flows and shareholder value (Galp 2023, 286). The Strategic Hedging Programme is aligned with Galp's Risk Appetite Statement, which defines the categories and extent of risk the company is prepared to accept to achieve its strategic objectives. Both are reviewed annually. While official documentation is unavailable, employee interviews suggest a conservative, risk-averse approach to financial risk management (Clemente Silva 2024; Franco 2024).

Employed Hedging Instruments

Galp employs an integrated approach, hedging net exposure at company level, to account for the sensitivity offsets which occur due to involvement Upstream and Downstream Operations. Derivative positions at year-end highlight a strong focus on commodity hedging, as evidenced by Total Notionals (Galp 2022, 304; Galp 2023, 279). While notional values are not disclosed by energy resource, fair value breakdowns confirm hedging activities address oil, gas, and electricity exposures. Refining margins are reported excluding hedging impacts, implying potential use of refined product or spread derivatives, though specific details are not disclosed. Alternatively, refining margin sensitivity may be mitigated by hedging highly correlated market variables (see Figure 1). FX and interest rate sensitivities are also managed, though with lower notional values, reflecting comparatively minor Ebitda exposure and volatility.

Hedging at Galp is focused on short-term contracts, with most positions maturing in under a year, followed by those with one- to two-year maturities (Galp 2022, 304; Galp 2023, 279). The company primarily uses linear derivatives, particularly futures and swaps, with minimal reliance on non-linear derivatives. No positions in forwards or exchange-traded funds (ETFs) are disclosed. This approach benefits from the liquidity and daily mark-to-market advantages of futures and the tailored hedging benefits of swaps. In contrast, the characteristics of forwards and commodity-linked ETFs make them less relevant, due to non-standardization, counterparty risks, lower liquidity, and poor alignment with Galp's concentrated exposure. The limited use of options reflects the absence of significant quantity risk. Key output indicators show minimal sensitivity to market variables, particularly in the Ebitda-dominant upstream segment, which remains largely unresponsive (Appendix: Figure 14). Galp holds both long and short positions across all instruments, except for those managing interest rate exposure. In this case, the company focuses on fixed-rate receiver swaps to mitigate interest rate risk by converting floating-rate debt into fixed-rate debt (Galp, 2023, 279).

Hedge Ratio Proxy

In assessing how Galp’s hedging programme aligns with expectations, the firm’s hedge ratio is compared to the established industry benchmark (33% of next-year production). However, Galp’s use of both linear and non-linear derivatives complicates the calculation of the hedged exposure ratio. The option delta, which measures sensitivity to price changes, cannot be determined from public data due to the lack of details such as moneyness, strike price, and maturity. As a result, a proxy approach was employed to estimate Galp’s hedged exposure.

$$Hedge\ Ratio\ Proxy = \frac{Notional\ of\ Short\ Linear\ Commodity\ Derivatives(maturity < 1\ year; (t-1))}{Upstream\ Revenue\ (t)}$$

Equation 1. Hedge Ratio Proxy

The combined notional of futures and swap sales with expirations under one year is used as a proxy for hedged exposure. Since linear derivatives have payoffs directly proportional to changes in the underlying commodity price (delta equal to one), their notional values provide a reliable estimate of hedged positions. The focus is on the notional of instruments sold, as these correspond to obligations to sell at a predetermined price, relevant to production exposure. By considering only derivatives expiring within a year of period t-1 and comparing this to revenue in period t, alignment with the timeframe for recognizing revenue is achieved. Upstream commodity revenue clearly reflects production value. Derivative notionals have been disclosed since 2021, and with the 2024 Annual Report due for release, two ratios for the reference period can be obtained.

Galp's production proxy hedge ratio of 35.15% (32.61% in 2022; 37.69% in 2023) closely aligns with industry standards and suggests one third of production exposure being hedged. The proxy serves as a robust metric, offering a valuable quantification of Galp's hedging of production during the period analysed. Acknowledging that it excludes non-linear products, and the nuances of hedge accounting, these represent the minor share of overall positions.

Cashflow Impact Analysis

While the analysis confirms that Galp's hedging program broadly aligns with the industry, and its exposure profile, there remains room for improvement. The importance of effective financial risk management - and potential shortfalls in Galp's current strategy - becomes evident when examining its cash flow challenges during two energy crises in the study period.

In 2020, the global collapse in oil demand, precipitated by the Covid-19 pandemic, caused unprecedented revenue disruptions. Galp’s Upstream and I&M segments experienced substantial declines in contributions, highlighting reliance on oil price stability. As a result, Galp reported low, to negative quarterly Free Cash Flow, while its Net Debt to Ebitda ratio doubled from 0.7x to 1.5x and dividends were cut in half compared to 2019 (Galp, 2020, 44). Similarly, Russia's invasion of Ukraine in 2022 triggered a surge in natural gas prices, which particularly challenged the I&M segment, as previously demonstrated. Galp's hedging activities resulted in margin calls on derivatives used to hedge trading risks, leading to a EUR 605m working capital outflow and strained cash flow ahead of the war (Galp 2021, 92). This cash draw caused Galp to report negative Free Cash Flow for two consecutive quarters in Q3 and Q4 2021, necessitating increased borrowing to meet liquidity needs (Galp 2022b).

For Galp, stabilizing cash flow is essential for supporting its strategic priorities, including capital expenditures and dividends. Annual capex is guided to remain below EUR 1,000m, while dividends (totalling EUR 591m in 2023, excluding buybacks) are projected to grow by 4% annually (Galp, 2024c; Galp 2024d). Accordingly, combined **discretionary cash flow needs** amount to approximately **EUR 1,500m**, assuming divestments to be EUR 100m per year.

Ensuring these discretionary cash flow needs can be covered with internally generated funds, represents a key objective of effective financial risk management. The inability to do so, hereafter, is described as a cash flow problem understood to result in underinvestment in strategic projects, creating uncertainty for shareholders, undermining confidence and long-term value creation. From a risk management perspective, it is critical for Galp to anticipate adverse market scenarios, evaluating the likelihood of resulting cash flow challenges.

The next section quantifies Galp's 5% worst-state expected cash flows, comparing them to cash flow needs, and identifying the variables, most suitable for hedging. Throughout, the impact of correlations, volatilities, and market dynamics on bottom-line operational cash flow beyond Ebitda, is considered. The analysis specifically targets cash flow challenges that could affect Galp’s strategic needs over a short-term horizon (1-2 years), as opposed to quarterly fluctuations.

Section 2: Prescriptive Analysis

Independent analysis, not presented as part of this project, developed a proprietary Cash Flow at Risk (CFaR) model to assess Galp's financial resilience in response to adverse developments in the identified critical market variables (Stilkenböhmer, 2024). The metric Post Obligation Operating Cash Flow (POOCF), representing the cash flow which Galp can utilize to meet its discretionary spending needs, was modelled by incorporating historical cash flow data, market variable relationships, and statistical simulations. The following analysis builds on these insights, most notably, that discretionary cash flow needs (assumed to total at least EUR 3,000m over two years, with EUR 1,800m for net capex and EUR 1,200m for dividends (refer to Section 1: Cashflow Impact Analysis)) fall short by **EUR 376m at the 5th percentile** over the considered Two Years period (upcoming eight quarters). Since the former is the operational cash flow contribution Galp is missing with a 5% probability at the end of the Two Years period, is the targeted metric to hedge.

Hedging Strategy

To reduce Galp's quantified Two Years Cash Flow at Risk and lower the missing operational cash flow contributions in the 5% most unfavourable market paths according to the CFaR model, a risk mitigating and value-adding Hedging Strategy is presented. The following measure is to be implemented at the company level, in addition to the financial risk management measures currently in place. Accordingly, the aim of the proposed strategy is to reduce the forward-looking dispersion of the Post Obligation Operating Cash Flow.

As quantified and exhibited, Galp has significant exposure to oil and refining spreads. Both exposures are positively correlated (no natural hedge) and have been quantified as impacting Galp's cash flow items with highest significance. The created macro view (managerial perspective) of the company is leveraged and thus, instead of hedging exposures independently as is often the case, the hereafter proposed risk management strategy is focused on the single market exposure (commodity) that incorporates both exposures, namely Gasoline (Brent + Gasoline vs Brent Spread).

A non-linear hedging approach has been strategically selected to balance risk management with the opportunity for profit maximization. To protect against the downside risk of selling oil and oil products at unfavourable (low) market prices, put options provide the ability to set the exact level at which compensation is useful and needed to prevent a Cash Flow Challenge, ensuring critical cash flow protection during adverse market environments. Flexibility in setting hedge levels (strike prices) is a major advantage compared to Futures - but it comes with a premium cost. To enhance cost efficiency, a collar hedging strategy - combining long put options with short call options – is implemented for Year One and Year Two. This strategy not only mitigates downside risks but also minimizes hedging costs, ensuring the company avoids additional cash flow strain while retaining a degree of exposure to potential price upside.

In line with the literature and Hedge Ratio findings, the Option Notional is linked to 30% of the output in the Upstream segment (112.5 kboepd, close to the average).

Options contracts are incorporated in the CFaR model and are initiated at the end of Q3 2024, with both collars designed to be self-financing. To hedge downside risk, a gasoline put option with a strike price of USD 75.0/bbl is utilized, which is close to the scenario analysis assumption of a one-standard-deviation decline in the combined Brent and Gasoline spread variables from Q3 2024 levels. Using the Black-Scholes option pricing model and assuming an implied gasoline volatility of 44% (Figure 9), call strike prices are determined such that the call premium offsets the cost of the put option (Black and Scholes 1973). This results in a call strike price of USD 135.8/bbl for Year One and USD 149.5/bbl for Year Two.

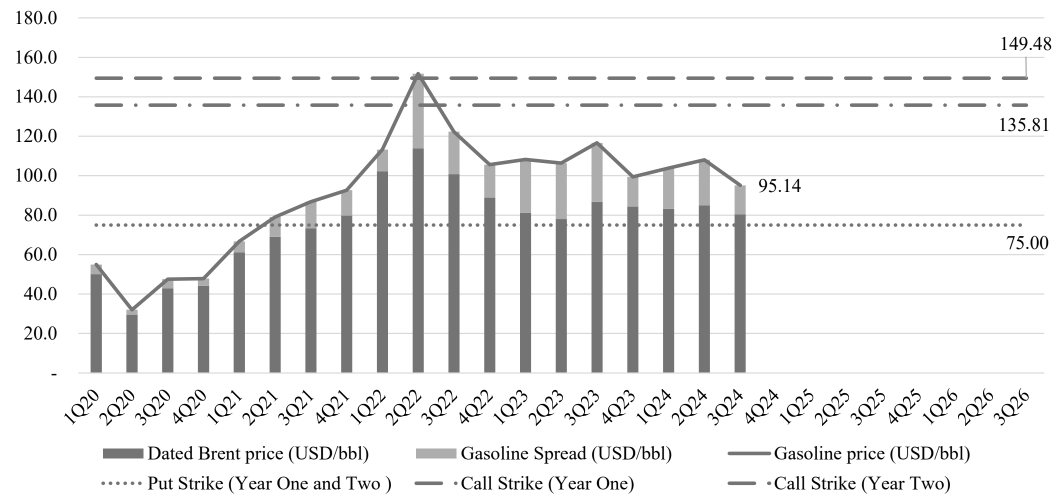

Figure 10. Gasoline Price and Collar Strike Prices (USD/bbl) used in Hedging Strategy

In Figure 10*,* the historical gasoline price and components (Brent + Spread) are illustrated, alongside the proposed collar strike prices. The proposed structure hedges part of Galp's production over two years. The Year One options mature at the end of four quarters, while the Year Two options mature at the end of eight quarters. This setup provides essential risk protection while allowing for the possibility of minor maturity mismatches, as price fluctuations may occur between option expiries.

€m	Post obligation operating cash flow			Post obligation operating cash flow (hedged)		
	Year One	*Year Two*	*Two Years*	*Year One*	*Year Two*	*Two Years*
Standard Deviation	351	731	930	346	619	712
Mean	1,962	2,054	4,016	1,966	2,060	4,026
Percentiles						
0.01	1,290	720	2,212	1,088	974	2,667
0.05	1,431	1,016	2,624	1,453	1,230	2,999
0.5	1,940	1,975	3,945	1,955	1,979	3,958
0.95	2,572	3,366	5,652	2,535	3,180	5,286
0.99	2,853	4,134	6,448	2,788	3,847	5,798
Skew	0.38	0.74	0.45	(0.30)	0.68	0.28
Kurtosis	(0.07)	1.13	0.22	2.74	1.60	0.50

Figure 11. Summary Statistic - Simulated POOCF (before and after hedging) N=100,000

The Collar Option Hedging Strategy is dynamically incorporated into the CFaR model and simulation of market variables determine the payoff at maturity. As demonstrated in the simulation results (Figure 11), the hedged Two Years Post Obligation Operating Cash Flow at the 5th percentile improves significantly to EUR 2,999 m, compared to EUR 2,624 m in the unhedged scenario. While the Hedging Strategy is shown to reduce downside exposure, it also limits upside potential by the same magnitude. Nevertheless, the strategy effectively mitigates Galp's tail risks and reduces cash flow dispersion, with particularly notable benefits in the second year. The simulation process, conducted with 100,000 iterations, extracted the Post Obligation Operating Cash Flows after implementing the gasoline collar hedging strategy. The resulting distribution is illustrated below (Figure 12).

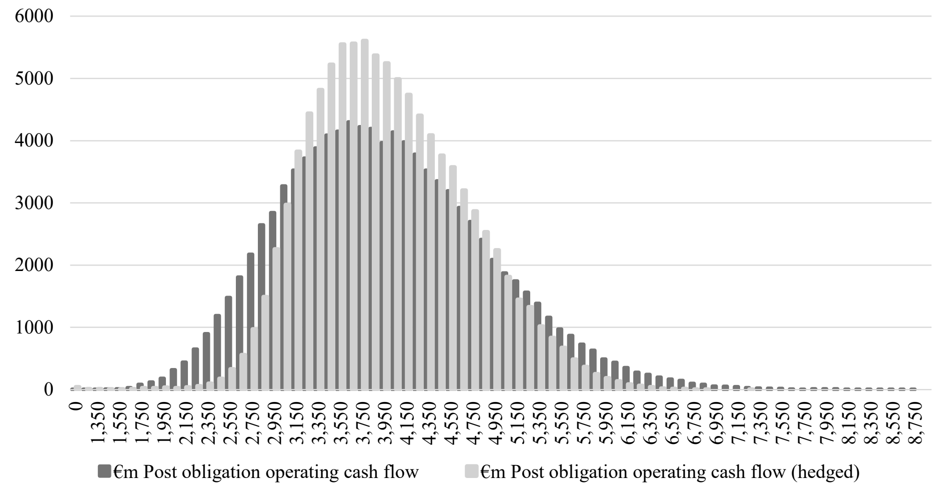

Figure 12. *Two Year POOCF distribution, Before and after hedging (N=100,000)*

The collar strategy results in a significantly less skewed cash flow distribution and exhibits higher kurtosis. The quantitative analysis demonstrates that the Hedging Strategy effectively mitigates forward-looking uncertainty related to cash flow generation and liquidity over the Two Years horizon. With this strategy in place, Galp achieves over 95% confidence in meeting its cash flow requirements, compared to 85% in the unhedged scenario, at no additional cost. The **Two-Year Cash Flow at Risk (hedged) at the 5th percentile** improves to **EUR 1m**, indicating a substantial reduction in downside risk and probability of a cash flow problem.

Conclusion

This thesis presents a thorough analysis of Galp's market exposures, offering a detailed quantification of the key risks influencing its cash flow volatility. It demonstrates the critical role of hedging in mitigating these risks, with a focus on maximizing financial resilience. Gasoline has been identified as an effective hedging instrument at the company level, due to its strong positive price correlation with both Brent crude and refined oil product spreads. This makes gasoline an optimal proxy for addressing Galp's exposure to market fluctuations, enabling a targeted reduction in cash flow volatility and supporting the company's overall financial stability.

The developed methodology - integrating Exposure Assessment, Cash Flow at Risk (CFaR) Modelling, and a Gasoline-Based Hedging Strategy - provides a comprehensive and adaptable framework for Galp's risk management. By quantifying hedge levels and ratios while improving transparency around market exposures, this approach delivers significant value for both managerial decision-making and investor confidence. For management, the proposed strategy ensures the safeguarding of dividend-paying capacity, minimizes the likelihood of underinvestment, and mitigates risks of credit rating downgrades or excessive debt burdens. For investors, it reinforces confidence in Galp's capacity to deliver consistent, stable growing, and predictable dividends that are justified by Galp's cash flow performance, positioning the company for sustainable growth in a volatile energy market.

The model effectively captures historical price dynamics while incorporating forward-looking scenarios, offering Galp a valuable tool to manage future uncertainties. Crucially, the proposed strategy ensures that Galp can mitigate risks without tapping into its cash reserves or resorting to additional debt - an increasingly important consideration given Galp's recognition of liquidity risk as a top priority. The developed framework enhances Galp's capacity to navigate these challenges, supporting data-driven, informed financial risk management for key exposures and ensuring greater stability in its operations and financial performance.

Findings of this thesis provide valuable insights for Galp's risk management strategy. Future studies could explore various aspects to build upon the existing framework. For instance, testing different market variable correlations and volatility assumptions, along with their impacts on cash flows and hedged cash flows, can provide deeper insights. Exploring alternative distributions for commodities, exchange rates, and interest rates, particularly those emphasizing heavier tails, could also refine the risk assessment.

Likewise, specific transitory supply and demand shocks related to Geopolitical Events, Unexpected Recessions or even Pandemics could be tested. Finally, several hedging intensities and instruments (although the theoretical implications are well known) could be compared. In all cases, the financial risk management approach would stay the same.

Bibliography

Adam, Tim R., and Chitru S. Fernando. 2006. "Hedging, Speculation, and Shareholder Value." *Journal of Financial Economics* 81 (2): 283–309.

Adam, Tim. 2005. "Capital Expenditures, Financial Constraints, and the Use of Options." *Journal of Financial Economics* 92(2): 238–251.

Adam, Tim, Sudipto Dasgupta, and Sheridan Titman. 2007. "Financial Constraints, Competition, and Hedging in Industry Equilibrium." *The Journal of Finance* 62 (5): 2445-2473.

Ahn, Dong-Hyun, Jacob Boudoukh, Matthew Richardson, and Robert F. Whitelaw. 2003. "Optimal Risk Management Using Options." *The Journal of Finance* 54 (1): 359–375.

Allayannis, George, and James Weston. 2001. "The Use of Foreign Currency Derivatives and Firm Market Value." *Review of Financial Studies* 14: 243–276.

Allayannis, George, Jane Ihrig, and James P. Weston. 2001. "Exchange-Rate Hedging: Financial vs. Operational Strategies." *American Economic Review* 91 (2): 391–395.

Basher, Syed Abul, Alfred A. Haug, and Perry Sadorsky. 2018. "The Impact of Oil-Market Shocks on Stock Returns in Major Oil-Exporting Countries." *Journal of International Money and Finance* 86: 264–280.

Bessembinder, Hendrik. 1991. "Forward Contracts and Firm Value: Investment Incentive and Contracting Effects." *The Journal of Financial and Quantitative Analysis* 26 (4): 519–532.

Black, Fischer, and Myron Scholes. 1973. "The Pricing of Options and Corporate Liabilities." Journal of Political Economy 81 (3): 637-654.

Bloomberg. 2024a. Financial Model for Galp Corporation, *Bloomberg Terminal*, accessed October 1, 2024.

Bloomberg. 2024b. WTI: Crude Oil 3m Implied Volatility, *Bloomberg Terminal*, accessed October 25, 2024.

Bloomberg. 2024c. Henry Hub: Natural Gas 3m implied volatility, *Bloomberg Terminal*, accessed October 25, 2024.

Brown, Gregory. 2001. "Managing Foreign Exchange Risk with Derivatives." *Journal of Financial Economics* 60: 401–448.

Chen, Jun, and Tao-Hsien Dolly King. 2014. "Corporate Hedging and the Cost of Debt." *Journal of Corporate Finance* 29: 221–245.

Culp, Christopher, and Merton Miller. 1995. "Hedging in the Theory of Corporate Finance: A Reply to Our Critics." *Journal of Applied Corporate Finance*.

Dolde, Walter. 1993. "The Trajectory of Corporate Financial Risk Management." *Journal of Applied Corporate Finance* 6: 33–41.

Duffie, Darrell. 1995. "Corporate Incentives for Hedging and Hedge Accounting." *Review of Financial Studies* 743–771.

European Central Bank. 2024. *Euribor 3-Month: Historical Close, Average of Observations Through Period, Euro Area (Changing Composition), Monthly*. ECB Data Portal. Accessed October 10, 2024. https://data.ecb.europa.eu/data/datasets/FM/FM.M.U2.EUR.RT.MM.EURIBOR3MD_.HSTA.

Fama, Eugene. 1970. "Efficient Capital Markets: A Review of Theory and Empirical Work." *Journal of Finance* 25 (2): 383–417.

Fisher, Bryan, and Ankush Kumar. 2010. "The Right Way to Hedge." *McKinsey on Finance* 36.

Federal Reserve Bank of St. Louis. 2024. *Interest Rates: Long-Term Government Bond Yields: 10-Year: Main (Including Benchmark) for Euro Area (19 Countries)*. Federal Reserve Economic Data (FRED). Accessed October 10, 2024. https://fred.stlouisfed.org.

Franco, Diogo Melo. 2024. Interview by Luisa Kloth and David Stilkenböhmer. LNG Trader, Galp, October 29, 2024.

Froot, Kenneth A., David S. Scharfstein, and Jeremy C. Stein. 1993. "Risk Management: Coordinating Corporate Investment and Financing Policies." *The Journal of Finance* 48: 1629–1658.

Galp. 2020. *Reports and Accounts, Q4 2020: Additional Information*. Excel file. Accessed October 10, 2024. https://www.galp.com/corp/en/investors/reports-and-presentations/reports-and-results.

Galp. 2021. *Annual Integrated Report 2021*. Lisbon: Galp. Accessed September 11, 2024. https://www.galp.com/corp/Portals/0/Recursos/Investidores/SharedResources/Relatorios/en/2021/AIRGalp2021EN2book1IMRFull.pdf.

Galp. 2022a. *Annual Integrated Report 2022*. Lisbon: Galp. Accessed September 11, 2024. https://www.galp.com/corp/Portals/0/Recursos/Investidores/2023_IR/1Q_RESULTS_2023/GALP_RC22_EN_ESEF.pdf.

Galp. 2022b. *Reports and Accounts, Q4 2022: Additional Information*. Excel file. Accessed October 10, 2024. https://www.galp.com/corp/en/investors/reports-and-presentations/reports-and-results.

Galp. 2023. *Annual Integrated Report 2023*. Lisbon: Galp. Accessed September 11, 2024. https://www.galp.com/corp/en/investors/publications-and-announcements/investor-announcements/investor-announcement/id/1526/annual-integrated-report-2023.

Galp. 2024a. *Reports and Accounts, Q3 2024: Additional Information*. Excel file. Accessed October 10, 2024. https://www.galp.com/corp/en/investors/reports-and-presentations/reports-and-results.

Galp. 2024b. "Debt Indicators and Debt Structure." Galp. Accessed November 1, 2024. https://www.galp.com/corp/en/investors/information-to-bondholders/debt-indicators.

Galp. 2024c. "Dividends." Galp. Accessed November 1, 2024. https://www.galp.com/corp/en/investors/information-to-shareholders/dividends#:~:text=The%20base%20dividend%20related%20to,after%20approval%20at%20the%20AGM.

Galp. 2024d. " Dividends and share repurchases." Galp. Accessed November 2, 2024. https://www.galp.com/corp/en/investors/information-to-shareholders/dividends-and-share-repurchases.

Galp. 2024. "3Q 2024 Results." Galp. Accessed November 12, 2024. https://www.galp.com/corp/Portals/0/Recursos/Inv_3Q24/Galp_3Q24_Presentation.pdf.

Gay, Gerald, Jouahn Nam, and Marian Turac. 2002. "How Firms Manage Risk: The Optimal Mix of Linear and Non-Linear Derivatives." *Journal of Applied Corporate Finance* 14 (4): 82–93.

Geczy, Christopher, Bernadette Minton, and Catherine M. Schrand. 1997. "Why Firms Use Currency Derivatives." *Journal of Finance* 52: 1323–1351.

Gerken, Arno, Olivier Plantefève, and Xavier Veillard. 2019. "Managing Industrials' Commodity-Price Risk." *McKinsey&Company*.

Guay, Wayne, and S. P. Kothari. 2003. "How Much Do Firms Hedge with Derivatives?" *Journal of Financial Economics* 423–461.

Hamilton, James D. 2009. "Causes and Consequences of the Oil Shock of 2007–08." *Brookings Papers on Economic Activity*.

Haushalter, David. 2005. "Why Hedge? Some Evidence from Oil and Gas Producers." *Journal of Applied Corporate Finance* 87–92.

Haushalter, G. David. 2000. "Financing Policy, Basis Risk, and Corporate Hedging: Evidence from Oil and Gas Producers." *Journal of Finance* 55 (1): 107–152.

Hennessy, Christopher A., Amnon Levy, and Toni M. Whited. 2007. "Testing Q Theory with Financing Frictions." *Journal of Financial Economics* 83 (3): 691–717.

Hull, John C. 2015. *Options, Futures, and Other Derivatives*. 9th ed. Pearson.

Jin, Yanbo, and Philippe Jorion. 2006. "Firm Value and Hedging: Evidence from US Oil and Gas Producers." *The Journal of Finance* 61 (2).

Kolb, Robert, and James Overdahl. 2003. *Financial Derivatives*. New Jersey: John Wiley & Sons, Inc.

Leland, Hayne E. 1998. "Agency Costs, Risk Management and Capital Structure." *Journal of Finance* 53: 1213–1243.

Li, Hao, Nuttawat Visaltanachoti, and Robin H. Luo. 2014. "Foreign Currency Derivatives and Firm Value: Evidence from New Zealand." *Journal of Financial Risk Management* 3.

McKinsey. 2013. "Strategic Commodity and Cash-Flow At-Risk Modeling for Corporates." *McKinsey*.

Patrick, M. U. M. U. 2016. "A Comparison of Prices Generated by the Derivative Commodity Model (Ornstein-Uhlenbeck Process) with Those Obtained by the Conventional Arbitrage-Free Method of Pricing Forward Derivatives with Respect to Tea in Nduti Tea Factory Kenya." *Journal of Statistics and Actuarial Research* 1 (1): 12–23.

Press, William H., Saul A. Teukolsky, William T. Vetterling, and Brian P. Flannery. 2007. *Numerical Recipes: The Art of Scientific Computing.* 3rd ed. Cambridge: Cambridge University Press.

Rampini, Adriano, and S. Viswanathan. 2010. "Collateral, Risk Management, and the Distribution of Debt Capacity." *The Journal of Finance* 65 (6): 2293–2322.

Repsol. 2020. "Financial and Operating Data Tables, Q3 2020." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Repsol. 2021a. "Financial and Operating Data Tables, Q1 2021." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Repsol. 2021b. "Financial and Operating Data Tables, Q3 2021." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Repsol. 2022a. "Financial and Operating Data Tables, Q1 2022." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Repsol. 2022b. "Financial and Operating Data Tables, Q3 2022." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Repsol. 2023a. "Financial and Operating Data Tables, Q1 2023." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Repsol. 2023b. "Financial and Operating Data Tables, Q3 2023." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Repsol. 2024a. "Financial and Operating Data Tables, Q1 2024." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Repsol. 2024b. "Financial and Operating Data Tables, Q3 2024." Excel file. Accessed November 12, 2024. https://www.repsol.com/en/shareholders-and-investors/financial-information/quarterly-results/archive/index.cshtml.

Rickman, J., M. Falkenberg, S. Kothari, F. Larosa, M. Grubb, and N. Ameli. 2024. "The Challenge of Phasing-Out Fossil Fuel Finance in the Banking Sector." *Nature Communications* 15.

Ross, Michael P. 1997. "Corporate Hedging: What, Why, and How?" *Working Paper*, Berkeley: University of California.

Schulte, Josh, Jeff Nicholson, and Reece Lambert. 2022. "Perspectives: Oil and Gas Companies Continue to Hedge." *Hart Energy*, July 15. Accessed October 30, 2024. https://www.hartenergy.com/exclusives/perspectives-oil-and-gas-companies-continue-hedge-201172.

Silva Clemente, Ana Sofia. 2024. Interview by Luisa Kloth and David Stilkenböhmer. Head of Corporate Enterprise Risk Management and Business Continuity, Galp, October 25, 2024.

Spanò, Marcello. 2004. "Determinants of Hedging and Its Effects on Investment and Debt." *Journal of Corporate Finance* 10 (1): 175–197.

Stilkenböhmer, David J. W. 2024 "Financial Risk Management at Galp: Modeling Cashflow at Risk." *Work Project, presented as part of the requirements for the Award of a Master's degree in Finance from the Nova School of Business and Economics*.

Stulz, René M. 1996. "Rethinking Risk Management." *Journal of Applied Corporate Finance* 9 (3): 8-25.

Stulz, René. 1984. "Optimal Hedging Policies." *Journal of Financial and Quantitative Analysis* 19: 127–140.

Stulz, René, and Clifford Smith. 1985. "The Determinants of a Firm's Hedging Policies." *Journal of Financial and Quantitative Analysis* 391–405.

The Wharton School. 1994. "Survey of Derivative Usage Among U.S. Non-Financial Firms."

Tufano, Peter. 1996. "Who Manages Risk? An Empirical Examination of Risk Management Practices in the Gold Mining Industry." *Journal of Finance* 51 (4): 1097–1137.

Uhlenbeck, G. E., and L. S. Ornstein. 1930. "On the Theory of the Brownian Motion." Physical Review 36 (5): 823–841.

Vasicek, O. 1977. "An Equilibrium Characterization of the Term Structure." *Journal of Financial Economics* 5 (2): 177–188.

Appendix

Key Output Indicators

	Indicator	*Unit*	*Source*
Upstream	Working Interest Production	(kboepd)	Galp
	Oil Production	(kbpd)	Galp
Industrial & Midstream	Raw Materials Processed	(mboe)	Galp
	NG/LNG Trading Volume	(TWh)	Galp
Commercial	Oil Product Sales	(mton)	Galp
	Natural Gas Sales	(TWh)	Galp
	Electricity Sales	(TWh)	Galp
Renewables & New Business	Power Generation	(GWh)	Galp

Figure 13. Key Output Indicators

Key Output Indicators

*Regression Results**	*WI Production*	*Oil Production*	*Raw Materials Processed*	*NG/LNG Trading Volume*	*Oil Product Sales*	*Natural Gas Sales*	*Electricity Sales*	*Power Generation*
Intercept	139.3	118.7	17.3	15.2	1.1	534.8	(121.7)	402.5
Dated Brent price (USD/bbl)	**(0.3)	(0.1)	0.04	-	**0.007	-	-	-
Dutch TTF natural gas price (EUR/MWh)	**0.1	-	(0.01)	(0.02)	-	**29.1	-	-
Gasoline vs Brent spread (USD/bbl)	-	-	0.09	-	-	-	-	-
Diesel vs Brent spread (USD/bbl)	-	-	(0.04)	-	-	-	-	-
Iberian baseload pool price (EUR/MWh)	-	-	-	-	-	-	**6.1	0.4
Exchange rate EUR:USD	-	-	-	-	-	-	-	-
Short Term Interest Rates (3m Euribor)	-	-	-	-	-	-	-	-
Long Term Interest Rates (10y Europe)	-	-	-	-	-	-	-	-
R-Square	0.33	0.11	0.12	0.05	**0.63	**0.32	**0.49	0.01
F-Test	5.07E-02	1.85E-01	7.74E-01	3.80E-01	7.27E-05	1.35E-02	1.12E-03	7.19E-01
N (Quarters)	18	18	18	18	18	18	18	18

* Model and Coefficient Not Significant at any Conventional Level

** Significant at 95% Confidence Interval

Figure 14. Key Output Indicator Regression Results

(€m) Ebitda

Regression Results			
Intercept	568.4	664.5	498.8
Dated Brent price (USD/bbl)	-	-	-
Dutch TTF natural gas price (EUR/MWh)	-	-	-
Gasoline vs Brent spread (USD/bbl)	-	-	-
Diesel vs Brent spread (USD/bbl)	-	-	-
Iberian baseload pool price (EUR/MWh)	*1.8	-	-
Exchange rate EUR:USD	-	-	-
Short Term Interest Rates (3m Euribor)	-	**64.5	-
Long Term Interest Rates (10y Europe)	-	-	**137.6
R Square	0.21	0.26	0.60
Significance F	5.60E-02	2.94E-02	1.51E-04
N (Quarters)	18	18	18

* Significant only at 90% Confidence Level

**Interest Rates in %

Figure 15. Supplementary Ebitda SLR Results

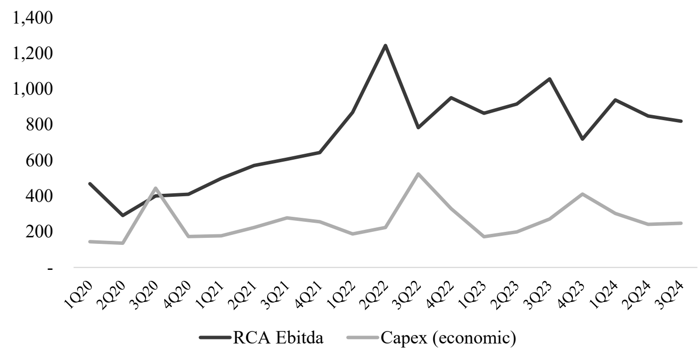

Figure 16. Galp Capex and Ebitda in EURm (2020-2024 period) (Bloomberg 2024a).

(€m) Capex	
*Regression Results**	
Intercept	246.8
RCA Ebitda	0.027
R Square	0.004
Significance F	8.00E-01
N (Quarters)	18

* Not Significant at any Conventional Level

Figure 17. Supplementary Capex SLR Results

(€m) Ebitda							
Regression Results	*Upstream*	*Upstream*	*Upstream*	*I&M*	*I&M*	*I&M*	*I&M*
Intercept	422.9	(34.4)	2217.4	(87.8)	1321.6	127.9	-32.0
Dated Brent price (USD/bbl)	-	7.6	-	**2.7	-	-	-
Dutch TTF natural gas price (EUR/MWh)	2.3	*(0.07)	-	-	-	*(0.1)	(1.10)
Gasoline vs Brent spread (USD/bbl)	-	-	-	-	-	-	12.8
Diesel vs Brent spread (USD/bbl)	-	-	-	-	-	-	-
Iberian baseload pool price (EUR/MWh)	-	-	-	-	-	-	-
Exchange rate EUR:USD	-	-	(1504.2)	-	(1081.5)	-	-
Short Term Interest Rates (3m Euribor)	-	-	-	-	-	-	-
Long Term Interest Rates (10y Europe)	-	-	-	-	-	-	-
R Square	0.41	0.89	0.28	0.21	0.26	0.003	0.89
Significance F	4.02E-03	7.95E-08	2.47E-02	5.50E-02	2.98E-02	8.30E-01	8.76968E-08
N (Quarters)	18	18	18	18	18	18	18

* Not Significant at any Conventional Level
** Significant only at 90% Confidence Level

Figure 18. Supplementary Segment Ebitda SLR Results

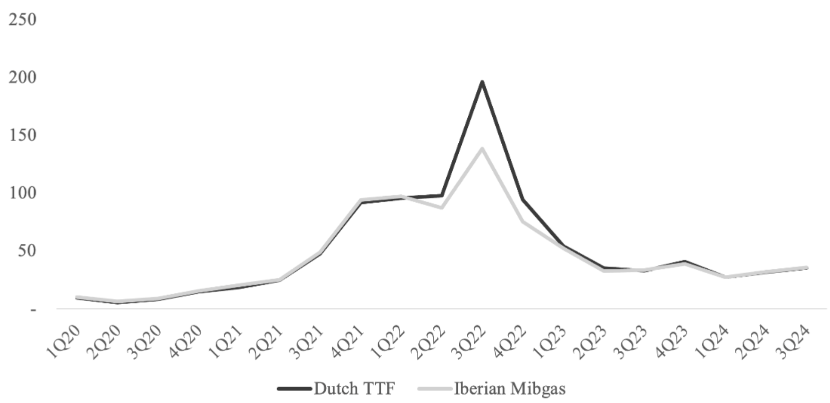

Figure 19. Natural Gas Benchmark - Dutch TTF vs Iberian Mibgas (EUR/MWh)