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Determinants of Financial Hedging Strategies among Commodity Producer Firms in Latin America

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ABSTRACT

This study investigates the determinants of hedging practices among commodity-producing companies in Latin America. The economic significance of the extractive sector in the region makes understanding firms' hedging decisions and their impact on firm value highly relevant. The findings reveal several key insights. Firm size, leverage, and commodity prices are important factors consistent with prior research. Additionally, the region's exchange rate exposure means that firms' acquisition of US dollar-denominated debt is a significant determinant of their hedging activities, as well as the firms' access to the international markets. Notably, the type of ownership also significantly impacts hedging, as state-owned firms are more likely to hedge to reduce volatility in their revenues for the case of oil-firms. In contrast to the limited research on Latin American extractive firms, an extensive literature has explored hedging strategies in developed countries' extractive companies. This study aims to address the gap by investigating the determinants of hedging practices among commodity-producing companies in Latin America and their impact on firms' value.

Keywords: Hedging; Risk Management, Derivatives, Commodity-Producing Companies
JEL Classifications: G32, G30, Q02, D81, C23

1. INTRODUCTION[1]

The extractive sector holds immense relevance for the macro-financial stability of Latin American countries. In most economies in the region, significant commercial and financial inflows originate from the extractive sector[2], and a portion of government income relies on the well-being of these companies, sourced either from the taxes paid by these entities or from the profits generated when the state owns a share of their assets[3]. This interdependence raises crucial questions about the sustainability of fiscal structures, particularly in light of global commodity price fluctuations that can severely impact revenue stability, thus necessitating effective hedging strategies to mitigate associated risks (Ayuk and Klege, 2017).

In this context, companies engaged in commodity production must navigate a landscape characterized by price volatility and

1 The opinions in this paper are those of the authors and do not reflect those of FLAR or its Board of Directors.

2 As an example, fuel exports account for 23% of merchandise exports in Bolivia, 17% in Brazil, 55% in Colombia, 35% in Ecuador, and 11% in Peru.

3 In 2021, according to World Bank data, oil rents accounted for 2.6% of GDP in Brazil, 3.4% in Colombia, 6.4% in Ecuador, and 2.1% in Mexico. Additionally, oil taxes represented 8.4% of fiscal revenue in Colombia for 2022, 7.2% in Brazil, 30.7% in Mexico, and 34.1% in Ecuador for 2021. These figures do not include income derived from profits from state firm participation.

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uncertainty, compelling them to adopt hedging practices as a means to stabilize their cash flows and protect against adverse market conditions, a strategy that has become increasingly vital following the sharp decline in commodity prices since 2014 (Fricke and Süßmuth, 2014; Bas and Acaravci, 2025). Furthermore, these hedging mechanisms are essential for ensuring that the revenue streams remain robust during periods of economic downturn, which have compounded the challenges faced by governments reliant on these sectors for tax income and public expenditure, particularly given the increased susceptibility of Latin American economies to external shocks due to their significant dependency on commodity exports (Campodónico et al., 2017; Fricke and Süßmuth, 2014).

The significance of the extractive sector and its stability poses a substantial challenge for Latin American economies, as companies within this sector consistently face various risks, including commodity price risk, financial constraints risk, and exchange rate risk. Therefore, it is highly relevant to understand whether companies in the Latin American extractive sector employ hedging strategies to mitigate the different risks associated with their productive activities and their impact on the value of firms.

Despite the critical nature of this topic, no research has been conducted to identify the drivers of the hedging decisions of Latin American extractive firms. The literature addressing hedging strategies in Latin American companies is notably limited, featuring only a few articles on the subject, and the sole paper that examines the factors prompting hedging decisions among the region's firms does not specifically focus on the extractive sector (Schiozer and Saito, 2009). One potential explanation for the dearth of literature in this area is the limited availability of financial information from Latin American extractive firms. As highlighted (Malaquias and Zambra, 2018), these companies in the region have faced challenges in adopting the latest accounting formats, which are designed to enhance the disclosure of financial instruments.

This study aims to investigate the determinants of hedging practices among commodity-producing companies in Latin America and their impact on firm value, building upon the existing gap in the literature. The extractive sector holds significant economic importance in the region, making the determinants of hedging decisions in extractive companies particularly relevant. Furthermore, this study incorporates variables overlooked by previous research focused on firms from developed countries, such as the presence of state ownership and the proportion of fixed-income securities issued in dollars. Lastly, the sample composition enables an examination of both oil and gas firms, as well as non-oil extractive firms, allowing for a separate determination of the hedging influences for these two sectors and facilitating an in-depth analysis of potential differences between them.

The study findings reveal several significant insights for the region covered. Consistent with prior research, key factors such as firm size, leverage, and commodity prices play an important role in companies' decisions to hedge financially. Additionally, given the region's exchange rate exposure, firms' acquisition of US dollar-denominated debt is an important determinant of their hedging activities. Furthermore, the type of ownership also significantly impacts hedging, as state-owned firms are more likely to hedge in order to reduce volatility in their revenues, whether fiscal or profit-based.

In contrast to the limited research on Latin American extractive firms, a wealth of articles has explored the hedging strategies adopted by extractive companies in developed countries. Originating from the seminal work of (Haushalter, 2000), which examined the potential motives for corporate hedging using a sample of 100 U.S. oil and gas producers, subsequent research has leveraged extensive datasets to analyze financial risk management in the oil and gas sector. Much of this literature focuses on assessing the impact of hedging strategies on various financial variables, such as the debt-to-capital ratio (Kim and Choi, 2019), firm value (Jin and Jorion, 2006; Phan et al., 2014; Dionne et al., 2018), and investment (Jankensgård and Moursli, 2020; Lobo et al., 2020; Ullah et al., 2023).

Similarly, prior studies have examined the factors influencing hedging decisions in extractive firms, even when hedging was not their primary focus. Notably (Dionne and Mnasri, 2020) and (Hong et al., 2019) utilized the Heckman methodology to investigate the use and dynamics of derivatives among U.S. extractive firms. As part of this analysis, they estimated probit models to determine the drivers of hedging decisions in these companies. Additionally (Choi et al., 2021) employed a probit model to explore the relationship between the value of cash holdings and the hedging practices of U.S. oil and gas firms, aiming to establish this connection. Their findings indicate that firms with greater cash reserves tend to hedge more aggressively, suggesting that liquidity influences hedging behavior by providing firms with the financial flexibility necessary to manage risks effectively (Dionne and Mnasri, 2020). Moreover, this financial flexibility is essential in enabling firms to implement hedging strategies that directly align with their risk profiles and investment opportunities, thereby enhancing their overall resilience against market fluctuations and uncertainties in the commodity sector (Dionne et al., 2023) (Laing et al., 2017).

Furthermore, articles such as (Choi and Kim, 2018) have analyzed the impact of oil and gas price volatility on project companies' hedging decisions, focusing primarily on the influence of one potential determinant. Another illustrative example is found in the work of (Ferriani and Veronese, 2022), which discovered a positive relationship between hedge production and the net worth of U.S. oil companies. Additionally (Dudley et al., 2022) have conducted estimations of the hedging decisions of U.S. oil and gas firms by types of financial derivatives, aiming to understand the composition of their portfolio, particularly in challenging scenarios.

Within the broader literature, there are also studies adopting a more general approach to understanding the determinants of hedging strategies in extractive firms. For instance (Mnasri et al., 2017) examined the factors influencing the use of nonlinear hedging instruments by U.S. oil producers, while (Mo et al.,

2021) focused their analysis on Canadian companies and found a direct relationship between a firm's perceived financial distress and its extent of hedging. Additionally, a recent study by (Dionne et al., 2023) conducted a comprehensive analysis of joint hedging practices among U.S. oil and gas companies, exploring the implications for firm value, performance, and risk.

Once the determinants of hedging within firms are understood, it is essential to determine whether the use of these tools increases investors' valuation of a firm (Stulz, 1996). Academic studies have presented mixed results (Ullah et al., 2023). Some studies suggest that hedging can increase firm value by reducing financial distress costs, mitigating agency problems, and optimizing investment decisions (Dionne et al., 2023; Dionne and Mnasri, 2020). Other studies find no significant relationship or even a negative relationship, attributing this to hedging costs, ineffective hedging strategies, or signaling effects (Mo et al., 2021).

As evident, the existing literature on hedging decisions in extractive firms has predominantly focused on companies from advanced countries, particularly in the oil sector and primarily in the United States and Canada. Notably, the (Choi and Kim, 2018) study is the sole instance using a sample spanning multiple countries, yet it did not carry out any analysis specifically on emerging market firms. This narrow focus restricts the applicability of previous findings to developed country firms. In response to this gap, our study aims to investigate the factors influencing the utilization of hedging derivatives in extractive companies across twelve Latin American countries. Leveraging a panel data sample comprising 253 firms over the period from 2000 to 2022, this research represents the first dedicated exploration into the determinants of hedging decisions in Latin American extractive firms, marking an inaugural endeavor in emerging markets research.

The paper proceeds as follows: Section 2 explains the data collection, methodology, and variable description. Section 3 discusses the multivariate results for the oil firms, non-oil firms, and full sample. Section 4 analyses the implications of hedging decisions on firm value. Section 5 concludes.

2. DATA AND METHODOLOGY

This section details the data sources, variable definitions, and methodologies employed pertinent to our study, highlighting the unique context of Latin American extractive firms and their hedging practices in comparison to more developed markets. The Data and Methodology section is organized into three distinct segments. The first segment aims to delineate the sample by elucidating the process of sample collection and its constitution. The second segment then expounds on the variables to be used in the analytical estimation procedure. Finally, the third segment succinctly elucidates the empirical methodology adopted.

2.1. Data Sources and Sample

This study is based on a comprehensive sample of 253 Latin American commodity firms obtained from the SandP Capital IQ database. The sample encompasses 89 firms in the oil sector, covering both upstream and downstream subsectors, as well as 164 firms in non-oil sectors. These non-oil firms are engaged in the exploration, exploitation, and initial manufacturing processes for a diverse range of commodities, including gold, copper, iron, steel, and other base metals. Additionally, the non-oil classification incorporates 6 biodiesel and 4 coal firms, reflecting the broader commodity landscape in Latin America.

The sample period spans from 2000 to 2022, providing annual observations to facilitate a comprehensive analysis. Importantly, the sample includes a diverse range of ownership structures, with 229 firms having 100% private ownership, 11 with 100% state-owned property, and 13 with mixed ownership. This diversity allows us to explore how varying degrees of state involvement and private ownership may influence hedging practices, which is particularly relevant in the context of Latin American markets where governmental policies and economic conditions can significantly impact corporate risk.

Table 1 presents the firm summary, categorized by subsample and countries. It provides a detailed overview of the sample composition and geographic distribution across the Latin American region.

2.2. Variables Descriptions

Documenting the use of derivatives in Latin American extractive firms remains a challenge, as prior research (Malaquias and Zambra, 2018) has demonstrated. Due to the lack of detailed information on the composition of these indicators, we faced difficulties in determining the specific instruments used by firms to hedge their risks or the precise exposures being hedged. Consequently, by leveraging multiple CIQ derivative variables, we pragmatically created a binary variable, taking the value of 1 if the firm utilized at least one derivative indicator and 0 otherwise, which will serve as our dependent variable. The utilization of hedge derivatives, as measured by this binary variable, is summarized in Table 2. Further analysis reveals that this approach enables us to capture a broad spectrum of hedging behaviors across the sample firms despite the inherent limitations in data granularity that often challenge studies in emerging markets (Giraldo-Prieto et al., 2017).

Evidently, the use of derivatives is unbalanced in terms of country. As we mentioned before, the data shortage and the intra-regional

Table 1: Sample composition summary

Country	Private		Mixed		State-own	
	Oil	Non-oil	Oil	Non-oil	Oil	Non-oil
Argentina	13	5	1	0	0	0
Bolivia	0	0	3	0	0	0
Brazil	39	92	4	1	0	1
Chile	2	13	0	0	3	2
Colombia	6	4	2	1	0	0
Costa Rica	0	0	0	0	1	0
Mexico	3	15	0	0	2	0
Paraguay	1	0	0	0	0	0
Peru	5	26	1	0	0	0
Ecuador	0	1	0	0	0	0
Uruguay	0	1	0	0	1	0
Venezuela	1	2	0	0	1	0
Total	70	159	11	2	8	3

Source: Own elaboration

financial depth differences make a country analysis very difficult. Nevertheless, seeing aggregated data, the use of derivatives becomes more balanced. In the oil sector, the firms that at least once time used derivatives achieved 40 against 49 that do not use this kind of hedge instruments. In the non-oil sector, 80 firms used derivatives against 84, respectively. Given these data particularities, adding estimations controlling for different firms' characteristics is more beneficial to understanding the motivations behind these hedging activities.

Table 2: Summary of the use of hedge derivatives by firms across countries

Country	Oil		Non-oil	
	Use	Non-use	Use	Non-use
Argentina	11	3	2	3
Bolivia	0	3	0	0
Brazil	13	30	36	58
Chile	3	2	13	2
Colombia	4	4	4	1
Costa Rica	0	1	0	0
Ecuador	0	0	0	1
Mexico	2	3	11	4
Paraguay	0	1	0	0
Peru	5	1	14	12
Uruguay	1	0	0	1
Venezuela	1	1	0	2
Total	40	49	80	84

Source: Own elaboration

The independent variables are selected based on theoretical and empirical literature on the determinants of corporate risk management, with a focus on the unique characteristics of Latin American extractive firms. Table 3 summarizes the independent variables and provides a brief description of each. The selection encompasses firm-specific factors such as size, profitability, and leverage, as well as external variables like price volatility and degree of multinationalism, which may influence the hedging decisions of Latin American extractive companies.

As evident from Table 4, the mean values of most variables exhibit two notable distinctions: Between hedged and unhedged firms; and between firms inside and outside the oil sector. These findings are consistent even when subjected to quartile analysis of each sector.

Table 3: Variable summary

Variable identifier	Description
Assets logarithm	The logarithm of assets in millions of dollars.
Debt to equity ratio	Total debt-assets ratio.
Commodity index logarithm	Calculated as the logarithm of the IMF-Primary commodity index. Given the sector's weighting in the sample, we use a Brent index for oil firms and a metal index for non-oil firms.
USD fixed income	The variable represents the proportion of the outstanding fixed income valued in US Dollars.
S&P rating	The dummy takes the value 1 if the firm has an S&P credit rating and 0 otherwise.
State-owned	The dummy takes value 1 if the firm is state-owned.
Brent volatility	Calculated as the absolute value of the return of annual average price.
ABHK	Following Laing et al. (2020), the ABHK is an indicator that measures the degree of multinationalism based on the location of its subsidiaries, inspired by the classification system of Aggarwal et al. (2011).
COVID	The dummy takes a value of 1 in 2020 and 2021 and 0 otherwise.
Cash and equivalents to assets ratio	Cash and equivalents-assets ratio.
Capex to assets ratio	Capital expenditure-assets ratio.
Dividend pay	The dummy takes value 1 if the firm paid dividends each year.
ROA	Return on assets ratio.
LT Debt to equity	Long term debt to equity ratio.
Accounts receivable	Accounts receivable to assets ratio.
NPP to assets	Net property, plant and equipment to assets ratio.
Current liabilities	The logarithm of current liabilities in millions of dollars.
Hedge	The dummy takes a value of 1 when firm engages in hedging and 0 otherwise.
Neth worth	Calculated as the logarithm of Net property plant and equipment+Cash and equivalents+Reserves−Total debt. Due to the lack of information to calculate Tobin's q, we use net worth as a proxy for firm value.

Source: Own elaboration

Table 4: Average values of key variables

Variable	Sample Hedged			Sample Unhedged		
	Total sample	Oil Sample	Non-oil sample	Total sample	Oil sample	Non-oil sample
Assets	14820	31488	7930	3111	5691	1745
Debt to equity	1.33	2.32	0.94	0.79	1.20	0.57
USD fixed income	0.26	0.41	0.19	0.07	0.13	0.04
ABHK	2.97	3.06	2.93	2.1	2.13	2.08
Cash and equivalents to assets	0.08	0.07	0.08	0.09	0.07	0.1
Capex to assets	0.07	0.09	0.06	0.06	0.09	0.05
LT Debt to equity	0.90	1.42	0.66	0.30	0.57	0.14
Accounts receivables	0.07	0.07	0.07	0.07	0.08	0.07
NPP to assets	0.50	0.60	0.46	0.46	0.53	0.42
Current liabilities	2.64	2.89	2.54	1.71	1.96	1.57
Neth worth	5436.36	11281.93	3009.13	1239.97	2454.51	581.61

Source: Own elaboration

Specifically, the comparison between the two types of firms reveals that oil sector firms are generally larger, carry higher debt ratios, and allocate more towards capital expenditure. However, more pronounced differences emerge when comparing firms that opt to hedge with those that do not. Hedged firms tend to possess larger asset bases, higher debt levels, increased exposure to exchange rates, and a more prominent international presence. In contrast, there is no discernible difference in cash and capex ratios between the subsamples, a pattern that aligns with previous research indicating that firms engaged in hedging practices often exhibit both significant size and capital expenditures, pointing towards their capacity and strategic necessity to manage financial risks effectively (Giraldo-Prieto et al., 2017) (Geyer-Klingeberg et al., 2019).

Based on the descriptive statistics and existing literature, we anticipate certain outcomes in the multivariate analysis. Regarding the likelihood of hedging, we expect a positive impact from variables such as assets, debt ratio, and degree of internationalization. As a distinctive contribution to the literature, we anticipate that firms, given the region's reliance on commodities and the absence of a strong regional currency, are more inclined to hedge when exposed to exchange rate fluctuations. Finally, there is no clear preliminary indication regarding the impact of cash and investment on hedging behavior. This uncertainty reflects the mixed findings reported in previous studies, where some researchers argue that liquidity and investment levels do not significantly influence hedging decisions, while others suggest that they may play a critical role depending on firm-specific and contextual factors within emerging markets (Geyer-Klingeberg et al., 2019) (Dionne et al., 2023) (Dionne and Mnasri, 2020) (Mo et al., 2021).

2.3. Empirical Methodology

Given the paper's specific focus on investigating the determinants of hedging in Latin American extractive firms and the constraint encountered regarding the dependent variable that required using a dummy variable, the chosen methodology is a binary choice model. Furthermore, considering the unbalanced nature of the dependent binary data and drawing insights from (Chen and Tsurumi, 2010) and (Cakmakyapan and Goktas, 2013), the Logit model has been selected as the most suitable approach to meet the research objectives in contrast to a probit model.

The model is represented as follows:

$$P(Y=1 \mid X) = \Lambda\,(X\beta) \tag{1}$$

Where $\ddot{E}(z) = \frac{\exp(z)}{1+exp\ (z)}$ is the standard logistic cumulative distribution function and X is the matrix that encompasses the observations of the predictive variables. This model will facilitate an in-depth understanding of the factors influencing hedging behavior among firms in this sector, thereby contributing valuable insights into the financial strategies employed in response to external market pressures and internal corporate governance considerations (Vural-Yavas, 2016). Moreover, this approach aligns with previous findings that emphasize the significance of firm-specific factors in determining hedging strategies, particularly in emerging markets where external influences such as market volatility and governance structures play a crucial role in shaping corporate behavior (Giraldo-Prieto et al., 2017) (Vural-Yavas, 2016).

Additionally, the chosen Logit model allows for the estimation of the probability that a firm engages in hedging based on the identified independent variables, which is particularly relevant given the complex financial landscape that these firms navigate within Latin America (Giraldo-Prieto et al., 2019) (Mo et al., 2021). Furthermore, the Logit model addresses the potential endogeneity issues associated with hedging decisions—specifically, how a firm's financial distress and leverage might simultaneously influence both its hedging behavior and its operational dynamics.

3. RESULTS

The empirical analysis now provides valuable insights into the determinants of hedging behavior among Latin American extractive firms. Building on the descriptive statistics and existing literature discussed in the previous section, the logistic regression model reveals several significant findings that contribute to the understanding of corporate risk management strategies in this context.

As highlighted earlier, one of the key contributions of this study is the comprehensive analysis of the entire extractive sector. However, it is also essential to delve into the particular dynamics of specific sectors. To that end, we have split the sample of commodity producer firms into oil and non-oil firms, and we present estimation results in two different subsections. This segmented analysis will provide deeper insights into the distinct dynamics and determinants that influence hedging decisions in each subset of the extractive sector. Furthermore, we present a third subsection with the results of estimations for the full sample of firms to uncover some generalities of commodity-producing firms' behavior regarding hedging decisions.

Before analyzing the estimation results, it is crucial to clarify certain methodological aspects. Results are presented through three specifications to check the result's robustness: number 1 takes the most extended period of observations available from 2000 to 2022, number 2 includes a COVID-19 dummy, and number 3 includes observations before the pandemic, particularly from 2000-2019. We incorporated a 2008 dummy for the Global Financial Crisis and a dummy for the 2014 oil price collapse in the estimations; however, these variables did not attain statistical significance and had no notable impact on the results. Furthermore, we included controls for profitability in the regressions, but they neither influenced the outcomes nor demonstrated statistical significance. In line with the suggestion from (Dudley et al., 2022), we calculated Tobin's-q and Merton's distance-to-default. Unfortunately, the available data in Latin America do not allow for building a long time series for these indicators, rendering their inclusion not contributing substantially to the empirical results.

Nonetheless, even without these last additional controls, the core variables demonstrate consistency and statistical significance, providing a robust foundation for the analysis of the determinants

of corporate hedging behavior in the Latin American extractive sector.

3.1. Oil Firms

The first set of results focuses on the subsample of oil-producing firms (Table 5). Considering the oil subsample, as expected and consistent with previous research (Haushalter, 2000) (Hong et al., 2019), and (Dudley et al., 2022), the results confirm that the likelihood of hedging increases proportionally with the size of a firm. Larger oil companies tend to have more resources and economies of scale, allowing them to better absorb the costs associated with implementing and maintaining a comprehensive hedging program. This alignment with the economy of scale hypothesis suggests a strong correlation between the adoption of hedging practices and the financial capacity and operational scope of larger oil and gas producers. The ability to spread the fixed costs of hedging over a larger production base appears to be a key driver of hedging behavior in this industry sector.

The results also indicate that the degree of financial leverage, as measured by the debt-to-equity ratio, is a significant determinant of hedging decisions among oil firms. Consistent with predictions from established theoretical frameworks (Haushalter, 2000), (Mnasri et al., 2017), (Hong et al., 2019), (Choi et al., 2021), and (Mo et al., 2021) highly leveraged oil companies are more likely to engage in hedging activities. This is because they seek to reduce their exposure to commodity price fluctuations and manage their debt servicing obligations. Firms with higher debt levels face greater financial distress costs and thus have stronger incentives to adopt comprehensive hedging strategies to mitigate these risks. This aligns with the financial distress cost hypothesis, which suggests that firms with higher levels of debt are motivated to mitigate expected costs and turn to hedging as a mechanism to achieve this goal.

Our findings suggest that oil prices have a direct relationship with the likelihood of hedging, which contrasts with the results reported in previous studies (Dudley et al., 2022)(Mo et al., 2021), where price exhibited no significance or price volatility had a negative effect. One potential explanation for this discrepancy, beyond potential regional differences, could be the use of lagged price variables in those prior studies, likely due to the availability of only quarterly data. However, our results indicate that firms appear inclined to hedge when they can lock in favorable prices for their production or when they adopt a more risk-averse stance during periods of high price volatility, seeking to mitigate its potential adverse effects.

Access to international markets emerges as a significant factor influencing the decision to hedge among Latin American firms. Credit ratings play a crucial role in this region, as the financial markets in several countries are shallow. Rated firms are more likely to acquire derivatives due to their recognition by rating agencies, which gives them access to the international market. Conversely, unrated firms may face market restrictions, making it more challenging to obtain derivatives. This disparity in access to derivatives based on credit rating underscores its importance in the decision-making process for hedging in Latin America. The existing literature shows no consensus regarding the effect of credit rating, with some studies finding a negative relation (Hong et al., 2019), while others observed no significant effects (Haushalter, 2000) (Mo et al., 2021). However, these previous studies were based on developed countries where market access is greater compared to emerging and frontier markets.

Firms with a greater degree of multinationalism, as measured by the ABHK index, are more likely to engage in hedging. This finding reflects the unique context of Latin American countries, where the characteristics of extractive firms in the region play a role. The ABHK results can be interpreted similarly to the previous variable. When a multinational firm has subsidiaries across different countries and continents, it enjoys better access to derivatives and global financial markets. This contrasts with firms in developed countries, where integration may not significantly impact derivative hedge decisions. This could explain the differences with previous studies, such as (Laing et al., 2020),

Table 5: Oil firms' results

Variable	(1)	(2)	(3)
Assets	0.15*** (0.05)	0.15*** (0.05)	0.17*** (0.06)
Debt to equity ratio	0.03* (0.02)	0.03** (0.02)	0.03 (0.02)
Commodity index	0.47** (0.22)	0.57** (0.23)	0.35 (0.24)
USD fixed income	0.93*** (0.23)	0.96*** (0.23)	1.13*** (0.25)
S&P rating	0.49** (0.23)	0.49** (0.23)	0.35 (0.25)
State-owned	1.13*** (0.23)	1.18*** (0.23)	1.18*** (0.25)
Brent volatility	0.01** (0.01)	0.00 (0.01)	0.00 (0.01)
ABHK	0.12* (0.07)	0.13* (0.07)	0.15** (0.08)
Cash and equivalents to assets ratio	1.03 (0.75)	1.03 (0.76)	0.95 (0.81)
Capex to assets ratio	−1.54 (0.95)	−1.22 (0.93)	−1.35 (0.99)
Dividend pay	−0.35* (0.19)	−0.33* (0.20)	−0.65*** (0.23)
COVID		1.09*** (0.31)	
Intercept	−5.31*** (1.03)	−5.73*** (1.05)	−4.74*** (1.13)
AIC	900.55	890.34	746.95
BIC	959.12	953.79	804.12
Log Likelihood	−438.28	−432.17	−361.48
Deviance	876.55	864.34	722.95
Num. obs.	973	973	866

Robust standard errors in parentheses ***P<0.01, **P<0.05, *P<0.1. The first column represents the regression sample spanning from 2000 to 2022, the second column incorporates a COVID dummy, and the third column focuses on the sample from 2000 to 2019

where the ABHK, viewed as a proxy for integration, was found to have no impact on financial hedge intensity.

Our results also indicate that, within the oil sector sample, state-owned firms tend to have a higher likelihood of using hedge derivatives. This trend can be attributed to the fiscal and financial dependency of certain countries on their commodity firms, which may compel these firms to mitigate various risks they encounter. This suggests that state ownership can influence hedging decisions as a strategic response to the unique challenges faced by commodity firms under state control. This finding is novel in the literature on hedging decisions of commodity-producing firms, as no existing studies (to our knowledge) have directly examined ownership structure as a determinant of hedging behavior in this sector for either developed or developing countries.

Another novel result is the exposure to exchange rates of commodity-producing firms in the region through foreign debt, which emerges as a robust and consistent factor in the likelihood of hedging. This finding aligns intuitively; if a firm has a substantial portion of its fixed income denominated in foreign currency and operates in a country susceptible to significant foreign exchange shocks, it is natural for the firm to seek to minimize the risk of an exchange rate mismatch. From a cost perspective, firms tend to hedge more when they have higher levels of foreign debt to avoid increases in their debt burden caused by exchange rate volatility. Nevertheless, further investigation into the specific channels and types of hedges employed by Latin American firms would be insightful. A more detailed data collection effort on the hedging strategies used by these firms could shed light on the intricacies of their risk management practices.

We also find a negative relationship between dividend pay and the hedging activity of firms. Dividend payments are commonly viewed as a signal of financial health, and firms paying dividends may have less incentive to hedge their commodity price exposure. This suggests that firms with higher dividend payout ratios are more likely to rely on internal funds to meet their financing needs, thereby reducing their need for external financing and the associated risks that hedging aims to mitigate, as findings of (Geyer-Klingeberg et al., 2019), which also shows that dividend payout ratios and hedging tend to be negatively correlated.

Finally, the COVID-19 dummy variable has strong statistical significance when included as a control in the regression, indicating that uncertainty plays an important role in firms' hedging decisions. However, as expected, the inclusion of this dummy variable reduces the significance of the price volatility variable.

3.2. Non-oil Firms

Turning to the broader sample of non-oil firms (Table 6), the results show some similarities but also notable differences compared to the oil sector. Like the oil subsample, firm size, USD fixed income issuance, credit rating, and commodity price remain statistically significant factors, indicating that these characteristics play a crucial role in the hedging decisions of both oil and non-oil firms. However, the state-owned dummy loses its significance, which is reasonable given the lower number of state-owned non-oil firms and the narrower gap between the assets of state-owned and private non-oil companies. This suggests that ownership structure may be less influential in the hedging behavior of non-oil firms compared to their oil counterparts.

Similarly, the significance of the ABHK measure drops, potentially explained by a lower level of multinationalism characterizing the non-oil sector, implying that the global reach and integration of a firm may be less relevant for non-oil companies when it comes to their hedging decisions. Interestingly, the pandemic appears to have had no discernible impact on the hedging decisions of non-oil firms, in contrast to the oil sector, where the COVID-19 dummy variable had a strong statistical significance, indicating that uncertainty plays a more critical role in the hedging behavior of commodity-producing firms.

Consistent with the findings for the oil sample, the cash variable remains not significant, making it difficult to draw conclusions about its importance or substitutive role. However, a key insight emerges from the regressions - the higher a firm's capital expenditure ratio, the greater the likelihood of it adopting derivatives. This aligns with prior research (Hong et al., 2019), where capital expenditure is found to predict a higher likelihood of hedge adoption. The rationale is that firms with more capital-intensive projects face greater uncertainty over their future cash flows, which incentivizes them to use hedging instruments to manage this risk and ensure the viability of their investments.

In a general way, it is possible to see an important difference between the oil and non-oil sectors when it comes to hedging strategies. The role of complementary operational hedging appears to play a more significant part in the firm's decision-making. For the oil sector, the greater presence of state-owned firms in the region tends to impact the financial hedging acquisition, as these firms may be compelled to mitigate various risks they encounter due to the fiscal and financial dependency of certain countries on their commodity operations. In contrast, the non-oil sector exhibits a shift in the operational impact, with the firms' capital expenditure hedging becoming more prominent. This suggests that non-oil firms facing greater uncertainty over their future cash flows from capital-intensive projects tend to use hedging instruments to manage this risk and ensure the viability of their investments.

3.3. Full Sample

To further validate the robustness of our findings, we also examine the determinants of hedging decisions across the full sample, which combines both oil and non-oil firms (Table 7). Notable variations emerge in terms of statistical significance; generally, most variables gain significance. Nonetheless, the overall behavior remains consistent, and the explanation for the observed patterns persists. This suggests that while certain determinants may vary in significance, the underlying trends and dynamics hold true.

The only significant difference in the results compared to the sample of oil firms is the loss of significance for the dividend paid dummy, contrary to the findings of prior studies (Hong et al., 2019) (Haushalter, 2000), (Mnasri et al., 2017). Our results indicate that dividend payments do not appear to significantly influence firm hedging decisions in the full sample case. This aligns with the observations made by (Choi et al., 2021), where the relationship

was found to be non-significant. The lack of significance may be attributed to the relatively low financial depth in the region, where firms may not be as diversified in their shareholdings, and the impact of dividend payments may not be as pronounced as observed in more developed financial markets. Hence, the role and significance of dividends in influencing hedging decisions in Latin American firms may differ from that seen in advanced economies.

The subsector estimations are generally robust and consistent with the full sample results for the region. For firms in both the oil and non-oil sectors, the exposure to USD-denominated debt represents a latent risk that needs to be hedged. Additionally, access to international markets through credit ratings becomes necessary to facilitate investment and leverage opportunities, influencing the decision to hedge. These findings from the full sample estimation support the differentiated hedging behavior of commodity-producing firms in Latin America compared to their counterparts in developed countries, as presented in the analysis of the oil and non-oil subsamples.

The findings from the full sample analysis provide further validation and support for the conclusions drawn from the examination of the oil and non-oil subsamples. This strengthens the robustness and reliability of the key determinants identified as influencing the hedging decisions of firms in the Latin American region. The consistency across the different samples underscores the validity of the explanatory factors that were found to play a significant role in shaping the hedging behavior of both oil and non-oil companies operating in this context.

4. THE IMPACT OF HEDGING DECISIONS ON FIRM VALUE

The relationship between firm value and the use of hedging strategies has been extensively studied in the literature. Once the determinants of hedging within firms are understood, it is essential to determine whether the use of these tools increases investors'

Table 6: Non-oil firms' results

Variable	(1)	(2)	(3)
Assets	0.41*** (0.04)	0.41*** (0.04)	0.42*** (0.04)
Debt to equity ratio	0.07* (0.04)	0.07* (0.04)	0.06* (0.03)
Commodity index	1.54*** (0.16)	1.52*** (0.17)	1.67*** (0.19)
USD fixed income	0.58*** (0.21)	0.57*** (0.21)	0.56** (0.23)
S&P rating	0.61*** (0.17)	0.61*** (0.17)	0.71*** (0.18)
State-owned	0.1 (0.42)	0.11 (0.42)	0.05 (0.44)
Brent volatility	0.01* (0.00)	0.01 (0.00)	0.01* (0.00)
ABHK	0.08 (0.05)	0.08 (0.05)	0.06 (0.05)
Cash and equivalents to assets ratio	−0.25 (0.52)	−0.26 (0.52)	−0.01 (0.55)
Capex to assets ratio	3.38*** (0.83)	3.41*** (0.83)	2.91*** (0.87)
Dividend pay	0.17 (0.13)	0.17 (0.13)	0.13 (0.14)
COVID		0.11 (0.23)	
Intercept	−11.68*** (0.79)	−11.57*** (0.82)	−12.31*** (0.92)
AIC	1829.7	1831.47	1595.52
BIC	1897.03	1904.4	1661.55
Log Likelihood	−902.85	−902.73	−785.76
Deviance	1805.7	1805.47	1571.52
Num. obs.	2019	2019	1813

Robust standard errors in parentheses ***P<0.01, **P<0.05, *P<0.1. The first column represents the regression sample spanning from 2000 to 2022, the second column incorporates a COVID dummy, and the third column focuses on the sample from 2000 to 2019

Table 7: Full sample results

Variable	(1)	(2)	(3)
Assets	0.32*** (0.03)	0.32*** (0.03)	0.34*** (0.03)
Debt to equity ratio	0.05*** (0.01)	0.05*** (0.01)	0.04*** (0.01)
Commodity index	1.35*** (0.12)	1.30*** (0.12)	1.44*** (0.14)
USD fixed income	0.49*** (0.15)	0.48*** (0.15)	0.48*** (0.16)
S&P rating	0.65*** (0.13)	0.66*** (0.13)	0.66*** (0.14)
State-owned	0.72*** (0.19)	0.72*** (0.19)	0.65*** (0.21)
Brent volatility	0.01*** (0.00)	0.01* (0.00)	0.01* (0.00)
ABHK	0.07* (0.04)	0.07* (0.04)	0.07* (0.04)
Cash and equivalents to assets ratio	0.18 (0.41)	0.16 (0.42)	0.34 (0.44)
Capex to assets ratio	0.32 (0.54)	0.44 (0.54)	0.14 (0.57)
Dividend pay	0.14 (0.10)	0.14 (0.10)	0.09 0.11
COVID		0.51*** (0.18)	
Intercept	−10.14*** (0.60)	−9.88*** (0.60)	−10.60*** (0.69)
AIC	2789.85	2783.87	2407.54
BIC	2861.89	2861.92	2478.26
Log Likelihood	−1382.92	−1378.94	−1191.77
Deviance	2765.85	2757.87	2383.54
Num. obs.	2992	2992	2679

Robust standard errors in parentheses ***P<0.01, **P<0.05, *P<0.1. The first column represents the regression sample spanning from 2000 to 2022, the second column incorporates a COVID dummy, and the third column focuses on the sample from 2000 to 2019

valuation of a firm. Academic studies have presented mixed results (Ullah et al., 2023). Some studies suggest that hedging can increase firm value by reducing financial distress costs, mitigating agency problems, and optimizing investment decisions (Dionne and Mnasri, 2020). Other studies find no significant relationship or even a negative relationship, attributing this to hedging costs, ineffective hedging strategies, or signaling effects (Mo et al., 2021).

The effect of hedging on firm value may depend on the specific characteristics of the firm, such as its size, financial leverage, industry, and the effectiveness of its hedging strategies. As mentioned above, commodity-producing companies in Latin America are especially exposed to risks arising from product price volatility and the instability of the markets in which they operate. This makes the sector particularly suitable for evaluating hypotheses about the potential positive effect of hedging on firm value. However, many Latin American firms are not listed on stock markets, making it impossible to observe their market value directly. For this reason, we rely on the firms' net worth indicator proposed by Ferriani and Veronese (Ferriani & Veronese, 2022):

$$Net\ worth_{it} = Net\ property\ plant\ and\ equipments_{it} + Cash\ and\ equivalents_{it} + Reserves_{it} - Total\ debt_{it} \quad (2)$$

To examine the effect of hedging decisions on firm value, we estimate a regression model applying a switching regression model known as the Tobit type 5, following the classification presented by Amemiya (1984), which generalizes Heckman's (1979) selection model to estimate the effect of hedging on the logarithm of firms' net worth. This approach allows us to account for the potential endogeneity of hedging decisions, as firms that choose to hedge may systematically differ from those that do not. Table 8 presents the estimated outcome equations.

The results indicate varying effects depending on the sample. Specifically, the hedging decision has a positive effect on the value of non-oil firms, but a negative effect on the value of oil firms. The estimated effect on the sample of oil firms aligns with some literature that reports a negative relationship between hedging and firm value in this sector (for example, Phan et al., 2014; Savas and Kapusuzoglu, 2020). However, these results are in contrast with other studies, such as Jin and Jorion (2006) and Xue et al. (2022), which find no significant effect. It's important to note that there are no prior studies specifically focused on commodity-producing firms in Latin America, making these results the first evidence of this kind.

The positive effect observed in the sample of non-oil firms is particularly noteworthy, as it represents a novel finding in the literature, likely stemming from the relative lack of studies focused on this sector. This result suggests that hedging can be a valuable tool for non-oil firms in Latin America to manage risks and enhance firm value. One key factor that may explain this result is the ownership structure of the firms. In contrast to most previous studies, which analyze publicly listed firms, our sample includes a significant number of privately held companies. This distinction is relevant from a theoretical standpoint. According to Stulz (1996, 2022), one benefit of hedging is that it can serve as a substitute for equity capital when equity is more expensive than debt, thereby allowing firms to increase their value through balance sheet expansion. This mechanism is especially applicable to the firms in our non-oil sample, many of which face high financing costs due to low credit ratings or limited access to equity markets.

In the same sense, the ownership structure of oil firms could explain the results. As mentioned before, most oil companies in the region are national firms with different interests than profit maximization, which could lead to fewer hedging incentives and risk management strategies (Adegun and Abiola, 2020). In essence, the impact of hedging on firm value is a complex issue that depends on various factors, including the firm's characteristics, the industry, and the effectiveness of the hedging strategies employed.

The parameter rho is of particular interest, as it indicates the correlation between the error terms in the first and second steps. A value different from zero suggests that the model is appropriate for addressing selection bias. In the oil sample, the positive rho suggests that there are unobserved factors that increase firm value while simultaneously being associated with a lower probability of hedging. Conversely, in the non-oil sample, the positive rho indicates that unobserved factors contribute both to higher firm value and a greater likelihood of engaging in hedging.

Table 8: Firm value effect of hedging choice

Variable	Full sample	Oil	Non-oil
Long-term debt to equity ratio	−0.023*** (0.007)	−0.027* (0.015)	−0.012 (0.008)
Accounts receivable to assets ratio	−2.099*** (0.401)	−6.107*** (0.689)	−0.210 (0.464)
Net property, plant, and equipment to assets ratio	1.667*** (0.107)	1.261*** (0.168)	2.455*** (0.169)
Brent volatility	−0.004*** (0.001)	−0.002 (0.002)	−0.004** (0.002)
ABHK	0.043** (0.017)	0.101*** (0.027)	0.041** (0.021)
Cash and equivalents to assets ratio	1.820*** (0.284)	0.686 (0.503)	2.275*** (0.334)
Current liabilities	0.725*** (0.017)	0.894*** (0.026)	0.707*** (0.021)
Hegde	1.624*** (0.068)	−1.395*** (0.110)	1.676*** (0.073)
Intercept	0.784*** (0.116)	1.206*** (0.196)	0.259* (0.149)
Rho	−0.831*** (0.016)	0.852*** (0.026)	−0.879*** (0.015)
Log Likelihood	−3321,726	−1.111.338	−2.117.732
Num. Obs.	1784	601	1183
Selection 1	1186	417	769
Selection 0	598	184	414

Robust standard errors in parentheses ***P<0.01, **P<0.05, * P<0.1. For simplicity, we present these results based on the second specification in the hedging determinants regressions, using data from 2000 to 2022 that includes a Covid dummy. However, the results are similar across the other two specifications

Findings strongly support the hypothesis that hedging strategies can positively impact firm value in contexts marked by high risk exposure and restricted access to financing, mainly for non-oil firms. These results pave the way for future research aimed at identifying whether specific dimensions of hedging play a differential role in shaping firm value. However, further progress in this direction requires significant improvements in both the quality and availability of firm-level data for commodity-producing companies in Latin America.

5. CONCLUSIONS

This comprehensive empirical investigation provides valuable insights into the key determinants of corporate hedging decisions in the Latin American region and their effect on the firm's value. The analysis provides a detailed understanding of the underlying dynamics by examining the differing hedging behaviors observed within commodity-producing firms and between the oil and non-oil sectors.

The findings reveal that the determinants of hedging decisions in Latin American firms exhibit a mix of similarities and differences compared to the existing literature on developed markets. Consistent with prior studies, factors such as firm size, leverage, and commodity prices emerge as significant predictors of hedging adoption. However, the study identifies additional key determinants for commodity-producing firms in Latin America, namely the effect of exchange rate fluctuations on firms' foreign-denominated debt and their access to international markets. The exposure to USD-denominated debt represents a latent risk that these firms need to hedge. Furthermore, access to international markets through credit ratings becomes necessary to facilitate investment and leverage opportunities, thereby influencing the decision to hedge.

The study reveals that ownership structure and the degree of multinationalism play a less influential role in the hedging decisions of non-oil firms compared to their oil counterparts. This suggests that these factors are more important for the hedging strategies of oil firms in the region.

Interestingly, the COVID-19 pandemic appears to have had a more significant impact on the hedging behavior of oil firms, indicating that uncertainty is a more critical factor for this sector. This emphasizes the importance of considering the unique characteristics and challenges faced by different industries when analyzing corporate hedging decisions.

An important distinction emerges regarding the role of operational hedging. While the oil sector's hedging practices are influenced by the presence of state-owned firms, the non-oil sector exhibits a greater emphasis on capital expenditure hedging, reflecting the need to manage the uncertainty associated with capital-intensive projects. This highlights the differentiated approaches to risk management between the two sectors, with the oil sector's hedging strategies being impacted by the important role that oil firms play in public finances and the implications this has on their hedging strategies.

The robustness of the findings is further validated through the examination of the full sample, which combines both oil and non-oil firms. This comprehensive analysis underscores the validity of the key determinants identified and emphasizes the differentiated hedging behavior of Latin American firms compared to their counterparts in developed economies.

Our research also presents robust evidence that hedging strategies can enhance firm value, particularly in environments characterized by high-risk exposure and limited financing options, with a notable emphasis on non-oil firms. These results open avenues for future investigations to assess whether aspects of hedging have varying impacts on firm valuation. However, advancing this analysis demands substantial enhancements in the quality and accessibility of firm-level data for commodity-producing companies in Latin America.

Overall, our study provides valuable insights into the factors that shape corporate hedging decisions in the Latin American context, underscoring the importance of considering industry-specific characteristics and regional variations when analyzing risk management strategies.

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