Hedged Exposures & Defensive Betas: An Empirical Analysis of Risk Determinants in Hochschild Mining PLC

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Abstract

Hochschild Mining faces a unique "double exposure" to commodity cycles and foreign exchange rate risks, often operating with revenue, costs, and equity listings denominated in various currencies. This study conducts an empirical analysis on the systematic risk and foreign exchange exposure of Hochschild Mining PLC, a UK-based FTSE 250 constituent who specilise in the production of precious metals in Peru, Brazil, and Argentina but report financials in United States Dollars. Utilising daily returns from November 2020 to November 2025, an augmented Capital Asset Pricing Model framework was applied, which rigorously adjusted for non-normality and heteroscedasticity.

The results presented a challenge to the typical association of miners as "aggressive" cyclical assets. The estimated market beta of 0.60 ($p < 0.01$) identifies Hochschild as a defensive stock, reflecting the counter-cyclical safe-haven properties of gold. No statistical significance was discovered between equity value returns and currency pairs (GBP/USD, GBP/BRL, GBP/ARS, or GBP/PEN) supporting the hypothesis that operational hedging successfully protects shareholders from the daily currency volatility. Furthermore, the Argentine Peso was found to be statistically irrelevant, as hypothesised, due to its decoupling from economic reality. Finally, the structural stability analysis was conducted using Chow Tests, which revealed that while external political and macroeconomic news did not alter the firm's risk profile, the operational expansion into a new mine in Brazil triggered a significant structural break (p = 0.03). These results suggest that operational changes to a firm's asset base drive long-term growth risk repricing than macroeconomic shifts.

1. Introduction

Hochschild Mining PLC is a British leading precious metals company; their focus is on the exploration, mining, processing and sale of gold and silver. It is a constituent of FTSE 250, and it is listed on the London Stock Exchange (LSE), but they primarily operate in South America with mines in Brazil, Peru, and Argentina. Although they are listed on the UK stock exchange, Hochschild Mining reports about their financials in United States Dollars (USD).

This analysis will investigate the extent of the foreign exchange exposure to Hochschild Mining. The currencies used will be chosen based on the scope of the operations and characteristics of Hochschild Mining. The company has heavy reliance on positive performance of gold and silver, which places them at the intersection of complex foreign exchange exposure and volatile commodity cycles. Unlike most UK-based firms, Hochschild Mining face a double exposure due to their revenues being predominantly denominated in USD, while their operational expenditure is in local currencies in local emerging markets, whilst their shares trades in a Great British Pounds (GBP). This empirical analysis will investigate the pricing of these exposures to Hochschild Mining PLC, and evaluate the resulting effects of exposure to USD, GBP, Brazilian Real (BRL), Peruvian Sol (PEN), and Argentinian Pesos (ARS).

The primary objective of this study is to estimate the extent of Hochschild Mining's systematic market risk (Beta, β) and to establish whether the company's theoretical foreign exposure is statistically priced into its stock's returns. Widespread financial literature in this field has attributed fluctuating exchange rates and exchange rate risk to the change of cash flow and stock prices of all firms (Martin & Mauer, 2004). Although exposure to risky currencies has proven to negatively impact a firm's stock prices, there is further literature that suggests operational hedging and volatile commodity prices can obscure these relationships (Dong et al., 2014).

To test these hypotheses, the empirical analysis will employ a multi-factor Excess Return Model, extending the standard Capital Asset Pricing Model (CAPM) to an Arbitrage Pricing Theory (APT) framework that will include USD, BRL, PEN, and ARS. The analysis will observe a 5-year dataset that ranges from November 2020 to November 2025, this will focus on the daily-log returns, adjusted for the daily-risk free rate – Sterling Overnight Index Average (SONIA) - to ensure rigorous measurement of excess returns. Given the financial characteristics of mining stocks, the model is tested for non-normality and heteroscedasticity. Accordingly, the detection of fat-tailed residuals and volatility clustering will result in robust standard-errors testing utilising the Newey-West estimator. Furthermore, dummy variables will ensure the results are not influenced heavily by single outliers in the dataset.

Finally, the analysis distinguishes itself by conducting a structural stability analysis to determine whether Hochschild Mining's risk profile is static or regime dependent. By applying Chow tests, specific events – Peruvian political interference, US Federal Reserve's rate hike, and operational expansion in Brazil - will be examined to answer the critical question – do external macroeconomic shocks alter a firm's systematic risk, or are structural breaks primarily driven by fundamental changes to the company's operations.

2. Theoretical Framework & Model Specification

This section investigates the theoretical underpinnings of the model chosen to explore systematic risk and market exposure of Hochschild Mining. Firstly, it explores the primary economic model – the Capital Asset Pricing Model and extends to the Arbitrage Pricing theory to specify the multi-dimensional exposures faced by the multinational mining firm.

2.1 The Capital Asset Pricing Model

To generate a comprehensive understanding of the factors which affect the share price of Hochschild Mining, we need to establish the base of our analysis – the CAPM. This model outlines the relationship between systematic risk and expected return for assets in an efficient market where risk-averse investors hold diversified portfolios (Sharpe, 1964 & Litner , 1965). This is a robust model in an efficient market, where it can effectively compensate for systematic risk, but it cannot account for the firm-specific risks associated with a multinational corporation such as Hochschild Mining (Fama and French, 1991). This inability to fully capture the risk exposures of Hochschild Mining is enhanced due to their status as a commodities company where exchange rate volatility plays an even more critical role in profitability. Accordingly, the Arbitrage Pricing Theory would be the optimal framework to explore the effects of multiple systematic risks to Hochschild Mining's share price (Ross, 1976).

2.2 Foreign Exchange Exposure

Foreign exchange is a fundamental driver of value for a multinational miner such as Hochschild Mining. The concept of currency exposure as the sensitivity of a firm's stock returns to fluctuations in foreign exchange rates, holding other factors constant was proposed by Adler and Dumas (1984). This creates two crucial streams of exposure for Hochschild Mining. The first of which is Translation Exposure; because Hochschild Mining reports their financial results in USD but their listing in the LSE fluctuations in the GBP/USD exchange rate affect the firm's dollar-denominated earnings when exchanged for the UK shareholders.

Furthermore, the firm's second stream of exposure is their Transaction Exposure in various currencies. These diversified operational expenses create a clear currency mismatch. This mismatch is mainly created by revenues being generated in USD (mainly because of global gold and silver prices), and most operational expenses (workers, taxes, and energy) being incurred in local currencies such as the BRL, PEN, and ARS. Changes in these currencies also affect the firm's operational margins and equity value through fluctuations in the named currencies. Traditionally, mining firms such as Hochschild Mining rely on exchange rates to act as a method of hedging and a 'shock absorber'. However, contemporary literature by Rees (2023) has warned that this mechanism may be weakening, meaning that USD strength will increasingly correlate with high commodity prices in future years. Additionally, operational transaction exposure to currencies such as BRL, PEN, and ARS will become less effective for shock absorbers. This may lead to increased volatility associated with Hochschild Mining's share price.

2.3 Augmented Excess Return Model

To conduct empirical analysis on these exposures, this study employs an augmented regression model on the basis of the APT, where multiple systematic risks will be accounted for. The model regresses the excess returns of Hochschild Mining against the excess returns of the market and the log-returns of the relevant currency pairs. The model will utilise the following factors from data ranging over a 5-year period:

- Daily log returns of Hochschild Mining share price.
- Daily log returns of FTSE 250 index, as the market proxy reflects risk characteristics of a UK mid-cap company.
- Daily Sterling Overnight Index Average (SONIA) rate, converted to a daily rate to match the frequency of stock returns.
- Daily log returns of each exchange rate against the GBP.
- $\beta 1$, which will represent the market beta.
- $\beta 2$ to $\beta 5$ representing the Beta of the foreign currencies.

2.4 A Priori Hypotheses

The following a priori hypotheses will be tested based on Hochschild Mining's operational structure and financial theory:

- **Hypothesis 1 – Market Beta > 1.** Mining stocks are typically characterised by high operating leverage and sensitivity to global economic commodity cycles. Consequently, Hochschild is expected to exhibit "aggressive behaviour", amplifying movements in the FTSE 250, and a broader mid-cap market.
- **Hypothesis 2 – USD Beta < 0.** A positive return in this variable would indicate an appreciation of the GBP against the USD. Hochschild Mining's reporting of revenue in USD could be reduced upon a strengthening of the GBP.
- **Hypothesis 3 – BRL & PEN Beta > 0.** A positive return here implies that GBP is strengthening against the local currencies. As a result, the firm's operational expenses in Brazil and Peru become cheaper in sterling terms. This reduction in real cost should be positive for the share price of Hochschild Mining and thus a positive coefficient is expected.
- **Hypothesis 4 – ARS Beta = 0.** The capital controls and historical fluctuations of the Argentinian Peso create a decoupling between the official exchange rate and the real effective exchange rate faced by Hochschild Mining. Consequently, the official rate fails to capture the reality and true volatility of the local cost base. Therefore, we hypothesize that it will be a statistically insignificant coefficient.

3. Methodology

This section will explore the use of data, the criteria used to collect related data to the empirical analysis, the construction of variables, and the framework in place to estimate the effects of various foreign currencies and market risk factors on the equity value of Hochschild Mining.

3. 1 Data Selection & Collection

To ensure data integrity and analytical robustness, financial data was retrieved from the Bloomberg database for the time frame between November 2020 and November 2025, with Capital IQ used for the graphical data. The study employs a five-year observation window to account for market volatility and trend consistency and because 'the exposure for stocks is significantly positive only for long horizons' (Chow, Lee, & Solt, 1997). This time frame was chosen as it has multiple significant volatility events, including the post-pandemic recovery of overall markets, and the global inflationary spike of 2022.

To capture the firm's full risk profile, there were multiple rates and variables needed. Firstly, the opening prices of the dependent variable – Hochschild Mining PLC – were collected. Then, the FTSE 250 Index daily prices were selected as the market benchmark (Item 10. In Appendix). This was primarily due to Hochschild's mid-cap market constituency and the FTSE 250 providing a more representative measure of systematic risk than the blue-chip FTSE 100. The foreign exchanges factors included in our data collection were the daily prices of the key cost-based currencies Argentinian Pesos, Peruvian Sol, Brazilian Real, and the reporting currency - United States Dollar, all against the Great British Pound.

3.2 Variable Construction & Transformations

Stationary and raw price data of the variable is unsuited to Ordinary Less Squares (OLS) regression analysis. Accordingly, all asset prices and exchange rates were transformed into continuously compounded daily prices using the logarithmic difference method (Brooks, 2019):

$$r_t = \ln\left(\frac{P_{t-1}}{P_t}\right)\times 100$$

P_t represents the price or rate at the time t . Brooks (2019) prefers logarithmic returns due to key features such as their interpretation as continuously compounded returns, making it easier to compare returns across assets.

Risk-Free Rate Adjustment: The SONIA, risk-free rate, was a crucial methodological inclusion in this empirical analysis. It is reported as an annualised percentage in the Bloomberg database; this means that we had to divide the rate by 252 (the number of trading days in a year) to ensure dimensional consistency with the daily equity returns:

$$R_{f,daily} = \frac{R_{SONIA,\,annual}}{252}$$

This daily risk-free rate was later subtracted from the returns of Hochschild Mining and the FTSE 250 to derive the excess returns used in the regression model.

3.3. Testing & Analysis

The analysis follows a rigorous flow and adjustment of the tests conducted in line with the results of each stage of the empirical analysis.

1. OLS Regression: Firstly, the primary model is estimated using OLS regression to explore the coefficients (β) for market and currency exposure.

2. Diagnostic Testing: Thereafter, diagnostic testing was implemented to test against the Gauss-Markov assumptions:

- **Normality:** The Jarque-Bera test was used to detect non-normality in the variable residuals, where common characteristics called 'fat-tails' are typically found (Brooks, 2019).
- **Heteroscedasticity:** The Breusch-Pagan test was utilised to check for non-constant variance. As a mining company, Hochschild Mining would be typically regarded as a volatile asset, therefore volatility clustering would be expected (Gaston, 2016).
- **Autocorrelation:** The Durbin-Watson test is used to ensure residuals are not serially correlated.
- **Multicollinearity:** The test of Variance Influence Factors (VIF) is used to determine the independent currency variables as non-linearly dependent. The gap in results versus perfect multicollinearity was reduced by the introduction of a dummy variable and a Chow Breakpoint Test (Brooks, 2019).

3. Robustness Testing: In the case of heteroscedasticity, the standard errors of the co-efficient are to be re-estimated through the Newey-West covariance matrix. This test provides a clear display of t-statistics and p-values even through the presence of volatility clustering.

4. Structural Stability Testing: To establish how the risk profile of Hochschild Mining has evolved over time, Chow Tests are conducted for known structural breakpoints. The specific test events focused on the Peruvian government's decision to close its flagship Immaculada underground gold and silver mine in 2021, the US Federal Reserve beginning its rate hike cycle in 2022, and the 2024 opening of the open-pit Rosa mine in Brazil.

5. Event Outlier Testing: An outlier of a single-day 27% fall in share price was identified in the preliminary analysis in November of 2021. To avoid this single exogenous event from causing bias in the overall observation window, a dummy variable (Item 1. in Appendix) was designed to take the value of 1 on the event date and 0 otherwise.

4. Empirical Results & Diagnostic Analysis

The following section will outline the economic estimation of risk exposures to Hochschild Mining PLC. The empirical analysis contains three key stages: the initial Ordinary Less Squares regression is evaluated, a rigourous diagnostic framework is applied to test the validity of the Gauss-Markov assumptions, and finally robust inference techniques and dummy variable testing that will be implemented to correct for statistical outlier bias.

4.1 Initial Regression Results

The initial regression model (Appendix Item 2.) demonstrates the regressed daily returns of the Hochschild opening share prices against the excess returns of the FTSE 250 and the log returns of the four examined foreign currency pairs: Brazilian Real, Argentinian Pesos, Peruvian Sol and United States Dollars against GBP. The results of the initial OLS regression are visible in Table 4.1.

	Estimate Coefficient	Standard Error	t-value	p-value
HM/FTSE 250	0.60203	0.11097	5.425	6.94e-08
GBP/USD	-0.08652	0.20713	-0.418	0.676
GBP/PEN	-0.16676	0.17419	-0.957	0.339
GBP/BRL	0.15175	0.10822	1.402	0.161
GBP/ARS	0.01110	0.04517	0.246	0.806

Table 4.1 - Linear Regression Results for Excess Returns of Hochschild Mining PLC.

Market Risk

The estimated Beta of the market return (β_1) is 0.60203 and is highly statistically significant (t-value = 5.425, p < 0.01). Interestingly, the Beta of Hochschild Mining falling under 1 outlines its characteristics as a 'defensive' stock relative to the FTSE 250. This contradicts my first hypothesis that the Market Beta > 1. This likely reflects the use of gold as a safe haven asset during periods of volatility, such as the last 5 years in the global markets, due to its lack of correlation with the broader economy and public markets. Consequently, posing Hochschild Mining as a diversified investment for investors looking for less aggressive options than the general UK mid-cap market.

Foreign Exchanges

GBP/USD: Firstly, we examine a β_{USD} of –0.8652 and are statistically insignificant (t-value = -0.418, p-value = 0.676). This result supports our a priori hypothesis that $\beta_{USD} < 0$. As discussed, the positive return of this result would have invariably meant that Hochschild Mining's reporting of revenue in USD would be reduced upon a strengthening of the GBP. This suggests that when GBP strengthens by 1%, there is typically a downturn of ~0.09%. Although this finding supports our hypothesis that $\beta_{USD} < 0$, there is not a highly significant p-value to support this finding implies the exchange rate affects the stock price.

Therefore, we fail to reject the hypothesis that the revenue exposure coefficient is zero. This does suggest that while there is an economic mechanism of risk, it is effectively neutralised before interfering with the market. This coincides with 'Hedging Hypothesis' that the firm will protect its investors from daily currency volatility through financial derivation or the natural inverse correlation of the USD (Klimczack, 2009).

GBP/BRL & GBP/PEN:

Hypothesis 3 outlined that β_{BRL} & β_{PEN}> 0. This was attributed to the theory that a strengthening GBP reduces the sterling value of local operating costs. This is both supported and contradicted by our results.

To begin with, BRL demonstrates a coefficient of 0.15175 (t-value = 1.402, p-value = 0.161), this is the most significant out of any of the currency pairs, but it still doesn't have enough significance to prove that it affects the share price. In contrast with this, the PEN has a coefficient of –0.16676 (t-value = -0.957, p-value = 0.339) which is insignificant. This negative relationship with a weaker Peruvian Sol correlating with a lower stock price may indicate that investor's view a decrease in the local currency as a sign of political instability or economic distress opposed to a cost-cutting mechanism, which causes an increase in the firm's country risk premium.

In summary, Hypothesis 3 is rejected. The linear regression model unveiled the lack of statistical significance that would support the BRL and PEN systematically changing the share price of Hochschild Mining. This reinstates the conclusion that operational hedging effectively protects the firm's costs from short-term foreign exchange volatility.

GBP/ARS:

Finally, Hypothesis 4 stated that the Argentinian Pesos would be statistically zero. This was driven strongly by the decoupling of the official exchange rate from the real economy due to strict capital controls. This is strongly supported by a foundational Federal Reserve System examination of the Argentinian currency with parallel exchange markets which states the official exchange rate is generally more depreciated during periods of exchange and displaced as much as 30% from the parallel market during political crisis (Kamin & Gehi, 1996). Accordingly, the estimated coefficient of 0.011 is negligible and holds the highest p-value (0.806) of all the factors in the model, confirming the statistical insignificance.

Therefore, hypothesis 4 can be accepted. This empirical analysis has resulted in the widely known view that the official exchange rate in Argentina fails to capture the economic volatility faced by Hochschild Mining in Argentina. It is common for investors to look beyond the official rate, recognising that the costs endured by Hochschild Mining are influenced by a totally different, parallel market (Kamin & Gehi, 1996). To conclude, the official GBP/ARS currency pairing acts as a 'noisy' variable with zero explanatory power for the firm's systematic risk.

Model Fit

The multiple R-squared (R^2) of 0.025 and adjusted R-squared ($\overline{R}^2$) of 0.021 is notably low (Item 3 – Appendix), showcasing the very limited impact of the systematic risk exposures in the model explaining only a small amount of the total variation in Hochschild's daily returns. While low R^2 values are common in single-stock regressions where idiosyncratic disturbances dominate (Brooks, 2019), this result demonstrates that the price-action is driven more by firm-specific factors – such as exploration results, operational updates, or specific commodity price shocks – rather than the broader market.

5. Diagnostic Testing & Structural Stability

This section evaluates the statistical robustness of the OLS model. It will begin with diagnosing violations of standard regression assumptions (normality and heteroskedasticity) and correcting them with robust inference methods. It then investigates the firm's risk profile over time to establish whether it has remained stable over time or shifted due to specific operational or external shocks.

5.1 Diagnostic Analysis of Residuals

To ensure the OLS estimates were valid, the residuals of the model were subjected to a battery of diagnostic tests.

1. Normality: The Jarque-Bera (JB) test strongly rejected the null hypothesis of normality ($p > 0.01$). As seen in Figure 5.1, the distribution of the residuals (black line) is leptokurtic, showing a high peak at the mean and having fatter tails (Brooks, 2019). The kurtosis value of 17.434 (significantly above the normal level of 3) indicates that Hochschild's stock experiences increased volatility and price shocks in comparison to normal distribution of a standard financial model (Item 4. in the Appendix). This is consistent with the characteristics of a typical mining company, where operational and political news can cause large pricing shifts.

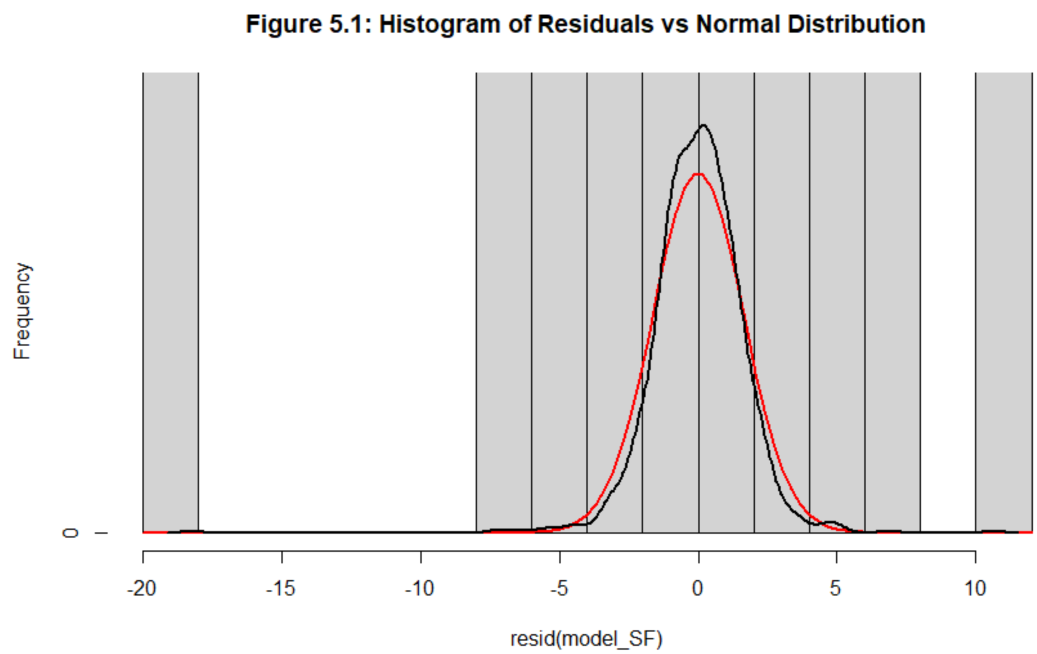


Figure 5.1 The Histogram of Residuals from 'model_SF' versus the normal distribution of a standard model.

2. Heteroscedasticity: To test for this, the Breusch-Pagan test was used. The test yielded a BP statistic of 1.64 and a p-value of 0.896 (Item 5. in the Appendix). In contrast to many financial time series, this implies the residual variance (Item 11. In the Appendix) is statistically constant over the sample period. These results indicate that the p-value is well-above the 5% significance value, so it can fail to reject the null hypothesis of homoscedasticity. However, given the severe non-normality detected by the Jarque-Bera test, we proceeded with the Newey-West robust standard errors as a precautionary measure to ensure valid inference.

3. Serial Correlation & Multicollinearity

Durbin-Watson (DW) Test: This tests for autocorrelation in the residuals from the regression analysis. The test yielded a DW score of 2.138; this score means that the null hypothesis of autocorrelation would not be rejected as the score is near 2 (Brooks, 2019).

H_0 = First-order autocorrelation does not exist.

H_1 = First-order autocorrelation exists.

Variance Inflation Factors (VIF) Test: VIF for all independent variables was approximately 1 (Item 6. in the Appendix). This result confirms that the currency pairs and market index are not linearly dependent and orthogonal (Brooks, 2019).

5.2 Robust Inference

Following the detection of heteroscedasticity and non-normality, Newey-West standard errors were completed. This procedure was conducted to ensure that statistical inference remained valid despite the non-normality results found by the JB test.

The robust results confirmed the validity of the initial model results: the results remained consistent with the initial OLS estimation (Table 5.1). The Market Beta (β_{mkt}) retained high statistical significance with the t-value slightly increasing to 5.523 and a p-value < 0.01. Additionally, the currency pairs all remained statistically insignificant, with the Brazilian Real (0.112) remaining the most relevant. This test of robustness confirms that the standard errors in the initial model were not influenced by distributional anomalies, validating the decision to reject the hypothesis regarding short-term currency exposure.

	Estimate Coefficient	Standard Error	t-value	p-value
HM/FTSE 250	0.60203	0.109	5.523	4.058e-08
GBP/USD	-0.08652	0.173	-0.499	0.618
GBP/PEN	-0.16676	0.167	-0.997	0.319
GBP/BRL	0.15175	0.095	1.591	0.112
GBP/ARS	0.01110	0.027	0.404	0.686

Table 5.1 - Newey-West Results for Robust Inference testing.

5.3 Robustness Check

Following on from the robustness inference test, there was an extreme outlier in November 2021 of the data – a 27% crash following the threats of the Peruvian government to close the flagship mine of Hochschild Mining. In response to this, a robustness check was conducted by introducing a dummy variable (Item 1. in the Appendix). This dummy variable demonstrated that it was highly significant (where t = -11.74, $p < 0.01$) with a coefficient of –18.23 (Item 7. in the Appendix). This clearly outlines the impact of the political shock on the firm's value, resulting in a decrease of –18.2% on a single day, when the reduction in firm value was independent of currency pairs or market exposure.

Crucially, the other key coefficients remained stable, with only marginal shifts in the β_{mkt} from 0.602 to 0.594, whilst retaining their statistical significance. The currency pairs remained stable and insignificant, with only marginal differences in p-values resulting in negligible changes. The R^2 and $\overline{R}^2$ also increased by approximately 12% (Items 8. & 9. in the Appendix), further increasing the fit of the model. This stability confirms that the 'defensive' risk of Hochschild Mining identified originally is a fundamental characteristic of the stock and not just a result of a single political exogenous factor.

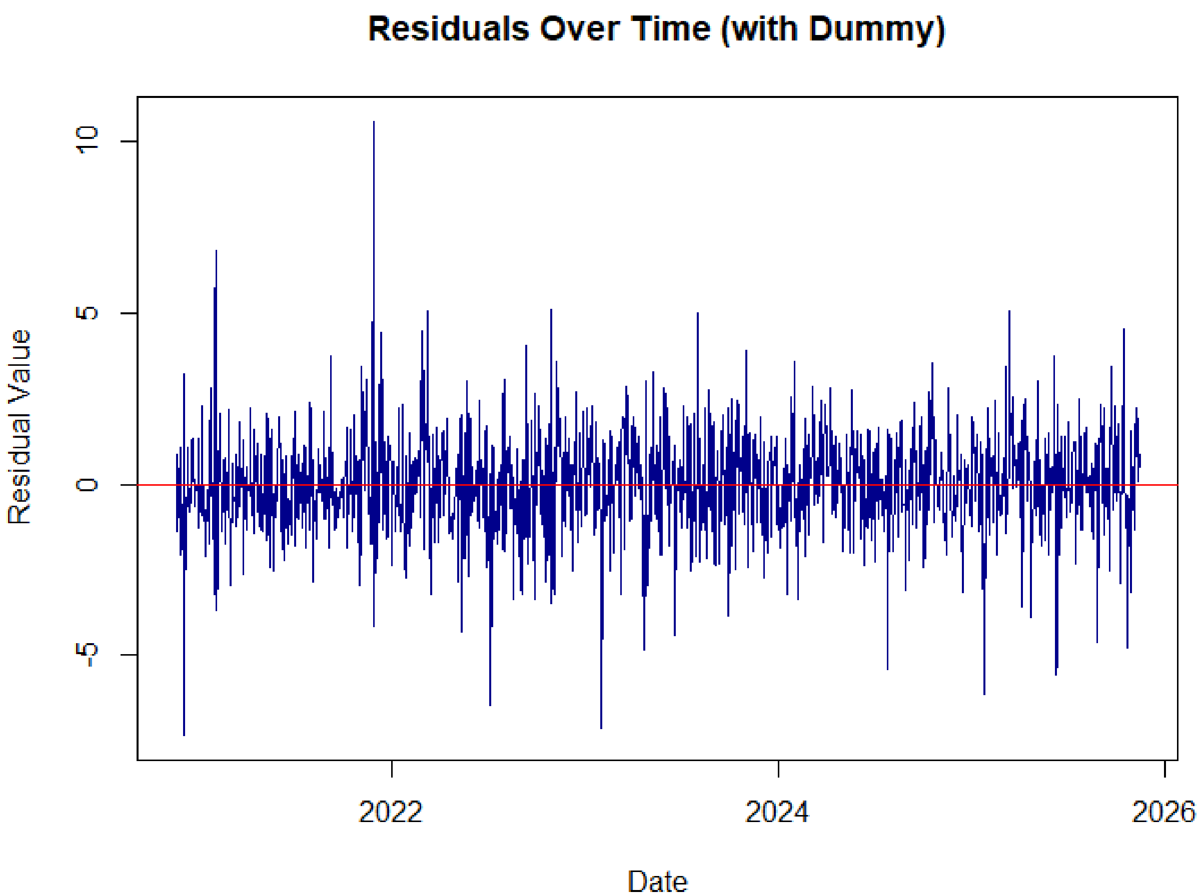


Figure 5.2 – Residuals of the Robustness Check Model (with the dummy variable). Note the removal of the negative outlier (Item 11. In the appendix), confirming the dummy variable successful in capturing the shock.

5.5 Structural Stability Analysis

Finally, to conduct proper scientific rigour Chow Tests were conducted to analyse whether specific events caused a structural break in Hochschild's risk profile. As illustrated in Figure 5.2, the cumulative sum of recursive residuals remains within the red critical significance lines, however in 2024 it starts to diverge from the central perfect stability line, confirming the parameter instability associated with the Brazil mine expansion. The results clearly outline a difference between reactions of operational changes to external shocks:

1. The first test investigated the Peru Political Crisis in 2021, and the second event study looked at the US Federal Reserve's decision to implement a rate hike cycle in 2022. These tests did not show any significant results (2021 Event p-value = 0.36, 2022 event p-value = 0.10). While both macro-events directly affect the currency pairs related to the operations and revenue of Hochschild Mining, neither caused short-term volatility nor their long-term pricing.

2. In contrast to these results, another event study of the announcement of the opening of a new mine in Mara Rosa, Brazil (2021) was found to be statistically significant (p = 0.03). This result indicates a structural break, showcasing that a fundamental change in their operational functioning had a more profound effect on their overall risk profile than a macroeconomic headline or political uncertainty.

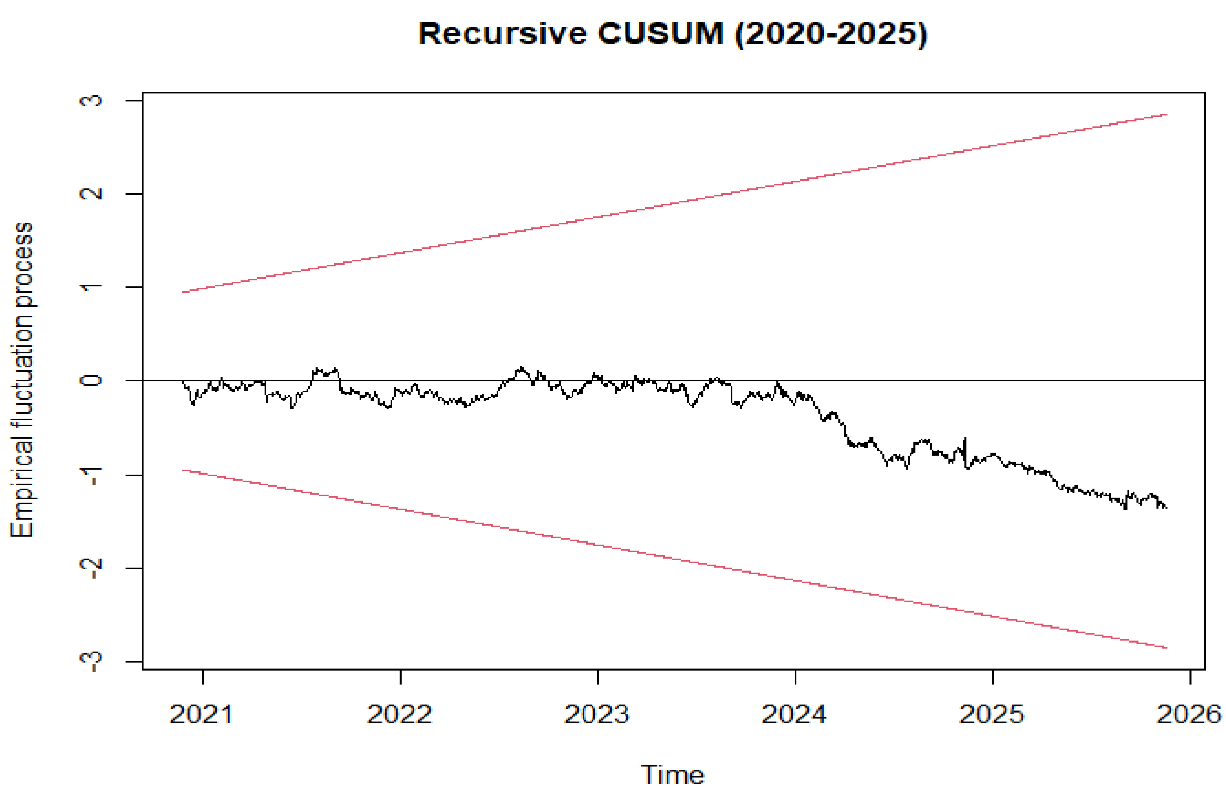


Figure 5.3 – The Recursive Cumulative Sum Chart confirms the divergence from prior stability around the expansion in Brazil.

6. Conclusion

In summary, this study has conducted a comprehensive empirical analysis of Hochschild Mining PLCs to outline the extent to which its firm value is driven by systematic market risk and foreign exchange exposure. By employing an augmented excess return model over a five-year period and subjecting it to appropriate diagnostic testing, this economic analysis can derive three key results regarding the pricing of risk in the mid-carpet UK mining sector.

Firstly, the analysis firmly rejects the a priori hypothesis that Hochschild Mining behaves as an "aggressive" stock. The estimated Market Beta of 0.60 ($p < 0.01$) outlines that the firm is a "defensive" stock in relation to our benchmark of the FTSE 250 index. This finding is significant and suggests that the firm can be seen as a safe-haven asset, dampening the firm's correlation with the broader UK market. For investors, this revelation implied that Hochschild is an effective method of diversifying within a mid-cap portfolio rather than relying merely on general economic growth.

Furthermore, the analysis also found that there was no statistical evidence to suggest that daily foreign exchange rates affect the firm's share price. All currency pairs (GBP/ARS, GBP/USD, GBP/PEN, GBP/BRL) demonstrated statistical insignificance, even after controlling non-normality and heteroscedasticity. This result strongly supports the hedging hypothesis, which outlines that a firm will protect its investors from daily currency volatility through financial derivation or the natural inverse correlation of the USD (Klimczack, 2009). Furthermore, we investigated the insignificance of the Argentinian Pesos and that the official exchange rate is strongly decoupled from the actual exchange reality faced by Hochschild.

Lastly, the structural stability analysis provided a critical insight into the various risks which directly affect the firm. It was discovered that the 202 Peruvian political crisis and the US Federal Reserve's interest hike cycle in 2022 did not break in the firm's risk profile. In comparison, the opening of the Mara Rosa underground mine in Brazil indicated a statistically significant break ($p = 0.03$). This underpins a key learning for valuations: political headlines may create noise, but it is the changes to Hochschild's asset base and operational footprint that primarily drives the market's repricing of risk.

Ultimately, Hochschild Mining is priced by the market not as a proxy for currency volatility, but as a defensively positioned, operationally sensitive miner. This research generates a potential indication of the sensitivity and market risks to companies in the mining or asset-based sectors. Future research could extend this framework by explicitly including exchange spot prices as independent variables to determine if the "missing" explanatory power ($R_2 \approx 0.12$) is attributable to gold and silver volatility, thereby completing the risk decomposition of Hochschild Mining.

Appendix

Item 1.

```
#Inserting a Dummy Variable
#This dummy variable will account for the outlier crash observed in my Residuals over Time graph
worst_day_rowSF <- which.min(Data_SF$ExRet_HOC_SF)
print(paste("The crash happened on: ", Data_SF$Date[worst_day_rowSF]))

#Dummy Variable
#Initalise the column with 0s which represent normal days
Data_SF$DummySF <- 0

#Set the value to 1 only for the day of the crash date
Data_SF$DummySF[worst_day_rowSF] <- 1
```

Item 2.

```
#My Linear Regression Model which tests how much the stock's performance is driven by each currency
model_SF <- lm(ExRet_HOC_SF ~ ExRet_FTSE_SF + Ret_USD_SF + Ret_PEN_SF +
                 +                     Ret_BRL_SF + Ret_ARS_SF, data = Data_SF)
```

Item 3.

```
Call:
lm(formula = ExRet_HOC_SF ~ ExRet_FTSE_SF + Ret_USD_SF + Ret_PEN_SF +
    +Ret_BRL_SF + Ret_ARS_SF, data = Data_SF)

Residuals:
     Min       1Q   Median       3Q      Max
-18.2065  -0.9218   0.0202   0.9515  10.6076

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    0.01300    0.04625   0.281    0.779
ExRet_FTSE_SF  0.60203    0.11097   5.425 6.94e-08 ***
Ret_USD_SF    -0.08652    0.20713  -0.418    0.676
Ret_PEN_SF    -0.16676    0.17419  -0.957    0.339
Ret_BRL_SF     0.15175    0.10822   1.402    0.161
Ret_ARS_SF     0.01110    0.04517   0.246    0.806
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.634 on 1254 degrees of freedom
Multiple R-squared:  0.02515,	Adjusted R-squared:  0.02126
F-statistic: 6.471 on 5 and 1254 DF,  p-value: 5.994e-06
```

Item 4.

```
> kurtosis(resid(model_SF))
[1] 17.43401
```

Item 5.

```
> #Heteroscedasticity Testing:
> #1. The Breusch-Pagan test will be used to calculate the changing variance
> bptest(model_SF)

	studentized Breusch-Pagan test

data:  model_SF
BP = 1.6407, df = 5, p-value = 0.8963
```

Item 6.

```
ExRet_FTSE_SF     Ret_USD_SF     Ret_PEN_SF     Ret_BRL_SF     Ret_ARS_SF 
     1.006107       1.066869       1.003863       1.001861       1.066816 
```

Item 7.

```
Coefficients:
               Estimate Std. Error t value Pr(>|t|)    
(Intercept)     0.02754    0.04394   0.627    0.531    
ExRet_FTSE_SF   0.59398    0.10537   5.637 2.14e-08 ***
Ret_USD_SF     -0.09656    0.19668  -0.491    0.624    
Ret_PEN_SF     -0.14191    0.16541  -0.858    0.391    
Ret_BRL_SF      0.16066    0.10277   1.563    0.118    
Ret_ARS_SF      0.01064    0.04289   0.248    0.804    
DummySF       -18.22619    1.55263 -11.739  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.552 on 1253 degrees of freedom
Multiple R-squared:  0.1217,	Adjusted R-squared:  0.1175 
F-statistic: 28.95 on 6 and 1253 DF,  p-value: < 2.2e-16
```

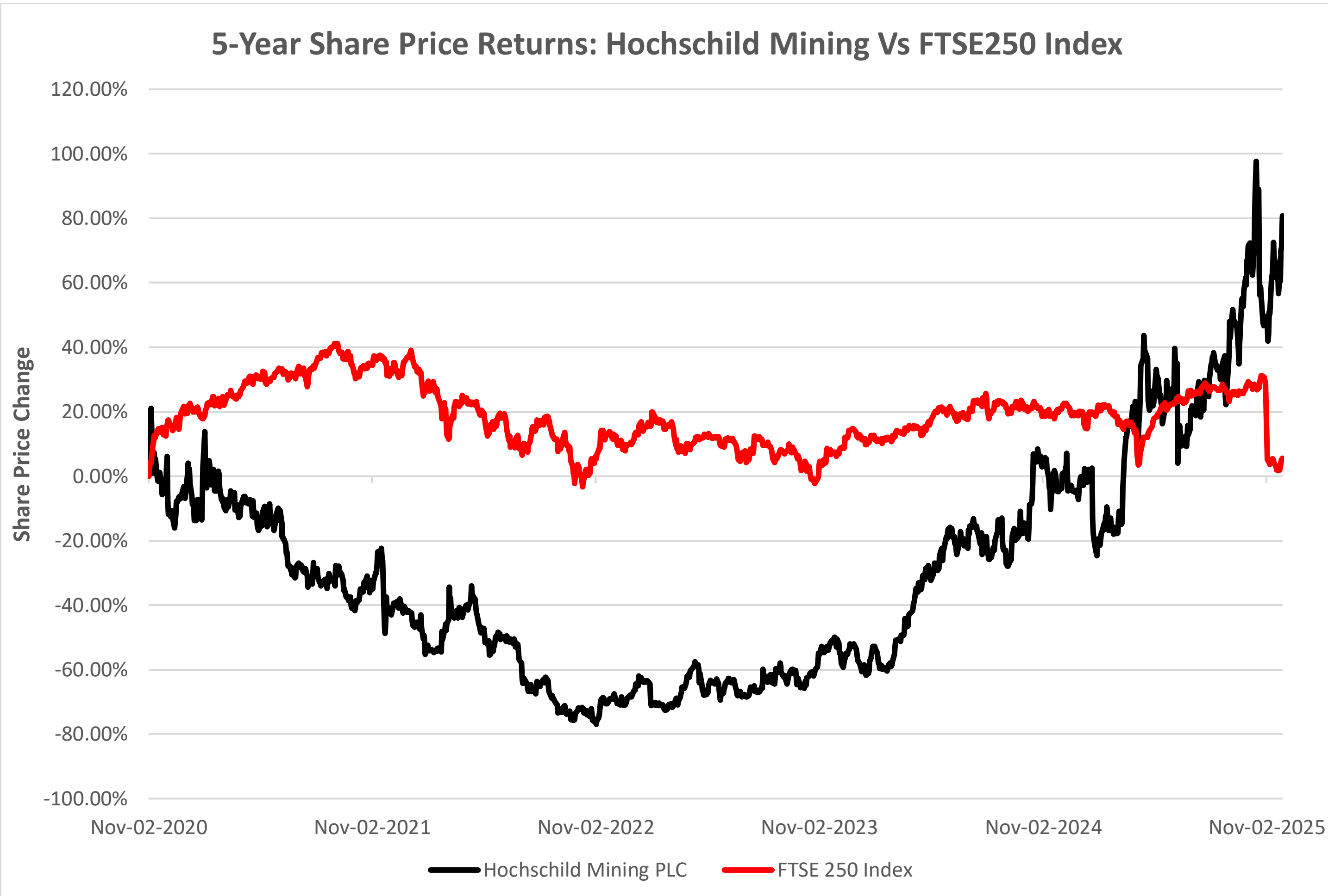
Item 8. Original Model R-values

```
Residual standard error: 1.634 on 1254 degrees of freedom
Multiple R-squared:  0.02515,	Adjusted R-squared:  0.02126 
F-statistic: 6.471 on 5 and 1254 DF,  p-value: 5.994e-06
```

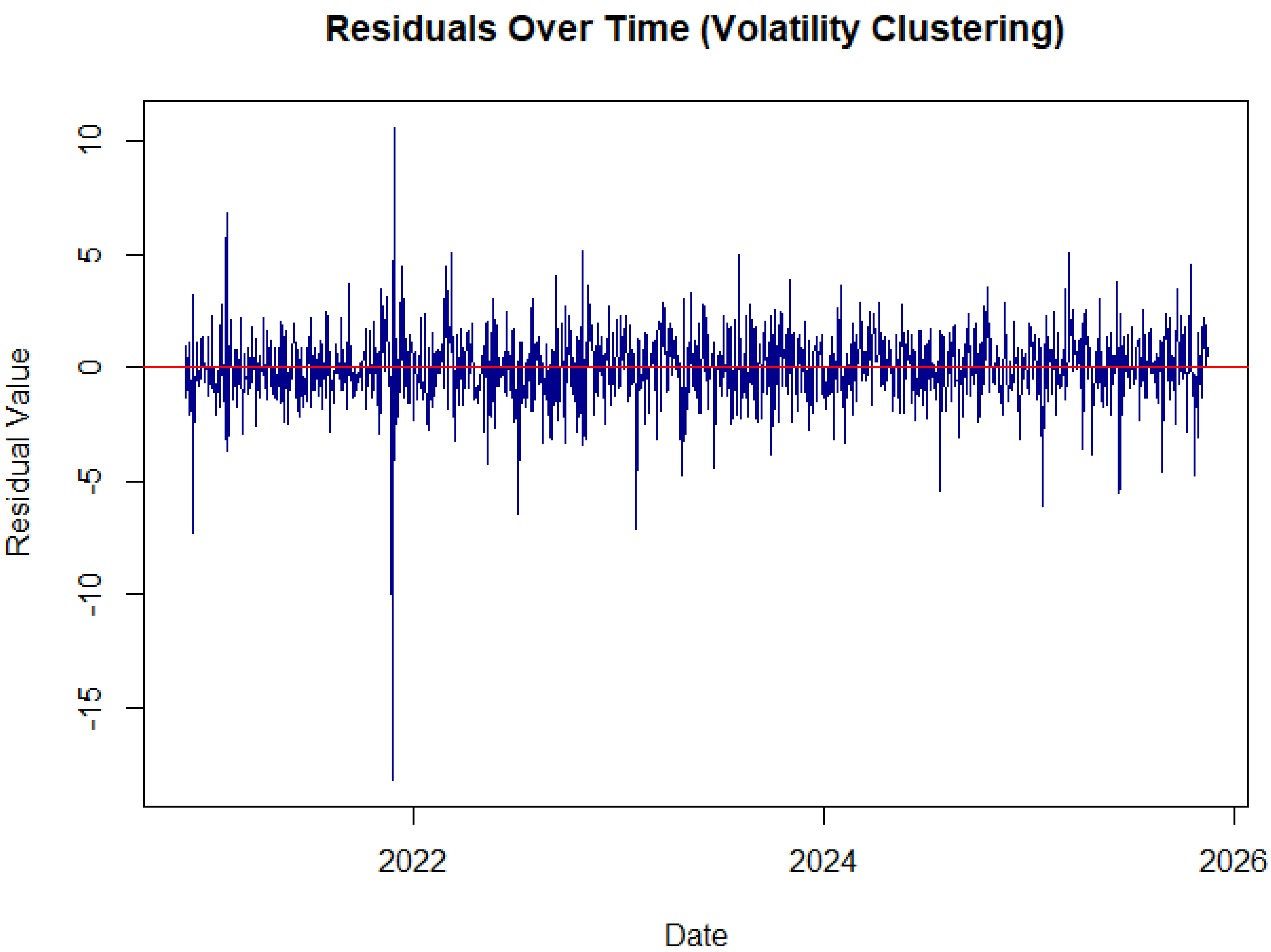
Item 9. Dummy Variable R-values

```
Residual standard error: 1.552 on 1253 degrees of freedom
Multiple R-squared:  0.1217,    Adjusted R-squared:  0.1175
F-statistic: 28.95 on 6 and 1253 DF,  p-value: < 2.2e-16
```

Item 10.



Item 11.



Residuals Over Time (Volatility Clustering)
Residual Value
10
5
0
-5
-10
-15
2022
2024
2026
Date

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All data utilised in this empirical analysis was generated from Bloomberg Terminals or Capital IQ.

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