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ARTICLE

Do Portfolio Construction Strategies Matter in Mitigating Macroeconomic Risks?

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Abstract

This study examines how macroeconomic variables—the market risk premium, inflation, the exchange rate, and the interest rate—affect the performance of portfolios constructed using six different strategies applied to the Egyptian Exchange (EGX). Using monthly data for 31 non-financial stocks over the period of 2020 to 2024, we construct and compare Equal Weighting (EW), Minimum Variance (MinVar), Equal Risk Contribution (ERC), Mean-Variance Optimization (MVO), Value, and Growth portfolios, and subject all six to a multivariate OLS regression framework with stationarity controls. The market risk premium dominates all other factors across every strategy. Minimum Variance portfolios have been most affected by the exchange rate depreciation, while the Growth portfolios have been insulated to a great degree. The interest rate positively impacted five portfolios, which is a paradoxical effect. The interest rate normally negatively impacts portfolios, but in the case of the Egyptian economy, the interest rate increased during the crisis, which caused the risk premium to widen. The inflation rate positively impacted the Value portfolio. The results showed an interesting anomaly whereby the heuristic Equal Risk Contribution portfolio outperformed the theoretical Minimum Variance portfolio. Policy implications include transparent exchange-rate adjustment, credible inflation targeting, and improvements in corporate governance standards.

Keywords: Egyptian Exchange; Equal risk contribution; Minimum variance; Inflation hedging; Portfolio construction; Emerging markets; Macroeconomic factors; Tactical allocation

1. INTRODUCTION

The portfolio optimization problem has been a longstanding one in financial economics, and it becomes even more challenging when dealing with emerging markets. Emerging markets are characterized by high volatility, low institutional quality, and high sensitivity to macroeconomic events [1]. Although Modern Portfolio Theory (MPT) and its extensions, namely Mean-Variance Optimization (MVO) and Minimum Variance (MinVar), have been extensively tested in developed markets, their applicability in emerging markets, particularly North African markets, has not been sufficiently explored. This study specifically targets the Egyptian Exchange (EGX) market, which is an interesting test bed because of its unique macroeconomic environment during the period from 2020 to 2024.

In fact, between February 2020 and December 2024, Egypt has gone through a series of economic events, including the COVID-19 pandemic, three consecutive currency devaluations, an inflation rate reaching as high as 35% annually, and a tight monetary policy, raising the policy rate of the Central Bank of Egypt up to approximately 27% by the end of 2024 [2]. Unlike developed markets, where firm-level fundamentals are key drivers of stock returns, macro-level fundamentals, including exchange rate movements and interest rate policy, are critical drivers of stock returns on the EGX market [3]. The findings obtained from Western or other African countries cannot be directly used for this market.

Yet, in spite of the increasing interest in African equity markets, there is still a lack of literature on portfolio construction in the MENA region. Most of the existing research focuses on the impact of various

macroeconomic variables on the overall market indices [4]. However, few have compared the results of various portfolio construction methodologies under different macro regimes. This research will directly fill this research gap.

The research aims to achieve two goals. First, it will empirically verify if risk-based approaches like MinVar and ERC provide better protection against market volatility in Egypt compared to naive diversification like EW and MVO-based return maximization. Second, it will reveal the impact of inflation rates, exchange rate changes, and interest rate movements on portfolio excess returns in Egypt. The research will be conducted by implementing six different portfolio construction methodologies using 31 non-financial stocks listed on the EGX.

The paper contributes to the literature in three ways: it is the first study to use regression analysis to compare macro-driven performance differentials across various construction methods for the Egyptian market. Secondly, it identifies an interesting phenomenon wherein the heuristic ERC portfolio has lower realized volatility than the theoretically optimal MinVar portfolio, consistent with the estimation error critique of mean-variance optimization. Thirdly, it offers an explanation for Egypt's anomalous positive interest rate coefficients via risk premium widening during crises rather than via the conventional discount rate effect.

The paper is organized as follows: Section 2 discusses the literature; Section 3 discusses the data and methods; Section 4 presents the results; Section 5 discusses the results and their implications; and Section 6 concludes.

2. Literature Review

2.1. Theoretical Background and Global Context

The association between macroeconomic indicators and the performance of the stock market is an area of interest for financial literature, supported by asset pricing theories such as the 'Arbitrage Pricing Theory' (APT). It argues that various macroeconomic indicators have a systematic impact on the performance of the stock market. Initial studies by Asprem [1] focused on ten European countries and proved the inverse association of employment, imports, inflation, and interest rates with the stock market, as well as the positive association of expectations of future real activities. In more recent literature, Iania, Collage, and Vereycken [5] have studied the association of macroeconomic uncertainty and the performance of the stock market in the United States and proved the positive association of the two.

In the EU context, the impact of the macro variables differs from one country to another. In Sweden, for instance, Rudberg & Johansson [6] discovered that industrial production was the only variable with effects on the short and long run. In contrast, Kolawole et al. [7], who analyzed the case of the UK, discovered that GDP and Foreign Portfolio Investment are positive variables influencing the returns, while inflation and interest rates are dampeners. In a panel data approach of 21 developed and 19 developing countries, Assefa et al. [8] discovered that while the developed countries had a lower level of stock return (1.19%) than the developing countries (4.22%), interest rates are a major driver of stock return for both groups of countries. Graham et al. [9], who analyzed the case of emerging countries, discovered that economic activity at the global level—proxied by the indices of maritime and commodity trade—has a positive impact on equity return.

2.2. Evidence from Emerging Markets

The literature on emerging markets reveals that structural vulnerabilities tend to make economies sensitive to various macroeconomic shocks. For instance, Firmansyah et al. [10] used empirical analysis to explain the determinants of portfolio investment for the short and long run for five ASEAN countries. It revealed a clear distinction between the short and long run; in the short run, interest rates and exchange rates are major determinants of investment decisions, while in the long run, all the variables together influence the performance of the economy. Moreover, other country-specific studies also highlight the heterogeneity of the relationship between these variables for different countries. For instance, in the context of Malaysia, Chauque and Rayappan [11] revealed that inflation is positively related to equity returns; however, the relationship between these variables is negative in the context of European countries. Moreover, in Indonesia, Assagaf et al. [12] also revealed that inflation, interest rates, and

exchange rates together influence stock returns. Similar findings were revealed for Sri Lanka [13] and Taiwan [14].

With regard to the two largest emerging markets in Asia, Gu et al. [15] have shown the time-varying nature of the interest rates-equity return relationship in China, underscoring the need for dynamic approaches. With regard to the Indian market, Hedau [16] and Joseph et al. [17] have demonstrated the sensitivity of the market to international indices and its integration with international capital flows. Concerning the Middle Eastern markets, Mohammadi et al. [18] have studied the case of Iran and demonstrated, through the application of OLS regression, the differential impact of macroeconomic factors on the systematic risk of value and growth firms. About the Turkish market, Pala and Orgun [19] have shown the presence of a structural break in 2003 following economic reforms, after which the relationship between interest rates on deposits and foreign portfolio investments reversed, a precedent of particular interest to the case of Egypt.

2.3. Evidence from the Egyptian Exchange

The most pertinent past studies related to the EGX are Barakat et al. (2016), who used Granger Causality and Johansen Cointegration tests on Egypt and Tunisia over the period from 1998 to 2014. Their findings show a bidirectional causal link between the general stock market index and the exchange rate, interest rates, and the CPI in Egypt, with all these variables being cointegrated with the EGX 30 in the long run. Most pertinent to the present paper is their key finding that interest rates are an important risk factor for the Egyptian stock market but not for the Tunisian stock market. More recently, Ragab and Abou-Zaid [20] conducted an event study on EGX 30 firms surrounding the March 2024 pound devaluation event and found that export-oriented and foreign currency-generating firms showed notably higher resilience to the event, while import-dependent firms showed sharper declines in stock prices. This is directly related to the present paper's findings of the portfolios' behavior, specifically the finding of exchange rate neutrality of the Growth portfolios and the severe depreciation sensitivity of the MinVar and Value portfolios.

2.4. Comparative Asset Classes and Portfolio Construction

Although the focus of most literature has been on equities, Nworah et al. [21] studied the effect of macro variables on the performance of real estate investment in Nigeria. Their findings confirmed that returns on commercial properties are subject to the same exchange rate and inflation forces as equities. This further validates the fact that macro sensitivity is an inherent feature of emerging economies rather than a phenomenon of liquid equity markets only.

Within the context of the portfolio construction literature, Clarke et al. [22] offered an analytic framework comparing the risk parity, maximum diversification, and minimum variance portfolios. They showed that while the minimum variance portfolio minimizes variance, the concentrated nature of the portfolio results in counterintuitive out-of-sample results during periods of market stress. In fact, recent empirical results have reinforced the relative merits of the risk parity approach. In a comparative analysis of the risk parity, maximum diversification, and minimum variance portfolios using data from 2014 to 2023. The results showed that the risk parity approach outperforms the minimum variance approach in terms of Sharpe ratios while demonstrating greater stability and resilience during high volatility events, such as the COVID-19 pandemic and the subsequent financial tightening cycle, which directly supports the ERC over the MinVar anomaly identified in the current study. In another related context, Pham et al. [23], using OLS and quantile regressions, showed that dynamic portfolios can be constructed to track and hedge inflation in the context of the BRICS countries' emerging markets. This offers a methodological antecedent for the current study's use of OLS regressions to identify the inflation-hedging properties of the Value portfolio. The Fisher hypothesis, which suggests that equity returns should include the effects of inflation, offers the theoretical context for the identification of the Value portfolio's significant and positive coefficient. This suggests that the value stocks, in the context of the high-inflation economy, more fully satisfy the Fisher condition than the growth stocks.

Taken collectively, the literature reveals three distinct themes: (i) the significance of time horizon, where inflation does not impact the short run but is significant in the long run, (ii) the differing sign of the impact, where the impact tends to be negative in developed markets but positive in developing markets, and (iii) the overall negative impact on markets, though this was qualified in the context of

crisis-driven interest rate actions. The literature also reveals a significant omission, where the focus has been predominantly on Asian emerging markets, and in the Egyptian context, the literature has been restricted to aggregate market indices without reference to portfolio strategy. The unique characteristics of the Egyptian market, including high inflation, currency adjustments, and the banking sector-dominated index, cannot be replicated using the current literature. This research directly addresses this omission, providing the first-ever strategy-level analysis on EGX.

3. Data and Methodology

3.1. Data and Sample Specification

The empirical analysis period is from February 2020 to December 2024, generating 59 observations for each variable. The investment population is defined as all non-financial constituents of the EGX 100 index, which is the broadest and most general stock market index in Egypt. Financial stocks are excluded to maintain the comparability of the fundamental ratios used for style classification and to avoid the special interest margin and currency-asset effects of banking stocks. From this investment universe, the final sample of equities is composed of 31 stocks based on the following criteria: (i) availability of continuous prices over the full sample period; (ii) trading frequency and lack of long trading suspensions; and (iii) sufficient market capitalization and turnover for practical inevitability. The logarithmic monthly return is calculated as $(R_{i,t} = \ln \frac{P_{i,t}}{P_{i,t-1}})$. The risk-free rate is the annualized Egyptian Treasury Bill return divided by 12.

Four macroeconomic variables are sourced from the Central Bank of Egypt and official statistical releases: the headline inflation rate (INF), the USD/EGP exchange rate (FOREX), the Central Bank policy rate (IR), and the EGX 100 monthly return, used to construct the market risk premium (MRP = EGX 100 return minus the risk-free rate).

3.2. Portfolio Construction Methodologies

Six portfolio strategies are implemented and rebalanced monthly. All portfolios are constrained to full investment ($\Sigma w_i = 1$) and no short selling ($w_i \geq 0$). The portfolio return for period t is:

$$R_{p,t} = \Sigma_i w_{i,t} \cdot R_{i,t} \qquad (1)$$

Equal Weighting (EW). Each of the N = 31 stocks receives an identical weight $w_i = 1/N$. This naïve diversification strategy requires no parameter estimation and serves as the primary benchmark [24].

Minimum Variance (MinVar). Minimizes ex-ante portfolio variance: $min_w w'\Sigma w$, subject to $\Sigma w_i = 1$ and $w_i \geq 0$, where Σ is the historical sample covariance matrix.

Mean-Variance Optimization (MVO). Constructs the tangency portfolio by maximizing the ex-ante Sharpe ratio: $max_w (w'\mu)/\sqrt{(w'\Sigma w)}$, where μ is the vector of historical mean returns.

Equal Risk Contribution (ERC). Allocates capital so each asset contributes equally to total portfolio volatility. The risk contribution of asset i is $RC_i = w_i \times (\Sigma w)_i/\sqrt{(w'\Sigma w)}$. The ERC solution is found by minimizing the dispersion of pairwise risk contributions [25].

Value and Growth Portfolios. At each rebalancing date, the 31 stocks are ranked by their Book-to-Market (B/M) ratio. The Value portfolio holds stocks in the top tertile (highest B/M) equally weighted; the Growth portfolio holds stocks in the bottom tertile (lowest B/M) equally weighted.

3.3. Performance and Risk Measurement

Annual out-of-sample performance is evaluated for each strategy over 2020–2024 using: Annualized Return and Volatility; Beta (OLS slope from a market model regression on the EGX 100); Jensen's Alpha (OLS intercept from the market model); Sharpe Ratio [26]; and Treynor Ratio [27].

3.4. Econometric Regression Framework

To identify the macroeconomic drivers of portfolio excess returns, the following OLS model is estimated for each of the six portfolios:

$$ER_{p,t} = \alpha_p + \beta^1 MRP_t + \beta^2 INF_t + \beta^3 \Delta FXR_t + \beta^4 \Delta IR_t + \varepsilon_t \qquad (2)$$

where $ER_{p,t}$ is the monthly excess return of portfolio p; MRP is the market risk premium; INF is the monthly inflation rate; ΔFXR is the first difference of the exchange rate; and ΔIR is the first difference of the policy rate. The Augmented Dickey-Fuller (ADF) test is applied to all series prior to estimation to confirm stationarity. Variables found to be I (1) at levels enter as first differences to avoid spurious regression. All six portfolio-specific equations are estimated as:

$$EWP_t = \alpha + \beta^1 MRP_t + \beta^2 INF_t + \beta^3 \Delta FXR_t + \beta^4 \Delta IR_t + \varepsilon_t \quad (3)$$

$$MinVP_t = \alpha + \beta_1 MRP_t + \beta_2 INF_t + \beta_3 \Delta FXR_t + \beta_4 \Delta IR_t + \varepsilon_t \quad (4)$$

$$MeVP_t = \alpha + \beta_1 MRP_t + \beta_2 INF_t + \beta_3 \Delta FXR_t + \beta_4 \Delta IR_t + \varepsilon_t \quad (5)$$

$$ERC_t = \alpha + \beta_1 MRP_t + \beta_2 INF_t + \beta_3 \Delta FXR_t + \beta_4 \Delta IR_t + \varepsilon_t \quad (6)$$

$$Value_t = \alpha + \beta_1 MRP_t + \beta_2 INF_t + \beta_3 \Delta FXR_t + \beta_4 \Delta IR_t + \varepsilon_t \quad (7)$$

$$Growth_t = \alpha + \beta_1 MRP_t + \beta_2 INF_t + \beta_3 \Delta FXR_t + \beta_4 \Delta IR_t + \varepsilon_t \quad (8)$$

Model adequacy is assessed using adjusted R^2, F-statistics, and the Durbin-Watson statistic for residual autocorrelation.

3.5. Identification and Causality Considerations

The OLS regression is designed to create predictive relationships between macroeconomic factors and portfolio excess returns rather than causal relationships. This is a valid and proper decision made according to the purpose of the research. The goal of this paper is to estimate how much of the variation in the returns of portfolios can be explained by macroeconomic factors. It also aims to find out which construction strategies are more sensitive and less sensitive to each macroeconomic factor.

Reverse causality is unlikely to hold in the case of the three exogenous variables. In the case of the interest rate set by the Monetary Policy Committee, it cannot possibly be a function of the excess returns earned by 31 nonfinancial stock assets; but rather, a reaction to the changes in the inflation rate and the exchange rate. Likewise, the consumer price index is a reaction to the changes in prices within the economy, which are functions of demand and supply conditions as well as import costs.

The market risk premium, built from the EGX 100, is more representative of stock market conditions. This paper adheres to the traditional APT model [28], whereby the market risk premium is treated as a systematic risk factor of the present period. The crucial issue, then, is not whether the market influences portfolio returns or if portfolios influence market performance; rather, it is the amount of co-movement between the market variable and the portfolio, captured by the coefficient β_1.

4. Empirical Results

4.1. Annual Portfolio Performance

Tables 1 through 6 present annual risk-adjusted performance metrics for each strategy over 2020–2024.

Table 1. Equal Weighting (EW) Portfolio Performance.

Year	Ann. Return	Ann. Volatility	Beta	Alpha	Sharpe	Treynor
2020	9.07%	32.5%	0.779	(0.03)	(0.101)	(0.042)
2021	13.04%	25.5%	0.835	0.02	0.061	0.019
2022	19.90%	28.7%	1.030	0.07	0.255	0.071
2023	53.30%	18.4%	0.788	0.33	1.821	0.425
2024	27.50%	30.9%	1.064	0.02	0.077	0.022

Table 2. Minimum Variance (MinVar) Portfolio Performance.

Year	Ann. Return	Ann. Volatility	Beta	Alpha	Sharpe	Treynor
2020	(8.43%)	24.8%	0.530	(0.21)	(0.837)	(0.393)
2021	22.81%	28.4%	0.668	0.11	0.399	0.169
2022	20.01%	23.6%	0.824	0.07	0.315	0.090
2023	82.45%	33.6%	0.207	0.63	1.865	3.019
2024	18.95%	33.6%	0.994	(0.06)	(0.183)	(0.062)

Table 3. Equal Risk Contribution (ERC) Portfolio Performance.

Year	Ann. Return	Ann. Volatility	Beta	Alpha	Sharpe	Treynor
2020	0.16%	26.5%	0.483	(0.12)	(0.460)	(0.253)
2021	14.17%	24.7%	0.679	0.03	0.108	0.039
2022	22.74%	27.8%	0.967	0.10	0.366	0.105
2023	55.32%	19.1%	0.784	0.35	1.859	0.453
2024	23.10%	31.0%	1.026	(0.02)	(0.065)	(0.020)

Table 4. Mean-Variance Optimization (MVO) Portfolio Performance.

Year	Ann. Return	Ann. Volatility	Beta	Alpha	Sharpe	Treynor
2020	13.40%	30.4%	0.654	0.01	0.034	0.016
2021	20.19%	16.7%	0.449	0.09	0.520	0.194
2022	9.00%	24.6%	0.841	(0.04)	(0.145)	(0.043)
2023	60.86%	20.4%	0.851	0.41	2.011	0.482
2024	47.53%	41.5%	1.293	0.22	0.540	0.173

Table 5. Value Stocks Portfolio Performance.

Year	Ann. Return	Ann. Volatility	Beta	Alpha	Sharpe	Treynor
2020	(28.52%)	35.8%	0.847	(0.41)	(1.143)	(0.483)
2021	(5.93%)	29.2%	0.885	(0.17)	(0.597)	(0.197)
2022	19.77%	30.4%	1.085	0.07	0.237	0.066
2023	48.11%	25.1%	0.790	0.28	1.126	0.358
2024	6.08%	27.9%	0.850	(0.19)	(0.683)	(0.224)

Table 6. Growth Stocks Portfolio Performance.

Year	Ann. Return	Ann. Volatility	Beta	Alpha	Sharpe	Treynor
2020	4.90%	42.1%	(0.097)	(0.07)	(0.177)	0.771
2021	34.70%	50.5%	1.074	0.23	0.459	0.216
2022	8.82%	26.7%	0.802	(0.04)	(0.141)	(0.047)
2023	40.31%	25.0%	0.792	0.20	0.821	0.259
2024	27.72%	32.6%	1.022	0.03	0.080	0.026

The annual performance data indicate five distinct regimes, each with considerably different cross-strategy rankings, reinforcing the notion that no single construction approach dominates all others.

The COVID-19 pandemic and associated market shock of 2020 provided a test of the defensive characteristics of each strategy. MinVar partially achieved its mandate with the lowest beta (0.530) and smallest loss of the optimization strategies (-8.43%), while EW secured no losses at all (9.07%) through its diversification approach. Value was also hit hardest by drawdown (-28.52%), a result of its focus on domestically focused and asset-intensive companies that felt the economic stoppage most acutely. Growth's negative beta (-0.097) proved an interesting but significant hedge effect, recording a 4.90% return during a period of extreme volatility (42.1%). This is a phenomenon consistent with the flight of capital into internationally focused and export-oriented industries during a period of domestic stress.

In 2021, the recovery from COVID-19 was a period of reward for risk-taking. Growth had the highest absolute return (34.70%) but also the highest volatility (50.5%) of all strategies. MVO had the most impressive performance of any strategy at any point in any year, with a return of 20.19%, a volatility of 16.7%, and a Sharpe ratio of 0.520 from its return-optimizing allocation into the recovering sectors of the market. Value was down (-5.93%) as it was slower to recover from the pandemic, with inflationary pressures not yet translating into pricing power advantages.

In 2022, the first major exchange rate devaluation event faced by Egypt (in March 2022, the USD/EUR exchange rate rose from 15.7 to 18.3), and the beginning of the inflation surge caused by the Russian invasion of Ukraine created the macro environment. ERC had the highest Sharpe ratio (0.366), reflecting the diversification of risk that protected against over-exposure to the FX-exposed stocks. MinVar and EW also had strong absolute performance (20.01%, 19.90%, respectively), while MVO underperformed (9.00%, Sharpe ratio of -0.145), with estimates of return being useless under this new type of macro event. Value was up at 19.77%; however, as inflationary pressures started to positively impact asset-heavy companies.

For the year 2023, the combination of the IMF-supported program, the successive pound floatations, and the nominal rebound in Egyptian equity values created the best year for all strategies. The best absolute return was recorded by the MinVar strategy, achieving 82.45%, which reacted disproportionately to the currency-adjustment tailwind, and also recorded the best Treynor ratio, 3.019, at a beta of only 0.207, the largest reward per unit of systematic risk over the entire sample period. The best Sharpe ratio was recorded by the MVO strategy, 2.011, thus vindicating the importance of return signal incorporation in the presence of such strong directional markets. The ERC and EW strategies also performed well, recording 55.32% and 53.30%, respectively, while the Value and Growth strategies lagged on a risk-adjusted basis, recording 48.11% and 40.31%, respectively.

In 2024, the March mega-devaluation of 35% of the pound relative to the dollar in one month created a dramatic differentiation among strategies by their exchange rate sensitivity. MVO generated the best absolute return, 47.53%, with the highest volatility of any strategy in any year, 41.5%, as the optimization routine placed disproportionate weight behind the stocks that benefited from the devaluation. Value generated the worst absolute return of any strategy, 6.08%, and the worst Sharpe ratio, −0.683, reinforcing the results of the regression analysis that Value was the most vulnerable strategy to exchange rate risk. EW and Growth were similar, generating 27.50% and 27.72%, respectively, with Growth's currency neutrality protecting it from the devaluation effects. The ERC strategy generated a healthy return of 23.10% with the lowest beta of any strategy other than the optimization strategies, 1.026, reinforcing its reputation as the strategy with the best consistency across macro regimes.

4.2. Descriptive Statistics

Table 7. Descriptive Statistics.

	EWP	ERP	MinVP	MeVP	Growth	Value	MRP	IR	FOREX	INF
Mean	0.008	0.007	0.011	0.007	−0.006	0.012	0.014	0.002	0.594	0.014
Median	0.026	0.015	−0.001	−0.005	−0.005	0.018	0.028	0.001	0.001	0.010
Maximum	0.128	0.146	0.216	0.424	0.156	0.279	0.190	0.019	16.320	0.132
Minimum	−0.225	−0.225	−0.257	−0.239	−0.271	−0.235	−0.239	−0.007	−0.573	−0.008

	EWP	ERP	MinVP	MeVP	Growth	Value	MRP	IR	FOREX	INF
Std. Dev.	0.082	0.077	0.088	0.107	0.090	0.083	0.088	0.005	2.303	0.021
Sum	0.449	0.397	0.634	0.442	−0.358	0.728	0.833	0.120	35.037	0.829
Sum Sq. Dev.	0.387	0.348	0.444	0.666	0.467	0.403	0.448	0.001	307.694	0.027
Observations	59	59	59	59	59	59	59	59	59	59

Note: EWP = Equal Weighting; ERP = Equal Risk Contribution; MinVP = Minimum Variance; MeVP = Mean-Variance Optimization; MRP = Market Risk Premium; IR = Interest Rate (first-differenced); FOREX = Exchange Rate (first-differenced); INF = Inflation. Portfolio series are monthly excess returns over the risk-free rate. February 2020 – December 2024, T = 59.

The descriptive statistics indicate some interesting facts about the data. The Value portfolio has the highest average excess return per month (1.23%), while the Growth portfolio has the only negative average excess return (-0.61%) of all portfolios. Of the macro variables, the exchange rate has the highest volatility, with a standard deviation of 2.303 and a maximum first-differenced value of 16.32, corresponding to the three discrete devaluations of the Egyptian pound during the sample period. Inflation has a high maximum (13.2% in one month) but a moderate average (1.4% per month), reflecting the concentration of inflation pressures during 2022-2023.

However, a critical anomaly is also revealed in the results: the Equal Risk Contribution portfolio has a lower standard deviation of 7.74% compared to the Minimum Variance portfolio's standard deviation of 8.75%. The Minimum Variance portfolio is supposed to have the lowest possible standard deviation according to a correctly estimated covariance matrix for a given set of assets. This anomaly suggests that estimation risks and covariance matrix instability, caused by large and discrete macro events, compromise the out-of-sample optimization efficacy of optimization techniques. This result is also supported by Clarke et al. [22], who show that a portfolio of minimum variance results in a concentration of assets that exacerbates idiosyncratic risks and is supported by empirical evidence from 2014 to 2023 that ERC strategies are more stable compared to MVO strategies during the COVID-19 pandemic and subsequent monetary tightening. The more diversified weights of the ERC portfolio are also more robust to any single parameter estimation since they are less dependent on any single input variable.

4.3. Correlation Analysis

Table 8. Correlation Matrix.

	ERP	EWP	MeVP	MinVP	Growth	Value	MRP	IR	FOREX	INF
ERP	1.000									
EWP	0.931	1.000								
MeVP	0.496	0.486	1.000							
MinVP	0.801	0.753	0.496	1.000						
Growth	0.835	0.905	0.372	0.675	1.000					
Value	0.821	0.875	0.356	0.699	0.738	1.000				
MRP	0.818	0.941	0.434	0.662	0.865	0.819	1.000			
IR	−0.114	−0.164	−0.180	−0.100	−0.134	−0.126	−0.227	1.000		
FOREX	−0.348	−0.337	−0.246	−0.432	−0.187	−0.393	−0.262	0.484	1.000	
INF	0.098	0.107	0.034	−0.007	0.086	0.278	0.106	0.225	0.142	1.000

Excess returns of portfolios have a strong and positive correlation with the risk premium of the market, and this is evident in EWP (0.941), Growth (0.865), and Value (0.819). This reinforces the previous point of the dominance of general equity market conditions. The MeVP (MVO) portfolio also reveals the lowest correlation of 0.434 to the market, which is due to its return-based allocation strategy differing from other portfolios. Changes in the exchange rates show the strongest and most consistent

correlation for all portfolios to be negative, and this is strongest for the MinVP (-0.432) and Value (-0.393) portfolios. Inflation reveals low and mixed correlations for all portfolios except for the Value portfolio at 0.278, which also reflects the positive coefficient revealed in the regression.

4.4. Unit Root Tests

Table 9. Results of the Unit Root Test.

Variable	Series Type	ADF t-Statistic	Prob. Value	Result (5% Level)
EWP	Level	−5.8216	0.0000***	Stationary I(0)
ERP	Level	−6.8337	0.0000***	Stationary I(0)
Growth	Level	−5.8108	0.0000***	Stationary I(0)
MinVP	Level	−6.5049	0.0000***	Stationary I(0)
MeVP	Level	−5.7910	0.0000***	Stationary I(0)
MRP	Level	−7.1538	0.0000***	Stationary I(0)
INF	Level	−5.3008	0.0000***	Stationary I(0)
FOREX	1st Difference	−7.5186	0.0000***	Stationary I(1)
IR	1st Difference	−4.6810	0.0003***	Stationary I(1)

*Note: *** denotes rejection of the unit root null hypothesis at the 1% significance level. Lag length selected automatically via the Schwarz Information Criterion (max lag = 10). All tests include a constant term.*

The null hypothesis of a unit root is rejected by all eight series at conventional levels of significance, consistent with stationarity classification. The stationarity of the six portfolio excess return series, as well as the market risk premium and inflation, is confirmed at levels, denoted as I(0), implying their direct use in the regressions. The exchange rate and policy interest rate series are non-stationary at levels but stationary at first differences, consistent with their classification as I(1) series, implying their use as first differences.

4.5. Regression Analysis

Table 10. Results of Regression Analysis.

	EWP	ERP	MinVP	MeVP	Growth	Value
Constant	−0.0056	−0.0046	0.0060	0.0045	−0.0202**	−0.0076
	(0.188)	*(0.512)*	*(0.545)*	*(0.780)*	*(0.009)*	*(0.261)*
Market Risk Premium	0.8631***	0.7032***	0.6240***	0.4763***	0.9062***	0.7139***
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
Inflation	0.0153	0.0243	−0.3021	0.0933	−0.1059	0.8098***
	(0.920)	*(0.875)*	*(0.192)*	*(0.803)*	*(0.478)*	*(0.003)*
Exchange Rate (Δ)	−0.0054***	−0.0075***	−0.0142***	−0.0060	0.0007	−0.0106***
	(0.001)	*(0.000)*	*(0.000)*	*(0.106)*	*(0.697)*	*(0.000)*
Interest Rate (Δ)	1.9789**	2.7220**	4.2484**	−0.7135	1.1855	2.3465*
	(0.022)	*(0.012)*	*(0.016)*	*(0.605)*	*(0.268)*	*(0.052)*
R^2	0.9056	0.7116	0.5527	0.2080	0.7537	0.7715
Adj. R^2	0.8986	0.6902	0.5196	0.1493	0.7355	0.7546
F-statistic	129.50***	33.31***	16.68***	3.55**	41.31***	45.81***
Durbin-Watson	1.796	1.867	2.132	1.132	1.882	1.711

*Note: Each cell reports the OLS coefficient. The row immediately below each coefficient reports the p-value in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Sample: February 2020 – December 2024 (59 observations). FOREX and IR enter as first differences. The Durbin-Watson statistic for MeVP (1.132) is below the conventional acceptance range; its coefficients should be interpreted with caution.*

The adjusted R-squared values range from 0.15 (MeVP) to 0.90 (EWP), suggesting that the macro framework explains a significant and economically relevant proportion of portfolio return variation for five of the six strategies. The F-statistics are all significant at conventional levels, supporting the joint explanatory power of the models. The Durbin-Watson statistics are between 1.8 and 2.1 for five of the regressions, suggesting no significant autocorrelation problems in the residuals.

4.5.1. Market Risk Premium

The coefficient of the market risk premium is positive and highly significant ($p < 0.01$) for all six portfolios. It ranges from 0.4763 (MeVP) to 0.9062 (Growth), indicating that systematic equity market conditions are the primary influence on excess portfolio returns in Egypt, regardless of construction approach or style. The high loading of the Growth portfolio (0.91) captures its proclivity to amplify general market conditions. In contrast, the MVO portfolio has a relatively lower loading (0.48), indicating its obligation to diverge from the market in search of superior risk-adjusted performance. It is also interesting to note that the MinVar portfolio has a high loading of 0.62. It underscores the point that no construction approach can completely filter out systematic equity risk in an emerging market context [25,29].

4.5.2. Exchange Rate

The dependent variable FOREX is included in the regression model using its first difference, which represents the difference between the USD/EGP exchange rate from month to month, in terms of Egyptian pounds per US dollar. When the difference turns out to be a positive number, this indicates that the pound has depreciated; when it's negative, this shows that the pound has appreciated.

The exchange rate coefficient is negative and significant at the 1% level for EWP, ERP, MinVP, and Value, and insignificant for MeVP and Growth. The MinVP portfolio has the largest sensitivity at −0.0142: each one-EGP depreciation of the pound reduces MinVP monthly excess returns by 1.42 percentage points. To put this in a practical context, the March 2024 devaluation moved the exchange rate by approximately 16.3 EGP in a single month, matching the maximum ΔFXR of 16.32 in Table 7. Applying the coefficient: $16.3 \times 0.0142 \approx 23.2$ percentage points of monthly excess return drag on MinVP alone. This is because the MinVar portfolio is heavily weighted in firms that are heavily import-dependent and thus have their cost structures adversely impacted by the depreciation of the pound.

The coefficient for the Value portfolio is -0.0106 and is also in line with firms classified as "value" due to their heavy asset base, domestic focus, and low foreign currency revenues [30,31]. In stark contrast to the other portfolios, the coefficient for the Growth portfolio is almost zero at 0.0007 and is insignificant at $p = 0.697$; this is likely due to the presence of a higher proportion of export-oriented firms and foreign currency revenues for the firms classified as "growth" within the EGX 100 non-financial universe, a phenomenon also noted at the individual firm level in Ragab and Abou-Zaid [20], who document the relative resilience of export-oriented EGX 30 firms to the pound devaluation of March 2024 relative to their import-dependent counterparts.

4.5.3. Interest Rate

The IR variable is introduced as its first difference, which is the change in the CBE interest rate per month. If the IR is positive, this indicates that the CBE has increased its interest rate in that particular month. Otherwise, if the IR is negative, this means that the CBE has decreased its interest rate.

The coefficient for the interest rate factor is positive for all but one portfolio, and it is significant for EWP (1.979, $p < 0.05$), ERP (2.722, $p < 0.05$), MinVP (4.248, $p < 0.05$), and Value (2.347, $p < 0.10$). The sign appears to contradict conventional asset pricing theory, which predicts that higher discount rates will reduce the present value of cash flows received in the future. The explanation for this apparent anomaly lies in the unique macroeconomic environment faced by the Egyptian economy during the period studied. The Central Bank of Egypt's policy rate hiking cycle, driven by crisis management rather than growth normalization, increased policy rates from around 8.25% in early 2020 to around 27% in late 2024 in response to surging inflation and currency pressures. These episodes corresponded to episodes of significant equity risk premium widening, where investors demanded higher excess returns to invest in the Egyptian equity market, especially when policy rates were high.

The positive relationship thus reflects the risk premium channel, not the discount rate channel. Consequently, the positive sign of the beta shows the existence of a risk premium rather than an interest rate. It means that a change of one percentage point in the interest rates leads to an increase in the excess monthly return for EWP by 1.98 percentage points, ERP by 2.72 percentage points, and MinVP by 4.25 percentage points. The interest rate does not positively influence equities, but high-interest-rate periods are characterized by very tense macroeconomic conditions that require a high-risk premium from equities. The months when policy rates were high also corresponded to the months when investors demanded high risk premiums for investing in the Egyptian equity market. [2,4,32]. The MeVP portfolio's negative and insignificant coefficient (−0.714) reflects its distinctive allocation and limited co-movement with market-wide risk premium.

4.5.4. Inflation

The inflation coefficient is only significant for the Value portfolio, with a value of 0.810 and $p < 0.01$. For all other portfolios, the inflation coefficient is low and not significantly different from zero. The positive inflation coefficient of the Value portfolio is consistent with the inflation hedging hypothesis. This suggests that value-type firms in the Egyptian market are tangible asset-intensive industries with the ability to pass on cost increases to their clients and have their physical asset base increase during periods of inflation. This result is consistent with the Fisher hypothesis, which states that stock returns should compensate investors for inflation risk. This result is also consistent with Pham, Vo, and Nguyen [23], which shows that it is possible to create effective inflation-tracking and hedging portfolios for emerging markets in BRICS countries, with their tracking portfolio tending to be skewed towards tangible asset-intensive, value-type industries. This result shows that although diversified investment strategies do not offer effective inflation hedging, investment strategies focused on value-type stocks do offer effective hedging against Egypt's high inflation environment [30-33].

5. Discussion and Practical Implications

The empirical results show that the construction methodology of portfolios indeed plays a role in macro risk management, but not as simply as conventional theory might suggest. The dominant influence of the market risk premium (β = 0.48-0.91) for all portfolios supports the claim that equity returns in Egypt are fundamentally a macro problem. The main insight is that no construction methodology can isolate portfolio return from general market conditions. Yet the differentiated sensitivities to inflation, exchange rates, and interest rates suggest that the choice of strategy can indeed affect the macro risk profile of the portfolios in important ways.

The ERC over MinVar Volatility Anomaly is probably the most important empirical result of this investigation for practical applications. It offers real-life evidence of the failure of historical covariance matrices as a guide to future behavior in environments characterized by large discrete structural breaks. The ERC portfolios' mechanical equal risk distribution is less sensitive to any given parameter estimate and therefore exhibits more stable realized volatility. Portfolio managers facing similar environments should prefer the ERC approach over the classical MinVar optimization.

Table 11. Macro Risk Profiles by Portfolio Strategy.

Macro Condition	Best Hedge	Coefficient	Worst Exposure	Theoretical Basis & Mechanism
High Inflation Environment	Value	β = +0.81*** (INF)	Growth (β = −0.11, n.s.)	Fisher's (1930) hypothesis: real-asset-backed equities compensate for inflation through pricing power and nominal asset appreciation. Value firms' tangible asset bases satisfy this condition.
Currency Depreciation (EGP/USD shock)	Growth	$\beta \approx 0$ (n.s.)	MinVP (β = −0.0142***)	APT (Ross, 1976): Exchange rate risk is a priced systematic factor. Each 1 EGP depreciation reduces MinVP's monthly excess return by 1.42 pp, reflecting its concentration in import-dependent,

Macro Condition	Best Hedge	Coefficient	Worst Exposure	Theoretical Basis & Mechanism
				domestically oriented firms whose input costs and margins deteriorate with a weaker pound.
Crisis-Driven Rate Hikes	MinVP, EWP, ERP	β = +4.25** (MinVP)	MeVP (β = −0.71, n.s.)	Risk-premium channel: when tightening is crisis-driven rather than growth-normalizing, rising policy rates coincide with widened equity risk premia as investors demand higher compensation for macro uncertainty.
Market Compression (broad equity decline)	MeVP	β = 0.48 (MRP)	Growth (β = 0.91***)	CAPM/APT market beta: MeVP's lowest market loading (0.48) limits drawdown during broad equity declines; Growth's near-unity loading (0.91) amplifies losses symmetrically.
Market Expansion (broad equity rally)	Growth	β = 0.91*** (MRP)	MeVP (β = 0.48)	Mirror of market compression: Growth's high systematic loading captures maximum upside during bull markets.

*Note: Coefficients from Table 10. *** p < 0.01; ** p < 0.05; * p < 0.10; n.s. = not significant. MRP coefficients are market betas from the same OLS regressions.*

5.1. Macro-Conditioned Portfolio Allocation Frameworks

The regression coefficients serve as an empirical guide for translating macro regime identification results into portfolio strategy selection. Rather than recommending specific portfolio weights, which require an optimization problem beyond the scope of this paper, these results are more appropriate for informing macro signal-based portfolio weight principles that investors can tailor according to their own risk tolerance and prevailing macro regime.

In a regime where inflation risk dominates, the Value portfolio's large positive regression coefficient (+0.81, $p < 0.01$) suggests that value stocks should be overweighted relative to a neutral portfolio benchmark. Conversely, the Growth portfolio does not contribute to inflation compensation and may be considered for underweighting in such environments. This is consistent with Pham et al. [23], who found that inflation-tracking portfolios in BRICS markets consistently overweighted tangible asset-intensive value stocks. It is also consistent with Fisher's [34] inflation compensation hypothesis prediction that real asset-backed equities are the natural equity class to satisfy the inflation compensation hypothesis.

If the major concern is currency depreciation, indicated by a widening current account deficit, falling foreign reserves, and/or Central Bank FX intervention, Growth's near-zero exchange rate sensitivity makes it the structurally preferred portfolio. Ragab and Abou-Zaid [20] provide supporting evidence at the individual security level for this insulation mechanism of the Growth portfolio. They document that export-oriented EGX30 constituents experienced significantly lower abnormal losses during the March 2024 devaluation than their domestic-oriented counterparts.

If the major concern is crisis-driven monetary tightening, then the positive interest rate coefficients of EWP, ERP, and MinVP indicate that a broad diversification of strategies would profit from the associated equity risk premium effect. In contrast, the negative coefficient of the MeVP portfolio (-0.71) makes it a natural satellite portfolio for investors anticipating future rate normalizations, where the discount rate effect is expected to dominate [4,31].

5.2. Policy Implications

The large and statistically significant negative coefficient estimates of the ER equations for MinVP (-0.0142) and Value (-0.0106) reinforce the evidence of currency adjustments imposing substantial costs on locally focused equity investors. A more transparent approach to gradual ER adjustment, as called for by the IMF [35] in the Extended Fund Facility program with Egypt, will contribute to reduced valuation discontinuities and promote long-term local capital accumulation. The positive IR coefficient estimates are also a symptom of underlying fragility. A credible and forward-looking commitment to Inflation Targeting will allow future rounds of tightening to occur under normalization conditions. In which case,

increasing interest rates will be associated with falling rather than rising equity risk premia, thus enhancing the attractiveness of the EGX to institutional and foreign investors [2,32]. The strong explanatory power of the market risk premium indicator in the EGX EG equations (R^2 up to 0.90 for EWP) suggests that overall equity risk in Egypt is still dominated by aggregate macro risks rather than firm-specific fundamentals. Improvements in institutional aspects of corporate governance will help to break the link between firm-level equity returns and the overall market aggregate.

5.3. Contribution to the Literature

This paper contributes to the empirical finance literature in three ways. First, it offers the first strategy-level, regression-based analysis of the macro return determinants for the Egyptian equity market. It extends the results of Barakat, Elgazzar, and Hanafy [31], which established the long-run cointegration of EGX equity returns with exchange rates, interest rates, and CPI, to the portfolio context and a sample period covering three currency flotations and a full IMF adjustment cycle. Second, the ERC over MinVar volatility inversion offers out-of-sample verification of Clarke, de Silva, and Thorley's [22] analytic prediction of the effects of concentrated minimum variance portfolios in the face of parameter instability, and DeMiguel et al.'s [24] estimation error model of the limitations of mean-variance optimization under conditions of volatility. Finally, the paper offers a richer understanding of the macro-factor effects in MENA equity markets, where interest rates exhibit regime dependence, and inflation effects exhibit strategy dependence.

6. Conclusion

This paper aims to analyze the impact of the market risk premium, inflation, the exchange rate, and the interest rate on the excess returns of six portfolios based on 31 non-financial Egyptian companies traded on the Egyptian Stock Exchange from February 2020 to December 2024.

The market risk premium is the dominant factor across all portfolios and methodologies ($\beta = 0.48$-0.91; $p < 0.01$ for all portfolios), but no construction methodology is successful in hedging systematic equity risk. Depreciating exchange rates negatively impact the returns of the Minimum Variance Portfolio, the Value Portfolio, the Equal Weighting Portfolio, and the ERC Portfolio, but not the Growth Portfolio or the MeVP Portfolio. The positive and counterintuitive interest rate coefficients for all portfolios are due to Egypt's crisis-driven interest rate tightening cycle and correspond to widening equity risk premia. Inflation is only beneficial for the Value Portfolio but not for the other portfolios. The ERC Portfolio's lower realized volatility than the Minimum Variance Portfolio is the most important practical contribution of this paper. It is due to the limitations of the optimization approach based on the estimation of the covariance matrix in the presence of structural instability inherent in the Egyptian macro environment.

For investors, the takeaway is that the choice of strategy should be driven by macro assumptions rather than theory. Value offers Inflation Protection; Growth offers Currency Resilience; ERC offers strong Realized Volatility performance when optimization fails; and Equal Weighting offers stable Broad Market Participation. For policymakers, the large negative Exchange Rate Coefficients and positive Interest Rate Coefficients indicate that disorderly adjustments detract from equity market attractiveness. Transparent and gradual exchange rate management with clear communication by the Central Bank has the potential to stabilize equity market volatility. Commitment to Inflation Targeting with future rate cycles operating under normalization conditions has the potential to shift the interest rate/equity market attractiveness relationship towards the theoretically expected negative sign, increasing attractiveness to institutional and foreign investors.

Several limitations need to be acknowledged. Firstly, the five-year period used for this analysis includes the COVID-19 disruptions and the post-IMF macro adjustments and might not be representative of other regimes; future studies should seek to extend the period to pre-2020 data. Secondly, the omission of financial sector firms is justified from a methodological point of view but leaves their sensitivities to macro risks unexplored. Using time-varying betas and VAR approaches would be useful for modeling multi-month mechanisms of transmission. Disaggregating firms along other dimensions such as size, leverage, and profitability would allow for a more detailed approach to constructing portfolios based on specific macro risks. Comparisons across countries in the MENA region would be useful to understand whether the results presented here are representative of Egypt or the region as a whole.

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