ECONOMETRIC ANALYSIS OF DETERMINANTS INFLUENCING RISK-ADJUSTED PERFORMANCE OF MUTUAL FUNDS

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ARTICLE INFO	ABSTRACT
	Objective: This study explores the relationship between Mutual Funds' (UCITS) performance and nine macroeconomic variables using a Vector Autoregressive (VAR) model. It aims to understand the dynamics between these variables and UCITS performance. **Theoretical Framework:** The study is grounded in economic theories and concepts relevant to macroeconomics and financial markets. The VAR model serves as the theoretical framework, facilitating the analysis of the interdependencies among variables. **Method:** The research methodology involved the application of a VAR model to 92 quarterly observations from January 2000 to December 2022. Non-stationarity tests indicated that all variables were non-stationary in levels but became stationary after first-order differencing. Data collection methods included obtaining information on macroeconomic variables and OPCVM performance. **Results and Discussion:** The findings indicate a long-term causality between OPCVM performance, and the macroeconomic variables studied. Significant variables affecting OPCVM performance include money supply, GDP, inflation rate, discount rate, and bond interest rate. However, interest rate and exchange rate showed no significant impact. The presence of an inertia effect suggests the utilization of Box-Jenkins ARMA modeling. **Research Implications:** This study provides insights into the influence of macroeconomic factors on OPCVM performance, offering implications for investors, financial analysts, and policymakers. Understanding these relationships can aid in making informed investment decisions and formulating effective economic policies. **Originality/Value:** The research contributes to the literature by employing a VAR model to analyze the relationship between OPCVM performance and macroeconomic variables in the context of the Moroccan market. The findings offer practical implications for stakeholders and advance the understanding of financial market dynamics.

ANÁLISE ECONOMÉTRICA DOS DETERMINANTES QUE INFLUENCIAM O DESEMPENHO AJUSTADO AO RISCO DOS FUNDOS DE INVESTIMENTO EM VALORES MOBILIÁRIOS

RESUMO
Objetivo: Este estudo explora a relação entre o desempenho dos Fundos de Investimento Coletivo em Valores Mobiliários (OICVM) e nove variáveis macroeconômicas usando um modelo Vetorial Autorregressivo (VAR). O objetivo é compreender a dinâmica entre essas variáveis e o desempenho dos OICVM.

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Quadro Teórico: O estudo está fundamentado em teorias econômicas e conceitos relevantes para a macroeconomia e os mercados financeiros. O modelo VAR serve como o quadro teórico, facilitando a análise das interdependências entre as variáveis.

Método: A metodologia de pesquisa envolveu a aplicação de um modelo VAR a 92 observações trimestrais de janeiro de 2000 a dezembro de 2022. Testes de não estacionariedade indicaram que todas as variáveis eram não estacionárias em níveis, mas se tornaram estacionárias após diferenciação de primeira ordem. Os métodos de coleta de dados incluíram a obtenção de informações sobre variáveis macroeconômicas e o desempenho dos OICVM.

Resultados e Discussão: Os resultados indicam uma causalidade de longo prazo entre o desempenho dos OICVM e as variáveis macroeconômicas estudadas. Variáveis significativas que afetam o desempenho dos OICVM incluem oferta monetária, PIB, taxa de inflação, taxa de desconto e taxa de juros de títulos. No entanto, taxa de juros e taxa de câmbio não mostraram impacto significativo. A presença de um efeito de inércia sugere a utilização da modelagem ARMA de Box-Jenkins.

Implicações da Pesquisa: Este estudo fornece insights sobre a influência de fatores macroeconômicos no desempenho dos OICVM, oferecendo implicações para investidores, analistas financeiros e formuladores de políticas. Compreender essas relações pode auxiliar na tomada de decisões de investimento informadas e na formulação de políticas econômicas eficazes.

Originalidade/Valor: A pesquisa contribui para a literatura ao empregar um modelo VAR para analisar a relação entre o desempenho dos OICVM e as variáveis macroeconômicas no contexto do mercado marroquino. Os resultados oferecem implicações práticas para as partes interessadas e avançam a compreensão da dinâmica do mercado financeiro.

Palavras-chave: Variáveis Macroeconômicas, Desempenho, OICVM, VAR.

ANÁLISIS ECONOMÉTRICO DE LOS DETERMINANTES QUE INFLUYEN EN EL RENDIMIENTO AJUSTADO AL RIESGO DE LOS FONDOS DE INVERSIÓN COLECTIVA EN VALORES MOBILIARIOS

RESUMEN

Objetivo: Este estudio explora la relación entre el rendimiento de los Fondos de Inversión Colectiva en Valores Mobiliarios (FICVM) y nueve variables macroeconómicas utilizando un modelo Vector Autoregressive (VAR). El objetivo es comprender la dinámica entre estas variables y el rendimiento de los FICVM.

Marco Teórico: El estudio se fundamenta en teorías económicas y conceptos relevantes para la macroeconomía y los mercados financieros. El modelo VAR sirve como el marco teórico, facilitando el análisis de las interdependencias entre variables.

Método: La metodología de investigación involucró la aplicación de un modelo VAR a 92 observaciones trimestrales desde enero de 2000 hasta diciembre de 2022. Pruebas de no estacionariedad indicaron que todas las variables no eran estacionarias en niveles, pero se volvieron estacionarias después de la diferenciación de primer orden. Los métodos de recopilación de datos incluyeron la obtención de información sobre variables macroeconómicas y el rendimiento de los FICVM.

Resultados y Discusión: Los resultados indican una causalidad a largo plazo entre el rendimiento de los FICVM y las variables macroeconómicas estudiadas. Variables significativas que afectan el rendimiento de los FICVM incluyen oferta monetaria, PIB, tasa de inflación, tasa de descuento y tasa de interés de bonos. Sin embargo, la tasa de interés y la tasa de cambio no mostraron un impacto significativo. La presencia de un efecto de inercia sugiere la utilización del modelado ARMA de Box-Jenkins.

Implicaciones de la Investigación: Este estudio proporciona información sobre la influencia de los factores macroeconómicos en el rendimiento de los FICVM, ofreciendo implicaciones para inversores, analistas financieros y formuladores de políticas. Comprender estas relaciones puede ayudar en la toma de decisiones de inversión informadas y en la formulación de políticas económicas efectivas.

Originalidad/Valor: La investigación contribuye a la literatura al emplear un modelo VAR para analizar la relación entre el rendimiento de los FICVM y las variables macroeconómicas en el contexto del mercado marroquí. Los resultados ofrecen implicaciones prácticas para las partes interesadas y avanzan en la comprensión de la dinámica del mercado financiero.

Palabras clave: Variables Macroeconómicas, Rendimiento, OICVM, VAR.

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1 INTRODUCTION

Mutual fund performance is not the result of a series of arbitrary decisions, but rather of active portfolio management that takes into account a multitude of factors and variables, among which macro-economic indicators occupy a significant place. Indeed, it is generally accepted that financial asset prices react sensitively to economic news. This observation is based on our experience.which confirms that individual asset prices are influenced by a wide range of unforeseen events, and that some of these events have a more pronounced impact on asset prices than others, as pointed out by Chen et al. (1986, p. 383).

The stock market is influenced by many highly interdependent economic, social and political factors, and these factors interact with each other in a highly complex way. As a result, it is generally difficult to identify the factors that have the greatest impact on the stock price index. Over the past few decades, the interaction between the stock market and macroeconomic variables has provided an interesting case study for the relationship between macroeconomic variables and the stock market, in both developed and developing countries. It is often argued that stock prices are determined by certain macroeconomic variables such as the interest rate, the exchange rate, the inflation rate and the money supply (Rad, 2011, p. 1).

It has been widely demonstrated in the financial literature that stock price movements are linked to macroeconomic variables. It has been observed that stock prices tend to fluctuate in response to economic news, and this observation is supported by empirical evidence showing that macroeconomic variables have explanatory power for variations in stock returns (Chaudhuri & Smiles, 2004, p. 121).

The multivariate vector autoregressive modeling technique is a useful alternative to the conventional structural modeling procedure. VAR analysis works with unrestricted reduced forms, treating all variables as potentially endogenous (Gjerde & Seattem, 1999, p. 64).

In this study we used 92 observations for the sampling period from January 2000 to December 2022, i.e. quarterly data. According to the Dickey-Fuller (ADF) and Philips-Perron (PP) non- stationarity tests, all the variables retained in our study are non-stationary in level. There is long-term causality between UCITS performance and the other variables in the study. According to the results, the most significant macroeconomic variables in explaining UCITS performance are money supply, GDP, inflation rate, discount rate and bond yield.

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2 LITERATURE REVIEW

In recent years, numerous studies have been carried out to investigate the relationship between UCITS performance and macroeconomic variables. In these studies, variables such as the exchange rate, money supply, the industrial production index, gold prices, inflation, imports, exports, interest rates, oil prices, GDP and the stock market index have all been used.

Chen et al (1986) tested whether innovations in macroeconomic variables constitute rewarded risks in the stock market. According to financial theory, the following macroeconomic variables should systematically affect stock market returns: the spread between long and short interest rates, expected and unexpected inflation, industrial production and the spread between investment-grade and non-investment-grade bonds. They found that these sources of risk were significantly valued. In addition, neither the market portfolio nor overall consumption were assessed separately. They also found that oil price risk was not rewarded separately on the stock market.

Gay (2008) studied the impact of macroeconomic variables on stock returns for four emerging economies, namely Brazil, Russia, India and China. He concluded that there was no significant relationship between the relative exchange rate and oil prices on the stock market index.

Kumar et al. (2008) examined the impact of macroeconomic variables such as exchange rate, inflation rate, oil price, interest rate and market yield. Observing the high volatility of Indian financial markets, the results indicate that the return and return variance of some funds are affected by macroeconomic variables, and that 35.29% of desired funds are not sensitive to any of the macroeconomic variables.

Humpe and Macmillan (2009) studied the effect of several macroeconomic variables on stock prices in the USA and Japan, using monthly data between 1965 and 2005. They investigated the relationship within a standard present-value model and applied a cointegration analysis between industrial production, the consumer price index, the money supply, long-term interest rates and stock prices in the US and Japan. Using US data, they found a single vector of cointegration between stock prices, industrial production, inflation and the long-term interest rate. Share prices are positively related to industrial production and inflation.

Negatively related to the consumer price index and the long-term interest rate. They also found a non-significant but positive relationship between US stock prices and the money supply. Using the Japanese data index, Humpe and Macmillan (2009) found two cointegration vectors.

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Gjerde and Saettem (1999) examined the extent to which important results concerning the relationships between stock returns and macroeconomic factors in large markets were valid in a small open economy, using the multivariate vector autoregression (VAR) approach on Norwegian data. Unlike many previous studies, which used a different methodology on other European markets, they established several significant relationships. In line with the results obtained in the USA and Japan, changes in real interest rates affected both stock market returns and inflation, and the stock market reacted accurately to changes in oil prices. On the other hand, the stock market reacted with delay to variations in domestic real activity.

Theophano and Sunil (2006) use bivariate VAR models and suggest that there is a negative impact of inflation and money supply on equity returns. The study was carried out over the period 1990-1999.

Rad (2011) examined the relationship between the Tehran Stock Exchange (TSE) price index and a set of three macroeconomic variables from 2001 to 2007 using an unrestricted vector autoregression (VAR) model. Its impulse response function (IRF)-based analysis indicates that the response of the TSE price index to shocks to macroeconomic variables such as the consumer price index (CPI), the free market exchange rate and liquidity (M2) was weak. In addition, the generalized forecast error variance decomposition (FEVD) revealed that the share of macroeconomic variables in fluctuations in the TSE price index is around 12%. Finally, it seems that political shocks or other economic forces can have an effect on the TSE price index in Iran.

İskenderoğlu et al (2011) studied the relationship between the stock market and industrial production. In this sense, the relationship between the industrial production index and the national ISE Industrials index was studied by Johansen using co-integration and error correction models. The sample period extended from January 1991 to December 2009. The empirical results revealed the existence of a long-term relationship between the industrial production and the ISE Industrials National Index. In addition, Johansen's error correction model indicates that the ISE Industrials National Index appears to be the source of the industrial production index.

3 METHODOLOGICAL DATA

In our study, we used variables such as UCITS performance as the dependent variable and independent variables including Brent oil price, Money supply, Inflation, Brent oil price,

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Discount rate, Exchange rate, Government bond interest rate, Money market rate, Deposit rate. The dependent variable is UCITS performance.

In this study, we also used 92 observations for the sampling period from January 2000 to December 2022. The variables and their definitions are presented in Table 1:

Table 1

Variables and their acronyms

Variable	Acronym
Performance	PERF
Money supply	MS
Discount rate	DR
Exchange rates	ER
Gross domestic product	GDP

4 METHODOLOGY

Morocco is one of the developing countries and its stock market has improved. The empirical methods employed in this paper are standard tools obtained from the vector autoregression (VAR) model. First, we examined the variables to determine whether or not they exhibit seasonal movements and a unit root. Using the ADF unit root test, we determined that all series are stationary in their first difference.

Secondly, we identified the lag selection of the VAR model using the Akaike Information Criterion (AIC). The optimal lag is fourth-order. Third, we estimated the VAR model. Fourth, we studied the response functions of any endogenous variable to a one-standard-deviation shock in any other endogenous variable in the system. Fifth, we analyzed structural regularities between factors using variance decomposition.

The VAR model is one of the most efficient, flexible and easy-to-use models for multivariate time series analysis. It is a natural extension of the univariate autoregressive model to multivariate dynamic time series. The VAR model has proved particularly useful for describing the dynamic behavior of economic and financial time series and for forecasting. It often provides superior forecasts to univariate time series models and theory-based simultaneous equation models. VAR model forecasts are highly flexible, as they can be conditioned by the potential future trajectories of the variables specified in the model.

A VAR model describes the evolution of a set of k variables (called endogenous variables) over the same sampling period (t = 1, ..., T) as a linear function of their past evolution

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alone. The variables are collected in a k × 1 vector yt , whose ith element is yi , t the observation at time t of variable yi (Zivot, Eric. Notes on Structural VAR Modeling, 2000).

Before starting the VAR analysis, we examined the variables in terms of seasonal movements and unit root. In this process, we tried to identify whether the series are stationary by using unit root tests for each variable. All variables have seasonal movements and then Johansen's Multivariate Cointegration Test by calculating the Trace and maximum eigenvalue statistics, in addition to determining and estimating the long-run relationships between the variables in the study and after Estimation of the unconstrained VAR model (if the variables are not cointegrated) or the constrained VAR model, qualified as an error-correction model (if the variables are cointegrated of the same order, especially order I); estimation of the weighting coefficients of the different variables; estimation of the speed of adjustment of imbalances and study of long-term causality; etc... and finally Validation of estimated model(s) by implementing diagnostic tests: Normality test ; serial autocorrelation; existence of ARCH effect; heteroscedasticity; linearity; stability; etc...

5 RESULTS OF NON-STATIONARITY TESTS

Table 2

Non-stationarity tests

Variable	ADF test			Test PP		
	Delay	Stat-ADF	Conclusion	Delay	Stat-PP	Conclusion
Lperf	1	-1,154	I(1)	2	-1,015	I(1)
LGDP	6	-1,559	I(1)	5	-0,79	I(1)
LMS	4	-1,893	I(1)	4	-1 ,256	I(1)
LDR	8	-0,785	I(1)	1	-0,459	I(1)
LER	0	-1,391	I(1)	3	-1,565	I(1)

With: - L(X) : Neperian logarithm of variable X
-I(1): Integrated series of order 1 (the variable is not stationary and contains a unit root)

By comparing the calculated statistics of the different ADF and PP tests with the critical values (for different thresholds: 1%, 5% and 10%) we conclude that all the variables in our study are not stationary in level. In fact, the statistics calculated are all above the critical values for at least one of the aforementioned thresholds. It should be noted that the conclusions of the two tests are different for the variable (TINF). The ADF test indicates that it is non-stationary, whereas the PP test indicates that it is stationary. To decide between the two, we used the KPSS test, whose null hypothesis is stationarity, unlike the other two tests, for which the null hypothesis is non-stationarity. The KPSS test confirms the non-stationarity of the variable (TINF).

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It should be pointed out that the optimal delay is calculated using the 1 information criteria used for this purpose. Determining this delay is in fact a tricky business, since it involves the question of residual whiteness, serial correlation and the degrees of freedom required to estimate the equations inherent in the tests.

These results prompt us to move on to the next stage, which consists of studying the stationarity of the different variables taken as first differences. Applying the ADF and PP tests again, we obtained the following results:

Table 3

ADF and PP test results for series in first differences: DXt = Xt-X(t-1)

Variable	ADF test			Test PP		
	Delay	Stat-ADF	Conclusion	Delay	Stat-PP	Conclusion
Lperf	0	-7,504	I(0)	1	-7,509	I(0)
LGDP	5	-6,64	I(0)	6	-14,509	I(0)
LMS	3	-3,641	I(0)	3	-6,757	I(0)
LDR	0	-8,999	I(0)	0	-8,999	I(0)
LER	0	-8,569	I(0)	1	-8,567	I(0)

With: I(0): the series is stationary (the series contains zero unit roots)

The results in the table above allow us to suggest that all variables, once differentiated once, become stationary in view of the ADF and PP tests.

Since the variables are all non-stationary, it's now time to study the long-run relationships, also known as cointegration.

The study of cointegration relationships between the variables in our study will be of great importance to us in the remainder of this work. In fact, it will enable us to decide on the appropriate econometric specification to use. In other words, whether to continue with standard VAR models (or unconstrained VAR models), or with cointegrated VAR models (or constrained VAR models or Error correction models: ECM), whose general equation is as follows:

Equation 1 General model equation:

$$\Delta perf_{tj} = ecm_j(-1) + \sum_{i=0}^{p} \delta_i \, \Delta pib_{t-i} + \sum_{i=0}^{p} \beta_i \, \Delta m3_{t-i} + \cdots + \sum_{i=0}^{p} \gamma_i \, \Delta tact_{t-i} + \alpha DUM + \varepsilon_{jt}$$

with:

$\Delta : l'\,operateur\;retard\;(ici\;la\;différence\;premiere\,)$

$j\;ecm$: The error-correction term for model (j)

$i\;\delta; \beta i\,; \gamma i\,; \alpha : les\;coefficients\;du\;modèle$

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P: optimum delay

DUM: dummy variables

$jt \, \varepsilon$: *le résidu du modèle* (j).

6 RESULTS OF NON-STATIONARITY TESTS

There are two methods for testing cointegration between variables. The first, known as the Engle-Granger method, consists of testing cointegration in two stages. The second, which is more robust than the first, is Johansen's method, which is based on maximum true semblance. This is why we have opted for the latter. Two statistics are calculated: the Trace statistic and the Maximum Eigenvalue statistic. Variables are said to be cointegrated if their calculated values are below the corresponding critical values. The thresholds used are generally 1% and 5%. The principle of cointegration is that even if the variables diverge in the short term, they can converge in the long term and end up on the same equilibrium path.

Table 4

Johansen cointegration test

Model	Johansen statisticssignificant at the 5% level		Conclusion: existence or not and number o f cointegrating relationships			
	Trace	Maximum eigenvalue	Trace		Maximum Clean Value	
			Yes	No	Yes	No
Model: Perf = f (gdp;m3;tc; Tact)	45.986	25.889	1	-	1	-

As shown in the table, the Johansen test indicates the existence of a single cointegrating relationship, based on the trace statistic, while the maximum eigenvalue statistic was able to detect only one cointegrating relationship. So, to continue, we're going to work with the hypothesis that our study variables are cointegrated of order 1. This means that leads us to estimate the error-correction model (constrained VAR model). The estimation results are shown in the following table:

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Table 5

ECM model

Dependent variable: mutual fund performance (DLPERF)					
Explanatory variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**	**Diagnostic tests**
Z3(-1)	-0.078261	0.020852	-3.753165	0.0164	-Normality
DLPERF(-1)	0.166262	0.056942	2.919844	0.0047	Skew = 0.6028
DLPERF(-4)	0.151255	0.053656	2.818971	0.0063	Kurt = 4,4107
DLPIB(-1)	-0.122294	0.127849	-0.956544	0.3421	
DLMS(-2)	-0.596595	0.367384	-1.623898	0.1089	-ARCH
DLMS(-4)	0.345923	0.297640	1.162220	0.2491	LM (2): F= 0.811 (**0.448**)
DLMS(-5)	-0.337111	0.275498	-1.223644	0.2252	LM(4) : F = 0.799 (**0.529**)
DLMS(-6)	0.538413	0.373189	1.442735	0.1536	
DLDR(-1)	-0.145477	0.066224	-2.196763	0.0314	
DLDR(-3)	0.201353	0.085228	2.362530	0.0209	
DLDR(-4)	-0.123322	0.070800	-1.741850	0.0859	-Serial correlation
DUMPERF2013	-0.045199	0.006333	-7.137417	0.0000	LM (2): F= 0.539(**0.586**)
DLPERF*DUMPERF2013	0.977924	0.076848	12.72539	0.0000	LM(4) : F = 0.412(**0.799**)
R-squared	**0.822270**	Mean dependent var		0.006125	**Conclusion**
Adjusted R-squared	0.786724	S.D. dependent var		0.066706	**Residues are normal**
S.E. of regression	**0.030806**	Akaike info criterion		-3.963429	**The absence of the ARCH effect**
Sum squared resid	0.066431	Schwarz criterion		-3.532373	**The absence of serial correlation**
Log likelihood	183.4458	Hannan-Quinn criter.		-3.790047	
Durbin-Watson stat	**1.852925**				

The estimation results show that:

The existence of long-term causality between performance and the macro-economic variables selected. And also the effect of inertia.Recall force is estimated at 0.078. Thus, an imbalance observed in period (t-1) is corrected in the following period by 7.826%. The model passes diagnostic tests for normality, ARCH effect and serial correlation.

7 CONCLUSION

This study focused on modeling the impact of macroeconomic variables on the performance of mutual funds in Morocco. Macroeconomic variables included mutual fund performance, GDP, money supply, interest rate, exchange rate, bond rate, discount rate, inflation rate and Brent oil price. The study covered the period from 2000:1 to 2022:4, with quarterly data and a total of 92 observations.

The results of the Dickey-Fuller (ADF) and Philips-Perron (PP) non-stationarity tests showed that all variables were non-stationary in level, but became stationary once differentiated by order 1. In addition, it was established that there was long-term causality between UCITS performance and the other variables in the study.

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Among the macroeconomic variables, money supply, GDP, inflation rate, discount rate and bond yield were identified as the most significant in explaining UCITS performance. On the other hand, the results indicated the absence of a significant effect of interest rate and exchange rate in explaining UCITS performance. This analysis provides important information for investors and portfolio managers concerning the macroeconomic factors influencing UCITS performance in Morocco.

Ultimately, although this study has yielded significant findings, it highlights the need for further research exploring other potential explanatory variables and using alternative statistical methods. Furthermore, future developments could contribute to enriching the understanding of the relationship between mutual fund investment decisions and macroeconomic variables, while addressing other issues relevant to the field of portfolio management.

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