

The Transmission Mechanisms of Oil Price Fluctuations on Prices

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Abstract :

This paper aims to understand the effects of oil price fluctuations on the real economy and prices, using an ARDL model with quarterly data from 2007 to 2021. The results will help policy makers and economic actors to better understand the transmission mechanisms of oil price fluctuations on the economy and prices, which is important for oil-dependent economies like Morocco. The question is to what extent do oil price fluctuations affect the real economy and price levels in oil import-dependent countries, with a particular focus on the case of Morocco?. The results of the study show that the impact of economic variables on price levels depends on the duration. In the short run, economic growth has a limited inflationary effect, oil price fluctuations have a significant inflationary impact, the nominal exchange rate does not have a significant impact and the openness of the economy does not have a significant impact. In the long run, oil price fluctuations, the real effective exchange rate, and the rate of economic openness have a significant inflationary effect, while economic growth also has an inflationary effect. The competitiveness of the Moroccan economy is important for the stability of price levels in the long run.

Keywords: Fluctuations, Oil Prices, Real Economy, Dependence, Morocco; ARDL, Cointegration

1. Introduction

Oil is a vital resource for economies worldwide, and fluctuations in its price have a significant impact on economies and price levels. In countries that rely heavily on imported oil, such as Morocco, these fluctuations have a significant impact on the real economy and on household purchasing power. This is why the question of how oil price fluctuations affect the real economy and prices is of great importance for Morocco.

Fluctuations in oil prices have a significant impact on the world economy, particularly on oil-dependent economies. This research problem aims to understand the transmission mechanisms of oil price fluctuations on the real economy and prices. The endogenous variable in this study is the general price level, while the exogenous variables include oil prices, the exchange rate, national income and interest rates.

In this study, we will focus on the transmission mechanisms of oil price fluctuations on the real economy and prices, particularly in Morocco. We will examine the different channels through which oil price fluctuations can affect the economy, including the supply, demand and financial channels. We will also look at the effects of oil price fluctuations on household purchasing power, examining the repercussions on the prices of everyday consumer goods such as fuel, electricity and foodstuffs.

We begin with a review of the existing literature on the subject, examining previous research conducted on the transmission mechanisms of oil price fluctuations and their effects on the real economy and prices. We will then proceed with an empirical analysis of economic data and oil prices to assess the magnitude of the effects of oil price fluctuations on the real economy and prices in Morocco.

The aim of this study is to better understand the transmission mechanisms of oil price fluctuations and their effects on the real economy and prices, focusing on Morocco as a country dependent on oil imports. The results of this study could have important implications for economic policy in Morocco and other similar oil import-dependent countries.

2. Literature review

2.1 Theoretical literature review

The subject of the transmission mechanisms of oil price fluctuations on the real economy and prices has attracted the interest of many economists and researchers over the years. Several theories have been put forward to explain the links between oil price fluctuations and the real economy.

One of the main theories is the theory of supply and demand, which states that oil price variations are mainly influenced by supply and demand on the world market. Supply shocks, such as wars, geopolitical conflicts and production disruptions, tend to upset the balance between supply and demand, which can lead to fluctuations in oil prices.

Another important theory is the monetary transmission channel theory. According to this theory, oil price variations have an impact on inflation and economic growth through monetary channels, such as monetary policy, interest rate variations and exchange rate variations.

Furthermore, supply chain theory suggests that fluctuations in oil prices can have an impact on production costs, product prices and the overall supply chain. Shocks to supply and demand can disrupt production costs, leading to variations in end-product prices.

Finally, consumption and savings theory suggests that fluctuations in oil prices can have an impact on household consumption and savings. Increases in oil prices can reduce households' purchasing power, which in turn can affect their consumption and savings.

In summary, the theories discussed in the literature suggest that oil price fluctuations have a significant impact on the real economy and prices. The transmission mechanisms of these fluctuations can be complex and influenced by a variety of factors, such as supply and demand, monetary channels, the supply chain and household consumption.

2.1. A review of previous empirical work

Numerous empirical studies have examined the transmission mechanisms of oil price fluctuations on the real economy and prices in oil-importing countries. Some of these studies have focused on the effects of oil price variations on economic growth, while others have examined the effects on inflation rates, household purchasing power, trade and capital flows. For example, a study by Mohsin S. Khan and Abbas Mirakhor (1984) examined the impact of oil price fluctuations on the economies of developing oil-importing countries. The authors found that oil price fluctuations had a negative effect on the economic growth of oil-importing countries, mainly due to the impact on their balance of trade.

Another study, by Bernanke and Gertler (1995), examined the effects of oil price variations on inflation and monetary policy in the USA. The authors found that oil price fluctuations had a significant impact on inflation, but that monetary policy could mitigate this impact.

Turning to Morocco, a study by El Hammaoui et al (2018) examined the impact of oil price fluctuations on the Moroccan economy. The authors found that oil price variations had a significant impact on the country's inflation rates and trade. In addition, 1 study showed that oil price fluctuations have a negative impact on household purchasing power.

These and other studies provide important empirical evidence on the transmission mechanisms of oil price fluctuations on the real economy and prices in oil-importing countries.

Table 1: Summary table of the main international empirical studies.

Authors	Study title	Survey period	Country	Methodology
Kilian	The effects of energy price shocks	1970-2007	United States	VAR
Hamilton, J.D.	Oil prices, macroeconomic fundamentals and behavioral factors	1970-2010	United States	VAR
Hooker, M.A.	Oil shocks are inflationary?	1970-2001	United States	Structural VAR

	Asymmetrical and non-linear specifications versus changes in diet			
Mork, K.A.	Oil and macroeconomics when prices rise and fall: an extension of the results from Hamilton	1970-1998	UNITED STATES	VAR
Jimenez-Rodriguez, R. and Sanchez, M.	Oil shocks and real GDP growth: empirical data for selected OECD	1970-2003	OECD	Panel VAR
Kilian, L. and Park, C.	The impact of shocks oil tankers on the stock market American	1970-2011	UNITED STATES	GARCH
Cunado, J. and De Gracia, F.P.	Oil shocks do they matter? Evidence from selected countries European	1970-2004	Europe	VAR
Lee, K.	On the importance of oil price in the american economy	1970-2004	UNITED STATES	SVAR
Kormilitsina, A. and Menzies, G.D.	Behaviour Canadian and U.S. economies in a cyclical global context	1970-2004	Canada, United States	VAR

Source: Authors' calculations.

Table 2: Summary Table Of The Main Moroccan Empirical Studies.

Author(s)	Title	Year of publication	Methodology
Bouchoucha et al.	The impact of oil prices on the Moroccan economy	2013	VAR model
Najib et al.	Oil shocks transmitted to the Moroccan economy	2016	SVAR model
El Hachimi et al.	The macroeconomic effects of oil shocks on the economy Moroccan	2019	DSGE model
Ait Lahcen et al.	Fluctuating oil prices, public spending and economic activity in an oil-importing country: data from Morocco	2020	ARDL model

Source: Authors' calculations.

These studies have sought to assess the impact of oil price fluctuations on the Moroccan economy, using different econometric methodologies. The results have been varied, but generally show that oil price fluctuations have a significant impact on the Moroccan economy through various transmission channels, such as the trade balance, public spending, inflation and economic growth.

3. Research Method

3.1. Variables of interest and data source

We used an Autoregressive Staggered Lag (ARDL) model to assess the impact of oil price fluctuations on prices in Morocco. The key variables taken into account to estimate the impact on prices (CPI) are: oil price fluctuations (OP), the Real Effective Exchange Rate (REER), the Economic Openness Rate in % of GDP (OR) and the Annual Economic Growth Rate in % (GR). The quarterly data were collected from various sources, including the Ministry of Economy and Finance (MEF) and the High Commission for Planning (HCP), for a period of 60 observations from the first quarter of 2007 to the fourth quarter of 2021.

Table 3: Description of model variables and data source

Rating	Description	Source
GR	Annual economic growth rate (%)	<i>Ministry of Economy and Finance (MEF)</i>
OR	Economic openness as % of GDP	
REER	Real effective exchange rate	
OP	Oil prices as % of GDP	

CPI	The Consumer Price Index	High Commission for Planning (HCP)
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Source: Authors' compilation

3.2. Choice of study variables

In this study, we have chosen to consider oil price fluctuations, the real effective exchange rate, the rate of economic openness as a percentage of GDP and the annual economic growth rate as a percentage as exogenous variables. We chose the consumer price index (CPI) as the endogenous variable. These variables were chosen because they are considered key factors in understanding the impact of oil price fluctuations on the real economy and price levels.

Fluctuations in oil prices (OP) are a relevant exogenous variable, as they have a direct impact on inflation due to the central role played by oil in the world economy and the importance of its use in the production of goods and services.

The real effective exchange rate (REER) is also an important exogenous variable, reflecting the competitiveness of a country's economy in relation to other countries. Fluctuations in the exchange rate affect the prices of imported and exported goods, which can have an impact on inflation.

The economic openness ratio in % of GDP (OR) is an exogenous variable that reflects a country's dependence on international trade. A more open economy is more exposed to external shocks such as oil price fluctuations, exchange rates and economic shocks in other countries, which can affect inflation.

The annual economic growth rate in % (GR) is an important exogenous variable, as economic growth can influence inflation in a number of ways. Higher economic growth can stimulate demand for goods and services, which in turn can raise prices. On the other hand, higher economic growth can lead to increased production and supply of goods and services, which can have an inverse effect on prices.

3.3. Model selection

The ARDL model is an econometric model designed to analyze long-term relationships between variables. It can model both short- and long-term dynamics of endogenous and exogenous variables. What's more, it is robust to problems of non-stationarity in time series, such as trends and structural breaks. It is therefore an appropriate model for studying the effects of oil price fluctuations on the real economy and prices in the case of Morocco, which is an oil-importing country and has undergone significant structural changes in recent decades.

4. Result and Discussion

4.1. Model specification

For the purposes of this study, the ARDL model is represented in the following theoretical form as follows: Autoregressive (AR) models : $Y_t = f(X_t, Y_{t-1}, Y_{t-2}, Y_{t-3}, \dots, Y_{t-p})$ (1)

Distributed Lag (DL) models : $Y_t = f(X_t, X_{t-1}, X_{t-2}, X_{t-3}, \dots, X_{t-q})$ (2)

From (1) and (2) we derive staggered delay autoregressive models (ARDL) in the following form:

$Y_t = f(X_t, Y_{t-p}, X_{t-q})$ (3)

$$Y_t = \alpha + a_1 Y_{t-1} + a_2 Y_{t-2} + \dots + a_p Y_{t-p} + b_0 X_t + b_1 X_{t-1} + b_2 X_{t-2} + \dots + b_q X_{t-q} + \varepsilon_t$$

$$Y_t = \alpha + \sum_{i=1}^p a_i Y_{t-i} + \sum_{j=0}^q b_j X_{t-j} + \beta_k X_k + \varepsilon_t$$

From Y_{t-p} is the lagged dependent variable, X_t is the explanatory variables and X_{t-q} their past values.

Taking into account the variables of interest, we obtain :

Y_t : The consumer price index (CPI)

t : Unit of time (quarterly) $t = 1, 2, 3, \dots, 60$; ε_t the model error term

The X_t : Explanatory variables, namely: Real effective exchange rate (REER), Economic openness rate (OR), Oil price (OP) and Growth rate (GR) The number of lags of the model estimated for the dependent variable: $i=1$ up to p is at to be determined at a later date.

The number of lags in the estimated model for exogenous variables: $j=0$ to q is to be determined later.

4.2. Stationarity test

Dealing with the stationarity properties of time series is a very important step in obtaining a non-false estimate in a non-stationary statistical universe. A time series is said to be stationary if its characteristics (expectation and variance) remain constant over time. In other words, there is no seasonality or trend in the series. To study the order of integration of the series used in the model, unit root tests were carried out on the level variables, using the Augmented Dickey Fuller test (ADF, 1981), the results of which are shown in Table 4 below.

Table 4: Summary of ADF tests

Variable	Critical value Model 3	Critical value Model 2	Probability	Order of integration
CPI	1,36	4,00	0,00	I(1)
OR	1,11	2,92	0,0527	I(0)
REER	1,01	1,73	0,5503	I(1)
OP	3,81		0,0167	I(1)
GR	4,34		0,0011	I(0)

Source: Authors' calculations, results of Eviews 12.

In order to obtain a non-falsifiable estimate in a non-stationary statistical universe, it is crucial to take into account aspects of time series stationarity. A time series is considered stationary if its mean values and variances do not vary over time. In other words, there are no trends or seasons in the series. Unit root tests were performed on the level variables using the Augmented Dickey-Fuller test (ADF, 1981) to study the order of integration of the series included in the model. Thus, to study the order of integration of our series, unit root tests were performed on the level variables using the augmented

ADF (1981) tests. As shown in the results presented in Appendix 3, we performed ADF tests for each of the time series. Examination of the various results reveals that: the endogenous variable is stationary after the first differentiation and the other exogenous variables are a mixture of stationary and non-stationary. Consequently, the non-stationarity hypothesis is accepted for all series, except for the rate of economic openness (OR) and the growth rate (REER), which are stationary at the level.

4.3. Determining the optimal ARDL model

The optimal number of delays in a model is the one that results in the ideal model. The Schwartz information criterion is generally one of the criteria used to determine the number of lags. The study of the data revealed twenty best models; however, the ARDL model has the ideal number of lags for both the dependent and explanatory variables (Schwartz information criterion (SIC) = -3.7). Determining the number of lags for the dependent and explanatory variables leads to the ARDL(2,1,3,0,2) model.

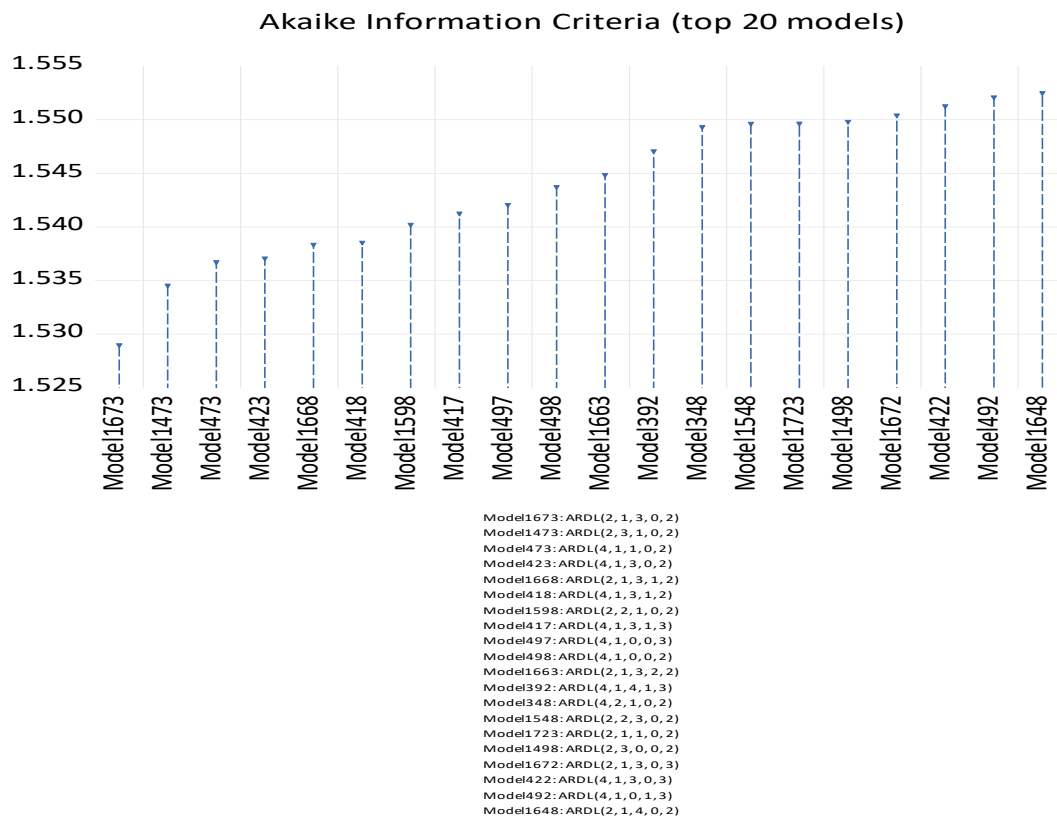


Figure 1: Akaike values of the 20 optimal models for delay (2,1,3,0,2).

Source: Authors' calculations, Eviews12 results.

4.4. Bonds test for cointegration

The co-integration test can be used to test the hypothesis of co-integration between variables. In this test, we use the asymptotic critical values of Narayan P.K. (2005). In fact, we can compare Fisher's critical value with the values of the limit test for the F-bonds test. The "Bondstests" show that for all levels of significance, the value of the Fisher statistic ($F = 5.73$) exceeds the value of the limit. This forces

us to recognize the existence of a short- and long-term link between the variables and to reject the null hypothesis that there is no co-integration between the series studied. (table 5)

Table 5: Summary of F-bonds test results

F-Bounds Test	Null Hypothesis: No levels relationship			
Test Statistic	Value	Meaning	I(0)	I(1)
F-statistic	6,27	10%	2.08	3
k	4	5%	2.39	3.38
		2,5%	2.7	3.73
		1%	3.06	4.15

Source: Authors' calculations,

4.5. Model estimation

4.5.1. Estimation of short-term effects

The results of the short-term estimation (Table 6) indicate that the estimated coefficient on the Coint Eq(-1) term measures the long-term fit of the model. the estimated coefficient is equal to -0.8. This means that the model's long-term fit is relatively rapid, with around 80% of the fit achieved after one year. In other words, if oil price fluctuations have a negative effect on the real economy and price levels in Morocco, it will take around a year for the variables to return to their equilibrium level after a disturbance. However, it is important to note that this interpretation depends on the specific context and the other variables in the model. The results show that :

For the annual economic growth rate (GR), a 1% increase in this variable leads to a 0.03% increase in short-term price levels. This suggests that economic growth has a limited inflationary effect in the short term. For oil price fluctuations (OP), a 1% increase in this variable leads to a 0.11% increase in short-term price levels. This suggests that Morocco is sensitive to oil price fluctuations and that this may have an inflationary impact in the short term.

For the nominal effective exchange rate (NEER), a 1% increase in this variable leads to a 0.02% decrease in short-term price levels. This suggests that the nominal exchange rate does not have a significant impact on short-term price levels.

For the rate of economic openness as a % of GDP (OR), a 1% increase in this variable leads to a 0.01% increase in short-term price levels. This suggests that the openness of the Moroccan economy does not have a significant impact on short-term price levels.

It is important to note that these short-term estimates are different from the long-term ones, and are often more limited in terms of their impact on inflation. However, these results show that oil price fluctuations can have a significant impact on short-term price levels, and that it is important to keep a close eye on this variable.

Table 6: Results of short-term estimates.

Form of cointegration				
Variable	Coefficient	Std.Error	t.statistic	Prob.
D(CPI(-1))	-0.431981	0.109062	-3.960877	0.0003
D(FEER)	-0.023617	0.061844	2.969037	0.0048
D(OR)	0.01516	2.784189	5.037429	0.0000
D(OR((-1)	3.331848	2.706912	1.230867	0.2249
D(OR((-2)	6.168380	2.845507	2.167761	0.0356
D(OP)	0.110994	0.934057	-0.900366	0.3728
D(OP((-1)	5.288788	1.108145	4.772649	0.0000
CointEq(-1)*	-0.801165	0.001305	8.556262	0.0000

Source: Authors' calculations, Eviews12 results.

4.5.2. Estimating long-term effects

The long-term results (Table 7) reveal the existence of a long-term, co-integrating relationship between economic growth and the explanatory variables. These results are based on the coefficient of the error correction term (ECM), which is negative and statistically significant, showing how quickly the endogenous variable (GDP) reaches equilibrium in the long term. The results also show that :

For oil price fluctuations (PTR): A 1% increase in oil price fluctuations leads to a 0.85% increase in long-term price levels, all other things being equal. This suggests that Morocco is very sensitive to oil price fluctuations, and that this can have a significant impact on long-term price levels.

For the Real Effective Exchange Rate (REER): A 1% increase in the real effective exchange rate leads to a 0.15% decrease in long-term price levels, all else being equal. This suggests that the competitiveness of the Moroccan economy is important for the stability of long-term price levels.

For the Economic openness rate as a % of GDP (OR): A 1% increase in the economic openness rate leads to a 0.24% increase in long-term price levels, all else being equal. This suggests that the openness of the Moroccan economy may have an inflationary effect in the long term.

For the Annual Economic Growth Rate in % (GR) A 1% increase in the economic growth rate leads to a 0.47% increase in long-term price levels, all else being equal. This suggests that economic growth can also have a long-term inflationary effect.

Table 7: Results of long-term estimates

Long-term coefficients				
Variable	Coefficient	Std.Error	t.statistic	Prob.
PCI	0.022500	0.067085	0.335394	0.7388
OR	0.245989	0.150954	0.900861	0.3722
REER	-0.150279	0.000566	0.493062	0.6242
OP	0.8500456	0.000653	0.007386	0.9941
GR	0,4708976	1,11E-08	0,117279	0,9072
c	-0.069738	0.115884	0.601796	0.5501

Source: Authors' calculations, Eviews12 results.

4.6. Model validation

4.6.1. ARDL residual tests

Model validation involves the analysis of tests on ARDL residuals to confirm their homoscedasticity, non-autocorrelation and normal distribution. These tests are ARCH (0.774), Breusch-Pagan Godfrey (0.419) and Jacques-Bera (0.000) respectively. The ARDL model is well specified, as the probability of all three tests is greater than 0.05, showing that the errors are homoscedastic, non-autocorrelated and normally distributed (Table 8).

Table 8: ARDL residual tests

Hypothesis H0	Applied test	Probability	Decision
Normality	Jarque Bera	0,000	Acceptance of H0
No autocorrelation	Breusch-Pagan Godfrey	0,419	Acceptance of H0
Homoscedasticity	ARCH	0,774	Acceptance of H0

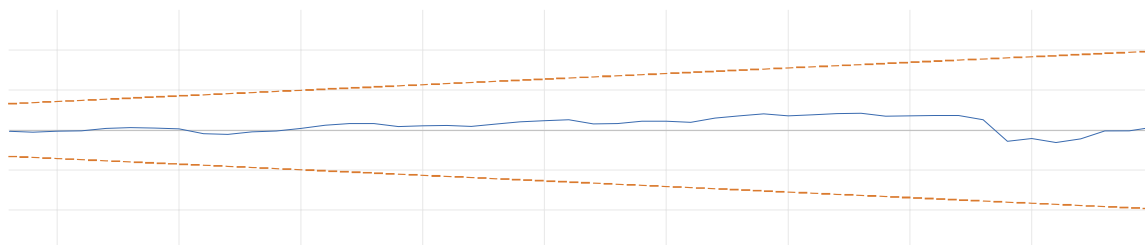
Source: Authors' calculations, results of Eviews 12.

4.6.2. Model stability test

Model stability can be assessed using CUSUM cumulative stability tests (Brown et al., 1975), which are based on the sum of residuals, in the model validation process. If the blue curve falls within the limits of the confidence interval in red lines, the model parameters are considered stable. In our case, the CUSUM curve falls within this range, allowing us to accept the

conclusion that the ARDL model coefficients are stable.

Figure 2: CUSUM tests



Source: Authors, Eviews12 results.

4.7. Discussion

In summary, the short- and long-term results for this issue indicate that oil price fluctuations have a significant impact on the real economy and price levels in Morocco.

The results of the study show that the impact of economic variables on price levels depends on duration. In the short term, economic growth has a limited inflationary effect, oil price fluctuations have a significant inflationary impact, the nominal exchange rate does not have a significant impact, and the openness of the economy does not have a significant impact. In the long term, oil price fluctuations, the real effective exchange rate and economic openness have a significant inflationary effect, while economic growth also has an inflationary effect. The competitiveness of the Moroccan economy is important for the long-term stability of price levels.

This study showed that oil price fluctuations have a significant impact on long-term price levels in Morocco, with a 0.85% increase in price levels for every 1% increase in oil price fluctuations. Furthermore, a 1% increase in the real effective exchange rate leads to a 0.15% decrease in long-term price levels, suggesting that the competitiveness of the Moroccan economy is important for the stability of price levels. The study also showed that the openness of the Moroccan economy and economic growth can have inflationary effects in the long term, with an increase of 0.24% and 0.47% in price levels respectively for each 1% increase in these variables. These results have important implications for policy-makers and economic players in Morocco.

5. Conclusion

Overall, our study has shown that oil price fluctuations have a significant impact on the real economy and price levels in Morocco. The results showed that Morocco is highly sensitive to oil price fluctuations, which can have a significant impact on long-term price levels. This suggests that Morocco must continue to diversify its economy and reduce its dependence on oil imports to reduce its exposure to oil price fluctuations.

The results also showed that the competitiveness of the Moroccan economy, economic openness and economic growth have significant effects on long-term price levels. Consequently, policies aimed at improving competitiveness, stimulating economic growth and strengthening economic openness could help maintain stable price levels in the long term.

Finally, an analysis of the short-term and long-term effects of oil price fluctuations on Morocco's real economy shows that the short-term effects are greater than the long-term effects. The results suggest that the Moroccan authorities need to take steps to reduce the country's vulnerability to oil price fluctuations, notably by diversifying the economy and increasing energy efficiency.

In conclusion, this study highlights the importance for Morocco of diversifying its economy and reducing its dependence on oil imports to reduce its exposure to oil price fluctuations. In addition, economic and monetary policies aimed at boosting competitiveness, economic growth and economic openness can help maintain stable price levels over the long term. These conclusions can serve as a basis for more effective economic and monetary policies, better adapted to the economic challenges facing Morocco.

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