Inflation in Egypt: Internal or External Phenomenon [1]

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Abstract

The aim of this paper is to identify precisely the most important determinants of inflation in Egypt over the period from 1976 to 2023 and investigate whether inflation in Egypt is internal or external phenomenon. To obtain the aim of the study, the NARDL approach of cointegration is utilized, and the long run equilibrium relationships, along with the short run dynamics coefficients are estimated simultaneously over the period of the study. The results of the study indicate that the government policies – monetary and foreign trade policies- are the key factor for controlling inflation in the short run, however, the real production and the gross national expenditure are the main players in the long run. Furthermore, the internal factors in Egypt play a more dominant role in the inflation surge. That is, national expenditure and a decrease in real income per capita, interest rate, and inflationary expectations better explain the change in inflation in Egypt than the oil and food price shocks. Finally, as far as the asymmetric effects are concerned, the findings demonstrate that prices in Egypt are flexible in upward direction, but steaky in the downward direction, which may cause market inefficiencies, and therefore, more inflationary pressures in the economy. Contractionary monetary policy is recommended to alleviate inflation in the short run, taking into consideration its effect on the growth. However, increasing production and reducing national expenditure is essential for controlling inflation in the long run.

Keywords: inflation – NARDL- Egypt- internal factors-external factors

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التضخم في مصر: ظاهرة داخلية أم خارجية

ملخص

يمثل التضخم في مصر ظاهرة مزمنة منذ بداية فترة الدراسة، وقد تزايد بقوة في العقد الثاني من الألفية الجديدة ليصل إلى ذروته (34%) في عام 2023. يهدف هذا البحث إلى تحديد أهم العوامل المحددة للتضخم في مصر خلال الفترة من 1976 إلى 2023، والتحقيق مما إذا كان التضخم في مصر ظاهرة داخلية أم خارجية. ولتحقيق هدف الدراسة، تم استخدام منهج التكامل المشترك، لاسيما أسلوب الانحدار الذاتي ذي الفجوات الموزعة غير الخطي (NARDL)، وتقدير علاقات التوازن طويلة الأجل، والعلاقات الديناميكية قصيرة الأجل في وقت واحد خلال فترة الدراسة. تشير نتائج

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الدراسة إلى أن السياسات الحكومية – السياسات النقدية والتجارية الخارجية – هي المؤثر الرئيسي على التضخم في الأجل القصير، بينما يعتبر الإنتاج الحقيقي والإنفاق القومي الإجمالي هما المحددين الرئيسيين في الأجل الطويل. علاوة على ذلك، تلعب العوامل الداخلية الدور الرئيسي في تحديد التضخم في مصر، أي أن الإنفاق القومي والدخل الحقيقي للفرد، ومعدل الفائدة، والتوقعات التضخمية تفسر بشكل أفضل التغير في التضخم في مصر مقارنة بصدمات أسعار النفط والغذاء. وبالتالي، فإن المحددات الداخلية أقوى من العوامل الخارجية في تحديد التضخم في مصر خلال فترة الدراسة. وأخيرًا، فيما يتعلق بالتأثيرات غير المتماثلة، توضح النتائج أن الأسعار في مصر مرنة في الاتجاه الصعودي، ولكنها غير مرنة في الاتجاه الهبوطي، مما قد يتسبب في عدم كفاءة السوق، ومن ثم المزيد من الضغوط التضخمية في الاقتصاد. توصي الدراسة باتباع سياسة نقدية انكماشية للتخفيف من حدة التضخم في الأجل القصير، مع الأخذ في الاعتبار تأثير هذه السياسة على النمو. فضلاً عن ذلك فإن زيادة الإنتاج وخفض الإنفاق القومي يمثلان حجر الأساس للتحكم في التضخم في الأجل الطويل.

الكلمات المفتاحية: التضخم– NARDL– مصر – عوامل داخلية – عوامل خارجية

1. INTRODUCTION

Inflation is a remarkable problem that occurs when the overall level of prices increases speedily and consistently over time (Kamal & Abdella, 2023). The consequences of inflation are serious. Inflation diminishes the purchasing power of the consumers, thus, decreasing their standard of living. It causes significant redistributions of income and wealth from savers to debtors and from fixed-income workers to self-employers and traders. Moreover, due to inflation, people spend most of their money income for consumption. Therefore, saving and investment decline, resulting in higher unemployment rate and lower economic growth. Furthermore, inflation causes resource misallocations and inefficiency, consequently, less economic growth in the long run. A high and volatile inflation rate increases uncertainty about future prices, instability, and deteriorates the competitiveness of a country's exports which lead to deficit in the trade balance and balance of payments (Melaku, 2020; Tommasi, 1999).

Inflation in Egypt is a chronic phenomenon since the beginning of the study period (1976 – 2023). Moreover, it has been increasing strongly in the second decade of the new millennium, since it becomes two-digit number soaring from almost 10% in 2011 to 34% in 2023, with a growth rate of 13%

annually over this period (WB, WDI, 2023). As a result, managing inflation is a fundamental goal of the government to keep a healthy economy. Therefore, the causes of inflation should be identified precisely for successful and effective implementation of sustainable development goals (SDGs) (Melaku, 2020).

Economic theory determined several reasons for inflation, the demand-pull inflation and the cost- push inflation are the most remarkable reasons. Demand pressure is generated by adapting expansionary fiscal policy, such as increasing government spending or expansionary monetary policy, such as increasing money supply or decreasing interest rate. In addition, an increase in aggregate demand due to the increase in public or private consumption expenditure or an increase in investment may create inflation since aggregate supply is inelastic in the developing countries, especially in the short run. Supply shocks can be represented by a decrease in labor, and other inputs, and the increase in cost of production; this is called the cost-push inflation. Furthermore, imported inflation is a result of the increase in prices in other countries worldwide, therefore, price of imports increases and pushes the domestic cost of production up, consequently, inflation arises. The exchange rate pass through effect causes cost-push inflation as well through its effect on the import's prices (Ghaly, 2022). Finally, backward looking inflation expectations and market rigidities have their increasing role in driving inflation dynamics in many countries staring from the mid-eighties onwards (Ali, 2011).

The determinants of inflation in the existing literature focus either on the external factors or the internal ones, but not on both. In addition, change in policy variables are ignored. Furthermore, many earlier studies do not distinguish between short-run and long-run effects. Besides, most of papers applied linear modelling to examine the determinants of inflation, but the results might be biased if the true relationship is nonlinear (Binti Mohd Shafie, et al., 2021). This study aims to fill these gaps. The main objective of this paper is to follow a comprehensive analysis of inflation by identifying and estimating the effect of both internal and external factors on inflation in Egypt over the period (1976-2023) to explain the long-run determinants and the short-run dynamics of inflation simultaneously, determining the speed of adjustment from the short-run disequilibrium to the long-run steady-state equilibrium. Furthermore, the nonlinear relationship between inflation and its

determinants are taken into consideration and estimated using the NARDL approach of cointegration. Finally, by standardized the estimated coefficients of the model, a comparison between the magnitude of the coefficients is possible, therefore, the strongest determinants of inflation in Egypt are identified whether in the long run or in the short run, which is extremely important for policy makers.

The remainder of the paper consists of six sections. **Section 2** gives a literature review of the determinants of inflation worldwide, with special focus on literatures which applied on Egypt. The descriptive analysis of inflation in Egypt is explained in detail in **Section 3**. The description of the adopted models and the specification of the variables are explained in **Section 4**. The utilized methodology is illustrated in **Section 5**. The results are reported, evaluated, and explained in **Section 6**. Finally, **Section 7** summarizes and draws conclusions and directions for future research.

2. LITERATURE REVIEW

To investigate the substantial determinants of inflation, theoretical and empirical evidence from literature about factors influence inflation in specific countries, especially Egypt is provided and discussed in this section.

2.1 Theoretical Literature

Many economic theories and hypotheses confirm different causes of inflation as illustrated in **Figure (1)**. First, in the nineteenth century **the Quantity Theory of Money** states that fluctuations in the money supply is directly proportional to the change of overall level of prices, holding the velocity of money and the income constant. Fisher's equation of money explained the relationship between money supply (M) and price level (P) as follows: $MV = PT$ where V is the velocity of circulation of money, and T is the total national output. Moreover, Friedman (1989) claimed that "inflation is always and everywhere a monetary phenomenon", confirming the quantity theory of money as an economically feasible fundamental. Therefore, for monetarists and monetary theory, inflation can be driven by monetary variables such as money supply and interest rates. While a growth in the supply of money causes high inflation, interest rates have opposite impact on inflation. An increase in interest rates boosts the cost of borrowing, decreasing investment, consumption and thus national expenditure, as a result inflation shrinks (Ghaly, 2022; Binti Mohd Shafie et al., 2021; Emam, 2023).

Second, **Demand-Pull Inflation Theory:** Regarding this theory and according to John Maynard Keynes, inflation occurs if the value of quantity demanded exceeds quantity supplied in both the output and input markets. At the level of full employment, an increase in national expenditure – for example consumption, investment, and government expenditure- gives rise to aggregate demand for goods and services, therefore, motivates the increase in the level of prices (Alfiky, 2023). By the same token, demand-pull inflation occurs if there is a shortage of goods and services in the economy. Due to a scarcity of supply, sellers can raise their prices until quantity supplied, and quantity demanded are balanced, therefore, inflation is magnified (Ghaly, 2022).
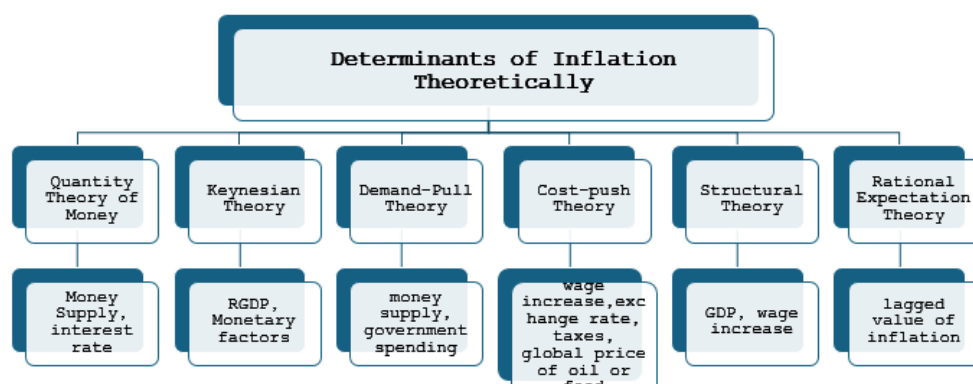

Figure (1): Determinants of Inflation According to Economic Theory

Third, **Cost-Push Inflation Theory**: When cost of production increases, producers is expected to rise the prices of their products to retain their profits. Then, the increase in the price of outputs tends to induce workers and trade unions to demand higher wages, consequently, the cost of production increases, forcing producers to raise prices again (Alfiky, 2023). Moreover, various **supply side inflation theories** interpret a rise in the level of price due to external shocks, such as a rise in oil prices, or the increase in global food prices or a depreciation of a country's currency (Ghaly, 2022). A rise in price of oil increases the cost of transportation, which boosts the cost of many products, including food, as a result, cost-push inflation occurs. This is called imported inflation (Emam, 2023). Moreover, fluctuations in the exchange rate can cause inflation. An increase in foreign exchange rate or currency depreciation- compared to US dollar- tends to push the price of imports up and decrease the price of exports. If demand for export and import

are price inelastic, this will lead to lower values of exports and higher values of imports, consequently, inflation will be stimulated and vice versa.

Furthermore, **Structural Theory of Inflation** indicates that there are structural factors that contribute to the rise in inflation. The inflexibility of the productive system in most of the developing countries leads to structural imbalances in their economies. An increase in amount of money and therefore spending, leads to an increase in aggregate demand, which is associated with the inability of the aggregate supply to increase. As a result, aggregate demand becomes greater than aggregate supply, and inflationary forces are driven (Alfiky, 2023).

Finally, the idea of **Rational Expectation Theory** was developed by John Muth in 1961, while it was popularized by Robert Lucas and Sargent in the 1970s and nowadays it is widely used in macroeconomics works. The theory assumes that people always learn from past mistakes and use the available information in addition to economic theories to make decisions. Furthermore, people understand how the economy works and how government policies alter macroeconomic variables such as inflation (CFI, 2024). Following this theory, past or lagged inflation can be a proxy for backward looking inflation expectations and market rigidities (Ali, 2011).

2.2 Empirical Literature

Empirical evidence from literature about factors influence inflation is clarified and divided according to different categories as illustrating in **Table A1** in **Appendix A**.

Some of the papers focus on the fiscal view of inflation, mainly deficit or public debt. Others concentrate on the monetary approach of determining inflation, using both interest rate and money supply as proxies. Only few literatures include both fiscal and monetary policy variables to study inflation. Both (Elkhadrawi, 2024 and Mohammed, 2023) studied the impact of Monetary Policy shocks on Macroeconomic variables and inflation in Egypt. Applying Structural VAR, Elkhadrawi (2024) used quarterly data (1991-2022), and he concluded that a higher interest rate policy produces a large negative shock to private investment and consumption but only a small effect on reducing inflation. Moreover, he found that 42% of the error variance of the inflation is explained by the fluctuations of the exchange rate, but only 7% is due to the fluctuations in interest rates. On contrary, Mohammed (2023) used annual data (1991-2020), and his results indicated that an increase in

both the exchange rate and interest rate increases inflation rates in the long run, but only interest rate affects inflation positively and significantly in the short run. He stated that an increase in interest rate tends to raise costs of production (increasing borrowing cost), as a results inflation increases.

On the other hand, two works concentrate on the effect of fiscal policy on the inflation and provide contradicting results. Joy, et al. (2021) concluded that public capital expenditure is negatively and statistically significant in influencing inflation rate in Nigeria for the period (1981 - 2015). However, Alfiky (2023) indicated that an increase in government consumption increases inflation in Egypt significantly whether in the long run or in the short run over the period from 1976 to 2021.

Abdallah & Elshafei (2023) studied the impact of both monetary and fiscal policies together on the inflation in three countries, Egypt, Nigeria and South Africa, using panel data over the period 1960-2020. They indicated that both policies are effective in changing inflation. About the fiscal policy, an increase in government spending tends to reduce inflation significantly. The authors justified their result since the increase in government spending increases the demand for local goods and services, and thus production increases to meet this demand, and therefore prices tend to decrease in the long run. As far as the monetary policy is concerned, expansionary monetary policy, reflected in an increase in money supply, tends to increase inflation. In addition, the decrease in interest rate increases inflation in the countries of interest. With almost the same objective, Emam (2023) aimed to determine the most significant policies (fiscal or monetary) affecting inflation in Egypt (1990-2022) using semi-annual data. He concludes that an increase in exchange rate and money supply, tends to increase inflation, while an increase in interest rate and government spending tend to reduce inflation in the long run. An increase in interest rate and exchange rate has significant positive effect on inflation in the short run.

Determinants of inflation are divided also in the literature into monetary factors or real factors. Binti Mohd Shafie, et al. (2021) analyzed the monetary and real determinants of inflation in Malysia (1997-2018) using quarterly data and the results reveal that money supply has only short-run impact on inflation meanwhile the real GDP has both short-run and long-run impact on inflation. In contrast, Ali (2020) studied the determinants of inflation in Egypt (1960-2017) and the results of his work indicate that a

growth of real gross domestic product reduces inflation in Egypt only in the long run, while the growth in money supply affects inflation positively whether in the short run or in the long run.

Other works concentrates on the demand side determinants of inflation, for example, Ghaly (2022) indicates that the main causes of inflation in Egypt are mainly related to the demand side factors (demand-pull inflation). According to the results of her study, supply of money, gross national expenditure, and the growth rate of imports have a substantial short and long-run influence on inflation in Egypt for the period (1960-2020), but the gross domestic product has no impact on inflation in both the short run and long run. Another evidence from emerging Asian countries from 2007 to 2008, Jongwanich and Park (2009) findings reveal that excess aggregate demand is far more important in defining inflation than cost-push factors. For more investigation, Jongwanich and Park (2011) examined the effect of supply-push factors (global prices of food and oil) on inflation in developing Asia and concluded that their effect on inflation is quite low.

Moreover, some papers concentrate on the effect of specific factor on inflation, mainly oil price, inflation inertia, or the depreciation of the currency, among others. Sherif (2024) aims to estimate the effect of exchange rate on wage-price spiral in Egypt (1991-2021) and the results indicated that money wage rate is positively affected by domestic price level and vice versa, so successive depreciation of the Egyptian pound would lead to explosive inflation due to the wage-price spiral. Ali (2020) investigates the asymmetric impacts of oil prices on inflation in Egypt over the period (1960-2017) and indicates that price of oil affects inflation positively in both the long and short run. The work of (El Baz, 2014 and Ali, 2011) assure the importance of the inflation inertia, which represents the backward inflation expectations and market rigidities, as the most important variable in determining inflation in Egypt.

Finally, more comprehensive papers concentrated on internal and external factors of inflation. All policy factors and real factors are considered as internal factors, while the import prices, prices in US, interest rate in US, global price of food or price of oil, global crises are categorized as external factors in the literature. Kia and Sotomayor (2020) aim to determine whether internal or external factors could influence inflation in Egypt and Mexico (1975-2015) using quarterly data. The results of Egypt reveal that the sources

of inflation are mostly internal (Monetary and fiscal policy) in the short run, but both internal and external factors are significantly affecting inflation in Egypt in the long run. More evidence from Kamal and Abdella (2023) indicates that the main driver of inflation in Egypt over the period (1991-2023) are both internal factors (expectation about inflation, an increase in output gap, depreciation of the Egyptian pound against the US dollar, expansion of the money supply), and external factors (price of food globally) whether in the long run or in the short run.

Various econometric techniques have been used to estimate the determinants of inflation using time series data in specific country or panel data in groups of countries. However, many papers apply the cointegration approach to get the long-run steady-state relationship between variables along with the dynamic relations in the short run. Among others, ARDL (Alfiky, 2023; Joy, et al., 2021; Binti Mohd Shafie, et al. 2021; Sherif, 2024; Ghaly,2022), FMOLS (Kia & Sotomayor, 2020), and recently NARDL (Emam, 2023; Binti Mohd Shafie, et al. 2021; Ali, 2020; Abdelkarim, 2022) are the most used techniques in the literature of determinations of inflation. In addition, Granger causality approach used to determine the direction of the causality in some papers. For example, Mohammed (2023) applied Engle granger two-step cointegration approach to determine the direction of the relationship between exchange rate, interest rate and inflation. Moreover, Abdallah & Elshafei (2023) used Granger causality test to examine the effect of both fiscal and monetary policies on inflation in Egypt. Other papers intend to analyze the dynamic responses of endogenous variables and inflation to external shocks using VAR and impulse response analysis (Kamal & Abdella, 2023; Ali, 2011; El Baz, 2014) and SVAR model (Elkhadrawi, 2024).

As far as the results of the literature applying on Egypt are concerned, the most important determinants of inflation are exchange rate, interest rate, money supply, investment, government consumption, real GDP or output gap, foreign debt, price of global food, price of oil, and finally expectations about inflation itself (Emam, 2023; Kia & Sotomayor, 2020; Alfiky, 2023; Kamal & Abdella, 2023; Elkhadrawi, 2024; Ali, 2011; Abdallah & Elshafei, 2023; Ghaly, 2022; El Baz, 2014) . Although conflicting results of the effect of these variables on inflation are obtained, we can acquire the main direction from most of these papers as follows. A positive shock in exchange rate, money supply, investment, government consumption, foreign debt, wages,

global prices of food or oil significantly push inflation up in Egypt whether in the long run or in the short run, whereas lags of inflation is the main positive determinants of inflation in the short run. On contrary, higher interest rate, growth of real output help in reducing inflation in Egypt.

In conclusion, despite the existence of many literatures about the determinants of inflation in Egypt, the results are inconclusive and there are no agreements about the most important causes of this phenomenon in Egypt nowadays, which confirms the importance of this study, especially in this period in which Egypt suffers from accelerating rates of inflation due to internal and external causes. Egyptian economic reforms, depreciation of the Egyptian pound several times, oil-price shocks, global food crises, wars and epidemics are witnessed recently, and it is valuable to estimate the effects of these shocks on the inflation in Egypt and determine which of them are the most substantial. Such investigation is very important for policy makers in Egypt.

3. Descriptive analysis

The level of prices soared in Egypt sharply for the period from 1976 to 2023. Its increase registered more than 10% annually throughout the period of the study as illustrated in **Figure (2)**.
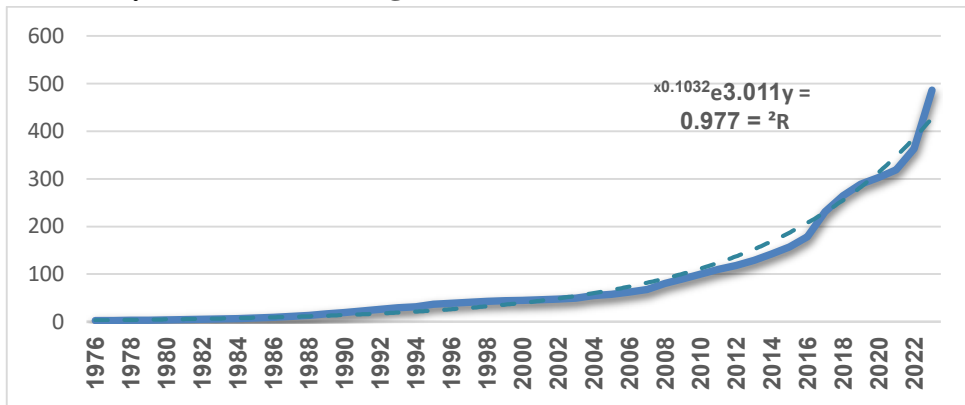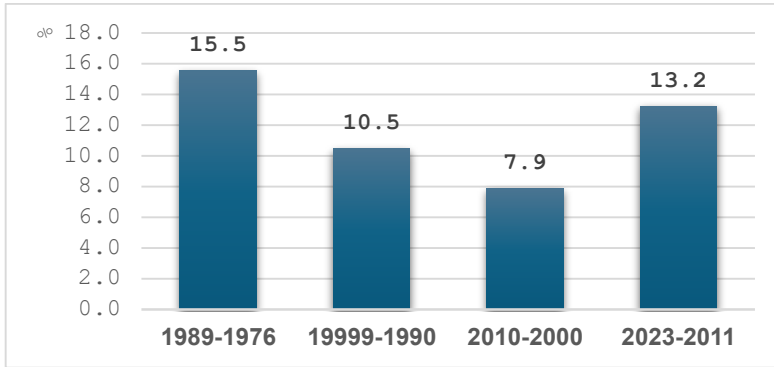

Figure (2): The Consumer Price Index in Egypt (1976 – 2023)
Source of data: World Bank (WB), World Development Indicators (WDI), 2023.

To analyze the inflation in Egypt, four sub main periods can be identified as represented in **Figure (3)**.

Figure (3): The average inflation rate in Egypt (1976-2023)

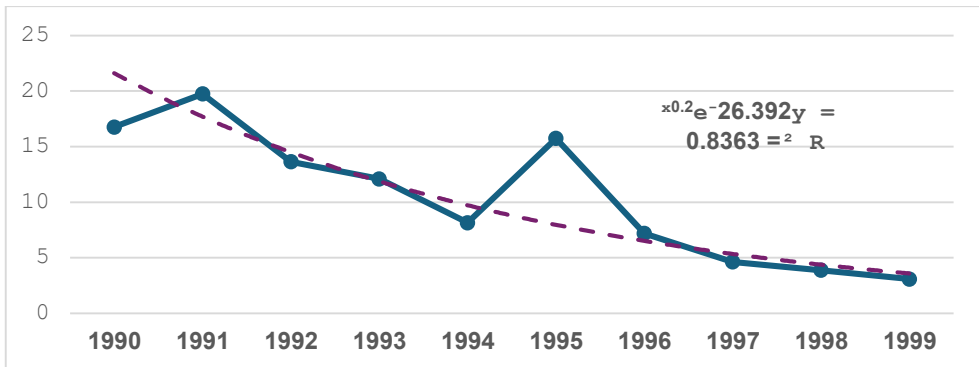Source of data: World Bank (WB), World Development Indicators (WDI), 2023.

The first one is from the beginning of the study to the end of the 1980s (1976 – 1989) as explained by **Figure (4)**. In this period, inflation rate was increasing sharply from 10% in 1976 to reach its highest level of 21% in 1989, with annual average rate of 16% over the period (1976-1989) for two reasons, the first one is external and the second is internal as follows. The external causes of inflation are represented in the "global oil shocks" during the 1980s, resulting from the increasing price of oil after the Arab Israeli war in 1973 and the Iranians Revolt in 1980, then the First Gulf War that lasted from 1980 to 1988, therefore, the global oil expenses hiked significantly during the 1980s. Therefore, the inflation rate increased in this decade due to the **cost-push** inflation (Ghaly, 2022). The second reason for the high inflation rate in this decade is internal, which can be explained by the adopted monetary policy, which was fully subordinating to the fiscal policy. Due to the growing budget deficit throughout this period, the central bank responded by issuing money to finance such a deficit. Thus, **demand-pull** inflation was created (Ali, 2011).

$$y = 10.171e^{0.051x}$$
$$R^2 = 0.5003$$
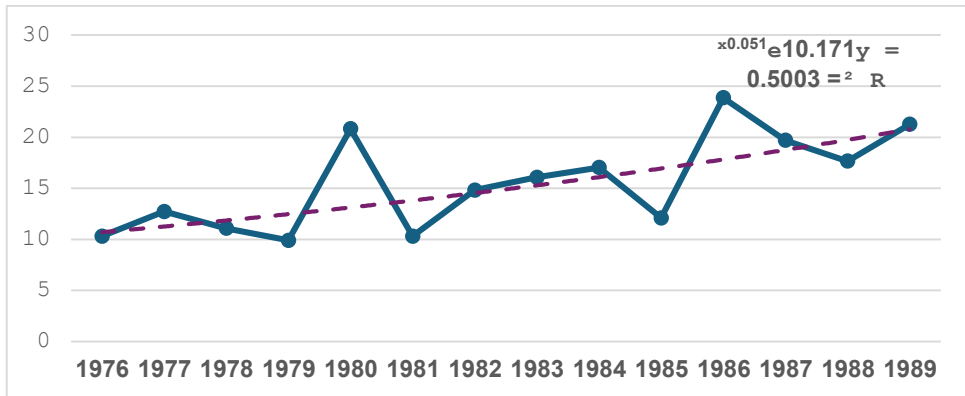
Figure (4): Inflation Rate in Egypt (1976-1989)
Source of data: World Bank (WB), World Development Indicators (WDI), 2023.

At the 1990s, as clarified by **Figure (5)**, the government adopted the economic reform and structural change program since 1991 with the assistance of the International Monetary Fund (IMF) and the world bank to fight inflation, keep the price stable, and offer financial help to Egypt. To do that, the government embraced deflationary policies, such as the use of treasury bills and bonds to finance the budget deficit with real sources instead of increasing cash issuance. Therefore, domestic liquidity had been controlled, as well as controlling the exchange market and fighting the black market for currency trade to achieve stability (Alfiky, 2023). Consequently, inflation lessened sharply in this decade from almost 20% in 1991 to reach 3% only in 1999, with an average rate of 10.5% annually over the 1990s.

$$y = 26.392e^{-0.2x}$$
$$R^2 = 0.8363$$

Figure (5): inflation rate in Egypt (1990-1999)
Source of data: World Bank (WB), World Development Indicators (WDI), 2023.

At the first decade of the new millennium (2000-2010), the government fostered the third generation of economic reforms, which are represented by the reform of banking systems, taxes, and custom. The inflation rate was still controlled at a low level up to 2003 as illustrated in

Figure (6), the year of the official shifting of the central bank towards a more flexible exchange rate regime to shift gradually towards targeting inflation and implementing the desired price stability (Ali, 2011). As a result of this new regime, Egyptian pound depreciated from 4.5 pound per US$ in 2002 to 6.2 pound per US$ in 2004 and inflation surged from 2.7% in 2002 to 11.3% in 2004. The depreciation of the Egyptian pound increased the price of imports and their values as demand for imports is inelastic, since most of them are mainly machines and inputs of production. Therefore, the cost of production elevated and pushed inflation up again over the **exchange rate pass-through** effect. Moreover, the global financial crises, which causes global commodity price shocks, pushed the inflation again to 18% in 2008 to register the highest inflation rate in this decade. From the above discussion, three drivers of inflation, both internals and externals, can be identified in this decade. Firstly, **cost-push inflation** due to the increase of the price of imports (cost of production) resulting from the currency depreciation. Secondly, inflation expectation was an important player in this decade because of adopting the floating exchange rate regime. Finally, the **demand-pull inflation** resulting from the expansionary monetary policy, which is embraced by the government to relieve the effect of the global financial crises. Accordingly, the average inflation rate flied from 2.7% in year 2000 to 11.3% in 2010 to register 8% annually over the decade.

$$y = 2.0832e^{0.1866x}$$
$$R^2 = 0.7599$$

Figure (6): inflation rate in Egypt (2000-2010)
Source of data: World Bank (WB), World Development Indicators (WDI), 2023.

At the second decade of the new millennium up to the end of the study period (2011-2023), there was an increasing rate of inflation, as presented in **Figure (7)**, because of the economic and political instability after the January 2011 revolution. The unrest following the revolution negatively affected most of the economic aspects. Therefore, the Central Bank of Egypt (CBE) adopted

a contractionary monetary policy to strengthen the financial system and to preserve overall confidence in the Egyptian economy, as a result, the inflation rate reduced to 7.11% and still controlled up to 2015. However, the black market for currency trade returned, which raised the stress on the value of the pound. Consequently, the CBE fostered the second liberalization for exchange rate in November 2016, which was the main reason for the strong accretion in inflation rate, to reach a peak of 29.5% in 2017 (Alfiky, 2023). The depreciation of the Egyptian pound was passed on to consumers again through the increase of the import costs (exchange rate pass-through effect).
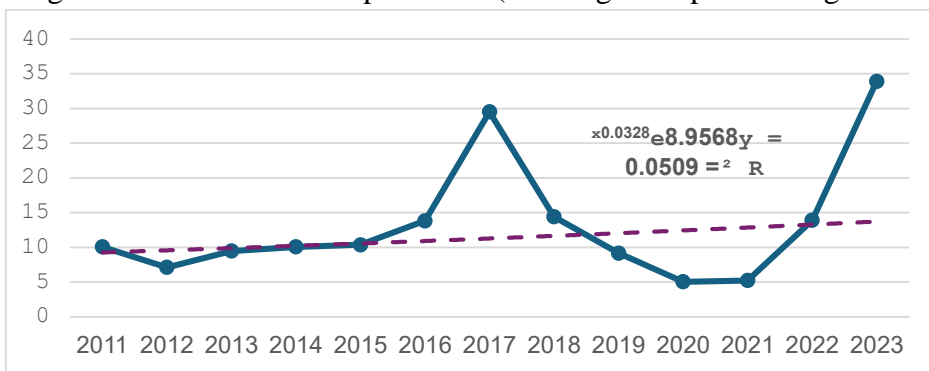

$y = 8.9568e^{0.0328x}$

$R^2 = 0.0509$

Figure (7): inflation in Egypt (2011-2023)

Source of data: World Bank (WB), World Development Indicators (WDI), 2023.

Due to the contractionary monetary policies used to recover the inflation, in addition to the government's investments in modernizing agricultural methods and food supply chains, a sustained decline in food prices since 2019 was obtained. Thus, inflation began to decrease gradually but strongly over the following years (2019, 2020, 2021) to register the lowest level in this period. However, two factors caused the cost-push inflation to increase again in the last two years (2022 and 2023). The first one is external, represented in the Russian invasion of Ukraine in February 2022, and the following increase in the global price of food. The second one is internal, since the CBE liberalized the exchange rate and devaluated the pound three times since March 2022. Subsequently, inflation soared again to reach its highest level throughout the period of the study, reaching 34% in 2023.

To sum up, many causes of inflation can be detected over the period of the study, such as the demand-pull inflation, represented in an increase in money supply, or cost-push inflation, represented in the increase in the global price of food or oil, the increase in price of imports because of the depreciation of the Egyptian pound, the expansionary monetary policy, which

adopted by the government to relieve the effect of the global financial crises, among others.

4. MODEL SPECIFICATION

Following the theory and literature as illustrated in Section 2 and analyzing the inflation rates in Egypt over the period of the study as clarified in Section 3, the most important determinants of inflation in Egypt (1976-2023) are identified carefully as follows. Gross domestic product per capita (GDPP) is included to refer to the supply of goods and services or to a real factor of inflation. To introduce the demand-pull factors in the estimated model, we added the gross national expenditure (GNE), in addition to the supply of broad money (MS). Furthermore, from the policy perspective, the monetary policy is represented by the interest rate (IR) as an important tool for it. The previous included variables are internal factors of inflation. Regarding the external factors, global price of food (PF) and global price of oil (POIL) as well as the foreign exchange rate (EXCH) are of great importance. They are considered as cost-push factors as well. EXCH is considered as cost-push determinant of inflation, since higher foreign exchange rate causes higher imports prices, therefore higher cost of production. As a result, imported inflation is driven.

From the above discussion, our model specification can answer the following questions. Is inflation in Egypt (1976-2023) internal or external phenomenon? Is it caused by real factors or monetary factors? Is it demand-pull of cost-push inflation? This investigation is very respectable guide for policy makers to implement successful policies to target inflation in Egypt.

Accordingly, our model is symbolized as in **Equation (1)**.

$$INF_t = \alpha + \beta_1 GDPP_t + \beta_2 GNE_t + \beta_3 MS_t + \beta_4 IR_t + \beta_5 EXCH_t + \beta_6 POIL_t + \beta_7 PF_t + u_t \dots (1)$$

where INF: Inflation, GDP deflator (annual %), GDPP: GDP per capita (constant 2015 US$), GNE: Gross national expenditure (% of GDP) or domestic absorption (private consumption, government consumption and gross capital formation), MS: Broad money (% of GDP), IR: Real interest rate (%), EXCH: Official exchange rate (LCU per US$, period average), POIL: Average annual OPEC crude oil price from 1960 to 2024 (in U.S. dollars per barrel), PF: FAO Food Price Index (real). t =1, 2, ….., 47 (1976 - 2023), α is intercept, u_t are the residuals of the regression, β_s are the coefficients to be estimated, and according to the theory, it is expected that: $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 > 0$,

$\beta_4 < 0$, $\beta_5 > 0$, $\beta_6 > 0$, $\beta_7 > 0$. Data for all the variables are collected from the world development indicators of the world bank 2023. Time series data for Egypt is utilized from 1976 to 2023. The beginning of the period is determined according to the availability of data to obtain the largest number of observations for the accuracy of the estimation.

5. METHODOLOGY

The co-integration approach is attractive as it retains the long-run relations and obtains highly consistent parameters in the long run (Stock & Watson, 1988). Moreover, the associated ECM estimates the short-run dynamics relations; in addition, the speed of adjustment toward the long-run equilibrium can be measured. However, there are integration and co-integration restrictions that the models must overcome in order to apply this approach. The unit root test is used first to examine the stationarity of the variables. Because of different shocks occur over the period of the study, breakpoint unit root test is used. The ARDL technique of co-integration is a linear time series, which can be applied and yields consistent estimates of the long-run parameters irrespective of whether the underlying variables are $I(0)$, or $I(1)$, or a combination of them (Pesaran, et al., 2001). In addition, it permits different number of lags for each independent variable to capture the data generation process in a general to specific framework (Feridun, 2009; Nosier, 2018). While ARDL technique can examine linear relationships, it fails to examine nonlinear relationships.

Granger and Yoon (2002) introduced the concept of "hidden cointegration" which means that the cointegration relationship among the variables could be determined from their positive and negative components. For recognizing the hidden cointegration, a nonlinear regression model was recommended (Schorderet, 2003). Subsequently, Shin et al. (2014) introduced NARDL, a nonlinear cointegration-based approach that can decompose each variable into its positive and negative components for detecting the steady state relationship and its simultaneous short-run effect (Chowdhury, et al., 2021). Inflation usually follows cycles, highlighting nonlinear behavior. Therefore, the NARDL cointegration approach of Shin et al. (2014) is more appropriate to be utilized in this work. NARDL is an extension of ARDL, and it involves several steps.

First, the optimal number of lags for all level variables is selected, using the appropriate information criteria, mainly the Akaike information criterion (AIC) and Schwartz Information Criterion (SIC).

Assuming that the price of food and exchange rate have asymmetric effect on inflation in both the long run and short run, **the second step** is the bounds test, which involves estimating the Conditional Unrestricted Error Correction Model (UECM) to test for the existence of asymmetric long run cointegration relationship between inflation and all the explanatory variables as in Equation (2)[2].

$$
\begin{aligned}
\Delta INF_t = \sigma_0 &+ \sum_{i=1}^{l-1} \gamma_i \Delta INF_{t-i} + \sum_{i=0}^{m-1} \sigma_{1i} \Delta GDPP_{t-i} + \sum_{i=0}^{n-1} \sigma_{2i} \Delta GNE_{t-i} + \sum_{i=0}^{o-1} \sigma_{3i} \Delta MS_{t-i} \\
&+ \sum_{i=0}^{p-1} \sigma_{4i} \Delta IR_{t-i} + \sum_{i=0}^{q-1} \sigma_{5i}^+ \Delta EXCH_{t-i}^+ + \sum_{i=0}^{q-1} \sigma_{5i}^- \Delta EXCH_{t-i}^- \\
&+ \sum_{i=0}^{s-1} \sigma_{6i} \Delta POIL_{t-i} + \sum_{i=0}^{v-1} \sigma_{7i}^+ \Delta PF_{t-i}^+ + \sum_{i=0}^{v-1} \sigma_{7i}^- \Delta PF_{t-i}^- + \rho_1 INF_{t-1} \\
&+ \theta_1 GDPP_{t-1} + \theta_2 GNE_{t-1} + \theta_3 MS_{t-1} + \theta_4 IR_{t-1} + \theta_5^+ EXCH_{t-1}^+ \\
&+ \theta_5^- EXCH_{t-1}^- + \theta_6 POIL_{t-1} \\
&+ \theta_7^+ PF_{t-1}^+ + \theta_7^- PF_{t-1}^- + \epsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)
\end{aligned}
$$

where l, m, n, o, p, q, s, v are the optimal lags of level of the regressors of the model. Moreover, Δ is the first difference operator and σ_0 is a drift component. Further, the left-hand side is the inflation (INF). The right-hand side of the equation represents the explanatory variables in one lag in level and in differences with the optimal lags for each variable. The parameters γ_i and σ_{si} correspond to the short-run relations of the dependent and independent variables respectively, whereas ρ and θ_s correspond to the long-run relations of the dependent and independent variables respectively; ϵt is the random error. θ_5^+, θ_5^-, θ_7^+, θ_7^-, σ_{5i}^+, σ_{5i}^-, σ_{7i}^+, σ_{7i}^- are the long-run and short-run coefficients of the exogenous variables that decomposed into positive and negative shocks (EXCH and PF) as following:

$$EXCH_t = EXCH_0 + EXCH_t^+ + EXCH_t^- \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$
$$PF_t = PF_0 + PF_t^+ + PF_t^- \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

where $EXCH_0$ and PF_0 are the initial values of the variables at time t=0, $EXCH_t^+, EXCH_t^-, PF_t^+ and PF_t^-$ are partial sums of positive and negative

---

[2] Variables which have asymmetric effect on inflation are determined using the asymmetric test (F-statistic) in both the long run and short run.

shocks in exchange rate (EXCH) and price of food (PF) respectively, which can be calculated as follows:

$$EXCH_t^+ = \sum_{i=1}^{t} \Delta EXCH_i^+ = \sum_{i=1}^{t} \max(\Delta EXCH_i, 0) \ldots \ldots \ldots \ldots \ldots \ldots (5)$$

$$EXCH_t^- = \sum_{i=1}^{t} \Delta EXCH_i^- = \sum_{i=1}^{t} \min(\Delta EXCH_i, 0) \ldots \ldots \ldots \ldots \ldots \ldots (6)$$

$$PF_t^+ = \sum_{i=1}^{t} \Delta PF_i^+ = \sum_{i=1}^{t} \max(\Delta PF_i, 0) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (7)$$

$$PF_t^- = \sum_{i=1}^{t} \Delta PF_i^- = \sum_{i=1}^{t} \min(\Delta PF_i, 0) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (8)$$

The F-statistic is used to test the joint significance of lagged levels of the variables in the UECM, and determine the existence of the long-run equilibrium under the null hypothesis of no co-integration ($H_0: \rho = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5^+ = \theta_5^- = \theta_6 = \theta_7^+ = \theta_7^- = 0$) against the alternative that a long-run relation exists ($H_0: \rho \neq \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5^+ \neq \theta_5^- \neq \theta_6 \neq \theta_7^+ \neq \theta_7^- \neq 0$) in Equation (2).

Thirdly, once a long-run relationship has been established by the bounds test, the long-run relations can be estimated as $\beta_j = \frac{-\theta_i}{\rho}$. Since j represents the independent variables in Equation (1), β_{js} are the long-run coefficients of the different independent variables in the equation.

Fourthly, using F-statistic, the asymmetric test should be performed in the long run as well as the short run to assure the nonlinear effect of the determined independent variables on the inflation under the following null hypotheses.

$H_0: -\frac{\theta_5^+}{\rho} = -\frac{\theta_5^-}{\rho}$ $\qquad\qquad$ $H_0: -\frac{\theta_7^+}{\rho} = -\frac{\theta_7^-}{\rho}$

Long-run hypotheses

$H_0 = \sum_{i=1}^{q-1} \sigma_{5i}^+ = \sum_{i=1}^{q-1} \sigma_{5i}^-$ $\qquad$ $H_0 = \sum_{i=1}^{s-1} \sigma_{7i}^+ = \sum_{i=1}^{s-1} \sigma_{7i}^-$

Short-run hypotheses

Finally, the models must undergo several statistical checking such as autocorrelation, heteroscedasticity, normality, and stability test to ascertain their statistical reliability.

6. RESULTS

6.1 Unit Root Results

The Augmented Dickey-Fuller (ADF) (1979) test is excessively applied in the literature to investigate the stationarity status of each series before performing the cointegration estimation approach. However, Perron (1989) signalized that failure to allow for an existing structure break leads to a bias which lowers the ability to reject a false unit root null hypothesis. To overcome this problem, Perron suggested allowing for a known or exogenous structural break in the ADF test (Glynn et al., 2007). The modified ADF test, which allows for levels and trends that differ across a single break date, is applied on all the variables of our model. The break point unit root test is running here to avoid the bias resulting from the existence of the structure break, which affects the results of the unit root test. **Table (1)** reports the results of the unit root test according to the appropriate time trend of each series. At the 5% level of significance, the results indicate that INF and IR are found to be trend stationary variables, $I(0)$, while the other variables in the model are non-stationary in levels, but stationary in first differences, $I(1)$ variables, according to the appropriate specification of each series. Thus, the NARDL model is the best appropriate technique to be performed to estimate the long run cointegration relationship and the short run dynamics simultaneously.

Table (1): Unit Root Tests According to the Appropriate Deterministic Trend

Variables	levels			First difference			Integration Degree
	Trend Specification	Break date	ADF	Trend Specification	Break date	ADF	
INF	Trend& Intercept	1992	-6.226 (0.000)	-	-	-	$I(0)$
GDPP	Trend& Intercept	2021	-3.358 (0.774)	Intercept	2017	-4.644 (0.029)	$I(1)$
GNE	Trend& Intercept	2011	-4.420 (0.160)	Intercept	1988	-7.165 (0.000)	
MS	Intercept	1979	-4.064 (0.136)	Intercept	1981	-6.490 (0.000)	$I(1)$
IR	Trend& Intercept	2006	-6.884 (0.000)	-	-	-	$I(0)$
EXCH	Intercept	2011	-0.481 (0.990)	Intercept	2016	-6.665 (0.000)	$I(1)$
POIL	Intercept	2005	-4.279 (0.078)	Intercept	2015	-7.629 (0.000)	$I(1)$
PF	Intercept	2006	-3.793 (0.240)	Intercept	1999	-6.671 (0.000)	$I(1)$

Source: Author's own calculations using EViews. P-value is in Parentheses ().

6.2 NARDL Approach Results

Two NARDL models are estimated and reported, one of them includes the price of oil (POIL) as one of the independent variables (Model 1), while the other includes the global price of food as an independent variable (Model 2) since the two variables are highly correlated as illustrated in the correlation matrix in the **Appendix**, **Table A2**. Price of oil affects the transportation costs; therefore, the price of food - as well as most of other goods and services- is positively affected. Consequently, we prefer not to include the two variables in the same regression equation to avoid multicollinearity.

As a first step in estimating NARDL, two lags are chosen as a maximum lag for the two models and the optimal number of lags for all level variables is selected using the appropriate information criteria, mainly the AIC as illustrated in the **Appendix**, **Figure A1, and Figure A2**.

Before proceeding to test the bounds test of cointegration, Wald test is running to determine whether long-run and short-run associations between inflation and its determinants are symmetrical or asymmetrical. At the 5% level of significance, the null hypothesis of "coefficient is symmetric" is rejected in Model 1 for exchange rate whether in the long run or in the short run, gross national expenditure has a nonlinear relationship in the long run, however both GDPP and interest rate have this asymmetric relationship in the short run only. Regarding Model 2, price of food has asymmetric relationship with inflation whether in the long run or short run, while the symmetric relationship is rejected for exchange rate in the long run and for GDPP in the short run as reported in **Table (2)**.

Table (2): Coefficient Asymmetric test

Model 1: INF GDPP GNE MS IR EXCH **POIL**				Model 2: INF GDPP GNE MS IR EXCH **PF**			
Variable	Statistic	Value	Probability	Variable	Statistic	Value	Probability
Long run				Long run			
EXCH	F-statistic	29.554	0.000	EXCH	F-statistic	7.701	0.012
GNE	F-statistic	4.439	0.048	PF	F-statistic	10.215	0.005
Short run				Short run			
EXCH	F-statistic	8.225	0.010	PF	F-statistic	7.075	0.016
GDPP	F-statistic	7.899	0.011	GDPP	F-statistic	5.635	0.028
IR	F-statistic	6.378	0.020				

Null hypothesis: Coefficient is symmetric

Thereafter, the bounds test of cointegration (computed F-statistics) is performed and the results for the two models are presented in **Table (3)**. The null hypothesis of "no co-integration" is rejected at the 1% level of

significance in the two models, indicating that there is a co-integration relation between inflation and its determinants at the 1% level of significance. Therefore, we can proceed by estimating the long-run relationships between these variables.

Table (3): The Results of F-Statistics for Co-Integration Relationship

Wald Test	Model 1	Model 2
F-statistic	11.031***	11.669***

*** indicate that F-statistics fall above the upper bound at the 1% level of significance.

6.2.1 Estimating the Long-Run Equilibrium Relationship and the Short-Run Dynamics Simultaneously

Having determined the best NARDL specification for the two models and detecting the cointegration relationship between inflation and the other variables, the long-run parameters were estimated along with the short-run dynamic relationship at the same time. By normalizing on inflation (INF), the static long-run steady-state parameters were obtained and reported in **Table (4)**, while the short-run dynamic coefficients are displayed in **Table (5)**. The error correction term (φ) is significantly different from zero and has the correct negative sign at the 1% level of significance in the two models as illustrated in Table (5), which confirms the existence of an equilibrium relationship between inflation in Egypt and their important determinants. Almost 51% of the disequilibrium in the short run will be corrected in a year, thus a long-run equilibrium will exist after two years[3]. Moreover, most of the long-run and short-run coefficients are significant, and consistent with the economic theory. The models perform reasonably, since the adjusted R^2 is almost 99% in the two models. R^2 is extremely high due to the existence of the Autocorrelation problem in Model 1 at the 5% level of significance and in Model 2 at 10% level of significance. The problem is solved, and the estimated coefficients and their standard errors are corrected and presented in Table 4 and 5.

The GDPP is a substantial variable in affecting inflation rate in Egypt whether in the long run or the short run. In the long run, an increase in GDPP by one hundred dollars, tends to decrease inflation by 1% at the 1% level of significance. The same outcome obtained in the short run with a lower effect.

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[3] The results of Model 1 are interpreted, in addition to some coefficients of Model 2, which have additional information, such as lags of the dependent variable, and the price of food.

A one hundred dollar increase in GDPP tends to reduce inflation by 0.9% at the 1% level of significance. On the other hand, the temporal negative shock of GDPP in the short run is insignificant but it is significant and strong at one lag. A decrease in GDPP last year by one hundred dollars, increases inflation rate by 10.3% at the 1% level of significance. The latter result arises warning from decreasing production due to its danger and strong influence on increasing inflation in Egypt. These findings are consistent with the Keynesian theory, since the increase in real production or supply of goods and services, other factors being constant is expected to alleviate inflation. Furthermore, these findings are largely consistent with those of other empirical research applied on Egypt (Ali, 2020; Abdallah & Elshafei, 2023) and other countries (KebretTaye, 2013; Ochieng, et al., 2016; Oatlhotse & Nicholas, 2018).

Table (4): Long-Run Results of NARDL Co-Integration Approach (1976-2023)

Independent Variables	Model (1) ARDL (1,2,2,1,2,1,2) (POIL)	Independent Variables	Model (2) ARDL (2,2,1,2,2,2,2) (PF)
GDPP	-0.010*** [-3.483]	GDPP	-0.015*** [-4.557]
GNE^+	0.858*** [5.156]	GNE	0.253*** [3.041]
GNE^-	0.615*** [5.476]		
MS	0.168*** [5.723]	MS	0.134*** [4.074]
IR	-0.910*** [-6.736]	IR	-1.064*** [-12.199]
$EXCH^+$	0.828*** [3.839]	$EXCH^+$	0.360** [2.337]
$EXCH^-$	3.753*** [3.942]	$EXCH^-$	2.478** [2.297]
POIL	0.080** [2.173]	PF^+	0.074* [1.909]
		PF^-	-0.171*** [-3.418]
intercept	16.867*** [4.861]	intercept	-4.328 [-0.369]

Source: Author's own calculations using EViews. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. T-state is in [].

As long as the asymmetric relationship between inflation and gross national expenditure in the long run is concerned, a positive shock in gross national spending boosts inflation by 0.86% annually, while a negative shock in national spending decreases inflation by less ratio counted for 0.62%. Thus, the positive shock is more influence on inflation than the negative shock is. Similarly in the short run, an increase in GNE by 1% of GDP, tends to increase inflation by 0.20% annually in the same year. This result is compatible with the economic theory; an increase in gross national expenditure represented in an increase in consumption, investment or government consumption rises the aggregate demand, which is associated with an increase in both GDP and inflation rate; it is a demand-pull inflation. Our results agree with the results of Ghaly, 2022.

Table (5): Short-Run Results of NARDL Co-Integration Approach (1976-2023)

Independent Variables	Model (1) ARDL (1,2,2,1,2,1,2) (POIL)	Independent Variables	Model (2) ARDL (2,2,1,2,2,2,2) (PF)
ECT$_{t-1}$	-0.513*** [-12.647]	**ECT$_{t-1}$**	-0.659*** [-13.113]
		DINF (-1)	0.360*** [4.899]
DGDPP$^+$	-0.009*** [-4.515]	DGDPP$^+$	-0.012*** [-5.423]
DGDPP$^-$	-0.003 [-0.160]	DGDPP$^-$	-0.003 [-0.149]
DGDPP$^+$ (-1)	0.006*** [3.111]	DGDPP$^+$ (-1)	0.011*** [4.710]
DGDPP$^-$ (-1)	-0.103*** [-6.158]	DGDPP$^-$ (-1)	-0.119*** [-6.505]
DGNE	0.198*** [6.464]	DGNE	0.056* [1.735]
DGNE (-1)	-0.101** [-2.694]	DGNE (-1)	-0.091** [-2.333]
DMS	-0.030* [-1.898]	DMS	-0.047** [-2.729]
DIR$^+$	-0.958*** [-33.597]	DIR	-0.981*** [-56.941]
DIR$^-$	-1.035*** [-46.295]		
DIR$^+$ (-1)	-0.137*** [-4.813]	DIR (-1)	0.457*** [5.460]
DIR$^-$ (-1)	0.124*** [6.157]		
DEXCH$^+$	0.725*** [18.214]	DEXCH	0.618*** [12.422]
DEXCH$^-$	1.826*** [4.820]	DEXCH (-1)	-0.189* [-2.022]
DPOIL	0.022*** [4.359]	DPF$^+$	0.092*** [4.222]
DPOIL (-1)	-0.018*** [-2.940]	DPF$^-$	-0.055** [-2.683]
		DPF$^+$ (-1)	0.048** [2.504]
		DPF$^-$ (-1)	-0.001 [-0.041]
R^2	0.998	**R^2**	0.998
Adj. R^2	0.997	**Adj. R^2**	0.997
AIC	1.506	**AIC**	1.629
SC	2.148	**SC**	2.311

Source: Author's own calculations using EViews. ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. T-state is in [].

The increase in broad money by 1% of GDP in the long run increases inflation by 0.17% annually. This finding is consistent with the economic theory. An increase in money supply reduces interest rate, therefore more investment and consumption are expected, which results in more aggregate expenditure. Accordingly, more aggregate demand is generated, and higher inflation is driven. Thus, money supply affects inflation mainly through demand side. On the other hand, an increase in money supply in the short run affects inflation negatively, which is unexpected result. A 1% increase in money supply as a percentage of GDP, leads to a decrease in inflation by 0.03% annually at only 10% level of significance. Due to the high-interest

rate deposits provided by the central bank in Egypt, the rise in money supply may be directed toward savings certificates, or to the investment in high-interest deposits that enable depositors to obtain a relatively stable monthly income to compensate their relatively low real income, which may reduce the inflation rate in the short run. Applying on Egypt, the latter result is supported by empirical literature (Emam, 2023; Alfiky, 2023; Abdelkarim, 2022). Furthermore, because of including aggregate national expenditure and interest rate in the regression model, the marginal effect of MS reflects the effect of MS (%GDP) on inflation through other channels rather than IR and GNE - which are assumed to be constant- which justify the unexpected sign of the MS coefficient in the short run and the small effect of MS on inflation in the long run.

Interest rate is very important determinant of inflation in Egypt whether in the short run or the long run. An increase in interest rate by 1% tends to decrease inflation by 0.90% annually in the long run. This result is supported by the economic theory and empirical literature (Kia & Sotomayor, 2020; Elkhadrawi, 2024; Abdallah & Elshafei, 2023), since the increase in interest rate shrinks both investment and consumption, consequently, reduces aggregate demand and in turn inflation. Furthermore, as far as the asymmetric effect of IR on inflation in the short run is concerned, the 1% positive shock of interest rate decreases inflation by 0.96%, while the 1% negative shock of interest rate increases inflation with a higher effect (almost by 1%). This means that the effect of expansionary monetary policy (by reducing IR) on increasing inflation is stronger than the effect of contractionary monetary policy (by increasing IR) on lessening inflation in Egypt. Moreover, the effect of interest rate on inflation is stronger in the short run than it is in the long run.

Our results support the significance of the external or global factors and imported inflation in Egypt through the exchange rate pass through effect and the global prices of food and oil as follows. The adopted programs of economic growth and structural adjustment have required a reform of the exchange rate regime in Egypt since the past decades (Sherif, 2024). Consequently, the foreign exchange rate raised strongly over the period of the study. The increase in the exchange rate increases the price of imported inputs for the purpose of producing domestic products and thus cost of production increases; as a result, inflation arises. Furthermore, the increase in prices

creates an increase in wages, thus more increase in cost of production, and inflation is strengthened.

The result of the regression model indicated that the increase in the foreign exchange rate by one pound per dollar -or the depreciation of the Egyptian pound- creates inflationary pressures in both the long run and short run. The effect of the depreciation is higher in the long run than the short run. In particular, an increase in foreign exchange rate by one pound per dollar (positive shock or depreciation of the pound) tends to increase inflation by 0.83% and 0.73% annually in the long run and short run respectively. In contract, a decrease in foreign exchange rate by one pound (negative shock or appreciation of the pound) leads to a decrease in inflation by 3.75% and 1.83% in the long run and short run respectively. Those results agree with the economic theory and the findings of the literature (Elkhadrawi, 2024; Sherif, 2024; Mohammed, 2023; Emam, 2023; Alfiky, 2023; Abdallah & Elshafei, 2023; El Baz, 2014; Ali, 2011).

Whereas the oil prices have indirect effect on price of most of consumer goods and services, the prices of food have a direct effect, since food is consumed directly. The increase in price of oil by one dollar per barrel induces the inflation significantly by 0.08% and 0.02% annually in the long run and short run respectively. The increase in the global price of oil, increases the cost of transportation, in addition to being a productive input of most of the products, as a result, the cost of production of these products is stimulated, and inflation climbed. Our findings agree with the economic theory and supported by literatures (Abdelkarim, 2022; Ali, 2020).

Furthermore, the change in the global price of food (whether positive or negative shock) by one-point results in stimulating the inflation rate by 0.07%, and 0.17% respectively in the long run. The short-run results emphasize the same finding of the long run, since the positive shock of the price of food by one-point increases inflation rate by 0.09% annually, while the one-point negative shock of the global price of food boosts the inflation rate by 0.06% yearly. In Egypt, such as most of developing countries, a substantial portion of the population is poor, thus they spend most of their income on food (domestic and imported), especially that Egypt is a net importer of agricultural commodities including wheat, soybeans, and yellow corn for feed (Omar & Akingbe, 2022). Therefore, rising global food prices

drives up the consumer price index and consequently domestic inflation. Our conclusion is supported by Kamal and Abdella (2023) and El Baz (2014).

Finally, backward inflation expectation plays an important role, as inflation rate responds positively to a shock of itself in the first year following the shock, which means that inflationary expectations generate more inflation, as illustrated by Model 2. Moreover, it represents inflation inertia and market rigidity. A 1% increase in lagged inflation increases inflation rate in Egypt by around 0.36% annually at the 1% level of significant. This result is compatible with the Rational Expectation Theory and empirical literatures (El Baz, 2014; Ali, 2011).

6.2.2 Diagnostic Tests

The diagnostic tests indicate no statistical problems in the estimated models; the residuals of the regression are normally distributed, there is no sign of heteroscedasticity in the residuals, and the models have no specification bias as illustrated by **Table (6)**. The only exception is the existence of autocorrelation at the 5% level of significance in Model 1. The problem is solved using the Newey West estimator, and the adjusted standard errors and t-statistics are reported in Table 4 and Table 5 above. Moreover, the two models are stable, since all the CUSUM, CUSUMSQ statistics and their plots fell consistently within their 95% confidence level, suggesting that the estimated parameters are all stable as illustrated in **Figure (8)** and **Figure (9)**.

Table (7): Diagnostic tests

	Model (1) ARDL (1,2,2,1,2,1,2) (POIL)	Model (2) ARDL (2,2,1,2,2,2,2) (PF)
Higher-order Autocorrelation: B-G LM Test F-statistics	5.209 (0.016)	3.162 (0.068)
Heteroscedasticity: Breusch-Pagan-Godfrey test F-statistics	0.506 (0.944)	0.647 (0.847)
Normality test: JB	0.674 (0.714)	1.824 (0.402)
Stability test: RESET F-statistics	1.677 (0.215)	2.527 (0.129)

Note that P-value is in Parentheses ().
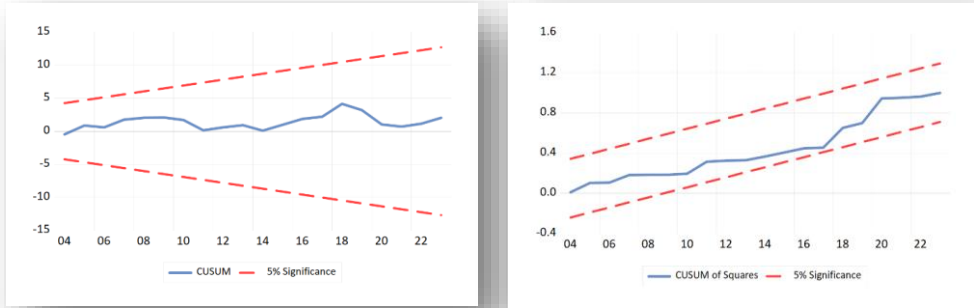
**Figure (8)**: Plots of CUSUM and CUSUMQ in Model (1)
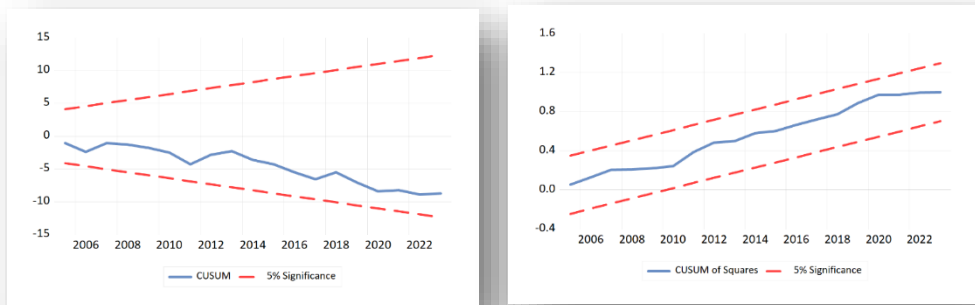
Figure (9): Plots of CUSUM and CUSUMQ in Model (2)

6.2.3 Comparability of the Determinants of Inflation in Egypt

The direction and magnitude of the effect of each independent variable on the inflation rate in Egypt in both the long run and short run are reported and discussed in Section 6.2.1 above, however the question of which determinant has a stronger effect than others in pushing or alleviating inflation, has not been answered since the determinants of inflation are expressed in different units or scales. In this section, this question is answered using the standardized coefficients or beta coefficients[4]. By standardizing the coefficients, all the variables are measured with a common scale. Therefore, the comparison of the impact of different determinants on the

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[4] To obtain the standardized coefficient for each independent variable (determinant of inflation), the unstandardized estimated coefficient is divided into its standard deviation. The resulting value represents the impact of a one-standard-deviation change in the determinant of inflation on the inflation rate (Fonseca, 2023).

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inflation rate within the same model is possible, regardless of their original units of measurement. This is important to identify which variable has the strongest or weakest influence on inflation in Egypt. By calculating the beta coefficients as illustrated in **Figure (10)**, the following results can be extracted.
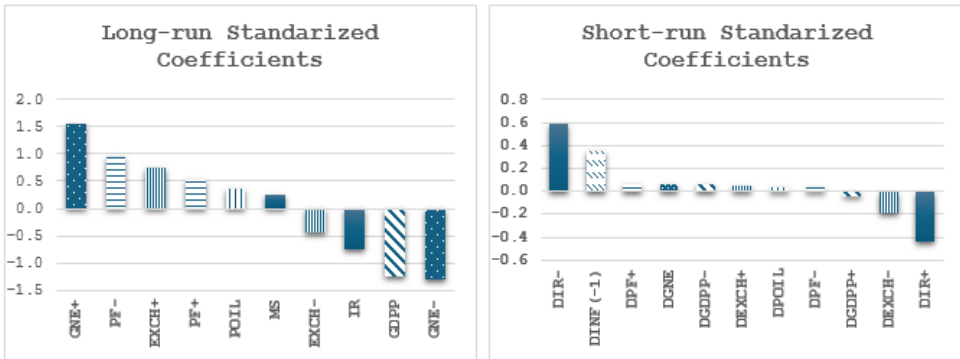
Figure (10): The Relative Importance of the Determinants of Inflation in Egypt (1976-2023)

The dominant players in determining inflation in Egypt in the long run are the gross national expenditure and gross domestic product per capita, therefore, demand-pull inflation and the real production are of great importance. The fluctuations in the global price of food at any direction – increase or decrease- boost domestic inflation in Egypt, so food security and reducing the dependency on imported food is fundamental requirement to alleviate inflation. Worth mentioning, the money supply is less important factor in determining inflation in the regression model because its effect passes through diminishing the interest rate, and therefore increasing the national expenditure and both variables are included in the regression model, so the effect of MS is minimal.

In the short run, government policies - especially the monetary policies- are the major factor in determining inflation in Egypt. Therefore, to fight inflation in the short run, increasing the interest rate or adapting a contractionary monetary policy may be required taking into consideration its negative impact on the investment and the economic growth. Then, the expectations about the prices play a significant role, followed by the foreign exchange rate policy. The depreciation of the Egyptian pound has a considerable role in increasing inflation, thus, the exchange rate regime in Egypt should take this dangerous effect into consideration.

The outstanding result of the asymmetric effects of the independent variables on inflation is that the effect of each variable on increasing inflation is much more than the effect of the same variable on reducing inflation whether in the long or short run. For example, the effect of the positive shock of exchange rate on pushing inflation up is higher than the effect of the negative shock of it on alleviating inflation in the long run. Therefore, a devaluation of the Egyptian pound should take with caution. Moreover, inflation increases because of expansionary monetary policy (negative shock of interest rate) more than the decrease in inflation because of a contractionary monetary policy (positive shock of interest rate) in both the long and short run. Similarly, the effect of a positive shock of gross national spending on increasing inflation is more than the effect of a negative shock of GNE on decreasing inflation. Finally, the positive shock of real GDPP decreases inflation less than the increase in inflation because of negative shock of GDPP. To sum up, prices in Egypt is flexible or elastic in upward direction, but inflexible or steaky in the downward direction. Price rigidity in downward direction may cause market inefficiencies, which could lead to inflationary pressures in the economy. The greedy traders may be responsible for these findings to maximize their profits.

7. CONCLUSION AND POLICY IMPLICATIONS

The objective of this study is to identify the most important determinants of inflation in Egypt over the period (1976-2023). To achieve this aim, the cointegration approach using the NARDL method is applied over the period from 1976 to 2023. The following conclusions are extracted from the findings of the study; therefore, recommendations for policy makers in Egypt are provided.

7.1 Conclusion

- The continuous increase in the level of prices in Egypt is a chronic phenomenon, registered more than 10% annually over the period of the study. The Eighties recorded the highest annual inflation rate (15.5%) over the period of the study, followed by the second decade of the twentieth (2011-2023), whereas the first decade of the twenties (2000-2010) has the lowest annual inflation rate (7.9%). Many causes of inflation can be detected over the period of the study and can be

categorized into internal and external factors.

- First, external causes give rise to cost-push inflation in Egypt, such as the global oil shocks in the 1980s, the global financial crises in 2008, which causes global commodity price shocks, the increase in the global price of food after the Russian invasion of Ukraine in 2022, and finally, the increase in price of imports due to the depreciation of the Egyptian pound in 2003, 2016, 2022 and 2023.

- Second, internal factors of inflation give rise to the demand-pull inflation, which represented in adopting expansionary monetary policy to finance the increasing budget deficit in the Eighties, or to relieve the effect of the global financial crisis in 2008. Finally, inflation expectation was an important player at the second decade of the new millennium because of the adopting floating exchange rate regime.

- Main reasons for lessened inflation in Egypt over the period of the study are adopting contractionary monetary policies and increasing food production.

- The real factors, such as the increase in production (GDPP) is a substantial variable in controlling inflation rate in Egypt whether in the long run or the short run.

- Demand pull inflation is of great importance in Egypt, especially though the increase in gross national expenditure in both the long run and short run, in addition to the increase in money supply in the long run.

- Policy variables have their significant role in controlling inflation in Egypt, an increase in interest rate tends to alleviate inflation in both the long run and short run, but its effect is stronger in the short run. Furthermore, the exchange rate pass through effect exists in Egypt since the increase in foreign exchange rate creates inflationary pressures and its effect is higher in the long run.

- Lagged inflation or the inflationary expectations generate more inflation in Egypt in the short run, which in turn cause inertia and market rigidity.

- External factors are significant driver of inflation in Egypt, the increase in the global price of food and the global price of oil contribute significantly to the increase in the imported inflation in Egypt in both the long and short run.

- The government policies – monetary and foreign trade policies- are the key factor for controlling inflation in the short run, however, the real

production and the gross national expenditure are the main players in the long run.

- The internal factors in Egypt play a more dominant role in the inflation surge. That is, national expenditure and a decrease in real income per capita, interest rate, and inflationary expectations better explain the change in inflation in Egypt than the oil and food price shocks. Thus, internal determinants of inflation are stronger than the external factors in determining inflation in Egypt over the period of the study. Our result is in accord with the ECB Working Paper (2017), which indicates that lower income countries have a markedly lower effect of the external factors on national inflation than other developed countries.

- As far as the asymmetric effects are concerned, for variables which have a direct effect on inflation, the effect of the positive shock of each is greater than the effect of its negative shock on inflation. In contrast, for variables which have an opposite effect on inflation, the effect of the positive shock of each is smaller than the effect of its negative shock on inflation in both the long and short run. The latter finding demonstrates that prices in Egypt are flexible in upward direction, but inflexible or steaky in the downward direction, which may cause market inefficiencies, and therefore, more inflationary pressures in the economy.

7.2 Policy implications and Future Research

- Contractionary monetary policy (an increase in interest rate) is recommended to alleviate inflation in the short run, taking into consideration its effect on the growth. However, increasing production and reducing national expenditure is essential for controlling inflation in the long run. Therefore, policymakers should strive for stable economic growth through accommodation of the appropriate policies.

- The inflationary effect of the flexible exchange rate regime in Egypt is very harmful in both the long run and short run, therefore controlling the value of the Egyptian pound and fighting the depreciation of it is substantial requirement to reduce inflation directly by reducing the exchange rate pass through effect and to reduce the inflationary expectations and market rigidity.

- Fluctuations of the global price of food is an effective factor in boosting inflation in Egypt especially in the long run, therefore, to mitigate its impact on inflation, policymakers may develop effective strategies to

achieve food security by increasing the production of essential food and reducing food imports. These strategies may include policies that handle supply chain disruptions, boost productivity in the agricultural sector, among others.

- Prices in Egypt are flexible in upward direction, but steaky in the downward direction, therefore, expansionary monetary policies should be taken with caution. By the same taken, reducing production due to closing or selling productive factories push inflation up more than reducing inflation due to increasing production. Furthermore, government may control the prices to protect consumers from greedy traders.

- Demand-pull inflation is very significant in Egypt through the expansionary monetary policy (reducing IR) and expansionary fiscal policy through the increase in the domestic demand shocks, consequently, policy cooperation between the central bank of Egypt and the ministry of finance is must to enable an appropriate balance between economic growth and price stability in Egypt.

- Finally, papers which deal with the effect of macroeconomic variables on inflation and economic growth simultaneously are recommended. Moreover, meta-analysis studies of the determinants of inflation in Egypt could be invaluable to recommend strategies for policymakers in Egypt.

Appendix

Table (A1): Literature Review on the Determinations of Inflation

Author	Country/time	Variables	Methods	Results
Emam, 2023	Egypt 1990 to 2022 Semi-annual data	Exchange rate lending interest rate money supply investment government spending	NARDL cointegration technique	An increase in exchange rate increases inflation in both LR and SR. A positive shoch in interest rate decreases inflation in the LR but increases it in the SR. However, negative shoch has no effect on inflation. Positive and negative shock in money supply reduces inflation in the LR, but have no effect in SR. More government

Author	Country/time	Variables	Methods	Results
				spending reduces inflation in the LR and has no effect in SR. Positive shock in investment lower inflation either in the LR or the SR.
Kia & Sotomayor, 2020.	Egypt 1975Q1-2015Q4 Mexico 1976Q1-2015Q4	Interest rate Exchange rate Foreign financed debt Money supply Government spending Price and interest rate of US	Johansen-Juselius Maximum Likelihood estimation (JML), and the FMOLS	-Inflation is affected by internal and external factors in both countries. Both monetary and fiscal policies affect inflation in the two countries in the LR. -Moreover, US price and interest rate affect inflation in both countries in the LR and in Mexico only in the SR. -The overall conclusion is that the sources of inflation over the SR in Egypt are mostly internal (Monetary and fiscal policy)
Alfiky, 2023	Egypt, 1976-2021	Lending interest rate broad money "M2" The foreign exchange rate Government spending Lags of inflation	ARDL	All the variables increase inflation in Egypt significantly whether in the LR or SR, except for money supply and lags of inflation, they reduce inflation in the SR.
Kamal & Abdella, 2023	Egypt 1991–2023	Output gap Exchange rate Global food price Money supply	VAR IRF	In the LR and SR, the main drivers of inflation are the country's internal fluctuations, the output gap, devaluation of the Egyptian pound against the US dollar, increases in the price of food globally, and finally the expansion

Author	Country/time	Variables	Methods	Results
				of the broad money supply.
Elkhadrawi, 2024	Egypt 1991–2022 quarterly data	Inflation Domestic credit to private sector by banks Exports to imports ratio Interest rate Exchange rate Final consumption expenditure Gross fixed capital formation	SVAR	- A higher interest rate policy produces a large negative shock to private investment and consumption but only a small inflation reduction. - About 42% of the inflation's error variance is explained by the fluctuations of the exchange rate, whereas about 7% is due to the fluctuations in market interest rates.
Joy, et al., 2021	Nigeria	public capital expenditure exchange rate	ARDL	Public capital expenditure affect inflation in Nigeria negatively and significantly.
Mohammed, 2023	Egypt 1991 to 2020	economic growth unemployment inflation exchange rate lending interest rate	Engle granger two-step cointegration approach	-the exchange rate & the interest rate had no effect on the unemployment rate and economic growth. - an increase in both the exchange rate and interest rate by one-unit increased inflation rates by 0.510% and 0.892% respectively in the LR. However, increasing interest rates by 1-unit increased inflation by 2.161% in the SR.
Binti Mohd Shafie, et al., 2021	Malaysia 1997 to 2018 Quarterly data	Inflation money supply (M1, M2 and M3) real gross domestic product real broad effective exchange rate	ARDL and NARDL	Money supply has short-run impact on inflation; however, the real GDP has both SR and LR positive impact on inflation. Real exchange rate does not affect inflation.

Author	Country/time	Variables	Methods	Results
Ali, 2020	Egypt 1960-2017	Inflation oil prices GDP money supply	NARDL	-Price of oil affects inflation positively in both LR and SR. Whereas positive shock of price of oil is insignificant in LR, it is significant and positive in the SR. - Negative shock reduces inflation significantly in both LR and SR. -Real economic growth affects inflation negatively (reduce inflation) and significantly only in the LR, while the money supply affects inflation positively whether in the LR or SR.
Sherif, 2024	Egypt 1991-2021	unemployment rate Exchange Rate Money Wages Domestic prices	ARDL	-The results show that domestic price level in Egypt is positively related to money wage rate, negatively related to real income and positively related to import prices. While Money wage rate is positively affected by domestic price level, so successive devaluation to the Egyptian pound in Egypt would lead to explosive inflation due to the wage-price spiral.
Ali, 2011	Egypt 1980-2009	Inflation expectations Demand-pull inflation (domestic liquidity to finance budget deficit) Supply-push inflation (price	VAR	Inflation inertia can explain around 33% of the changes in inflation rates, followed by demand-pull inflation 31%, supply side shocks 20%, fiscal deficit 15%, and finally pass through effect with a minor relative

Author	Country/time	Variables	Methods	Results
		of food, crises-output gap) Fiscal deficit Pass through effect (exchange rate)		importance doesn't exceed 1%.
Abdallah & Elshafei, 2023	Egypt, Nigeria and South Africa Panel data 1982-2020	Inflation broad money exchange rate GDP per capita growth General government final consumption expenditure interest rate	Panel least square and Granger causality test	The three countries experienced a negative effect of real interest rate, GDPP, Government expenditure on inflation. On contrary, positive effect of broad money, and exchange rate on inflation.
Ghaly, 2022	Egypt 1960-2020	Inflation gross national expenditure broad money imports of goods and services gross domestic products growth Lags of inflation	ARDL	The findings show that the supply of money, gross national expenditure, and the growth rate of imports have a substantial LR and SR influence on inflation, but the gross domestic product has no effect in both LR and SR. Lags of inflation is negative and significant in the SR.
El Baz, 2014	Egypt 1991-2012	Inflation output gap domestic liquidity growth rate nominal exchange rate price of food	VAR	In the SR, inflation is explained mostly by its own fluctuations, followed by output gap, domestic liquidity growth rate, and nominal depreciation of the Egyptian pound against the US dollar.

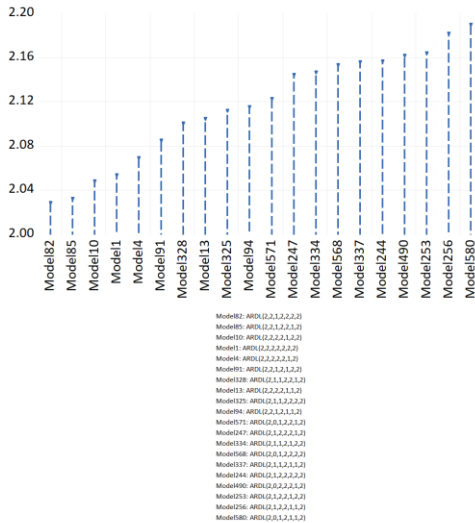**Note: LR: refers to Long Run, SR: refers to Short Run.**

Table A2: The Correlation Matrix of All the Variables

	INF	GDPP	GNE	MS	IR	EXCH	POIL	PF
INF	1							
GDPP	0.042	1						
GNE	0.251	-0.419	1					
MS	-0.122	0.420	-0.446	1				
IR	-0.890	-0.108	-0.232	0.318	1			
EXCH	0.251	0.853	-0.286	0.280	-0.241	1		
POIL	0.170	0.762	-0.286	0.160	-0.337	0.567	1	
PF	0.200	0.480	0.039	-0.244	-0.466	0.517	0.724	1
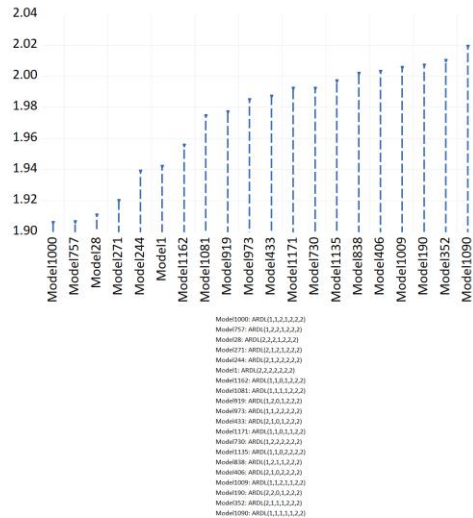
Model 1   (2,2,1,2,2,2,2)   Model 2   (1,1,2,1,2,2,2)

(INF, GNE, MS, IR, PF, EXCH, GDPP)   (INF, MS, POIL, EXCH, GNE, GDPP, IR)

Figure A1: Lag Length of NARDL Models

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