

Demand-side Determinants of Inflation in Egypt: A Dynamic Analysis

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Abstract

Over time, inflation has become one of the most pressing issues. Egypt's inflation is driven by a variety of causes. This paper analyzes several factors that impact inflation in Egypt and emphasizes the effect of the demand-side on inflation using annual data from 1960 through 2020. The variables investigated are gross national expenditure, broad money, the imports of goods and services, and gross domestic products. The variables under investigation are integrated into I(0) and I(1) as per the "Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests", which justifying the adoption of the "Autoregressive Distributed Lag Model (ARDL)" approach. Using the ARDL co-integration technique, the empirical findings show a short- and long-run connection amid some of the independent variables and inflation. The findings show that the supply of money, gross national expenditure, and the growth rate of imports have a substantial short and long-term influence on inflation but the gross domestic product has no influence in the both the short- and long-term. The study concludes that demand-side inflation is still perceived as one of the most significant inflation determinants. Since the R-square value is almost 60%, there are various factors that might influence Egyptian inflation besides the previous factors.

Keywords: Inflation - ARDL model - Error correction model ECM - Dynamic analysis – Gross national expenditure - long-run coefficient.

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محددات جانب الطلب للتضخم في مصر: تحليل ديناميكي
ملخص

بمرور الوقت، أصبح التضخم أحد أكثر القضايا إلحاحًا. يحرك التضخم في مصر مجموعة متنوعة من الأسباب. تحلل هذه الورقة العديد من العوامل التي تؤثر على التضخم في مصر وتؤكد تأثير جانب الطلب على التضخم باستخدام البيانات السنوية من عام 1960 حتى عام 2020. والمتغيرات التي تم فحصها هي إجمالي الإنفاق القومي، ومعدل عرض النقود، وواردات السلع والخدمات، وإجمالي الناتج المحلي. كشفت اختبارات جذر وحدة ديكي فولر المعزز (ADF) وفيليبس بيرون (PP) أن المتغيرات قيد الدراسة مدمجة في $I(0)$ و $I(1)$ ، مما يبرر اعتماد نهج ARDL. باستخدام تقنية التكامل المشترك ARDL، تظهر النتائج التجريبية علاقة طويلة المدى بين بعض المتغيرات المستقلة والتضخم. تظهر النتائج أن المعروض من النقود والنفقات الوطنية الإجمالية ومعدل نمو الواردات لها تأثير كبير على المدى القصير والطويل على التضخم ولكن الناتج المحلي الإجمالي ليس له تأثير على المدى القصير والطويل. خلصت الدراسة إلى أن جانب الطلب لا يزال يُنظر إليه على أنه أحد أهم محددات التضخم. بما أن قيمة معامل التحديد تقارب 60٪ فإن هناك عوامل أخرى قد تؤثر على التضخم المصري بجانب العوامل السابقة.

الكلمات المفتاحية: التضخم - نموذج ARDL - نموذج تصحيح الخطأ - ECM - التحليل الديناميكي - إجمالي الإنفاق القومي - نمو الناتج المحلي الإجمالي - معامل المدى الطويل.

Introduction:

Inflation is one of the utmost extensively used economic terminologies and one of the significant issues that have arisen throughout time. (Öner, 2012; Islam, Abdul Ghani, Mahyudin and Manickam, 2017) Inflation is defined as the pace at which prices grow over a set period of time. (Öner, 2012) it is also described as an upsurge in the overall cost of goods and services, rather than just individual items. (European Central Bank) While some inflation is unavoidable in a thriving and expanding economy, continuous sustainable inflation is detrimental for households through eroding savings and scrubbing out income growth. Consumer confidence can be shattered by inflation, causing industries to endure. (Benson, 2021) It is a massive threat to global price stability, which is widely regarded as fundamental for long-term growth and development. (Kiganda, 2014)

Several causes contributed to the increase in inflation. Inflationary pressures can arise from the economy's demand or supply sides. Demand burdens are generated by either expansionary fiscal policy as the increase in government outlay or expansionary monetary policy such as the supply of money. (Mehrra and Sujoudi, 2015) "The aggregate demand and aggregate supply model" might be used to characterize the determinants of inflation. Aggregate demand rises when both public and private expenditure and investment rise. Higher prices occur from an increase in aggregate demand because aggregate supply is inelastic in the near run. (Nguyen, 2019) Credit expansion is frequently associated with prolonged periods of high inflation. Monetarists argue that the pace at which the money supply expands is a driving factor of inflation. When the money supply in proportion to the size of an

economy is enormous, the currency unit value declines; in other words, the currency's purchasing power falls and prices rise. (Öner, 2012) Supply shocks are increased by a drop in capital, a fall in labor supply and increase in demand, and a decrease in other inputs. (Mehrrara and Sujoudi, 2015) Natural disasters and other supply shocks that induce a decline in production or boost production costs can limit total supply and lead to "cost-push" inflation, which occurs when the incentive for price rises is triggered by a disruption in supply. (Öner, 2012) Dual crisis such as the Covid-19 pandemic is a jumbled up of supply and demand shocks from many sectors. These shocks spread across production chains, generating cyclical circumstances in a variety of economic sectors. (Baqae and Farhi, 2020)

Imported inflation befalls when there is an increase in import costs which have a direct impact on any expenditure-based measure of inflation. Increases in the price of imported energy, materials, and components increase manufacturing costs, raising the price of locally produced goods. Imported inflation can be caused by both price increases in other countries and currency rate depreciation. (Black, Hashimzade, and Myles, 2012) In developing countries, the association among both the currency rate and inflation is crucial. Exchange rate fluctuations in these economies might have a significant influence on prices. Currency fluctuations will have an impact on both manufacturing costs and the pricing of imported goods. (Monfared and Akin, 2017) As a result of inflation, countries have been driven into extended periods of uncertainty. (Öner, 2012)

Inflation is one of the most serious contemporary problems encountering the global economy, and there is still ambiguity concerning its causes. (MK and Bawady, 2018) With annual

inflation rates exceeding 5 percent in 78 emerging and developing countries, the majority of emerging markets are suffering the consequences of inflationary spike. Commodity price increases that correspond with increased global demand are a trend that affects both developing and developed countries. Oil prices were 77 percent higher in January 2022 than in December 2020. (Reinhart and Luckner, 2022) Egypt is not cloistered, with inflation rising from 4.8 percent in January 2021 to 8 percent in January 2022. (CAMPUS, 2022) The pervasiveness of today's inflation is the most striking feature. Thus, the examination of inflation factors is indispensable since the results will interpret shock propagation and the interrelationship between inflation and economic variables. As a result, early intervention may be necessary to avert high inflation and its severe economic consequences. (Lim and Sek, 2015) Due to the obvious variations in factors and time periods used in the inflation determinants studies, the findings provided a diverse range of results. (Lim and Sek, 2015) Therefore, the purpose of this study is to examine several factors that impact inflation in Egypt and accentuate the demand-side factors using "Autoregressive Distributed Lag Model (ARDL)" approach over an extended period of time from 1960 to 2020. The ARDL model was used to determine each factor's short and long- run effects on inflation. To explore the effect of the demand-side on inflation, this study uses different factors such as gross national expenditure, broad money, and import of goods and services. Gross national expenditure was known before as domestic absorption and it is a vital factor in demand analysis. (OECD) It consists of the sum of household expenditure, government expenditure, and gross capital formation, but it excludes export. (Worldbank) As a corollary, the hypothesis that can be

empirically evaluated is whether these demand-side factors affect inflation in Egypt.

The study consists of six sections; the first part presents an introduction to the concept of inflation. The second section investigates literature, both theoretically and empirically. The third section analyses inflation in Egypt. The fourth section inspects the model specifications and methodology with an emphasis on data description, model construction, and the ARDL technique employed, the fifth section analyses the model results, and the sixth section summarizes the key findings and policy recommendations.

Literature and theoretical Review:

The review of the literature initiates with a theoretical assessment of the drivers of inflation, followed by an examination of empirical evidence.

Theoretical Background

The inquiry into the ancestries of inflation has undoubtedly ignited one of most important economic debates. The fundamental theories discussed below are particularly concerned with the macroeconomic determinants of inflation. Originally, the quantity theory of money, which was central to the nineteenth-century classical monetary analysis, stated that fluctuations in the supply of money circulated are primarily responsible for changes in the overall level of prices. David Hume explained how monetary changes impact relative price and quantity as they move from one section of the economy to another. (Totonchi, 2011) Inflation, according to monetarists and monetary theory, is primarily a domestic monetary concern. Inflation occurs when, in proportion to demand, the monetary authority creates an extravagant quantity of money causing the economy's aggregate demand to rise. Friedman's most

renowned assertion was that "inflation is always and everywhere a monetary phenomenon," proving "the quantity theory of money" as an economically feasible fundamental. (Friedman, 1989) Inflation, according to classical and neoclassical economists, is monetary in origin and is a demand-pull phenomenon. (Froyen, 2013)

"Demand-pull Inflation", according to John Maynard Keynes, is induced by an increase in aggregate demand. Consumption, investment, and government expenditure all have an impact on overall demand. The inflationary gap develops at full employment each and every time the value of quantity demand exceeds the value of quantity supplied. (Totonchi, 2011) Demand-pull Inflation is defined as the notion of the economy requiring more products and services than are available. Due to a scarcity of supply, sellers can raise their prices until supply and demand are balanced. (Ulke and Ergun, 2011) On the other side, Inflation can be attributed to a variety of nonmonetary, supply-side phenomena that affect the unit cost of specific product prices. (Humphrey, 1998) According to the cost-push hypothesis, lacks or shockwaves to the available supply of a given item or commodity would generate a cascading impact across the market by boosting prices across the distribution network from the supplier to customer. (Ulke and Ergun, 2011) Consequently, many economists came to the conclusion that cost-push considerations were crucial in understanding how inflation may originate. (Schwarzer, 2018)

Throughout the 1960s and early 1970s, the dispute over whether inflation is a "demand-pull" or a "cost-push" phenomenon overshadowed discussions on the causes of inflation. Supply variables which affect the marginal cost and profit of particular product pricing are frequently related to

inflation in cost-push inflation theories. Among the most important forms of cost-inflation theories is "the structuralist approach to inflation". In the 1970s, "the Scandinavian model of inflation" was a key sort of structuralist approach. The notion that salaries in north Europe nations are determined by government-controlled bargaining, resulting in relatively consistent wage rises for all union members, is a distinguishing aspect of the sophisticated Scandinavian theory. In the 1970s, post-Keynesian inflation theory arose, and the tradition's brief disequilibrium economics produced other sorts of cost-push inflation theories, with an emphasis on the influence of overcharge pricing, revenue entitlements, and relative price fluctuations. Cost-push theories, whether Keynesian, structuralist, or post-Keynesian, tend to have analogous distributional processes that include changes in relative prices and induce continual rises in the general price level, resulting in a persistent inflationary process. Nonetheless, various "supply-side inflation theories" sought to explain just one a rise in the price level as a result of external shock, such as a spike in oil prices or with a depreciation of a country's currency. (Kibritçioğlu, 2001)

The "rational expectations hypothesis" has been conceivably the most broadly adopted prospects hypothesis in macroeconomic research since 1970. The entrance of rational expectations into macroeconomics, like monetarism, appeared to be irreconcilable with the neoclassical synthesis at first. John Muth's rational-expectations theory was founded on the idea that individuals construct expectations optimally, which is a natural extension of the neoclassical concept that the economy is populated by rational, maximizing participants. (Goodfriend and King, 1997) In other words, the hypothesis asserts that

individuals' predictions match the model's projections for those individuals. However, it wasn't until the 1970s when Robert Lucas developed and tested the rational expectations assumption in macroeconomics. (Taylor, 2001) Due to this hypothesis, consumers think prices to increase if the monetary authority declares an incentive spending in advance. (Totonchi, 2011) Since the early 1990s, The "New Neoclassical Synthesis" expands on the past's legacy by merging Keynesian and classical elements. The new synthesis, according to Robert Lucas, makes systematic use of intertemporal optimization and realistic expectations. These findings are applied to pricing and production choices, which are at the heart of both new and old Keynesian models, as well as consumption and investment. Furthermore, the new synthesis incorporates monetarist ideas such as Milton Friedman's and Karl Brunner's into monetary policy theory and practice. (Goodfriend and King, 1997) The "New Neoclassical Synthesis" has held that monetary as well as demands fluctuation are a significant predictor of economic trends. Furthermore, the New Neoclassical Synthesis considers supply shocks to have a significant role in interpreting real economic activity. (Totonchi, 2011)

Thus far, the majority of research has concentrated on macroeconomic causes of inflation, neglecting the importance of noneconomic elements including organizations, governmental institutions, and society in the establishment or amplification of inflation. They likewise reject the notion that chronic public debt may be partially or entirely developed internally by taking into consideration the influence of the political system and future efforts at politicization on government finances and, hence, inflation. The investigation of how the governmental aspect of decision-making influences

policy decisions and, eventually, economic consequences is known as "New Political Macroeconomics of Inflation". (Kibritçioğlu, 2001) This research is grounded on the monetarist, Friedmanist, and Keynesian perspectives.

Empirical Evidence

To identify the reasons for inflation, several empirical pieces of research have been conducted utilizing diverse techniques and different periods of time. Despite the fact that the topic is no longer unique, researchers are still attempting to figure out what factors may be driving inflation's movement. These studies yielded a diverse set of findings. (Lim and Sek, 2015) The conflicting empirical results are explained by the sensitivity of the results to the various variables and different periods used in each study. (Magkonis and Zekente, 2020)

Several empirical pieces of literature used money supply as the explanatory variable of inflation and conclude that the supply of money has a substantial influence on inflation in the short and long-run by using different techniques, including "Ordinary Least Square (OLS)" and "Error Correction Modeling (ECM)". Mbongo, Mutasa, and Msigwa, (2014) used OLS and ECM methodologies to explore the effect of specified variables on Tanzanian inflation. The findings demonstrate that the money supply and the exchange rate have a significant impact on inflation in both the short and long run. Simwaka, Ligoya, Kabango, and Chikonda, (2012) employed Johansen Analysis of cointegration in Malawi, and conclude that Inflation is caused by money supply expansion. Other empirical studies used "Vector Error Correction Modeling (VECM)", "Autoregressive Distributed Lag Model (ARDL)", and "Pooled Mean Group (PMG) estimation-based error correction models", as well as the "panel difference method of moment (GMM)", to

confirm the long-run relationship only. (Sultana, Koli, and Firoj, 2019; Narayan, Narayan, and Prasad, 2019; Ofori, Danquah, and Zhang, 2017; Nguyen, 2015; Kiganda, 2014). Further studies indicated that the money supply does not affect inflation using the "Johansen co-integration and Vector Error Correction Model (VECM)". (Emmanuel *et al.*, 2019; Ditimi, Sunday, and Onyedikachi, 2017)

Further studies used the exchange rate as the explanatory variable and concluded that it had a significant impact on inflation using a different technique such as the Vector Autoregression model (VAR). (Monfared and Akin, 2017; Fetai, Koku, Caushi, and Fetai, 2016). Further studies inspected the impact of import on inflation using ARDL and conclude its positive impact. (Kiganda, and Omondi, 2020; Shilongo, 2019; Shyalini, 2019) Other few studies used imports of products and services as a determinant of inflation such as Ulke, and Ergun (2011) who affirmative the relation in Turkey using the ARDL model in the short and long term. The study of Corrigan (2005) supports the hypothesis that import prices have been significant in interpreting current inflation trends in the United States.

Further pieces of literature used different explanatory variables, such as the study of Mohanty and John (2015) that used the oil prices, output gap, fiscal deficit, and money rate and determine that inflation dynamics have evolved over time, with many causes exhibiting substantial temporal variation in recent years. Chaudhary and Xiumin (2018) used money supply, real GDP, and the consumer price index to demonstrate that in the long term, all of the variables investigated are significant. Dahiru and Sulong (2017) included the exchange rate, the broad money supply, GDP, interest rates, financial instability, and the price of oil. The statistics revealed a long-term correlation between

the exchange rate, the money supply, the price of oil, and inflation. Edward and Ramayah (2016) utilized the money supply, oil prices, and the exchange rate and confirmed that the money supply is a predictor of inflation. Lim and Sek (2015) explore the causes driving inflation in dual sets of nations (high inflation and low inflation) using money supply, gross national expenditure, imports and GDP growth. An "Error Correction Model based on Autoregressive Distributed Lag" was utilized. According to the findings, in high-inflation nations, the inflation factors that have a long-run influence on inflation are money supply, national expenditure, and GDP growth. Other studies used an element of gross national expenditure to measure its effect on inflation. Magazzino (2011) explores the relationships between government spending and inflation in Mediterranean nations. The analysis finds a long-run relationship between government spending and inflation in Portugal. Additionally, in Cyprus, Malta, and Spain, there is a directional flow from expenditure to inflation, as well as a bidirectional flow in Italy. Nguyen (2019) used the cointegration and Vector Error Correction Model to analyze the long-run and short-run effects of government spending on inflation in three Asian developing economies. The findings show that there is a long-run correlation between government expenditures and inflation in these countries.

Various explanatory factors were employed in certain studies to comprehend the origins of inflation in Egypt. Using the ARDL model, Abdelraouf *et al.*, (2021) demonstrated that money supply and a rise in the degree of relative price volatility proved to have a substantial impact on inflation. Abonazel and Elnabawy (2020), using the ARDL model demonstrated that the exchange rate and the money supply growth rate have a

significant impact on Egypt's inflation rate, but that real GDP has minimal impact. Helmy, Fayed and Hussien (2018); using Structural Vector Auto-regression (SVAR) technique; determined that Egypt's exchange rate pass-through is significant but partial and sluggish, posing a serious threat to Egypt's economic capacity to execute a mechanism that efficiently targets inflation. El baz, (2014) concluded that the internal dynamics of inflation, followed by the supply of money, worldwide food prices, the production gap, and the exchange rate, drive Egypt's inflation. The widely held researches showed that the money supply and exchange rate are the key causes of inflation. (Lim and Sek, 2015)

As declared, the studies yielded a diverse set of findings due to the difference in variables and periods used in each study. Therefore, this study attempts to identify the demand-side reasons for inflation in Egypt unlike previous studies using prolonged periods of times (from 1960 to 2020) and a different set of variables in addition to identifying the effect of the gross national expenditure on inflation in Egypt following the work of Lim and Sek (2015).

Inflation in Egypt:

Egypt's economy has been plagued by severe bouts of inflation. In 1965, the country's prices increased by 15 percent. As a result of the Egypt War in 1973, the 1979 Iranians Revolt as well as its war with Iraq, the global oil expenses soared significantly during the 1980s. This produces global oil shocks, which impact domestic retail fuel costs. Prices soared sharply as a result of disruptions in global energy and food supply. (Islam, *et al.*, 2017) Therefore, in the years after 1973 oil shock, inflation averaged 13 percent per year until the mid-1980s as demonstrated in (figure 1). Following that, the annual rate of

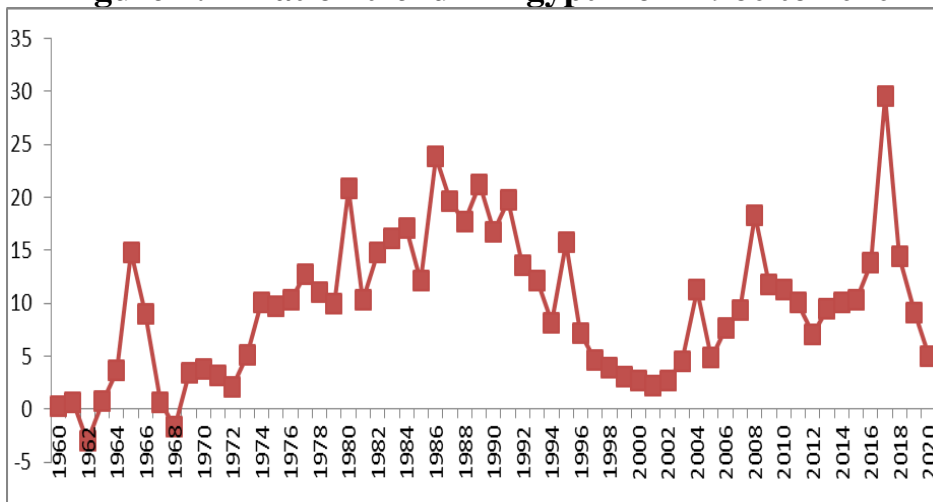
inflation surpassed 20 percent between 1986 and 1992. In the early 1990s, Egypt's government embarked on a reform program. After 1996, Egypt had a large deterioration in inflation, which lasted for a few years. As a consequence, inflation was decreased to 4 percent in 1997. (Handy, 1998) Monetary policy, throughout the 1990s, was largely geared at achieving maximum levels of price stability and controlling increases in domestic liquidity. (El baz, 2014) Inflation surged following the Egyptian pound's depreciation in 2003. However, there has been a consistent upsurge in both the inflation rate and its instability. This was seen in recurrent inflation waves, the causes of which ranged from rapid exchange rate depreciation to supply-side disruptions in certain sectors, with periods of fractional price liberalization during which directed prices for energy related products surged substantially. (Abdelraouf, El-Abbadi, and Nouredin 2021) In 2008, inflation reached a new high, owing mostly to the financial recession which causes global commodity price shocks at the time. (Hosny, 2013)

Egypt suffered significant inflation rates regularly throughout the previous decade. The average yearly rate of inflation was close to 10 percent between 2011 and 2015. Then in 2016, the Egyptian pound was floated, which increased inflation to almost 30 percent, the highest average within the sixty years, as the devaluation was passed on to consumers through higher import costs, a process known as exchange rate pass-through. (Khan and Miller, 2017)

Egypt's inflation rate was greater than the regional and worldwide averages for the same periods as demonstrated in figure (2). With the exception of the period from 1997 to 2002, the inflation was at the same average as the worldwide average which emphasizes on the inflation problem of Egypt and

implies that there are internal factors that affected the inflation in Egypt.

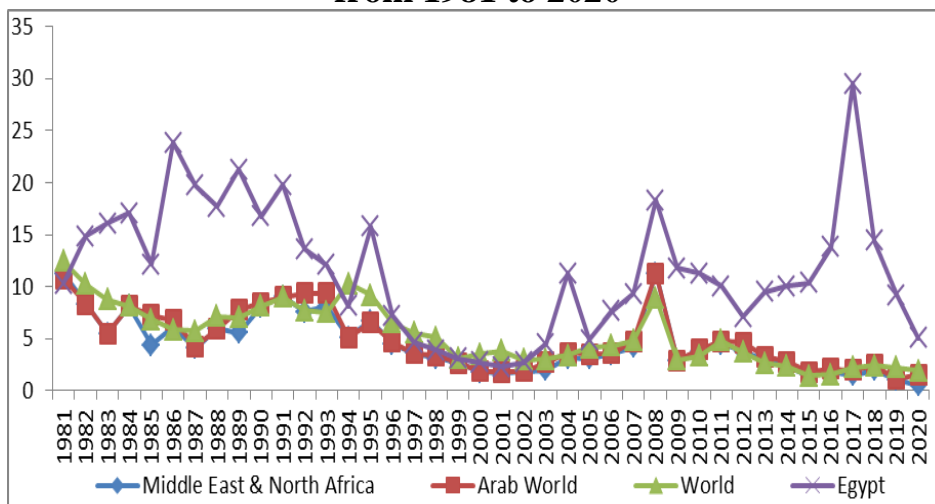
Figure 1: Inflation trend in Egypt from 1960 to 2020



Source of data: Worldbank database

“Inflation, as measured by the consumer price index, is the annual percentage change in the cost of purchasing a basket of goods and services for the average consumer”.

Figure 2: Inflation trend in Egypt versus group averages from 1981 to 2020



Source of data: Worldbank database

Model specification and Data description:

Following an analysis of the theoretical and empirical bases, the variables were chosen based on the monetarist, Friedmanist, and Keynesian perspectives.

The defined model of inflation determinants is as follows:

$$inf = f(imp, gne, gdp, bm)$$

The variables utilized as shown in table (1) include inflation as the dependent variable, imports of goods and services, gross national expenditure, annual percentage growth rate of gross domestic products, and broad money as the explanatory variables. Data from the World Bank and IMF databases were used to conduct this study. The study is based on annual data from 1960 to 2020.

Table 1: Variables description

Variable name	Description	Abbreviation
Inflation	Inflation, consumer prices (annual %)	Inf
Imports	Imports of goods and services (annual % growth)	Imp
Gross national expenditure	Gross national expenditure (% of GDP)	Gne
Growth rate of GDP	GDP growth (annual %)	Gdp
Broad money	Broad money (% of GDP)	Bm

Empirical methodology

The economic analysis exposes a long-term relationship between the variables under consideration. This implies that the long-run relationship's properties are still extant. As a result, whether dealing with variables of various order, $I(0)$, $I(1)$, or a mix of the two, When there is a single long run connection between the regressors with a small sample size, the ARDL cointegration strategy is superior and resilient when there is a single long run connection between the underlying variables in a small sample size. (Nkoro and Uko, 2016) Therefore, in this study to analyze time series with a mixed order of integration ($I(0)$ and $I(1)$), an autoregressive distributed lag (ARDL) model has been employed. The lag in this model is sufficient to reflect the data generation process. To generate a dynamic error correcting model using ARDL, a simple linear transformation may be employed (ECM). Similarly, the ECM blends short-run dynamics with long-run equilibrium without compromising long-run information, eliminating problems such as spurious connections generated by non-stationary data sets. (Shrestha and Bhatta, 2018)

ARDL Model

Pesaran and Shin (1998) established and developed the ARDL technique, which was enhanced further by Pesaran, Shin, and Smith (2001). The ARDL approach has been widely used because it offers significant benefits over standard statistical methods for assessing cointegration and short/long-run connections. As we mentioned, ARDL, unlike previous approaches such as Johansen's tests, the Granger causality test, and Vector Autoregression (VAR), can test for a level link for either $I(0)$ or $I(1)$ variables, as well as a combination of $I(0)$ and $I(1)$ variables. ARDL, on the other hand, cannot work with non-

stationary variables integrated to order two I(2). Furthermore, employing an error correction term, the ARDL technique combines the short-run influence of the supplied variables with a long-run equilibrium without losing long-run information. As a result, the short-run and long-run relationships between the supplied variables may be evaluated concurrently. Furthermore, contrary classic cointegration tests, alternate lags for each variable in the model may be identified, making it more adaptable. Finally, most cointegration techniques are sample size sensitive, whereas the ARDL given significant robust and consistent findings even with small datasets, which is useful given that we have 61 observations. (Haq and Larsson, 2016)

The following is the generalized ARDL (p, q) model:

$$Y_t = \gamma_{0i} + \sum_{i=1}^p \delta_i Y_{t-i} + \sum_{i=0}^q \beta'_i X_{t-i} + \varepsilon_{it}$$

Where: Y is the dependent variable for inflation; X is a vector of explanatory variables; δ_i and β' are coefficients; γ is the constant; $i = 1, 2, \dots, k$; p lags of Y and q lags of X; ε_{it} is a vector of the disturbance term.

This study's model is expressed as follows:

$$inf = f(\beta_0 + \beta_1 imp + \beta_2 gne + \beta_3 gdp + \beta_4 bm)$$

Where: inf is the dependent variable for inflation; imp, gne, gdp, and bm are the explanatory variables for imports, gross national expenditure, gross domestic product, and broad money consecutively.

$$\begin{aligned} \Delta inf = & \beta_0 + \sum_{i=1}^p \beta_{1i} \Delta inf_{t-i} + \sum_{i=0}^q \beta_{2i} \Delta imp_{t-i} \\ & + \sum_{i=0}^q \beta_{3i} \Delta gne_{t-i} + \sum_{i=0}^q \beta_{4i} \Delta gdp_{t-i} \\ & + \sum_{i=0}^q \beta_{5i} \Delta bm_{t-i} + \beta_6 inf_{t-1} + \beta_7 imp_{t-1} \\ & + \beta_7 gne_{t-1} + \beta_8 gdp_{t-1} + \beta_9 bm_{t-1} + \varepsilon_{it} \end{aligned}$$

To ensure that the variables are connected over time, the F-test of the joint significance of the coefficient of lagged variables is included in the test. If the F-test value is greater than the upper critical bound (UCB), the variables in the study are co-integrated; otherwise, the variables in the research are not co-integrated (LCB). (Chandio and Rehman, 2019)

For the long-run estimate, the error correction model (ECM) can be stated as follows:

$$Y_t = \gamma_{0i} + \sum_{i=1}^p \delta_i Y_{t-i} + \sum_{i=0}^q \beta'_i X_{t-i} + \lambda ECT_{t-1} + \varepsilon_{it}$$
$$\Delta inf = \beta_0 + \sum_{i=1}^p \beta_{1i} \Delta inf_{t-i} + \sum_{i=0}^q \beta_{2i} \Delta imp_{t-i}$$
$$+ \sum_{i=0}^q \beta_{3i} \Delta gne_{t-i} + \sum_{i=0}^q \beta_{4i} \Delta gdp_{t-i}$$
$$+ \sum_{i=0}^q \beta_{5i} \Delta bm_{t-i} + \lambda ECT_{t-1} + \varepsilon_{it}$$

Any long-run imbalance between dependent variables and a set of independent variables leads to the long-term equilibrium relationship when the coefficient λ of the error correction term ECT_{t-1} is statistically significant and has a negative sign.

Empirical results:

In this section, the study presents and analyzes the empirical results and findings of the conducted empirical analysis.

Unit root analysis:

Unlike other techniques, the Autoregressive Distributed Lag (ARDL) cointegration methodology does not need unit root pretests. However, the ARDL cointegration methodology will fail in the face of an integrated stochastic trend of I(2) therefore the unit root test should be applied.

Table 2: Augmented Dickey-Fuller (ADF) & Phillips-Perron (PP) unit roots tests

Variables	ADF		PP	
	level	first differences	level	first differences
Inflation (inf)	-3.513156***	-10.13240***	-3.394050***	-12.72389***
Broad Money (bm)	-1.350116	-5.990298***	-1.553974	-6.017080***
Gross domestic products (gdp)	-4.743655***	-9.896933***	-4.750107***	-20.12233***
Gross national expenditure (gne)	-2.893828	-7.701463***	-7.701463	-8.679392***
Imports (imp)	-6.786511***	-7.212864***	-6.763870***	-36.43563***

*** Significant at 1%.

Source: Calculated by the author from the outputs views10.

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests identify the integration sequence of the series, and the results of both tests are shown in table (2). Both tests revealed that the time series variables are a combination of I(0) and I(1) which means that the variables are stationary in different orders, indicating that the ARDL cointegration method is appropriate in this situation. For example, whereas inflation, gross domestic product, and imports are integrated at the level I(0), gross national expenditure and broad money are integrated at the level I(1).

Lag length criteria:

It is essential to determine the appropriate lag length before conducting the ARDL bounds test. The lag selection is critical since it impacts the model's output. There are numerous ways of determining the appropriate latency for each variable. As a result, the "Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ)" are used to verify that the lag duration is sufficient. Lag 1 was revealed to be the preferable choice as per all the criteria shown in table (3). However, in small samples, the SC criteria provide somewhat better estimates than the AIC criteria within the ARDL model. In addition, the AIC criteria have a tendency to overestimate the number of delays to include, which is undesirable in small samples because increasing the lag lowers the number of observations. (Haq and Larsson, 2016)

The ARDL model was built with a variety of combinations up to a maximum delay of one for each variable. Based on the findings of table (4), the ideal model is ARDL (1, 0, 1, 0, 0) as shown per the lowest AIC, BIC, and HQ values, and the highest Adjusted R-squared of the top 16 models.

Table 3: Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-168.4533	NA	28.71334	6.194762	6.375597	6.264871
1	-163.2881	9.223656*	24.75313*	6.046003*	6.263005*	6.130134*
2	-162.6864	1.052929	25.12006	6.060229	6.313398	6.158382
3	-162.6387	0.081816	26.00606	6.094239	6.383575	6.206414
4	-162.4084	0.386502	26.75346	6.121730	6.447233	6.247927
5	-162.3640	0.072983	27.71160	6.155857	6.517527	6.296076

The symbol * denotes the lag order chosen by the criteria.

Source: Calculated by the author from the outputs views10.

Table 4: Model Selection Criteria Table

Model	LogL	AIC*	BIC	HQ	Adj. R-sq	ARDL Specification
12	-168.796	5.959188	6.205675	6.055406	0.596409	(1, 0, 1, 0, 0)
4	-168.065	5.968312	6.250012	6.078276	0.538886	(1, 1, 1, 0, 0)
3	-167.126	5.970382	6.287294	6.094092	0.544398	(1, 1, 1, 0, 1)
11	-168.267	5.975138	6.256838	6.085102	0.535727	(1, 0, 1, 0, 1)
10	-168.686	5.989361	6.271061	6.099325	0.529076	(1, 0, 1, 1, 0)
1	-166.906	5.996802	6.348927	6.134257	0.538563	(1, 1, 1, 1, 1)
2	-167.942	5.998041	6.314953	6.12175	0.53162	(1, 1, 1, 1, 0)
9	-168.095	6.003226	6.320138	6.126935	0.529185	(1, 0, 1, 1, 1)
16	-171.484	6.01642	6.227695	6.098893	0.501758	(1, 0, 0, 0, 0)
8	-170.867	6.029384	6.275871	6.125603	0.502697	(1, 1, 0, 0, 0)
15	-171.084	6.036763	6.28325	6.132981	0.499014	(1, 0, 0, 0, 1)
7	-170.145	6.038829	6.320529	6.148794	0.505195	(1, 1, 0, 0, 1)
14	-171.304	6.044195	6.290683	6.140414	0.495277	(1, 0, 0, 1, 0)
6	-170.669	6.056588	6.338288	6.166553	0.496329	(1, 1, 0, 1, 0)
13	-170.835	6.062205	6.343905	6.17217	0.493492	(1, 0, 0, 1, 1)
5	-169.84	6.062379	6.379291	6.186089	0.500495	(1, 1, 0, 1, 1)

Source: Calculated by the author from the outputs views10.

Bound test approach:

The series' long-run relationship is thought to be formed when the F-statistic surpasses the crucial value range. The benefit of this approach is that it can detect cointegrating vectors even when there are plenty of them. (Nkoro and Uko, 2016) When inflation is employed as a dependent variable, the estimated F-statistics of the cointegration test based on the ARDL approach is 7.306654, as shown in table (5) which is greater than UCB at the 1 and 5% significant levels. The test findings demonstrate cointegration, indicating the occurrence of a long-run connection between inflation and the independent variables. Some of the variables show no cointegration when employed as independent variables.

Long-run and short-run analysis:

The long-run cointegration of inflation and its determinant was validated by this analysis. Therefore the study calculated both long-run and short-run models. The short-run results, as shown in table (6), demonstrate that the lag of gross national expenditure, broad money, and annual growth of imports rate all have a significant impact on inflation. The lag of gross national expenditure has a significant relationship with inflation. It has been observed that a one percent increase in gross national expenditure one year ago (one lag) resulted in a 0.6 increase in inflation, supporting the notion that gross national expenditure has an impact on inflation as demonstrated by Lim and Sek, 2015. Likewise, a 1 percent increase in broad money increases inflation by 0.06 percent supporting the finding that supply of money affects inflation as the finding of Edward and Ramayah 2016; Mbongo *et al.*, 2014; Simwaka *et al.*, 2012. Meanwhile, the study shows that a 1 percent increase in imports results in a 0.11 percent increase in inflation

supporting the finding of Ulke and Ergun (2011) that imports effects inflation. Import price increases were driven by an increase in imports, which fuelled inflation as the Egyptian pound declined

Table 5: Cointegration test

Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	7.306654	10%	2.45	3.52
k	4	5%	2.86	4.01
		2.50%	3.25	4.49
		1%	3.74	5.06

Source: Calculated by the author from the outputs eviews10.

Table 6: Short-run Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-58.6033	18.8673	-3.10608	0.003
D(INF(-1))	-0.638637	0.12047	-5.301227	0.0000***
D(IMP)	0.11789	0.054499	2.163165	0.0351***
D(GNE)	0.027003	0.244522	0.110431	0.9125
D(GNE(-1))	0.628342	0.206394	3.044378	0.0036***
D(GDP)	-0.083365	0.257882	-0.32327	0.7478
D(BM)	0.06427	0.032217	1.994908	0.0512***
ECM	-0.638637	0.101885	-6.268213	0.0000***

*** Significant at 1%, ** Significant at 5%.

Source: Calculated by the author from the outputs eviews10

In the long run, the same variables have a considerable influence on inflation as shown in table (7). Inflation rises by 0.1% for every one percent increase in broad money supporting findings of Sultana, *et al.*, 2019; Narayan, *et al.*, 2019; Ofori, *et al.*, 2017; Nguyen, 2015 and Kiganda, 2014. The findings are in accordance with the Quantity Theory of Money, which claims that in all economies, there is a proportionate direct association between money supply and inflation. Money supply causes inflation through the demand side because an increase in money supply stimulates investment and, as a result, job possibilities, resulting in higher aggregate demand in the economy. (Bashir, Yousaf and Aslam, 2016) Similarly, the gross national expenditure has a significant relationship with inflation as a one percent increase in gross national expenditure resulted in a 1 percent increase in inflation supporting findings of Lim and Sek, 2015. One of the main components of gross national expenditure is the government expenditure. If the government spends on several programs this boosts aggregate demand in the economy, which imposes upward pressure on prices, resulting in inflation, which is consistent with the finding of Magazzino 2011 and Nguyen 2019. It's worth noting that a 1% increase in imports boosts inflation by 0.18%. Import increases will put a strain on long-term investment plans. The supply of products and services in the economy will be reduced, forcing prices to rise. (Bashir, *et al.*, 2016) Hence, the main implication from the long-run cointegrating and short run dynamics estimation verifies the study hypothesis that long-run inflation is predominantly influenced by the demand-side, as measured by excessive monetary expansion, gross national expenditure, and imports.

Furthermore, the gross domestic product is insignificant in the short- and long-term; supporting the finding that GDP has no effect on inflation as the finding of Dahiru and Sulong (2017)

Table 7: Long-run Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IMP	0.184597	0.094084	1.962052	0.055***
GNE	0.98388	0.268218	3.668214	0.0006***
GDP	-0.130537	0.400298	-0.326098	0.7456
BM	0.100636	0.044938	2.239454	0.0293***

*** Significant at 1%, ** Significant at 5%.

Source: Calculated by the author from the outputs views10

The error correction term ECT_{t-1} (ECM) is significant and negative at the 1% significance level, implying that the inconsistency may be rectified to the long run in the absence of any preceding shock in the explanatory variables. Furthermore, an error correction term of -0.638637 shows that inflation is highly errored correcting, with any inflation imbalance being corrected at a rate of 64 percent in the next period. The duration of correction ($1 / ECM$) is 0.0156 of the year.

The model's overall performance is relatively worthy, with an adjusted **R-squared** of (0.597597), implying that the explanatory factors considered in this study explain almost 60 percent of Egypt's inflation.

Diagnostic Testing

To evaluate model stability, the LM serial correlation test and Heteroskedasticity test were used as shown in table (8) and table (9). All diagnostic tests were fulfilled by the ARDL model. The diagnostic test results demonstrate that the model is accurately defined.

Meanwhile, the cumulative sum recursive residuals (CUSUM) and the cumulative of square of recursive residual (CUSUMSQ) were employed to evaluate the stability of long- and short-run characteristics. The residuals are recursively adjusted and shown against the break points of the 5% significance line. The CUSUM test concept is illustrated in Figure (4) by charting the cumulative sum of recursive residuals vs. the upper and lower 95 percent confidence intervals.

Table 8: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.000943	Prob. F(1,52)	0.9756
Obs*R-squared	0.001088	Prob. Chi-Square(1)	0.9737

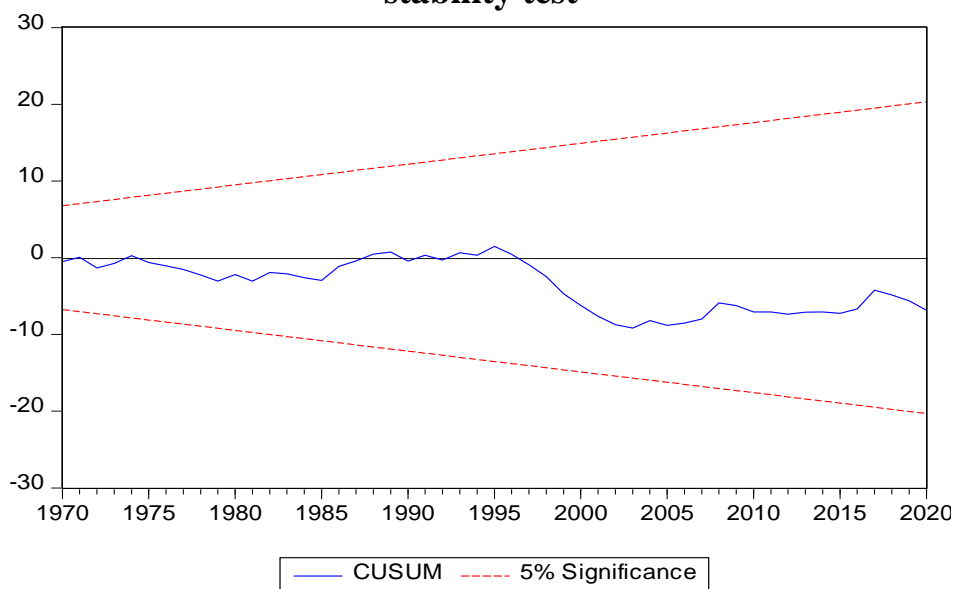
Source: Calculated by the author from the outputs eviews10

Table 9: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.896928	Prob. F(6,53)	0.5041
Obs*R-squared	5.530754	Prob. Chi-Square(6)	0.4777

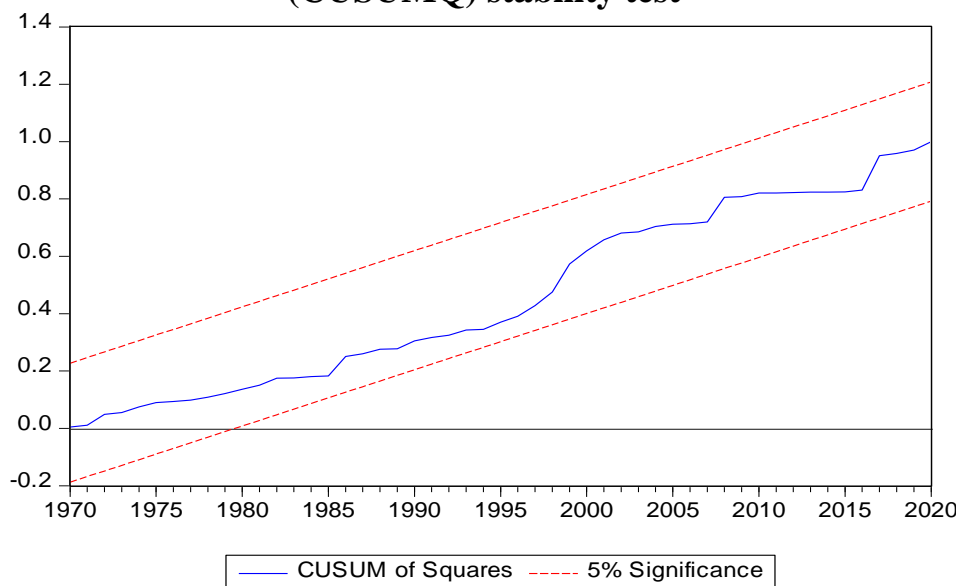
Source: Calculated by the author from the outputs eviews10

Figure 4: Cumulative sum recursive residuals (CUSUM) stability test



The premise remains the same for CUSUMSQ depicted in Figure (5). If the plots of CUSUMSQ and CUSUM fall below the 5% significance threshold, the long-run and short-run coefficients are stable. (Haq and Larsson, 2016) In other words, both tests employ parallel critical lines to assess if the residuals differ considerably from their mean value. If the recursive residuals of a model are within the two specific critical bounds, the model demonstrates stability. At the 5% level of significance, both stability tests are within critical limits. This validates the long-run and short-run components of inflation from 1960 to 2020.

Figure 5: Cumulative of square of recursive residual (CUSUMQ) stability test



Conclusion:

Using the ARDL approach, this study investigated at the short-run and long-run the effects of several variables on inflation in Egypt and emphasis on the effect of the demand-side from 1960 to 2020. The ADF and PP unit root tests are used to determine the order of integration of the research variables. At the 1% and 5% significant levels, the computed F-tests in the ARDL limits testing technique to cointegration were larger than upper critical bound. As a consequence, this empirical study found that some explanatory factors had statistically significant effects on the long-run and short-run periods as gross national expenditure, broad money, and imports of goods and services. GDP has no discernible impact on inflation which is in accordance with the results of various studies. The study concludes that the demand-side is still perceived as one of the most significant inflation determinants. Since the R-square value is almost 60%, there are various factors might influence Egyptian inflation besides the previous factors. It implies that the three key features mentioned in this study are merely a subset of the variables driving inflation. The influence of the various components of gross national spending on inflation, as well as the impact of the covid-19 on inflation, might be valuable to inspect in future research.

Policy recommendations:

Understanding the mechanisms influencing pricing behavior is becoming increasingly crucial for developing optimal disinflationary measures, or policies aimed at decreasing inflation. Contractionary policies, such as rising interest rates, can be used by central banks. Several central bankers have opted to enforce monetary discipline by fixing the exchange rate, and therefore their monetary policy to that of another

country. Such efforts, however, can cause negative effects on production and may fail if inflation is driven by global rather than local causes. (Öner, 2012) Financial market participants may get apprehensive about growing inflation. This might lead to massive increases in risk and financing costs. Emerging economies are acutely susceptible to financial market upheavals due to the historically high levels of debt and weak retrieval. In the case of a financial market crisis, rapid currency depreciation and capital outflows might require governments to stiffen policies rapidly, so delaying their recovery. In order for central banks to remain flexible even during times of market turmoil, inflation expectations must be kept under control. (Jongrim, Kose, and Ohnsorge, 2021)

According to the findings, it is suggested that inflation can be controlled by monitoring imports, broad money, and government expenditure, all of which are under the government's control. In order to achieve the intended inflation target, policies should be designed based on requirements rather than preferences. (Bashir, *et al.*, 2016) Generally, inflation is induced by a decrease in aggregate supply that is greater than the upsurge in aggregate demand. To manage aggregate demand, increase the supply of products and services while decreasing the money supply. (Islam *et al.*, 2017) In the Long term, developing countries such as Egypt have to improve a country's supply-side productive capacity which enables the economy to prosper without having to contend with increased cost and price inflation. Thus, increased economic development and reduced government deficits are critical for monetary policy to help contain inflationary pressures in Egypt. (Helmy, 2008) Moreover, the government should try to reduce unnecessary expenditure on non-development programs.

Furthermore, policymakers should consider the import pricing patterns and explicitly examine the consequences of additional reductions in the Egyptian pound's foreign currency value.

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