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Inflation in Saudi Arabia:

Revisiting the Macroeconomic Determinants

By:

Soleman Alsabban, Bander Alghamdi, and Faisal Alhodaithy

Economic Research and Reports Department

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Abstract

The primary factors influencing inflation movements may have experienced significant changes due to the COVID-19 pandemic. This research reexamines the macroeconomic factors that determine inflation in Saudi Arabia, which is crucial for adjusting the suitable policy response. That said, Saudi Arabia's inflation is influenced by domestic and external factors. Domestic factors include domestic demand, net government spending, and liquidity. External factors include imported inflation and exchange rate movements. This paper provides additional insights compared to previous studies by adopting different approaches. First, we used quarterly data (Q1:2013 to Q4:2022) instead of annual data to capture inflation trends more accurately. Second, we employed net government spending to measure the impact of government spending on inflation, unlike previous studies that investigated total government spending. Our approach better reflects the influence of non-oil revenues like the value-added tax (VAT) and expatriate levy on inflation. Third, we use 35 countries accounting for 91% of total imports by volume to measure trading partners' inflation, different from previous literature which only examined a few major countries. Lastly, the Autoregressive Distributed Lag model (ARDL) was applied instead of the Vector Error Correction Model seeing its robustness for the 40-quarter sample size used in this study. The results confirmed that inflation movements in Saudi Arabia were more susceptible to external factors than domestic ones.

Keywords: Imported inflation, net government spending, autoregressive distributed lag model, inflation determinants, Saudi Arabia.
JEL Codes: E31, E41, E51, C01, C22

[1] Corresponding author's email: Salsabban@sama.gov.sa

1. INTRODUCTION

The current global inflation developments and its persistently high environment are perhaps among the most pressing issues being discussed today. Such topics are being brought up again in the wake of the recent multi-decade high inflation in many advanced and emerging economies. On that note, the key drivers of inflation and its dynamics may have shifted dramatically as a result of the Covid-19 outbreak. Therefore, in this study, we revisit the macroeconomic determinants of inflation in Saudi Arabia, as they are particularly important in calibrating the appropriate policy response. However, before doing so, we will first take a closer look at inflation in 2022 from a global perspective.

By early 2022, inflation exceeded central banks targets in many parts of the world. This striking departure of inflation from its recent trends poses a real threat, particularly in the long run, to all agents of the economy, from firms and governments to households. For instance, according to Bonatti et al. (2022), persistently high inflation can potentially raise inflation expectations in the long run, and consequently, higher expectations feed into the current inflation, making it either higher or persistent at its already high level. As a result of this feedback loop, high inflation becomes the new norm, and only the most aggressive and painful policies could bring inflation under control.

Against this backdrop, economists, for the most part, were able to trace the high inflationary pressures in 2022 to several overlapping forces. First, in relation to the supply chain bottlenecks, the pandemic spillover had two separate impacts on the global supply chain. According to Agarwal et al. (2022), in the early stages of the pandemic, lockdowns and mobility restrictions in 2020 and 2021 caused serious disruptions in the global supply chain, leading to a temporary supply shortage. In the later stage of the pandemic, supply chain bottlenecks worsened as a result of strong overall demand due to economic recovery.

Second, a shift in demand toward goods and away from services: given the nature of the pandemic, spending on goods rose rapidly and significantly, widening the demand and supply gap (Rees & Rungcharoenkitkul, 2021). They also add that this happened particularly because the labor market was not able to keep up with the rapid post-pandemic recovery, triggering further upward pressure on prices. For instance, the rising demand for goods had led to an increase in the demand for imported consumer goods, which resulted in considerable increases in port output that have placed a strain on port capacity. Consequently, the global shipping industry has been under pressure, resulting in shipment delays and significant cost hikes. This is observed in many regions of the world, perhaps most prominently in the US and the Euro zone (Nersisyan and Wray, 2022; Giovanni et al., 2022).

Third, the fiscal stimulus and post-pandemic recovery: there have been approximately $16 trillion in fiscal measures and support programs that were initiated globally to cushion the consequences of the pandemic, according to Liu et al., (2022), Niermann and Pitterle (2021), and Cutler and Summers (2020). That is, the large fiscal stimulus, combined with loose monetary conditions, has led to high and persistent inflation. More specifically, Aladangady et al., (2022) state that households were spending the savings they had accumulated earlier to the pandemic, which led to a rapid increase in aggregate demand resulting in a stronger-than-expected economic recovery.

Fourth, the supply-side shocks to energy and food due to the Russia-Ukraine conflict: given that the two countries are exporters of major commodities, the ramifications resulting from the war have caused global prices to increase, perhaps most observable in the oil and natural gas prices (Liadze et al., 2022). In addition, global food prices have also climbed upward due to the conflict (Revoredo-Giha et al., 2022). For instance, wheat price volatility reached record highs in 2022 as Ukraine and Russia account for 30 percent of global wheat exports.

Evidently, not all countries go through the same inflationary process. Such variations depend on the size of the monetary and fiscal policy responses, the economic structure, and the changes in the spending behavior of the economic agents (households, firms, and governments). That being said, an appropriate monetary policy response to combat the current inflationary environment seems the obvious recommendation in this regard. While this could theoretically hold true, the practical side, however, is tremendously challenging. Particularly, when the inflationary pressures in 2022 have been fueled by several factors as mentioned above, such as supply and demand mismatches, supply chain bottlenecks, the massive government fiscal support in 2020, and 2021, and the rising food and energy prices. Nevertheless, the design of appropriate policy responses is typically guided by the forces driving inflation in the long run (Williams, 2018). With that in mind, going forward, we will discuss the literature review, followed by the data and model specification and subsequently, we will conclude with the model results.

2. LITERATURE REVIEW

There is a substantial amount of literature on inflation and its determinants in both advanced and emerging economies. However, only a handful of studies are related to Saudi Arabia. For instance, Hamad (2011) considered the internal and external factors influencing inflation in Saudi Arabia. His findings suggest that inflation is caused by external factors such as movements in global inflation and the US dollar, which is consistent with the Saudi economy's high degree of openness, as most goods and services are imported. Al Khathlan (2011) identified the determinants of inflation in Saudi Arabia in the short run and the long run by applying the cointegration method using money supply, output gap, exchange rate, and global inflation as independent variables. His results indicate that external factors are the main contributors to inflation in the long run, while internal factors have a more dominant impact on inflation in the short run.

Altowaijri (2011) examined the internal and external factors' impact on inflation in Saudi Arabia. The results indicate that external factors, such as the exchange rate and global prices, contributed more to inflation compared to domestic factors, such as money supply and real non-oil GDP. Ben Ali et al. (2011) investigated the determinants of inflation for eight countries in the Middle East and North Africa (MENA) region including Saudi Arabia. In their analysis, they identified key inflation determinants, such as global inflation, global oil prices, exchange rate, trade openness, capital account openness, money supply, output gap, and government spending. The study used various estimation methods and identified global inflation, exchange rate, trade openness, money supply, output gap, and government spending as significant variables in determining inflation.

Al-Qenaie (2016) investigated inflation determinants in oil-exporting countries using interest rate, money growth, government spending, oil prices, and exchange rate by applying the pooled OLS method. Saudi Arabia pooled OLS results indicated that only government spending and government spending were significant. Alnefaee (2018) used the Vector Error Correction Model (VECM) to identify the internal and external determinants of inflation in Saudi Arabia by applying money supply, non-oil GDP, exchange rate, and oil prices as dependent variables. The result suggested that external factors had a more dominant effect on inflation compared to internal factors in the long run. While in the short run, the effect of the exchange rate on inflation deteriorated.

Bokhari (2018) examined the relationship between unemployment and inflation in Saudi Arabia by estimating the Philips curve. The results of the cointegration indicated a long-run relationship between unemployment and inflation, while the VECM bald results suggested the absence of unemployment impact on inflation in the short run. Naseem (2018) investigated the macroeconomic determinants of inflation in Saudi Arabia by utilizing a simple regression model with the exchange rate, money supply, oil prices, export value, import value, and unemployment as explanatory variables. Her analysis revealed statistical significance in all explanatory factors except unemployment.

In addition, Mahmood (2018) applied the ARDL model to examine the short and long-term internal and external causes of inflation in Saudi Arabia. His empirical findings showed that money supply and global inflation had a positive and significant impact on inflation in Saudi Arabia. However, GDP growth was found to have a negative effect. Osman et al. (2019), discussed the short-run and the long-run determinants of inflation in Saudi Arabia for the period using the Auto Regressive Distributed Lag (ARDL) model. They utilized the broad money supply, the stock price index, the real GDP, the oil prices, and the world inflation rate as independent variables. They found a long-run positive relationship between inflation and broad money supply, GDP, oil prices, and world inflation, while the stock price index has a negative impact.

In addition, there are three key studies published by the International Monetary Fund (IMF). These studies attempted to measure what derives inflation movements in Saudi Arabia (Hasan & Alogeel, 2008; Kandil et al., 2009; and Alkhareif et al., 2017). They have also established an important foundation to understanding inflation movements by testing both the domestic and external factors mentioned above. Notably, all mentioned studies mutually share a common conclusion, which points to the notion that inflation in Saudi Arabia is dominantly driven by external factors (Trading Partners Inflation as a proxy for imported inflation and exchange rates). Table 1 shows a summary of these studies.

Table 1: Summary of key studies related to inflation and its drivers in Saudi Arabia

	Hasan and Alogeel (2008)
Time series	1966 – 2007 (annual frequency)
Model	Vector Error Correction Model
Variables	• Nominal Effective Exchange Rate *(significant in the long run)* • Trading Partners Inflation *(significant in the long run)* • Money Supply - M3 *(significant in the short run only)* • Demand - Real Output Gap *(significant in the long run)* • Brent – oil prices *(significant in the long run)*
	Kandil et al. (2009)
Time series	1970 – 2007 (annual frequency)
Model	Vector Error Correction Model
Variables	• Nominal Effective Exchange Rate *(significant in the long run)* • Trading Partners Inflation *(significant in the long run)* • Money Supply - M3 *(not significant)* • Total Government Spending *(not significant)* • Demand - Real output gap *(significant in the long run)*
	Alkhareif et al. (2017)
Time series	1960 - 2016 (annual frequency)
Model	Vector Error Correction Model
Variables	• Nominal Effective Exchange Rate *(significant in the long run)* • Trading Partners Inflation *(significant in the long run)* • Money Supply - M3 *(significant in the short run)* • Government Spending - Current *(not significant)* • Government Spending - Capital *(significant in the long run)* • Demand - Real GDP *(significant in the long run)*

3. DATA

In light of the fact that it is an open economy with a pegged exchange rate regime, inflation movements in Saudi Arabia become inevitably determined by both domestic and external factors, which can be further broken down into domestic factors, which include domestic demand (we will use the purchasing managers' index (PMI) as a proxy), net government spending[2], and money supply M3 (as a proxy for liquidity). On the other hand, the external factors include imported inflation and nominal effective exchange rate (as a proxy for exchange rate movements). The time span under investigation in this study ranges over Q1:2013 - Q4:2022 (all variables are transformed into log form), providing enough sample period of 40 quarters as an input for the model. The data are collected from different sources, including Saudi Central Bank monthly database, Saudi General Authority of Statistics, IHS Markit, Saudi Ministry of Finance, and Federal Reserve Bank of St. Louis.

4. THE STUDY'S CONTRIBUTION

While we acknowledge the significance of those studies in Table 1, we believe this paper provides additional insights by undertaking different approaches compared to the IMF's studies.

First, this study uses the latest data (from Q1:2013 to Q4:2022) compared to the previous studies capturing a more recent trend of inflation movements. In addition, using quarterly data is certainly more advantageous as it captures the movements of the variables within each year. In contrast, all the mentioned studies published by the IMF use an annual data set.

Second, given that one of the domestic factors influencing inflation is government spending, we used the net government spending, while the published studies by the IMF used total government spending (Hasan & Alogeel, 2008; Kandil et al., 2009; and Alkhareif et al., 2017). We believe net government spending represents a more accurate proxy for government spending when studying its relationship with inflation. The reason is that since 2016, the government has begun generating non-oil revenues sourced mainly from the value-added tax (VAT) on all goods and services and the

[2]Net government spending is the government spending sourced from oil revenues, foreign debt, and government reserve minus non-oil revenue plus deficit financed domestically.

expatriate levy, in addition to reducing certain subsidies, such as energy prices and utilities, water and electricity. In other words, within a fiscal year, while the government continues its planned budget spending in the domestic economy, it collects revenues from the VAT and expatriate levy. For instance, if we assume that the government plans to spend SAR 1 trillion, and at the same time, the government collects SAR 150 billion of non-oil revenues, then we can say that the actual net impact of the government spending on the domestic economy is SAR 850 billion.

Third, to measure trading partners' inflation, previous studies used a range of a few major countries that Saudi Arabia imports from, such as the US, China, and a few selected European countries (Hasan & Alogeel, 2008; Kandil et al., 2009; and Alkhareif et al., 2017). However, more accurately, this paper uses 35 countries based on their share of total imports (those countries have a share of 91 percent of total imports by volume).

Fourth, after running multiple tests, it turned out that using the Vector Error Correction Model might not be the most fitted model, given that most of the variables did not have the same order of integration.[3] Therefore, we used the Autoregressive Distributed Lag model (ARDL). In addition, one of the advantages of using the ARDL test is that it is more robust and performs better for a small and medium sample size of data, which is suitable for this study as the sample size is 40 quarters.

5. MODEL SPECIFICATION

The empirical model used in this study considers both the external and domestic forces that could potentially impact the inflation movement in Saudi Arabia. The variables used in this study are as follows: Saudi Consumer Price Index (P) as the dependent variable, and external forces include Imported Inflation (P^*) and Nominal Effective Exchange Rate ($NEER$). On the other hand, the domestic forces include Money Supply ($M3$), economic activities (PMI), and net government spending (G). All the variables used in this study are based on a quarterly frequency which has been

[3]Order of cointegration: Saudi headline inflation (P) = I(0), net government spending (G) = I(0), nominal effective exchange rate (NEER) = I(0), imported inflation (p*) = I(1), money supply (M3) = I(1), economic activities (PMI) = I(0).

transformed into a natural logarithm. Hence, the long-run inflation movement is assumed to depend on the set of independent variables as follows:

$$P = f(P^{*}, NEER, G, M3, PMI) \qquad (1)$$

Equation (1) can be rearranged in a natural logarithm form where X represents the vector of the external factors, M is the vector of the domestic factors, and D is the dummies of 2018 and 2020.

$$lnP_t = \alpha + ln\sum_{t=1}^{p} \beta_t X_t + ln\sum_{t=1}^{s} \beta_t M_t + \sum_{t=1}^{k} \beta_t D_t + \varepsilon_t \qquad (2)$$

More specifically, equation (2) can be rewritten as:

$$lnP_t = \alpha + ln\sum_{t=1}^{p} \begin{pmatrix} \beta_t {P^{*}}_t \\ \beta_t NEER_t \end{pmatrix} + ln\sum_{t=1}^{s} \begin{pmatrix} \beta_t M3_t \\ \beta_t G_t \\ \beta_t PMI_t \end{pmatrix} + \sum_{t=1}^{k} \begin{pmatrix} \beta_t D(Q1{,}2018) \\ \beta_t D(Q2{,}2020) \end{pmatrix} \qquad (3)$$

Accordingly, in order to estimate the ARDL model, the following specification is created as shown in equation (4):

$$\mathrm{d}lnP_t = a_0 + dIn\, \beta_i P_{t-1}$$

$$+ dln\sum_{j=0}^{p} \begin{pmatrix} \beta_i {P^{*}}_{t-j} \\ \beta_i NEER_{t-j} \end{pmatrix} + dln\sum_{j=0}^{s} \begin{pmatrix} \beta_i M3_{t-j} \\ \beta_i G_{t-j} \\ \beta_i PMI_{t-j} \end{pmatrix} + D1 + D2 + \lambda ECT_{t-1} + \varepsilon_t \qquad (4)$$

Before running the model, we tested for the correlation to check for multicollinearity. Table 2 indicates that the correlations between the variables are less than 0.5, implying to some extent weak relationships among the explanatory variables.

Table 2: Correlation test

	P	P*	NEER	PMI	M3	G
P	1					
P*	-0.12513	1				
NEER	-0.3914	0.046668	1			
PMI	-0.17106	0.258457	-0.20363	1		
M3	0.35226	0.046285	0.067482	0.091944	1	
G	0.044752	-0.08444	-0.12305	-0.15583	-0.27957	1

In addition, to test for the heteroscedasticity, we use the following assumption. For Simplicity:

$$y = X\beta + \varepsilon$$

It is assumed that: (5)

$$v(\varepsilon) = \sigma_i^2$$

Where, $var(\varepsilon_i^2) = \sigma^2$ and $cov(\varepsilon_i \varepsilon_j) = 0, i \neq j = 1,2, \dots n.$

If these assumptions are satisfied, the data variance is not heteroskedastic, which is the preferred outcome, as seen in Table 3.

Table 3: Heteroskedasticity Test (Breusch-Pagan-Godfrey)

F-statistic	324	F(23,6)	2
Obs*R-squared	739	Chi-Square(23)	1
Scaled explained SS	406	Chi-Square(23)	0

To check for model stability, as presented in Figures 1 and 2, we show that the model used in this study has no structural break, indicating a stable model.

Figure 1: CUSUM test

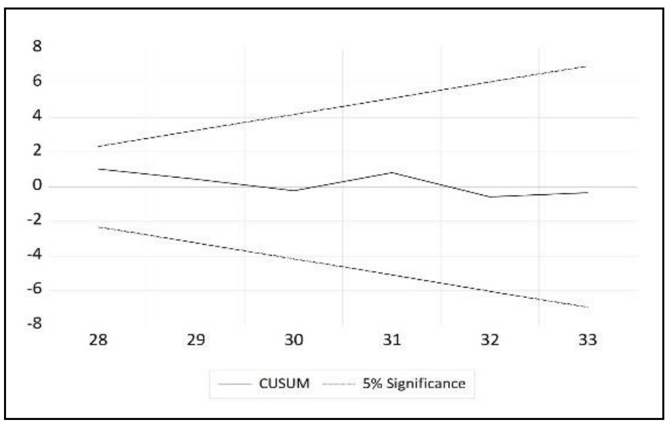
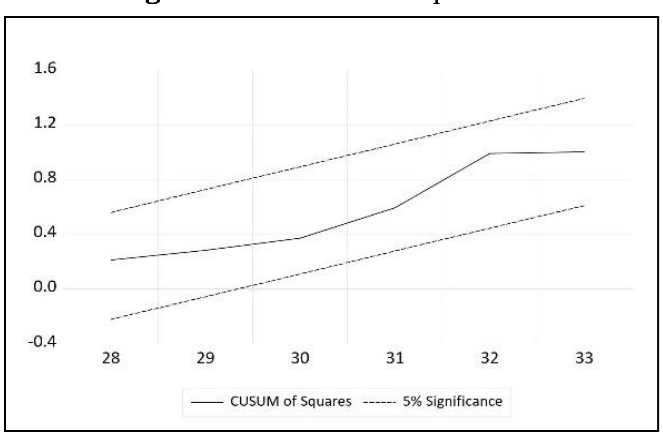


Figure 2: CUSUM of Squares test



6. THE RESULTS

After running the ARDL model, the long-run estimated determinants of inflation in Saudi Arabia are presented in Table 4.

Table 4: Drivers of Inflation in Saudi Arabia in the long run (ARDL model)

	Coefficient	Impact	P-value
Domestic Factors:			
Demand (PMI)	0.0937	9%	0.0249**
Net Government Spending (G)	0.1815	18%	0.0152**
Money Supply (M3)	0.0072	0.7%	0.0447**
External Factors:			
Imported Inflation (P*)	0.2990	29%	0.0580*
Nominal Effective Exchange Rate (NEER)	-0.2648	-27%	0.0230**

The model goodness of fit:
$R^2 = 0.9693$
Adj $R^2 = 0.9304$
S.E. of regression = 0.0036
Durbin-Watson stat = 2.14
Sum squared resid. = 0.00014
Log likelihood = 120.4354
Akaike info criterion = -8.1104

Note 1: *** p-value < 0.01, ** p-value < 0.05, P-value < 0.1

Note 2: CointEq coefficient is -1.0811 (P-value = 0.0003). This study uses oil price (Brent) as a fixed regressor to elim its effect, as it is already accounted for in the imported inflation through trading partners' inflation.

Based on the results, imported inflation seems to be the dominant factor in the long run, with an estimated value amounting to 29 percent. For instance, if we assume that the inflation rate is at 1 percent, then 0.29 percent could be attributed to imported inflation. This can be attributed to the high dependency of Saudi Arabia on imports. One way to look at the degree of Saudi Arabia's dependency on imports is by looking at its share of the non-oil GDP. On average, during the past 5 years, Saudi Arabia recorded 37 percent of total imports as a share of non-oil GDP compared to an average of 24 percent for the G20, according to World Bank data. This indicates that the dependency of the Saudi economy on imports is relatively high.

Similarly, the second dominant factor is exchange rate movements, with an inverse relationship, as they account for about 27 percent.[4] Exchange rates influence inflation in Saudi Arabia, more specifically, through the purchasing power of the Saudi Riyal, which is pegged to the US dollar. For instance, a stronger US dollar means a stronger Riyal. Therefore, imports become relatively cheaper for Saudi Arabia, which implies that they can increase.

Net Government Spending is also significant, with an impact of 18 percent. Indeed, inflation in Saudi Arabia is partly driven by government spending, for instance, through infrastructure projects, public sector wages, and welfare programs, which create demand-pull inflation. Similarly, domestic demand is significant, and accounts for 9 percent. We believe that there is limited demand pressure on firms and producers in Saudi Arabia, given that higher domestic demand is mostly met with higher imports. Therefore, imported inflation, as we have seen, affects Saudi inflation more than domestic demand.

Lastly, the money supply recorded the lowest impact of about 1 percent. This is somewhat in line with IMF's results, which show that the money supply is insignificant in Saudi Arabia. Nevertheless, this might raise a flag, particularly as the quantity theory of money claims that money supply should affect inflation in the long run. This could be true in the context of advanced and industrialized economies. However, that does not necessarily apply to all countries across the board. We looked at the velocity of money in Saudi Arabia and found that the average 10-year velocity of money in the non-oil economy is roughly at 0.9 compared to an average of 1.5 in the US.[5] In the context of Saudi Arabia, a value below 1 perhaps indicates that the portion of the liquidity is not being spent in the economy; instead, it is perhaps being saved or invested in the financial market as stocks. Another explanation for the low velocity of money could be explained by the high level of remittance, which leaks the liquidity outside of the economy.

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[4]When the NEER increases, this implies a strong US dollar, and since Saudi Riyal is pegged with the US dollar, this becomes advantageous to Saudi Arabia as imported products becomes cheaper.

[5]The Velocity of Money = GDP / Money Supply. In general terms, the velocity of money measures the speed of circulation of money in the economy. A ration above 1 indicates that that money is moving fast (more transactions) in an economy towards the purchase of goods and services. A value below 1 indicates that money is not moving fast to keep up with the growth.

7. CONCLUSION

In this study, we investigated the determinants of inflation in Saudi Arabia using an ARDL model from Q1:2013 to Q4:2022. Our findings suggest that domestic factors have a lower impact on inflation, accounting for only 28.5% of the variation in inflation. External factors, on the other hand, dominate inflation movement, accounting for 55.5% of the variation. The remaining 16% could be interpreted as the unobserved factor of net effects of government policies, such as the VAT implementation, expatriate levy, and energy price reforms. These findings are consistent with existing studies, which have found that external factors have a more significant impact on inflation in Saudi Arabia than domestic factors. In addition, for future research on the determinants of inflation in Saudi Arabia, we recommend investigating the role of supply-side factors and the role of labor market conditions. Further research on these factors could help provide a more comprehensive understanding of the determinants of inflation in Saudi Arabia, and could help develop more effective policies to manage inflation.

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