ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA (ESCWA)

**INFLATION DYNAMICS IN THE ESCWA REGION:
A VECTOR AUTOREGRESSIVE ANALYSIS**

United Nations

CONTENTS

"Inflation is always and everywhere a monetary phenomenon."
Milton Friedman

Introduction

Inflation is a key macroeconomic variable that affects everything from public policymaking to the daily lives of people. In recent years, most central banks have made it their mission to keep inflation rates low and stable in order to avoid major disruptions to the economy.

In terms of public policymaking, inflation matters for a number of reasons. Controlling inflation is important for long-term economic growth, because high and volatile inflation can create uncertainties about the future and therefore have the potential to depress investment. The conduct of macroeconomic policies, such as exchange rate and monetary policies, are influenced by the level of inflation and the forces that drive it.

Inflation also has an impact on the cost of living and therefore impacts the living standards of most people. In the past, high inflation has been a driving force of social unrest and instability, as people manifest their discontent with rising prices and increasing deprivation. Higher prices, especially for food, are believed to have been one of the triggers for the uprisings in the Arab world since 2011. Inflation can also have an impact on the distribution of wealth, as some people are set to gain from higher inflation while others are set to lose. Inflation adversely affects people with non-indexed wages, who are often the poorest in society. However, an excessive focus on controlling inflation may also have adverse effects on the poor if the focus on doing so comes at the expense of job creation and economic growth.

The first step in the process of managing inflation is to understand its determinants. Inflation is driven by many factors and to fully understand the different sources is a difficult, if not impossible, task. However, a thorough understanding of the sources of inflation is a prerequisite for devising effective economic policies in order to mitigate inflationary pressure.

The importance of correctly estimating the sources of inflation can be illustrated with an example from Yemen. During the early 2000s, the agricultural sector in Yemen caused inflationary pressure to increase, with food prices leading prices in other sectors.[1] In such circumstances, a narrow focus on money supply would not have addressed the inflation problem and might even have exacerbated the unemployment problem. Having conducted an analysis of the sources of inflation in Yemen, McKinley and Mehran suggested a short-term policy of stabilizing food prices in order to dampen inflationary pressures, maintain real incomes and improve international competitiveness in the non-oil sector.

A long line of research has been devoted to inflation, but has mainly focused on the developed world. Much less attention has been given to other regions, and research on the member countries of the Economic and Social Commission for Western Asia (ESCWA) is particularly limited. A few studies have considered inflation in the Gulf Cooperation Council (GCC) countries, but other ESCWA member countries have been neglected in terms of inflation research. The objective of this paper is therefore to fill that gap by investigating and comparing the sources of inflation in selected ESCWA member countries, comprising three countries of the GCC, three countries of the Arab Mashreq and one of the least developed countries (LDCs) in the region.

In its 1999 publication "Inflation in the ESCWA region: Causes and Effects", ESCWA surveyed the historical inflation pattern from 1970 to 1997 and found that inflationary pressure had occurred in response to exogenous shocks, especially from disruptions to the commodity markets. This paper will discuss those findings and investigate the main drivers of inflationary pressure during the period between 2000 and 2010.It

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[1] McKinley and Mehran, 2006.

will further examine whether such pressure also originated from external factors associated with the recent evolution of commodity prices, or from other sources, such as aggregate demand pressure. Aiming to quantify the contribution made by the various factors to the recent inflationary episodes, the paper will use the most recent data available, which encompasses a remarkable period of food, fuel and financial crises and the subsequent global recession. The use of monthly data also offers new opportunities not previously exploited, since high-frequency data permits the measuring of trends in global commodity price inflation and other recent factors, as well as assessment of their respective roles in domestic price developments over a relatively short period. Higher-frequency data also facilitates more effective disentangling of the underlying relationship between the different variables.

In recent years, a large literature has investigated the causes of the recent increases in food and oil prices. Most agree that it has come as a combination of various factors, including speculation, high demand from fast-growing developing countries, climatic effects and conflicts in exporting countries. This paper will not investigate the sources of global prices, but will quantify how those prices affect local consumer price inflation in the ESCWA region.

The analysis has been undertaken using a vector autoregressive (VAR) approach. On the basis of the VAR analysis, variance decomposition is used to analyse the effect of shocks on inflation and assess the extent to which the different shocks explain the variation in inflation. Compared with previous papers on inflation dynamics in the ESCWA region, it is intended that the combination of high frequency data and the empirical methodology used in this paper will offer new and valuable insight.

The paper is organized as follows: part I offers a brief discussion on the movement of inflation in the ESCWA member countries, first from a historical perspective and then with a particular focus on the last 10 years. Part II reviews both the literature related to inflation theory and empirical studies, where a number of studies on ESCWA member countries will be discussed. The empirical methodology, data and analytical framework are presented in part IV, while part V reports and discusses the empirical results. The final part highlights the main findings of the paper and concludes with a discussion about the policy implications.

I. INFLATION IN THE ESCWA MEMBER COUNTRIES: A FIRST GLANCE

A. HISTORICAL PERSPECTIVE

Inflation has varied extensively through time and across regions. A brief discussion of the rise and fall of worldwide inflation between 1970 and 1999 will provide the backbone to a better understanding of the roots of inflation in the decade under scrutiny in this paper, namely 2000 to 2010.

The first inflation shock came in 1973 and 1974 after the sudden increase in oil prices (see figure I(d)). World inflation, which had stood at around 6 per cent for many years, increased from 9.8 per cent in 1973 to 16.3 per cent in 1974. The oil price shock aggravated inflationary pressure in most regions of the world, and many ESCWA member countries experienced double-digit levels of inflation (see figures I(a), I(b) and I(c)). The historically stable patterns of world and developing country inflation since World War II were disrupted and the stage was set for future inflationary periods in the developing world by the alteration of financial resource patterns, which affected their capacity for economic growth, at least in the short term.

In 1979 and 1980, the second oil price shock pushed the rate of world inflation even higher, increasing from 13.9 per cent in 1979 to 17.7 per cent in 1980. This shock affected different regions in different ways. The Asian economies, which had taken steps to contain aggregate demand during the period between 1975 and 1980, were less affected than other regions. The ESCWA member countries were strongly affected and experienced inflation rates of around 20 per cent at the beginning of the 1980s. Inflation rates remained high across the region, at just below 20 per cent, until the end of the decade.

During the period between 1988 and 1998, the world experienced two more inflationary peaks: one around 1989 and another in 1994. The 1989 peak was caused by a rise in non-fuel commodity prices in 1988. Further increases in non-oil commodity prices also gave rise to the 1994 inflationary peak, but did not affect inflation levels globally to the same extent as the previous shocks.

All the major world inflationary peaks came at a time when worldwide demand pressure was high and commodity markets were booming. Fiscal policies in most countries were expansionary and capacity constraints contributed to rising levels of inflation.The dissimilar experiences in different regions and countries indicate that while the commodity price shocks were a contributing factor globally, the major determinants of inflationary pressure were the economic conditions prevailing before the shocks and the economic policies adopted by individual countries.

During the 1990s, policymakers in most countries accorded increasing importance to fighting inflation, and this approach has borne fruit. Figures I(a), I(b) and I(c) show the historical pattern of inflation in selected ESCWA member countries and it is clear from the graphs that inflation was more stable, and at a lower level in the 1990s than it was during the 1970s and 1980s. Table 1 shows how both the average level and volatility of inflation have been reduced in most countries since the 1990s.

TABLE 1. AVERAGE INFLATION AND VOLATILITY, BY DECADE,
SELECTED ESCWA MEMBER COUNTRIES

Country	Average inflation				Average volatility			
	1970-1979	1980-1989	1990-1999	2000-2010	1970-1979	1980-1989	1990-1999	2000-2010
Bahrain	12.6	2.1	0.8	1.6	8.3	4.9	1.4	1.7
Egypt	7.8	17.0	10.5	7.9	3.8	4.3	5.9	5.0
Jordan	10.8	6.6	5.1	4.0	4.6	7.7	4.4	4.2
Kuwait	4.3	3.2	3.1	3.4	11.7	2.8	3.6	3.0
Qatar		3.5	2.9	5.7		2.5	1.7	6.6
Saudi Arabia	12.4	-0.4	1.3	2.4	13.2	2.1	2.1	3.4
The Sudan	15.3	37.4	80.4	8.7	10.4	17.6	43.9	2.5
Syrian Arab Republic	9.2	23.0	8.2	4.9	5.8	17.2	7.2	5.1
Yemen			28.1	10.7			18.9	3.9

Source: *International Financial Statistics*, IMF.

Figure I. Inflation, ESCWA member countries, 1970-1999
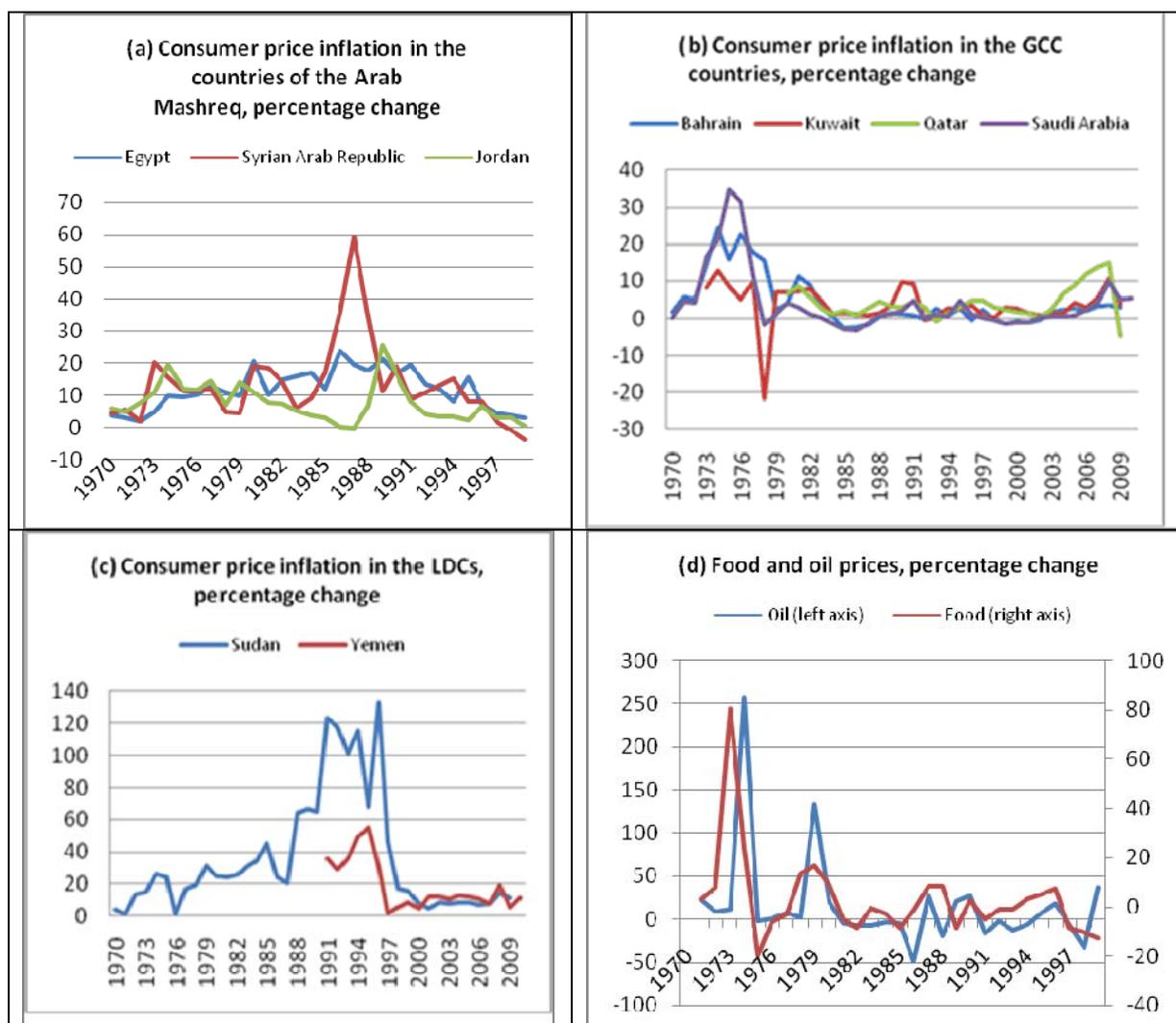
Source: Adapted from *International Financial Statistics*, IMF.

B. PATTERNS OF INFLATION IN THE ESCWA MEMBER COUNTRIES IN THE 2000S

As was seen in the previous section, most ESCWA member countries managed to reduce inflation considerably during the 1990s, moving from a high and volatile inflation regime to one with stable and relatively low inflation. However, inflationary pressure re-emerged after 2003 and most countries in the region witnessed a substantial increase in prices (see table 2). This situation lasted for several years and in 2008, most countries experienced double-digit inflation rates. Since 2008, however, the trend within the ESCWA region has diverged, as some countries have moved back to a low inflation regime, while others have experienced a less significant decline. Inflation in Egypt fell after 2008, yet remained in double digits in 2009 and 2010. Qatar and Jordan experienced negative inflation rates in 2009, whilst other countries experienced a less dramatic fall.

TABLE 2. CONSUMER PRICE INFLATION, PERCENTAGE CHANGE,
SELECTED ESCWA MEMBER COUNTRIES, 2000-2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Bahrain	-0.7	-1.2	-0.5	1.6	2.4	2.6	2.0	3.3	3.5	2.8	
Egypt	2.7	2.3	2.7	4.5	11.3	4.9	7.6	9.3	18.3	11.8	11.3
Jordan	0.7	1.8	1.8	1.6	3.4	3.5	6.3	5.4	14.9	-0.7	5.0
Kuwait	2.5	1.3	0.9	1.0	1.2	4.1	3.1	5.5	10.6	4.0	
Oman		-0.8	-0.3	0.2	0.8	1.9	3.2	6.0	12.1	3.9	3.2
Qatar	1.7	1.5	0.2	2.3	6.8	8.8	11.8	13.8	15.1	-4.9	
Saudi Arabia	-1.1	-1.1	0.2	0.6	0.3	0.7	2.2	4.2	9.9	5.1	5.3
The Sudan	8.0	4.9	8.3	7.7	8.4	8.5	7.2	8.0	14.3	11.2	
Syrian Arab Republic	-3.8	3.0	-0.1	5.8	4.4	7.2	10.0	3.9	15.7	2.9	4.4
Yemen	4.6	11.9	12.2	10.8	12.5	11.8	10.8	7.9	19.0	5.4	11.2

Source: *International Financial Statistics*, IMF.

The rise in inflation in 2008 coincided with an increase in global commodity prices, especially food and oil (see figure II(a)). However, this correlation does not imply causation, and the extent to which global commodity prices have caused domestic consumer price inflation merits further investigation. The increase in commodity prices happened at a time of benign economic circumstances in which most countries experienced rapid economic growth. Most developed countries experienced higher growth rates than in the 1990s and, furthermore, several large developing countries (in particular China and India) experienced double-digit growth rates that fuelled global demand. A combination of high growth rates in the developed world, coupled with exceptionally high growth rates in several large, emerging economies, is believed to have fuelled the increase in commodity prices between 2004 and 2008. Other factors include speculation, conflict and political instability in exporting countries, and climatic changes.

During this period, the United States Dollar (US$) weakened dramatically against most other major currencies, and particularly relative to the Euro (see figure II(b)). This is believed to have affected the situation in the ESCWA region, since most member countries have a fixed exchange rate to the US$. In countries that have a fixed exchange rate pegged to the US$, a weakening dollar can lead to inflation by increasing import prices from non-dollar countries. Another source of inflation may be higher inflation in trading partner economies, as was the case during the 2000s.

Figure II. United States Dollar (US$) depreciation during the 2000s and the commodity price boom
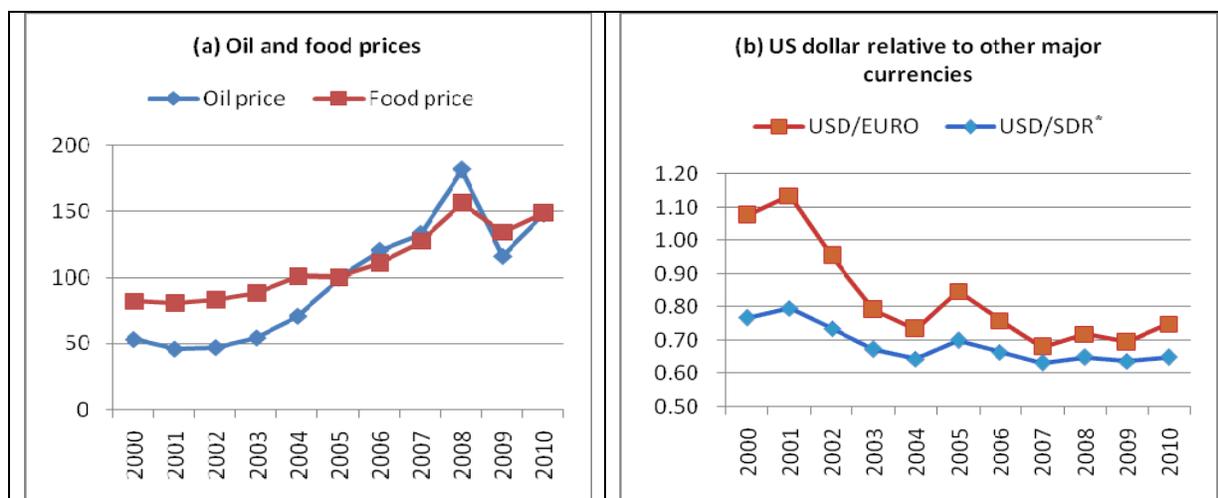
Source: Adapted from *International Financial Statistics*, IMF.

* SDR: special drawing rights.

It is clear from the above discussion that inflation in the ESCWA member countries exhibits certain common characteristics. To investigate this further, the correlation between inflation rates in various member countries were calculated (see table 3). The correlation with respect to oil prices, food prices and world inflation rates were also calculated. It is clear from table 3 that inflation rates in most ESCWA member countries are positively correlated with each other. It is also worth noting that certain countries are more closely correlated with the price of commodities. For example, Jordan has the highest correlation with the price of oil, whilst Qatar has the highest correlation with the price of food. The two Least Developed Countries (LDCs), the Sudan and Yemen, have the highest correlation with the global inflation rate.

TABLE 3. CORRELATION BETWEEN INFLATION RATES, WORLD INFLATION AND COMMODITY PRICES, SELECTED ESCWA MEMBER COUNTRIES

	Bahrain	Egypt	Jordan	Kuwait	Oman	Qatar	Saudi Arabia	Sudan	Syrian Arab Republic	Yemen	Oil	Food	World
Bahrain	1.00												
Egypt	-0.06	1.00											
Jordan	0.52	0.30	1.00										
Kuwait	0.19	0.13	0.45	1.00									
Oman*	0.72	0.85	0.84	0.98	1.00								
Qatar	0.42	0.05	0.39	0.49	0.62	1.00							
Saudi Arabia	0.79	-0.03	0.48	0.45	0.94	0.50	1.00						
The Sudan	-0.26	0.33	0.08	0.00	0.81	-0.20	-0.16	1.00					
Syrian Arab Republic	0.00	0.62	0.08	0.10	0.75	0.03	0.03	0.14	1.00				
Yemen	0.07	0.55	0.21	0.11	0.39	-0.13	0.21	0.78	0.67	1.00			
Oil	0.37	-0.13	0.46	0.34	0.27	0.42	0.26	-0.13	-0.05	-0.18	1.00		
Food	0.23	-0.08	0.22	0.10	0.53	0.61	0.14	-0.12	0.18	0.12	0.34	1.00	
World	0.09	0.55	0.33	0.22	0.54	-0.19	0.06	0.61	0.47	0.87	0.02	-0.08	1.00

Source: *International Financial Statistics*, IMF.

* *The correlation with Oman is not fully comparable, since the country only has ten observations.*

This section has considered the historical evolution of inflation and established certain basic stylized facts about inflation in the ESCWA member countries. The results in this section are based on simple correlations and it is therefore important that they be interpreted carefully. The following section will discuss the theoretical and empirical literature related to inflation dynamics and introduce the empirical methodology used to investigate the determinants of inflation, facilitating a more rigorous examination of inflation and its causes.

II. LITERATURE REVIEW

By the means of demand-pull and cost-push theories, economists have formulated different approaches to understanding the inflationary process. The Monetarists believe that inflation occurs because of excess demand and inappropriate monetary responses to economic situations, while the Keynesians have linked inflation and output, manifested in the Phillips curve. More recently, the New Keynesian Phillips Curve (NKPC) has been the dominant paradigm in inflation theory. By incorporating price stickiness and inflationary expectations, advocates of the NKPC claim that it better fits the empirical characteristics of inflation.

Friedman (1987) is one of the most widely cited theorists regarding inflation. The quantity theory of money describes the crudest form of inflation theory. It implies that inflation is a monetary phenomenon in the long term. The textbook formula describing the quantity theory of money is $M \times V = P \times Q$, where M is the

quantity of money in circulation, V is velocity of money, P is the price level and Q is real final expenditure. Since velocity and real expenditure are fixed, inflation equals change in money supply.

Loungani and Swagel (2001) reviewed the theoretical literature related to inflation and grouped the sources of inflation into the following four categories:

- **Policy** – Inflation in developing countries is often linked to underlying fiscal imbalances. Such imbalances can lead to an increase in inflation, either by triggering higher money growth or by triggering a balance of payments crisis, forcing exchange rate depreciation;

- **Demand** – Inflation in developing countries can also indicate overheating of the economy and is influenced by a demand variable such as the output gap. Intuitively, it is easy to explain the correlation between the output gap and inflation. When the output gap, which is defined as actual output minus potential output, lowers, the overcapacity problem escalates. Competition pressures rise and producers are forced to cut prices in order to survive;

- **Cost shocks** – A third source of inflation is supply-side "cost shocks" originating from changes in the price of particular goods, such as food and oil;

- **Inertia** – Inflation has a substantial inertial component stemming from sluggish adjustment of inflationary expectations or the existence of staggered wage contracts.

The bulk of the empirical literature on inflation dynamics covers developed countries, notably the United States of America and European countries, with few papers focusing on developing or emerging countries. Recently, however, more research has started to investigate inflationary pressure in developing countries.

Two particularly interesting papers are those written by Jongwanic and Park (2008) and Habermeier et al. (2008). The former identified the sources underlying inflation in nine East Asian countries using a structural VAR and variance decomposition. The central finding was that inflation is largely due to excess aggregate demand and inflationary expectations. The latter considered a panel of 49 emerging market economies from January 2005 to June 2008 and concluded that the recent inflationary episode was driven by a combination of internal and external factors, including commodity prices and internal demand pressure.

Relatively few studies have analysed the inflation process in ESCWA member countries. Table 4 provides an overview of the most relevant papers, most of which focus on the GCC countries, although a few discuss other ESCWA countries. They all employ similar econometric approaches, which are comparable to the method used in this paper.

TABLE 4. STUDIES ON INFLATION IN THE ESCWA REGION

Author	Econometric approach	Country studied	Key findings
Moriyama (2008)	Single equation model, structural vector autoregressive (SVAR) and vector error correction model (VECM)	The Sudan	Money supply growth and nominal exchange rate changes are found to be key determinants. The author argues that the pronounced relationship between the nominal exchange rate and inflation could justify putting greater emphasis on nominal exchange stability.
Kandil and Morsy (2009)	Cointegration and error correction model (ECM)	GCC countries	Results show that inflation in major trading partner economies and the depreciation of the nominal effective exchange rates have a significant inflationary effect in the long term for most GCC countries, while the money growth channel is inflationary in the long term in Bahrain and the United Arab Emirates only.

TABLE 4 (*continued*)

Author	Econometric approach	Country studied	Key findings
Hasan and Alogeel (2008)	ECM	Kuwait and Saudi Arabia	Results were remarkably similar for both countries. The authors find that inflation in major trading partner economies is the main factor affecting inflation, with significant but lower contributions from the exchange rate pass-through effect and oil prices. Given that the authorities have no control over the inflation of trading partners, containing inflationary pressures under the peg regime would need to be based on containing domestic demand and addressing non-tradable supply bottlenecks, especially in the real estate sector.
DIFC (2009)	Granger causality tests and VAR analysis	GCC (aggregated)	The role of money supply shocks remains predominant in explaining aggregate GCC inflationary pressure. The results highlight the importance of an independent monetary policy. Containing inflationary pressures would have required containing domestic demand, addressing non-tradables inflation and easing supply bottlenecks with a tighter monetary policy, all of which was prevented by the peg to the dollar.
Basher and Elsamadisy (2010)	Panel data	GCC	The authors find that money supply is the most significant determinant of inflation in both the short and long term. Based on those results, they advocate more independent monetary policy in the GCC countries.
Almounsor (2010)	Single equation model, SVAR and VECM.	Yemen	The outcomes suggest that inflation dynamics in Yemen are driven by international price shocks, exchange rate depreciation, domestic demand shocks and monetary innovations.They argue for limiting exchange rate depreciation to stabilize prices in the short term. Over the medium term, close coordination between monetary policy and fiscal policy is important to alleviate inflationary pressures.

III. ANALYTICAL FRAMEWORK

The inflation process in the ESCWA region is widely believed to stem from a range of factors, several of which have been discussed above, including oil and food prices, depreciating exchange rates and inflation in trading partner economies. In addition, both the empirical and theoretical literature have shown a number of other variables to be significant. Money supply, for example, should be included in any model explaining inflation, as should a measure of demand pressure, both domestic and external.

In terms of econometric techniques, this paper uses a VAR modelling framework to examine the determinants of inflation. The modelling approach draws on McCarthy (2000), Duma (2008), and Ito and Sato (2008) by using a recursive Choleskyorthogonalization. The methodology will be detailed in section B.

A. DATA

The investigation was undertaken using monthly data from January 2000 to October 2010.[2] The sample period was determined by the availability of data for the variables being examined and its remarkable

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[2] Simultaneity bias is frequently a major issue when estimating macro models with less frequent data. However, this is less of a concern when monthly data is used, since correlations between contemporaneous variables are low.

inflation characteristics. While it was considered important to include countries representing the different subregions, the final choice of countries for the analysis was inevitably guided by the availability of data. Given those constraints, the following sample of seven ESCWA member countries was selected:

- GCC countries: Kuwait, Oman and Saudi Arabia;
- Countries of the Arab Mashreq: Egypt, Jordan and the Syrian Arab Republic;
- LDC: Yemen.

In terms of variables, the theoretical and empirical literature was followed and the variables that have been proven to be most relevant selected. This paper builds on Loungani and Swagel (2001) by including the following four sources of inflation:

- Money growth and exchange rate, variables suggested by the policy view;
- Aggregate demand pressure and a measure of the world business cycle;
- Changes in the prices of oil and non-oil commodities, to capture cost shocks;
- Past realizations of inflation, to reflect the inertial component of inflation.

As seasonality issues tend to be pronounced with monthly observations, all data was adjusted accordingly (except for the monetary stance) prior to estimation using the X-12 filter. Working with both year-on-year and month-on-month growth data was considered; however, as discussed in the following section, only month-on-month growth data are stationary. Table 5 describes the variables used and their sources.

TABLE 5. DESCRIPTION OF VARIABLES

Variable	Description	Source
Money supply	M2	IMF IFS[*]
Nominal exchange rate	Since most countries in the sample have a peg to the US$, a measure of the US$ exchange rate (US$-Euro) was included. Nominal, rather than real exchange rates were used, as the latter already takes into account the inflation rates that this paper seeks to explain.	IMF IFS[*]
Global business cycle	As monthly data were being used and no information is available on monthly GDP, the industrial production index by IMF IFS[*] can be used as a proxy for aggregate demand pressure, as suggested by Ito and Sato (2008) and Yiping et al. (2010).The measure of global business cycle was derived by applying the Hodrick-Prescott filter to the natural log of the industrial production index for the advanced countries.	IMF IFS[*]
Domestic output gap	Ideally, the domestic output gap would be calculated in the same manner as the global business cycle. However, for the countries sampled, the industrial production index is only available for Jordan. Habermeier et al. (2008) was therefore followed and credit growth used as a proxy for domestic aggregate demand pressure (growth of credit to the private sector, IFS Series 22D).	IMF IFS[*]
Oil prices	An index of the average of the spot UK Brent, Dubai and West Texas Intermediate was calculated.	IMF IFS[*]
Food price	Food price index as calculated by IMF.	IMF IFS[*]
Inflation	Consumer price index (CPI) as calculated by IMF.	IMF IFS[*]

[*] International Monetary Fund *International Financial Statistics* publication.

This section sets out the econometric procedure in detail. First, the test for stationarity was carried out, then the relevant lag length was decided and a baseline VAR model was estimated using the Cholesky decomposition.

Test for stationarity (Augmented Dickey-Fuller and Phillips-Perron)

The variables are expressed in log terms on which unit root tests are performed. It was found that year-on-year growth variables were non-stationary I(1), while the month-on-month variables were stationary I(0). The output gap variable in levels was found to be integrated of order zero.

It was decided to proceed using month-on-month growth data according to the belief that doing so would provide more information about inflation dynamics. By using the stationary month-on-month growth rates, differencing the series was avoided and useful information therefore not discarded.[3] All the variables entered in first differences, except the output gap variable, which entered in levels due to its order of integration.[4]

Deciding lag length

In designing a VAR model, the lag length must be carefully selected. The model must attempt to balance over-fitting and model misspecification. Model over-fitting was avoided by limiting the length of lags included in the VAR given the short sample, and model misspecification was minimized by not selecting too small a lag length.

To select the number of lags of the VAR, standard lag length selection criteria were used, namely the sequential modified likelihood ratio test and the Akaike information criterion. To ensure the correct specification, residual tests of the VAR were performed. Multivariate serial correlation of the residuals was tested to determine whether the residuals were stationary (residual serial correlation Lagrange multiplier test).

Estimating the baseline VAR

Over the past two decades, there has been an increasing interest in the literature in using VARs as a tool for analysing different channels of transmission of macroeconomic shocks. The interest began with Sims (1980) who used a recursive VAR to analyse the interest channel of monetary transmission. Since then, a number of other studies have used the VAR modelling framework in analysing different channels of transmission.

Many macroeconomic variables are characterized by reinforcing mechanisms. Thus ordinary least squares regressions may suffer from endogeneity problems. For example, it is likely that the relationship between exchange rate and inflation goes both ways. It is therefore appropriate to use a technique that treats both of them as endogenous. The most commonly used method in the literature to address this issue is the VAR method.

In terms of VAR modelling, two different approaches are used, namely the recursive VAR and the structural VAR. A structural VAR uses economic theory and detailed institutional knowledge to impose restrictions on the model, while in a recursive VAR no restrictions are imposed. A drawback of the non-structural VAR methodology is that certain results may be sensitive to the ordering of the variables in the system.

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[3] Yiping et al. (2010) investigated both month-on-month and year-on-year for China and found that the results were generally consistent with each other.

[4] Given the short horizon studied in this paper, the use of this simpler model should have little effect on the results (see McCarthy (2000)).

However, the recursive VAR analysis allows the investigation of contemporaneous interactions of the variables, without imposing any constraints on the particular channels through which the factors interact. It was therefore decided to proceed using the recursive approach and use the Cholesky decomposition to estimate a recursive VAR. As mentioned earlier, the order of the variables is crucial, as the results are sensitive to ordering. Past literature on the ordering of the variables was followed and the recursive VAR was estimated in the following order: oil prices, food prices, global business cycle, domestic output gap, US\$-Euro exchange rate, M2 and CPI.

The underlying assumption of the model is that oil and food prices are driven by exogenous developments that are not affected in the same year by the other factors. Global business cycle and domestic output gap were placed before the three nominal variables (exchange rate, money and inflation) as per Loungani and Swagel (2001). It was assumed that contemporaneous correlation between innovations in money growth and innovations in inflation reflect causation from money growth to inflation. The baseline VAR model was therefore estimated with those eight variables, in the recursive system outlined below.

$$\Delta oil = E_{t-1}\Delta oil + u_t^{oil}$$
$$\Delta food_t = E_{t-1}\Delta food_t + \alpha_1 u_t^{oil} + u_t^{food}$$
$$GapGlobal_t = E_{t-1}\Delta GapGlobal_t + \alpha_2 u_t^{oil} + \alpha_3 u_t^{food} + u_t^{GapGlobal}$$
$$\Delta Credit_t = E_{t-1}\Delta Credit + \alpha_4 u_t^{oil} + \alpha_5 u_t^{food} + \alpha_6 u_t^{GapGlobal} + u_t^{Credit}$$
$$\Delta USD - EUR_t = E_{t-1}\Delta usd - eur + \alpha_7 u_t^{oil} + \alpha_8 u_t^{food} + \alpha_9 u_t^{GapGlobal} + \alpha_{10} u_t^{Credit} + u_t^{usd-euro}$$
$$\Delta m_t = E_{t-1}\Delta m_t + \alpha_{11} u_t^{oil} + \alpha_{12} u_t^{food} + \alpha_{13} u_t^{GapGlobal} + \alpha_{14} u_t^{Credit} + \alpha_{15} u_t^{usd-euro} + u_t^{m}$$
$$\Delta cpi_t = E_{t-1}\Delta cpi_t + \alpha_{16} u_t^{oil} + \alpha_{17} u_t^{food} + \alpha_{18} u_t^{GapGlobal} + \alpha_{19} u_t^{Credit} + \alpha_{20} u_t^{usd-euro} + \alpha_{21} u_t^{m} + u_t^{cpi}$$

whereΔ indicates the first difference and E represents the conditional expectation operator.

IV. EMPIRICAL RESULTS: VARIANCE DECOMPOSITION

Variance decomposition shows the contribution of each structural shock to the forecast error variance of the variables in the model at different forecast horizons and helps to assess the importance of shocks in explaining inflation over the sample period. It offers a way to quantify the impact of the different variables in the system and to evaluate which variables most heavily influence the inflation rates in different countries.

Figures III(a), III(b), III(c), III(d), III(e), III(f) and III(g) show the variance decomposition for the seven ESCWA member countries studied. The determinants of inflation are illustrated graphically by showing the time horizon on the horizontal axis and the response on the vertical axis. The time horizons cover 10 months after the shock.

In order to determine the robustness of the results, different specifications were tested. A sensitivity test was conducted by checking whether the estimates were stable over time. Different Cholesky orderings of the variables were also tested, as were other variables to control (non-oil commodities) and other measures of the variables included (M1 instead of M2, the nominal effective exchange rate instead of the bilateral exchange rate, and different measures of oil and food prices). The results were similar to those discussed below and are therefore not reported here.

It is clear from figure III that the inflation determinants have important cross-country differences. The first observation is that inflation inertia is present and considerable in all the countries studied. However, the extent of that inflation inertia varies significantly between countries. In Yemen and Saudi Arabia, more than 50 per cent of inflation after 10 months is explained by its own lag. In Egypt and Jordan, the figure is over 40 per cent, while at the other end of the spectrum, in Oman, only 20 per cent of inflation after 10 months is explained by its own lag.

For a more in-depth investigation of the cross-country differences, the countries and the indicators were subsequently considered individually. The impact of the different variables on inflation after 10 months is summarized in table 6.

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Figure III. Variance decomposition
(*Percentage*)

(a) Egypt

(b) Jordan

(c) Kuwait

(d) Oman

(e) Saudi Arabia

(f) Syrian Arab Republic

(g) Yemen

- CPI
- M2
- USD-EURO
- Domestic output gap
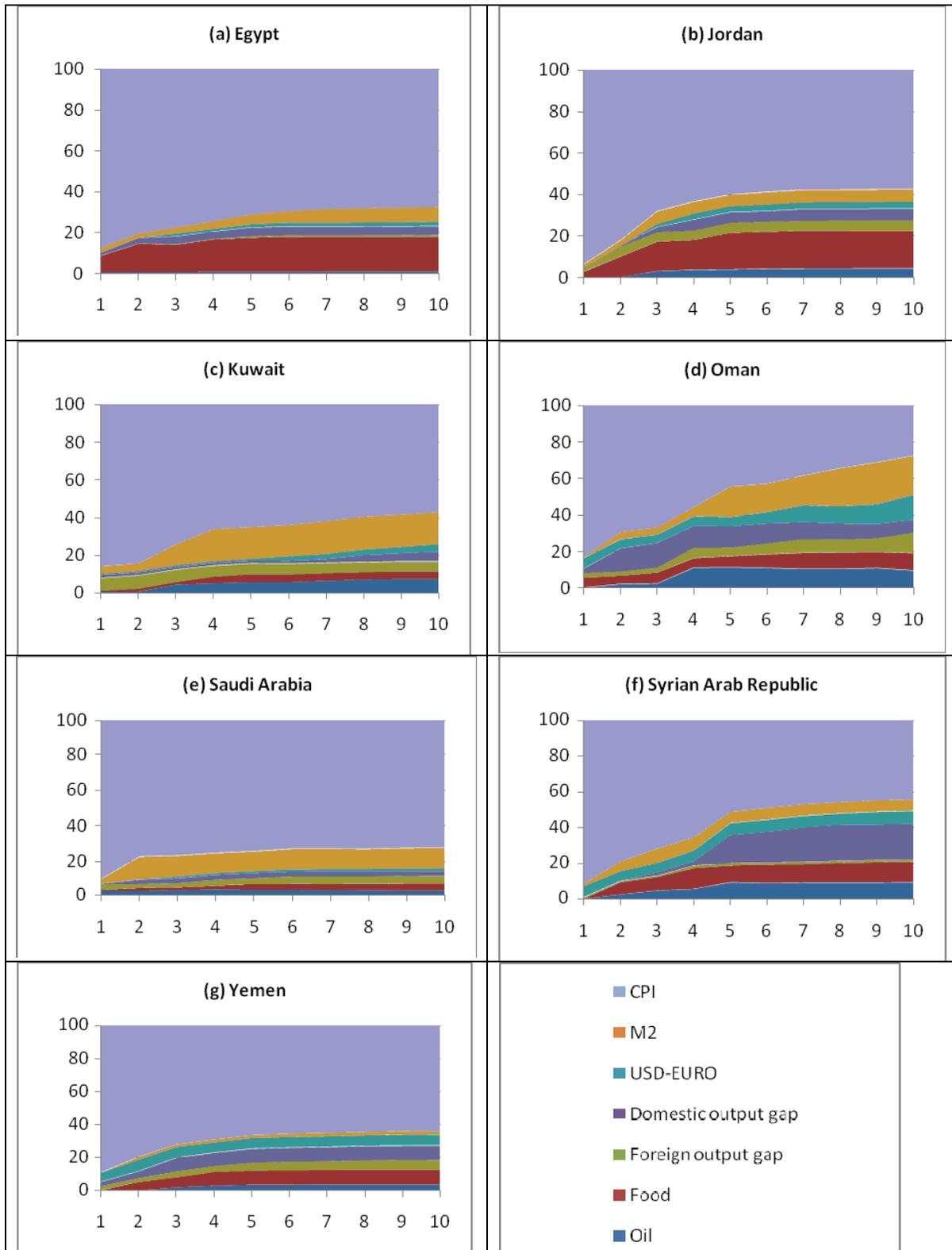- Foreign output gap
- Food
- Oil

TABLE 6. VARIANCE DECOMPOSITION, IMPACT AFTER 10 MONTHS

	Oil prices	Food prices	Advance output gap	Domestic output gap	US4-EUR	M2	CPI
Egypt	1.2	16.6	1.2	4.2	2.1	7.3	67.5
Jordan	4.5	18.0	5.1	5.7	3.4	5.9	57.4
Kuwait	7.3	4.3	5.2	5.1	4.0	16.9	57.2
Oman	9.9	9.4	11.3	7.0	13.6	21.5	27.3
Saudi Arabia	2.6	5.2	4.0	2.7	1.7	11.4	72.4
Syrian Arab Republic	9.4	11.5	1.2	20.3	7.2	6.1	44.4
Yemen	3.9	8.8	6.1	8.7	6.4	2.2	63.9

From the data presented in table 6, the following conclusions can be drawn:

- In Egypt, besides inflation inertia, money supply and food prices are the key determinants of domestic inflation. Some 16 per cent of inflation is determined by food prices, while money supply determines around 7 per cent of inflation;

- Inflation in Jordan is heavily influenced by food prices (18 per cent). Several other variables also affect inflation to a sizeable extent, such as domestic output gap (5.7 per cent) and money supply (5.9 per cent);

- In the case of Kuwait, money supply explains more than 16 per cent of inflation. Oil prices are the second most important variable, accounting for around 7 per cent;

- Oman is of particular interest, showing a very different pattern from the other countries studied. Money supply in Oman accounts for 21.5 per cent of the forecast variance in inflation, and the bilateral US$-Euro exchange rate is highly influential (13.6 per cent). Inflation is also heavily influenced by the output gap in the advanced world, oil, and food prices;

- The two most important determinants of inflation in Saudi Arabia are food prices (5.2 per cent) and money supply (11.4 per cent);

- The Syrian Arab Republic is heavily affected by the domestic output gap, which accounts for more than 20 per cent. In addition, the oil prices, food prices and US$-Euro exchange rate variables account for 9.4 per cent, 11.5 per cent and 7.2 per cent respectively;

- Finally, inflation in Yemen is primarily influenced by food prices (8.8 per cent) and domestic output gap (8.7 per cent).

Table 7 summarizes the impact by determinant and categorizes the countries according to the importance of the impact. Of the countries in the sample, Oman and the Syrian Arab Republic are most affected by global oil prices, while Egypt and Jordan are affected primarily by food prices. The global output gap and the US$-Euro exchange rate have the highest impact in Oman, while the domestic output gap is most significant in the Syrian Arab Republic and money supply has the highest impact in Oman, Kuwait and Saudi Arabia.

TABLE 7. IMPACT OF DIFFERENT SOURCES OF INFLATION

Source	Major impact	Some impact
Oil	Oman, Syrian Arab Republic	Kuwait, Jordan
Food	Egypt, Jordan	Syrian Arab Republic, Oman
Global output gap	Oman	Yemen
Domestic output gap	Syrian Arab Republic	Yemen, Oman
US$- Euro exchange rate	Oman	Syrian Arab Republic, Yemen
Money supply	Oman, Kuwait, Saudi Arabia	Egypt, Syrian Arab Republic

In figure IV(a), the impact is divided into the four categories outlined in the literature review. It is clear that inertia is not only a key component, but also the most important factor in all the countries studied except Oman. The impact of the cost shock is the second most important category in most of the countries. It is also worth noting that the importance of the demand and policy categories varies between countries. In Egypt, Kuwait, Oman and Saudi Arabia, the policy variables are of greater influence than the demand variables.

By isolating the impact of inflation inertia and examining the importance of the other domestic and global variables, it becomes clear that certain countries depend more on domestic circumstances than others (see figure IV(b)). Of the countries sampled, Egypt, Jordan, Oman and Yemen are heavily dependent on global circumstances, while Kuwait and Saudi Arabia are the only countries in which domestic variables account for a larger share than global variables.

Figure IV. Impact of inflation source, categorized
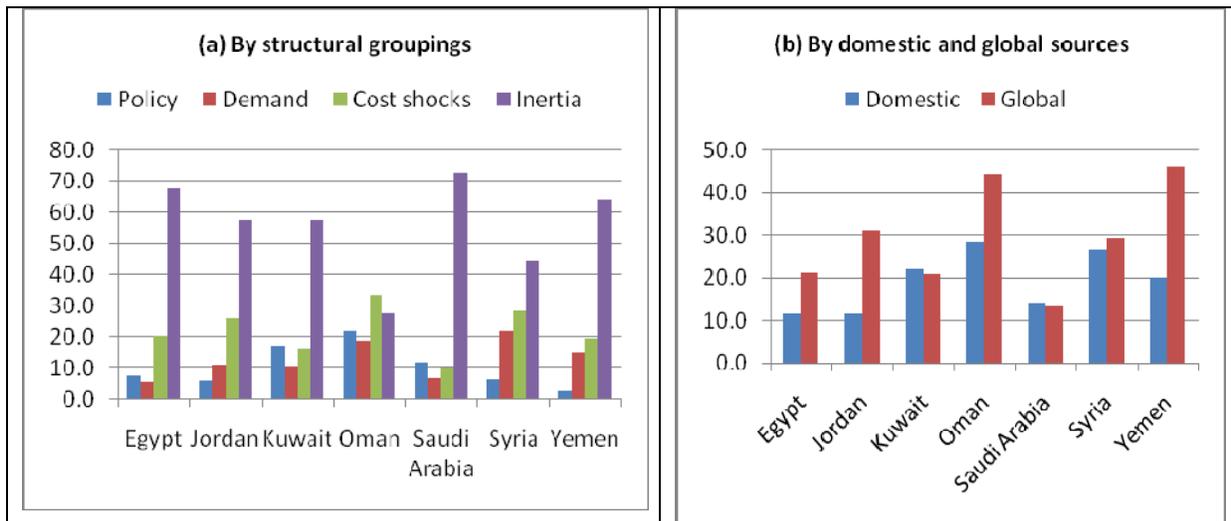
V. POLICY IMPLICATIONS AND CONCLUSIONS

Macroeconomic policy often targets inflation due to its distortionary effect, which may be too low, too high or too volatile. The most commonly-used tool to control inflation is the setting of interest rates to influence the amount of money in the economy. When interest rates go up, the cost of borrowing increases, which discourages borrowing and subsequent expenditure. While that would normally be expected to bring inflation down, in certain circumstances it may not have that effect. Indeed, the reason may be the source of inflation, such as, for example, a supply shock through higher import prices resulting from external factors beyond the control of a particular country.

This makes inflation a major predicament for policymakers and central banks. Not only is it difficult to decide on an optimal level of inflation, it is also difficult to understand the sources of inflation and which tools should be used to minimize its negative impact. Since the efficiency of the various tools depends on the source of inflation, it is crucial to improve understanding of the determinants of inflation in order to ensure that the right tools are used in any given circumstances.

It is hoped that the findings of this study will help to advance the understanding of the sources of inflation in the ESCWA member countries. It does not take a stand on the distortionary effects of inflation, nor does it aim to discuss the optimal level of inflation. However, by quantifying the determinants of inflation, it offers policymakers an improved understanding of the dynamics of inflation, which should

enable them to improve public policy. Although the results presented here should be treated with caution, given the limitations on data and possible structural changes, the estimated sources of inflation should help central banks to construct and implement their monetary framework based on economic theory and empirical results.

In countries where the pass-through from the US$-Euro exchange rate is important, the role of the pegged system requires further investigation, since in addition to reducing the scope for monetary policy, inflation is also directly influenced by an exchange rate outside national control. That is the case in Oman and, to a lesser extent, in the Syrian Arab Republic and Yemen. However, a departure from a fixed exchange rate can be inflationary unless the new monetary arrangement is able to assume part of the role of an exchange rate peg in moderating the impact of money shocks on inflation.

In countries where external shocks do not play a major role in influencing domestic inflation, domestic policies can be highly important in containing inflation. This is especially the case in Kuwait and, to a lesser extent, in Oman, Saudi Arabia, the Syrian Arab Republic and Yemen.

In countries such as Egypt and Jordan where global variables account for some 70 per cent of inflation the impact of domestic policies may be insufficient to control inflation. In those countries, global food prices have a significant influence on domestic prices, indicating an extreme vulnerability to foreign food price shocks and the countries affected should therefore investigate further the channels through which inflation is determined in order to design optimally efficient policies.

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