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Domestic and External Sources of Inflation in Saudi Arabia: An Empirical Study

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ABSTRACT. The main objective of this study is to determine the sources of inflation in Saudi Arabia. For achieving this objective a single-equation model of inflation in Saudi Arabia is specified and estimated. This model is based on the monetarist single-equation model of inflation. However, the model departs from the monetarist single-equation model of inflation by including the external factors that are expected to have impact on inflation in Saudi Arabia namely; the U.S. Dollar short-term market interest rate, the changes of the Saudi Riyal exchange rate against the U.S. Dollar and imported inflation. Our single-equation model includes three more explanatory variables beside the external variables. These variables are, nominal money supply, real income (real GDP) and the lagged dependent variable (p_{t-1}).

The empirical results that emerge from estimating our single-equation model of Saudi inflation reveal that all the explanatory variables, except the U.S. Dollar short-market interest rate, bear the correct sign and are statistically significant at the 5 percent level of significance. The overall fit of the regression (the estimated equation No. 4.3) is very good with five explanatory variables jointly explaining large proportion of the total variations in inflation rate ($R^2 = 0.92$). This means that our model fits the actual data remarkably well. The empirical results also indicate that among the various explanatory variables, three are found to exert especially strong effects on the Saudi inflation, namely, the growth rate of money supply, the growth rate of real income and the changes of the Saudi Riyal exchange rate against the U.S. Dollar. Moreover, the empirical results of this study support our expectation that the growth in money supply is an important source of inflation in Saudi Arabia. The depreciation of the Saudi Riyal against the U.S. Dollar is another important source of Saudi inflation (its long-run elasticity = 0.68). Finally, the real economic growth is found to exert relatively strong mitigating effect on inflation in Saudi Arabia.

Introduction

Among key economic issues, the inflation problem has received a great deal of attention both in public and policy circles alike due to its significant economic and social cost. Thus, several theories have been advanced in the literature attempting to explain the causes of inflation and proposing ways to contain it[1]. In the last three decades, the inflation has been a serious problem world-wide.

(1) See, for example, **Harberger** (1963), **Vogel** (1974), **Barth** and **Bennett** (1975), **Karnosky** (1976), **Batten** (1981), **Gordon** (1988), **Haslag** (1990), **Salih** (1993), and **Darrat** (1994).

Consequently, a considerable amount of empirical studies hase been carried out by many economists all over the world[2]. The main aim of these studies is to determine inflation. The main conclusion that can be drawn from these studies is that there has been no single theory or model that can be used to explain fully the changes in rate of inflation in every economy. Moreover, there are several other considerations, such as the stage of economic development, economic and institutional setting, economic policies particularly the monetary and fiscal policies and external factors (i.e., imported inflation, exchange rate movements, and foreign interest rate).

Saudi Arabia represents an interesting case of studying inflation. It has a very open economy, with negligible restrictions on the movement of commodities and funds. During the 1970s and early 1980s, Saudi Arabia experienced drastic increases in oil revenues. As a result of this, the Saudi government launched ambitious spending programmes to build the infrastructure of the economy and create structural changes in the economy. Escalating domestic government spending resulted in a significant transformation of the financial structure of the economy, a rapid increase in almost all components of aggregate domestic expenditure (See Table 1) an increase in the contribution of the non-oil sectors to gross domestic product (See Tables 1 and 2), and a substantial rise in the rate of domestic inflation (See Table 2). In short, the Saudi economy has developed and expanded in a very short period. Despite this fact, it exhibits several features of under-development such as limited absorptive capacity, the existence of unorganised financial markets, and the dependence on the export of one primary commodity viz. oil.

The Objectives of the Study

The main purpose of this study is to specify empirically the sources of inflation in Saudi Arabia. As mentioned above, Saudi Arabia has a very open economy, with negligible restrictions on the movement of commodities and funds. This means that inflation in Saudi Arabia is generated not only by domestic sources, but also by external sources. The focus of this study is to determine empirically the importance of these sources.

Methodology and Sources of Data

This study is based on a theoretical and empirical analysis. An econometrics model of inflation in Saudi Arabia will be specified and estimated. The model will be based on the monetarist single-equation model of inflation. However, it departs from the monetarist single-equation model by including the external factors such as, foreign interest rate, exchange rate and imported inflation[3].

(2) See, for example, **Diz** (1970), **Vogel** (1974), **Darrat** (1981), **Thomas** and **Akkina** (1982), **Aljuhani** (1990) and **Salih** (1993).

(3) Several empirical studies on the demand for money in Saudi Arabia carried out by **Darrat** (1981), **Al-Bassam** (1990), **Nagadi** (1985), **Al-Juhani** (1990) indicate that the Riyal exchange rate, particularly against US dollar and foreign interest rate, particularly US dollar interest rate, have an important impact on the demand for money in Saudi Arabia. This means that these factors could have an important effect on the price levels in Saudi Arabia.

A yearly data that runs from 1970 to 1995 is employed to estimate the model of this study.

The sources of the data are:

(1) Saudi Arabian Monetary Agency, *Annual Report*, different-issues, 1972-1996.
(2) International Monetary Fund, *International Financial Statistics*, different issues, 1974-1997.

Table (1) The growth rate of private consumption, government expenditure, domestic consumption, total investment and domestic expenditure.

Year	PPC	PGC	PDC	PIN	PDE
1971	0.07538	0.12065	0.09245	0.24899	0.12755
1972	0.13281	0.21917	0.16674	0.46718	0.24685
1973	0.21878	-0.09243	0.10467	0.50363	0.24047
1974	0.34156	1.18515	0.70522	0.62585	0.67533
1975	0.31368	0.57221	0.46024	0.73004	0.56799
1976	0.59686	0.37516	0.47018	0.37290	0.42931
1977	0.46292	0.13649	0.29857	0.36903	0.32370
1978	0.22825	0.42446	0.32385	-0.07281	0.17477
1979	0.20179	0.20434	0.20310	0.19893	0.20172
1980	0.20150	-0.05191	0.07968	0.42279	0.20612
1981	0.21242	0.22904	0.21992	-0.06442	0.11322
1982	0.17511	0.18623	0.18017	-0.06885	0.10169
1983	0.03939	-0.04456	0.00198	-0.00296	0.00055
1984	0.01251	-0.00223	0.00612	0.03090	0.01331
1985	-0.00479	-0.05665	-0.02685	-0.56946	-0.15766
1986	-0.12364	-0.07270	-0.10198	-0.19919	-0.12011
1987	-0.03344	0.01257	-0.01335	-0.02817	-0.01599
1988	0.02807	-0.10041	-0.02679	0.13092	0.00300
1989	0.03963	-0.00879	0.01999	0.11864	0.04064
1990	0.07209	0.21834	0.13313	0.13084	0.13263
1991	0.07938	0.31740	0.18999	0.20370	0.19299
1992	0.08607	-0.10223	-0.00260	0.13969	0.03041
1993	0.03253	-0.02010	0.00932	0.01909	0.01172
1994	4.75500	-0.06400	-0.02260	0.16470	0.01393
1995	0.01677	0.02750	0.02085	0.02118	0.04243
1996	0.02000	0.03100	0.02200	0.02400	0.05001

Key to Abbreviations:
PPC = Private Consumption
PGC = Government expenditure
PDC = Domestic Consumption
PIN = Total Investment
PDE = Domestic Expenditure
Source: 1. **Saudi Arabia Monetary Agency**, *Annual Report*, different issues, 1974-1996.
2. **International Financial Statistics**, 1994, 1997.

Table (2) The Percentage change of gross domestic product, government expenditure, money supply and inflation rate.

Year	GDP	GE	M_1	INF. Rate
1971	6.0	4.4	11.5	4.86
1972	7.1	29.2	25.0	4.3
1973	12.9	24.9	45.6	13.9
1974	15.1	83.1	38.4	21.5
1975	13.0	88.4	62.6	34.7
1976	19.8	133.4	83.2	31.5
1977	16.9	30.5	59.5	11.2
1978	14.5	28.5	45.1	11.2
1979	11.2	6.7	11.5	1.9
1980	11.8	27.0	10.2	3.6
1981	12.4	24.1	13.9	2.9
1982	11.3	22.9	20.8	1.12
1983	7.0	-13.5	13.7	0.8
1984	5.0	-6.0	-0.8	-1.2
1985	-2.7	-16.1	-3.7	-3.2
1986	-6.0	-28.2	-0.1	-3.0
1987	1.6	-20.2	4.0	-1.60
1988	3.5	-11.6	4.8	0.90
1989	9.0	-0.52	-2.0	1.00
1990	10.7	156.0	11.5	2.10
1991	12.8	-49.7	17.8	4.60
1992	4.0	8.8	4.1	-0.40
1993	-3.9	-18.9	-3.2	0.80
1994	1.7	-6.3	3.4	0.60
1995	4.5	0	0.9	5.00
1996	8.5	20.6	6.9	0.90

Key to Abbreviations:
M_1 = Money supply defined as currency in circulation + demand deposits at commercial bank.
GE = Government expenditure
GDP = Gross domestic product
INF. = Rate of inflation
Source: 1. **Saudi Arabia Monetary Agency**, *Annual Report*, different issues, 1974-1996.
2. **International Financial Statistics**, 1994, 1997.

Table (3) Total actual government revenue, its components and their share on the total actual government revenue (Saudi Riyal in Million).

Year	Actual Total Govt. Revenue	Oil Revenue	Percentage Share	Other Sources of Revenue	Percentage Share
1971	8000	7073	88	927	12
1972	11100	10173	92	927	8
1973	15400	14298	92	1102	8
1974	41700	3995	96	1750	6
1975	100103	94190	94	5918	6
1976	103384	93481	90	9903	10
1977	135957	121191	89	14766	11
1978	130654	114042	87	16617	13
1979	131505	115078	88	16427	12
1980	211196	189295	90	21901	10
1981	348100	319305	92	28795	8
1982	368006	328595	89	39412	11
1983	246256	186572	76	59684	24
1984	190753	128109	67	62644	33
1985	171510	11900	70	52510	30
1986	133565	88425	66	45140	34
1987	106926	74183	69	32743	31
1988	105300	73525	69	31775	31
1989	N.A*	N.A*	N.A*	N.A*	N.A*
1990	N.A*	N.A*	N.A*	N.A*	N.A*
1991	151000	117693	77	33307	23
1992	169150	121703	71	47447	29
1993	120000	86933	72	33067	28
1994	135000	101461	75	33539	25
1995	131500	99606	75	31894	25
1996	164000	129444	78	34556	22

N.A* = Not Available

Source:1.**Saudi Arabia Monetary Agency**, *Annual Report*,different issues,1974-1996.

2. **International Financial Statistics**, 1994, 1997.

Table (4) The Exchange Rate of Riyal Against the Dollar and SDR.

Year	Saudi Riyal / U.S. Dollar	Saudi Riyal / SDR
1970	4.5000	4.5000
1971	4.4868	4.5057
1972	4.1448	4.5057
1973	3.7066	4.2825
1974	3.5500	4.3464
1975	3.5176	4.272335
1976	3.5300	4.075608
1977	3.5251	9.115433
1978	3.3996	4.282340
1979	3.3608	4.343038
1980	3.3267	4.330570
1981	3.3825	3.990027
1982	3.4282	3.786944
1983	3.4548	3.692904
1984	3.5238	3.610328
1985	3.6221	3.681722
1986	3.7033	4.348328
1987	3.7450	5.3124
1988	3.7450	5.0396
1989	3.7450	4.9215
1990	3.7450	5.3279
1991	3.7450	5.3570
1992	3.7450	5.1494
1993	3.7450	5.1440
1994	3.7450	5.4671
1995	3.7450	5.5669
1996	3.7450	5.3852

Source: 1. **Saudi Arabia Monetary Agency**, *Annual Report*, different issues, 1974-1996.

2. **International Financial Statistics**, 1994, 1997.

Organisation of the Study

This study consists of five sections: Section I, the introduction, explains the objective of the study, the methodology employed and the data sources. Section II, focuses on some features of the Saudi economy, especially those related to inflation in Saudi Arabia. The inflation in Saudi Arabia during the 1970-1995 will be discussed. In Section III, the theoretical background of inflation and some empirical examinations of inflation in Saudi Arabia and elsewhere will be reviewed. Section IV is devoted to the specification, estimation and empirical analysis of inflation model of Saudi economy. Finally, Section V presents a summary of the work and its conclusion.

Inflation in Saudi Arabia

The aim of this section is to analyze theoretically the movements of price level during the period from 1970 to 1996. Before doing this, it is appropriate to shed light on some important features of Saudi economy. These features are essential for the discussion of the inflations' sources in Saudi economy.

Some Important Features of Saudi Economy

As mentioned above, several important features of the Saudi economy will be highlighted. These features are very useful for the discussion of inflation in Saudi Arabia:

Firstly, The Saudi economy, like most oil-producing developing economies is largely dominated by the oil sector which has set the pace of overall economic activity. Although, the non-oil sector hase made a significant contribution to the total Gross Domestic Products (GDP) over the past two and half decades, the oil sector is still the main contributor to the GDP. It appears that oil sector will continue for a considerable time to be the dominant sector in the economy and the main contributor of foreign exchange to the national income.

As mentioned earlier, the drastic increases in oil revenue during the 1970s and early 80s, provided the Saudi economy and financial system with a unique opportunity to expand and develop in a very short period (See Table 1 and 2). During the past two and half decades, the major economic and monetary indicators have experienced rapid increases.

An important factor that has been affecting the money market in Saudi Arabia is the fact that international reserves generated from oil revenues accrue directly to the government. Theoretically, this has an implication. That is, the government could at least in the short-run maintain a balance of payments surplus without affecting the domestic money market by simply not injecting part of these international reserve into the domestic economy. In reality, however, as government revenues increase, its expenditure also increases, first, because of its desire to fulfill economic development plans and, second, due to pressure from the public to transfer oil wealth to the citizens. As a result, domestic money supply is linked to government expenditures rather than to international reserves.

Secondly, Almost all Saudi government's revenue is derived from oil exports. Although, the other sources of government revenue, such as taxes and government debt have experienced substantial increases over the last fifteen years, they are still

noticeably small comparing with oil revenues (See Table 3). This significantly reduces the effectiveness of the fiscal policy in Saudi Arabia. At present, government expenditure is the only effective fiscal policy instrument available to Saudi government. Moreover, the monetary authority in Saudi Arabia has a very limited control over the monetary aggregates. This is largely due to the fact that SAMA[4] lacks two important monetary tools, namely open market operations and discount window. Therefore, it seems that the behaviour of these monetary aggregates hase been determined largely by fiscal operations (i.e., increasing or decreasing government expenditure), factors which are out of monetary authorities control[5]. Saudi Arabia therefore, can be seen as a good example of complete coordination between fiscal and monetary policy. The following estimated single-equation model represents the relationship between money supply and government expenditure in Saudi Arabia:

$$\text{Ln } M1_t = \underset{(29.07)}{6.6441} + \underset{(18.56)}{0.89118 \text{ Ln } GE_{t-1}}$$

$$\bar{R}^2 = 0.9398 \qquad F = 344 \qquad D\text{-}W = 0.8043 \qquad SER = 0.268$$

Where:

$M1_t$ = Money supply defined as currency icirculation + demand deposits at the Saudi commercial banks.

GE_{t-1} = Government expenditure (It is lagged one year).

Note:

The numbers in parenthesis below the coefficient estimates are the absolute values of the t-ratios. $\bar{R}^2$ is the determination coefficient adjusted for degrees of freedom. SER is the standard error of regression. D-W is the Durbin Statistic (the Durbin-Watson d-Statistic).

The above estimated equation indicates that the government expenditure exerts a significant and strong effect on the money supply. Yet, there are other variables such as the commercial banks' claims on the private sector, and the net private sector balance of payment deficit or surplus could have a significant impact on the money supply. The exclusion of these variables is reflected in the large and highly significant constant term and reflected also in a low value of the Durbin-Watson d-Statistic. An yearly data running from 1971 to 1995 was used in estimating the above relationship.

Thirdly, As it was mentioned above, the Saudi economy is a very open economy operating under a pegged exchange rate regime. There have been negligible restrictions on the movement of commodities and funds. Therefore, external monetary and financial factors such as foreign interest rate, particularly U.S. interest rate, exchange rate movements, world inflation and balance of payment, exert significant effect on the economic activities, financial markets and price level. These factors should be taken into account in formulating appropriate financial, monetary and fiscal

(4) SAMA stands for 'Saudi Arabian Monetary Agency'.

(5) See for example **Al-Bassam** (1990), **Aljuhani** (1990), **Al-Ali** (1988), **Nagadi** (1985) and **Darrat** (1981).

policies. Several empirical studies(6) related to the Saudi money market reveal that the foreign interest rate, particularly U.S. interest rate, and the movement of the Riyal's exchange rate, especially against US dollar, have a significant impact-on the Saudi money market (i.e. demand for money, supply of money and Riyal interest rate). The net private sector balance of payments deficit or surplus is another external factor which has a significant impact on gross domestic private sector liquidity.

Inflation in Saudi Arabia during the 1970-1995

The Inflation became a serious problem in Saudi Arabia during the seventies (See Table 2) threatening living standards. It reached its highest level in 1975 (34.4 percent). It was caused mainly by supply bottlenecks, upward movement of salaries, and non-wage income and also by the monetary expansion which resulted mainly from the drastic increases in government expenditure. The government, in keeping with its prime objective of improving the well-being of the people, took a number of measures to mitigate this situation. It abolished a number of taxes and reduced others. For example, the road tax and taxes on domestic petroleum products were eliminated. Many customs duties were also eliminated and tariffs on the remainder were reduced to a token 3 percent. Other important measures taken, either to reduce or to offset the rise in living costs, included a number of import subsidies on milk and milk products, and on medicines. The government also began progarams to encourage bulk imports of certain products to reduce pressure on price increases. The government also reduced the cost of electricity from 20 halalahs (the smallest currency unit in Saudi Arabia) to 14 halalahs per Kwh. on 19th August 1974, it again reduced the cost of electricity to 7 halalahs (US $ 0.02) for domestic consumption and 5 halalahs for industrial consumption. These measures, together with the reduction in government expenditure and the evaluation of Saudi Riyal against U.S. Dollar (See Table 2 and 4), brought inflation in Saudi Arabia under control. Inflation dropped dramatically from 34.7% in 1975 to 3.6% in 1980.

During the period from 1984 to 1989, inflation reached its lowest level. This may be largely due to the noticeable reduction in the government expenditure. Moreover, since 1990 the inflation rate has recorded increases (See Table 2). This may be due to substantial increases in the government expenditure.

Review of Literature on Inflation

In this Section, theoretical background and some empirical investigations for explaining the inflation process world-wide will be reviewed. In addition, several important empirical studies on inflation in Saudi Arabia also will be reviewed.

Theoretical Background and Some Empirical Investigations of Inflation

Among key economic issues, the inflation problem has received a great deal of attention both in public and policy circles alike due to its significant economic and social cost. Several theories have thus been advanced in the literature attempting to

(6) See for example, **Al-Bassam** (1990), **Aljuhani** (1990), **Nagadi** (1985), El-**Mazri** (1982), **Darrat** (1981), **Barry** (1980).

explain the causes of inflation and proposing ways to contain it[7]. In the last three decades, inflation has been a serious problem world-wide. Consequently, a considerable number of empirical studies hase been carried out by many economists all over the world[8] . The main aim of these studies is to determine the sources of inflation.

Fan (1970) used the quantity theory model to test empirically the effect of monetary policy on real income and price level in less-developed countries. He divided these countries into two sets, Asian and Latin American countries. He regressed two different equations. The first was the rate of growth of real income as a function of the rate of growth of money supply. The second was the rate of change in price level as a function of the rate of growth of money supply. His findings suggest that for Asian countries monetary policy can stimulate real income. At the same time, this increase in real income is accompanied by a substantially less than one-to-one relationship between the rate of growth of money supply and the rate of growth of price level. For Latin American countries he found that the effect of monetary policy on real income is negligible. On the other hand, the relationship between growth rate of money supply and inflation rate in the Latin American countries is more than unity, which suggests that a one percent increase in the rate of growth of money supply results in more than one percent increase in inflation rate. He attributed this result to the hyperinflation existing in some of Latin American countries. He concluded that the quantity theory model yields a good prediction in the case of hyperinflation. Furthermore, he suggested that hyperinflation and less aggressive monetary policies are inferior to a moderate one which increases money supply by about 16 to 17 percent for the countries investigated.

Keynes, on the other hand, argued that inflation originates in the goods market and money has no significant relationship with it. He suggested the "inflationary gap" model to explain the change in price level. According to this model, the inflation gap is caused by an upward shift in the expenditure function. This shift is not necessarily caused by money supply expansion but by other factors such as the business sector's expectations becoming more optimistic leading to an increase in the investment function or a tax cut which results in an increase in consumption. Some economists like Harris (1980) have argued that this inflationary gap would not be sustained unless the money supply increased. That is because price increases result in increases in the nominal demand for money; if this increase is not matched by an increase in money supply, interest rates will increase resulting in the expenditure function returning to its original position. Thus, the inflationary gap is eliminated.

The Keynesian assumption concerning the demand for money does not permit the above conclusion. According to this assumption, demand for nominal money is not a stable function in prices and interest rates. Therefore, a rise in price level does not imply an upward shift in the function of nominal demand for money so that interest rate increases and expenditure returns to its original level. This instability in the nominal demand for money is due to the unstable propensity of the private sector to replace money with credit as a medium of exchange. As a result, the inflationary gap

(7) See for example, **Frisch** (1983), **Frisch** (1976), **Flemming** (1976) and **Friedman** (1969).

(8) See for example, **Noorbakhsh** (1990), **Saini** (1980), **Aghevli** (19770 and **Vogel** (1974).

would be sustained and the excess expenditure would be financed by extending credit within the sector.

Pigou (1949) did not accept the inflationary gap theory. He attributed inflation to the increase in money income. Inflation, according to him, exists when money income increases more than the income earning capacity. He distinguished between three types of inflation: wage- induced inflation, deficit-induced inflation, and galloping inflation. The first type is the increase in money stock due to an increase in wages, which requires entrepreneurs to have more money to pay workers in order to maintain the working capacity. The second type of inflation occurs when government expenditures exceed its revenues from taxes and borrowing and as a result it finances its excess expenditures by creating money. The last type is a result of the increase in money stock which can lead to distrust in currency and therefore increase the rate of change of prices. In other words, Pigou considered that an increase in money stock is a necessary and sufficient condition for inflation according to Zawadzki (1986).

Another theoretical framework to explain inflation is the well-known Phillips curve which was developed by Phillips (1958). He empirically investigated the relationship between the change in money wages and unemployment for Great Britain; he found that a negative correlation exists between these two variables. Samuelson and Solow (1960) have further investigated this relationship. They have modified this curve to represent the relationship between the rate of price change and the rate of unemployment. As a result, this curve has been utilized as a policy instrument by the policy makers who have to make a compromise between unemployment and inflation rates.

However, Friedman (1969a) argued that the trade-off between inflation and unemployment is a temporary one, stemming from unanticipated inflation. This means high inflation does not decrease unemployment but a rising inflation does because of the different expectations of the employees and employers. Friedman states:

> ...selling prices of products typically respond to an unanticipated rise in nominal demand faster than prices of factors of production, real wages received have gone down--though real wages anticipated by employees went up, since employees implicitly evaluated the wages offered at the earlier price level. Indeed, the simultaneous fall *ex post* in real wages to employers and rise *ex ante* in real wages to employees is what enabled employment to increase (Friedman 1969b, p. 103-4).

Another theoretical approach dealing with inflation was developed in the 1960s by some economists, such as Machlup (1960), which is cost-push. According to this approach the cause of inflation is rising money wages. Money wages increase independent of the labor market because of social pressure caused by unions. Inflation results because these wages increase faster than productivity. The result of inflation is a decrease in the real value of money stock and unemployment. As the government tries to maintain full employment it expands money supply. According to this approach, the causation runs from prices to money supply and not the reverse.

Finally, the monetary approach to inflation has been widely investigated and gained empirical support of many economists[9], especially when both unemployment and inflation exist in contrast with the Phillips curve hypothesis. This approach was developed by monetarists such as Friedman who redefined the quantity theory as a theory of demand for money and not for prices. Unlike the crude quantity theorists, the advocates of this approach did not assume demand for money to be a constant fraction of nominal income. Instead, they argued that the real demand for money is a stable function in some limited variables such as relative rate of return on assets, wealth and the expected change in price level.

Friedman (1969a) developed this approach by equating money supply multiplied by its velocity to nominal income which implied equilibrium in the money market. Even though this equity is not very different from the crude version of the quantity theory, it has two new assumptions. The first is that the quantity theory is a theory of demand for money; the second is that the velocity of money is not constant but stable. According to this identity, if money supply increases, the price level increases when there is full employment. However, the relationship is not one-to- one between money supply and absolute price level. Friedman stated that:

> The relationship between changes in the stock of money and changes in prices, while close, is not of course precise or mechanically rigid. Two major factors produce discrepancies: change in output and changes in the amount of money that the public desires to hold relative to its income (Friedman, 1969b, p. 174).

According to this approach the change in the real output in the long-run is due to basic factors such as resources availability, technological change and growth of population. Taking these factors into consideration with the fact that demand for money is a stable function, inflation can be explained by the variations in the supply of and demand for money since the latter depends on output in a stable manner.

Two other theoretical approaches are reviewed here which deal with price stability and monetary policy in small open economies such as that of Saudi Arabia. The first one is related to monetarists who argue that under certain assumptions the small open country inflation equals the world inflation. That is because any change in domestic money stock will be transmitted by the dynamic adjustment process to become part of the world money stock wherein national and world inflation will have risen in proportion to the increase in the world money supply. The policy implication of this approach is that monetary policy is ineffective under a system of fixed exchange rates and that its only function is to determine the composition of money supply, such as shares of domestic credit and international reserves in domestic money supply.

The second is the structural approach, which has two views, the Scandinavian model and the Latin American experience. The first one deals with the small open developed economy. This model was developed by Edgren, Faxen and Odhner (1973). According to this model the economy of the home country is divided into two sectors: the open competitive sector, which produces goods traded in the world market, and the

(9) See for example **Salih** (1993), **Haslag** (1990), **Thomas** (1982), **Karnosky** (1976), **Otani** (1975), and **Diz** (1970).

sheltered sector, which is not exposed to the world market. Inflation in the competitive sector is exogenous and equal to the world inflation. The inflation rate, along with an increase of labor productivity, determines the increase in wage rate within this sector. The wage rate in the competitive sector is equal to the wage rate in the sheltered sector. Because productivity is greater in the competitive sector, then inflation rate in the home country depends on the difference in productivities between the two sectors, and can be written as:

$$\dot{p}_i = \dot{p}_w + a(q_c - q_s) \qquad (3.1)$$

where:

$\dot{p}_i$ = inflation rate in the home country.
$\dot{p}_w$ = world rate of inflation.
a = the share of sheltered sector in the economy.
q_c = rate of increase of labor productivity in the competitive sector.
q_s = rate of increase of labor productivity in the sheltered sector.

Some economists criticized this model on the grounds of its silence on the demand conditions (Frisch, 1976).

The Latin American view was developed by Campos (1967) and concerned the less-developed countries. According to this view the economy of the home country is also divided into two sectors: the open sector, which produces goods for export, and the domestic sector, which produces domestically consumed goods. Structuralists such as Campos claimed that inflation is a result of transition of the less-developed countries from outward-based economies to inward-oriented domestic market-based economies. This transition requires a change in the structure of the economy, which the price mechanism is unable to achieve due to an imperfect market structure. Kirkpatrick and Nixon (1976) identified three structural constraints: the inelastic supply of foodstuffs, the foreign exchange bottleneck, and the financial constraint.

As can be seen from the above discussion, the structuralists built their models on an unrealistic assumption in the monetary approach for the global inflation, namely, that all goods are mobile and tradable.

From the above brief review, it is obvious that there is a wide variety of theoretical frameworks to explain inflation. This indicates the differences among economists in explaining this economic phenomena. However, some of these theories, such as cost-push are static and cannot explain the continuation of inflation without extra assumptions about the economy, such as increasing money supply in order to be able to pay for the factors of production in order to sustain the level of output.

In general, these theoretical frameworks can be divided into two main categories: the structuralist and the monetarist. The advocates of the former believe that the increase in prices can be sustained without increasing money stock because of the ability of the private sectors to create credit within each sector to finance the increased price level. The monetarists, on the other hand, argue that increasing money stock is

the main cause of inflation because of the stability of the private sector's demand for money. As a result, inflation can only be sustained by increasing money stock.

These two frameworks also provide two different explanations for the rate of change of prices in the small open economies. The structuralist inflation, which is close to the Keynesian, refers to the intra-inflation for this kind of economy according to the different productivities between traded and non-traded goods since both productivities pay equally. In contrast, the monetarists argue that a small, open economy operating under a fixed exchange rate has an inflation rate equal to the world rate. The reasoning is that the country concerned has no control over its money stock. As a result, the monetary policy is ineffective and there is no reason for this kind of economy to have a different rate of change in prices from the world.

Some Empirical Studies on Inflation in Saudi Arabia

In the last two decades, inflation in Saudi Arabia received a great deal of attention. Many empirical studies have attempted to explain the causes of inflation in Saudi Arabia, proposing ways to contain it[10]. We intend to review some empirical studies here:

Keran and Al-Malik (1979) examined empirically the inflation problem in Saudi Arabia. A quarterly data that runs from 1967:1 to 1976:4 was used in their study to estimate the following single-equation model:

$$\dot{p}_t = a + \sum_{i=o}^{12} b_1 j \dot{M}_{t-1} + \sum_{i=o}^{4} b_2 j(\dot{pw}) + \in_t$$

that is, inflation is a function of two variables, namely, a 12-quarter distributed - lag of the growth rate of money supply, a 4-quarter distributed - lag of the world inflation and $\in_t$ is an error term. The empirical result of this study is presented in the following estimated equation:

$$\dot{p}_t = \underset{(5.6)}{-5.2} + \sum^{4} \underset{(8.0)}{0.51}(\dot{pw}) + \sum^{12} \underset{(16.0)}{0.70}(\dot{M}_o)$$

$$R^2 = 0.94 \qquad D-W = 1.62 \qquad SER = 3.24$$

The estimated equation indicates that the explanatory (regressors) variables are highly significant. It also indicates that every 1.0 percent increase in world inflation over the previous four quarters has approximately a 0.51 percent effect on the Saudi Arabian price level. Moreover, every 1.0 percent increase in the money supply over the previous twelves quarters has approximately a 0.71 percent effect on the Saudi Arabian price level.

The problem with Keran and al-Maliks' study is:

Firstly, authors imposed arbitrarily a 12-quarter lag on the monetary variable and a 4-quarters lag on the world inflation without any empirical investigation or rational

(10) See for example, **Salih** (1993), **Al-Bassam** (1990), **Aljuhani** (1990), **Nagadi** (1985), **El-Mazri** (1982), **Darrat** (1981), **Barry** (1980).

reasons for such a lag choice. Such practice can readily lead to specification errors in the Saudi inflation equation.

Secondly, Keran and Al-Malik excluded from their single-equation model all the variables of the money demand function such as real income and interest rate. These variables could have a very significant effect on price level. The exclusion of these variables is reflected in the large and highly significant constant terms and reflect also in the low value of the Durbin-Watson Statistic.

Thirdly, based on some "fragmentary and incomplete" analysis, Keran and Al-Malik argued that M_o (Currency in the hands of the public) has the most stable money demand function.

An important empirical study on the inflation in Saudi Arabia was carried out by Darrat (1981). He used the monetarist approach to inflation to analyze the Saudi inflation process. Since the monetarist approach to inflation is critically based on a money demand function that is temporaly stable, Darrat began his research by determining appropriate money demand function of Saudi economy and testing its stability. After establishing the temporal stability of the money demand function, he drove from this function, a single equation monetarist model of inflation for Saudi economy. It was written in the form of distributed lag model as follow:

$$\dot{p} = \alpha + \sum_{i=o}^{n_1} B_i \dot{M}_{t-i} + \sum_{i=o}^{n_2} r_i \dot{X}_{t-i} + \sum_{i=o}^{n_3} \delta_i \Delta \dot{p}_{t-1-i} + \sum_{i=o}^{n_4} \theta_i \Delta r^f_{t-i} + \sum_{i=o}^{n_5} \nu_i \dot{p}^f_{t-i} + \epsilon_t$$

where:

$\dot{p}$ = Growth-rate of consumer price index (inflation rate index).
$\dot{M}$ = Growth-rate of consumer price index (inflation rate index).
$\dot{p}$ = Growth-rate of money supply (The money supply in device as currency in the calculation plans demand deposits at commercial bank).
$\dot{X}$ = Growth-rate of real income.
r^f = Growth-rate of foreign interest rate defined as 3-month eurodollar deposit rate.
$\dot{p}^f$ = World inflation.
$\Delta\dot{p}$ = Expected rate of inflation.
ϵ_t = Disturbance (error) term.
"." = A dot over a variable denotes the rate of change over time.

Darrat indicated that the model is an open one, because it took into account the foreign influences (e.g., US Dollar interest rate and world inflation). The above model was estimated using quarterly data cover the period between 1963 to 1978.

The empirical results of Darrat's study can be summarized as follow:

1- The model fits the actual data remarkably well with satisfactory overall statistical properties. All of the variables suggested by the monetarist approach bear the correct sign and are all statistically significant. Moreover, the magnitudes of the estimated coefficients of key variables (The growth rate of

money supply and growth rate of real income) are within the bounds postulated by the theoretical considerations.

2- Among the various explanatory variables, three were found to exert strong effects on Saudi inflation, namely the rate of growth in the money supply, rate of growth in real income, and world inflation. In short, the empirical findings of Darrat's study provide a strong support for the monetarist approach in analyzing the Saudi inflationary process. This means that the inflation problem in Saudi Arabia has a monetarist origin, and can be controlled by domestic policy actions involving reductions in the monetary growth.

Hafiz and Darrat (1983) used the monetary approach to analyze the inflationary process in Saudi Arabia. A quarterly data running from 1963 to 1979 and unconstrained Almon distributed - lag approach were used in estimating the following single - equation monetarist model of the inflation in Saudi Arabia.

$$\dot{p} = \alpha + \sum_{i=o}^{G_1} \alpha_i \dot{M}_{t-i} + \sum_{i=o}^{G_2} B_i \dot{X}_{t-i} + \sum_{i=o}^{G_3} r_i \dot{p}_{t-1-i} + \sum_{i=o}^{G_4} \Psi_i r_{t-i}^{f} + \in_t$$

$$\alpha \sim 0 \quad , \quad \sum \alpha_i > 0, \sum \beta_j > 0, \sum r_i > 0, \sum \Psi_i > 0,$$

where:

$\dot{M}$ = The growth-rate of money supply.

$\dot{X}$ = Growth-rate of real income.

$\dot{p}$ = Growth-rate consumer price index

r_t^f = The growth-rate of foreign interest rate defined as 3-month eurodollar deposit rate.

$\in_t$ = Disturbance (error) term.

The empirical results of Hafiz and Darrat's study can be summarized as follows:

$\dot{R}^f_{t-1}$	$\dot{R}_{t-1}$	$\dot{X}_t$	*Cons* tan *t*
0.277	0.043	0.44	0.002 –
(3.65)	(2.15)	(6.98)	(0.004)

$R^2 = 0.75$ D.W = 2.01 SE = 0.0435

Note:

The empirical results indicate that:

1- The proposed monetarist model of inflation for Saudi economy fits the actual data quite well with satisfactory overall statistical properties.

2- All of the explanatory variables suggested by the model bear the correct anticipated sign and are all statistically significant. Moreover, the magnitudes of the estimated coefficients of key variables (the growth rate of money supply and growth rate of real income are within the bounds postulated by the theoretical considerations).

The main conclusion of this study is that the empirical findings provide strong support for the monetarist approach in analyzing the Saudi inflationary process. This means that the inflation problem in Saudi Arabia has a monetarist origin. Hafiz and

Darrat pointed out that the most important conclusion of this study is that inflation problem in Saudi Arabia has its origin in the excessive money supply growth of the 1970s. Therefore, appropriate anti-inflation policy must involve reduction in such uncharacteristically high monetary growth.

Aljuhani (Spring 1990) used the monetarist approach to inflation to analyze the price instability in Saudi Arabia. He pointed out that the main reasons of selecting this approach are: First, Saudi Arabia has small and open economy with little to produce for export except oil. Domestically-produced goods are used mostly for internal consumption. Therefore, as money supply increases, demand for both imported and domestic goods increases, which raises the prices of domestic goods. The other reason of choosing this approach is that the available data suggest a relatively strong relationship between the growth rates of money supply and the inflation.

The following single - equation model was used in this study:

$$\dot{p} = \beta_o + \beta_1 \dot{G}E + \beta_2 G\dot{D}R + \beta_3 F\dot{I}R + \beta_4 RG\dot{D}P + \beta_5 \dot{P}W + \beta_6 P_{t-1} + u$$
$$\beta_o = 0,\ \beta_1 > 0,\ \beta_2 > 0,\ \beta_3 > 0,\ \beta_4 > 0,\ \beta_5 > 0,\ \beta_6 > 0,$$

where:

$\dot{p}$ = Price level define as.
$\dot{G}E$ = Government expenditure.
$G\dot{D}R$ = Currency demand deposits.
$F\dot{I}R$ = Foreign interest rate defined as 3-month eurodollar deposit rate.
$RG\dot{D}P$ = Real non-oil GDP.
$\dot{P}W$ = World inflation.
β's = Regression coefficient.
U = Disturbance (error) term.
" . " = A dot over a variable denotes the rate of change over time.

As it can be seen from the above model, the lag of inflation rate ($\dot{p}_{t-1}$) was included as an independent representing the expected rate of inflation in the next period that could be generated from current and past values. However, employing a from of distributed lag to generate expected rate of change in price level required a lot of observations. Because of the limited supply of data, the expected rate of change in price level in the current period had to be approximated by means of the previous rate. Furthermore, this might be a legitimate approximation since the data employed in this study was annual.

Annual data that runs from 1970 to 1986 is employed for estimating the above model. The empirical results that emerge from estimating the proposed model of this study indicated that only three variables, namely government expenditure, real non-oil GDP and the lag of inflation rate were found to be significant in explaining the changes of inflation rate in Saudi Arabia. Consequently, Aljuhani used the following estimated model in analyzing the changes of the Saudi inflation rate.

$$\dot{P} = .014 + .290\ \dot{G}\dot{E} - .243\ \dot{R}\dot{G}\dot{D}P + .470\ \dot{P}_{t-1}$$

$$R^2 = .936, \quad F = 53.9 \quad D.W = 1.8 \quad h\text{-}test = .41$$

Clearly the above estimated model fits the actual data quite well with satisfactory overall statistical properties. Moreover, the above estimated model showes that the government expenditure, the lag of inflation rate and real income exert significant strong impact on the inflation in Saudi Arabia.

Inflation Model of Saudi Economy

In this Section an attempt will be made to specify and estimate a single-equation model of inflation in Saudi Arabia. The specification of this model will be based on the monetarist approach of inflation. As mentioned earlier, the Saudi economy is a very open economy, with negligible restrictions on the movement of commodities and funds. This means that inflation in Saudi Arabia is generated not only by domestic sources, but can also be generated by external sources such as, foreign interest rate, exchange rate movements and import prices (imported inflation). Thus, my single-equation model of inflation in Saudi Arabia departs from the monetarist single-equation model of inflation by including the external factor in my model. This means that I intend to open up the monetarist single-equation model of inflation by considering the external factors that are expected to influence the Saudi inflationary process. Since the inflation model of this study is based on the monetarist approach to inflation, it is appropriate to throw some light on this approach.

The monetarist approach to inflation in its simplest form states that the inflation rate ($\dot{P}_t$) is equal to the difference between the growth rate of the nominal money supply ($\dot{M}^s$) and the growth rate of the real money demand $\left(\frac{\dot{M}}{p}\right)^d$. This can be shown in the following equation[11]:

---

(11) The equation is derived from the money market equilibrium as follows:

$$\frac{M^s}{p} = M^d \quad \text{..... (1)}$$

Where:

M^s = nominal money supply
p = price level
M^d = real money demand

Taking the log of equation No. 1 yields:

$$\log (Ms) - \log (p) = \log (Md) \quad \text{..... (2)}$$

Rearranging equation No. 2 and differentiating it with respect to time to obtain in the rate of growth yields:

$$\frac{1}{(p)}\ \frac{d(p)}{dt} = \frac{1}{(M^s)}\ \frac{d(M^s)}{dt} - \frac{1}{(M^d)}\ \frac{d(M^d)}{dt} \quad \text{.....(3)}$$

equation 3 can be written as follows:

$$\dot{P}_t = \dot{M}_t^s - \left(\frac{\dot{M}}{p}\right)_t^d$$

dots over the variables denote the rate of change over time.

$$\dot{p}_t = \dot{M}_t^s - \left(\frac{\dot{M}}{p}\right)_t^s$$

Several important issues related to the implementations of this approach are important to be highlighted here:

1- According to this approach, for any factor to exert a significant and lasting influence on inflation, it must affect the growth rate of real money supply and / or the growth rate of real money demand. Given a reasonably stable money demand function, substantial swings in the price level would likely be associated with similar movements in the money supply. It is obvious, therefore, why monetarists have generally placed heavy emphasis on the role of monetary growth in explaining the inflation process. This implies that inflation can be effectively controlled by restrictive monetary policies.

2- Despite some claims to the contrary, most theoretical and empirical studies of inflation that have used this approach have concluded that the nominal money supply is predominantly policy-controllable. Therefore, in deriving the monetary model of inflation, money supply is typically assumed exogenous (policy controllable). Real money demand, on the other hand, is dependent on the behavior of the public. Therefore, it requires a behavioral specification. Established theory suggests that real money demand depends positively on a scale variable like GDP, and negatively on the opportunity cost of holding money instead of either physical assets (i.e., the inflation rate) and / or financial assets (i.e., the interest rate). Moreover, in open economies, the foreign factors such as the changes in the foreign interest rate and the expected changes in the exchange rate could have significant influence on the demand for money(12) .

3- The deficiency of the various applications of the monetarist approach to inflation is that they are closed-economy models where external influences (factors) play no role in determining domestic inflation. Essentially, the closed-economy nature of these monetarist inflation models is partly the result of ignoring the influence of international monetary factors in the (implicit) underlying money demand function. Obviously, this view is inappropriate particularly in the case of highly open economies.

Saudi Arabia has a very open economy. This implies that the external (foreign) factors such as, foreign interest rate particularly the U.S. Dollar interest rate, the Saudi Riyal exchange rate, particularly against the U.S. Dollar, could exert significant influence on the Saudi money market especially on the demand for money. Several empirical studies on the demand for money revealed that the U.S. Dollar short-term market interest rate and the expected movements of the Saudi Riyal exchange rate against the U.S. Dollar exert negative and significant effect on the demand for money in Saudi Arabia(13). Thus, one would expect that these factors could have positive and

(12) See **Al-Bassam** (1990), **Hamburger** (1977), and **Johnson** (1976).

(13) See for example, **Al-Bassam** (1990), **Nagadi** (1985), and **Darrat** (1981).

significant impact on inflation in Saudi Arabia[14].

The Specification of Inflation Model for Saudi Economy

In the light of the literature review (See Section 3) and the preceding discussion, I intend to open up the monetarist single-equation model of inflation by taking into account the impact of the external factors on the Saudi domestic inflation. Accordingly, the proposed single-equation model of inflation in Saudi Arabia is:

$$\dot{p} = b_o + b_1\dot{M}_1 + + b_2\dot{y} + b_3\dot{r}^f + b_3\dot{E} + b_4\dot{E} + .. \quad (4.1)$$
$$b_5\dot{IP} + b_6\dot{P}_{t-1} + \in_t$$

$$\frac{\partial p}{\partial M_1} > 0 , \frac{\partial p}{\partial y} < 0 , \frac{\partial p}{\partial E} > 0 , \frac{\partial p}{\partial r} > 0 , \frac{\partial p}{\partial Ip} > 0 , \frac{\partial p}{\partial p_{t-1}} > 0 , b_o \simeq 0$$

Where:

- "." = A dot over a variable denotes its respective rate of growth (rate of change over time).
- p = Consumer price index (CPI, 1988 = 100).
- M_1 = Money supply defined as the currency in the hands of the non-bank public + demand deposits of the public at the commercial banks.
- y = Real income (real GDP).
- r^f = The U.S. Dollar short-term market interest rate (three months deposit rate).
- E = The Saudi Riyal exchange rate against the U.S. Dollar.
- IP = Imported inflation.
- P_{t-1} = lag of the dependent variable.
- B's = Regression coefficients.
- $\in_t$ = Disturbance (error) term.

Several issues related to the specification of our single - equation model of Saudi inflation (See the above proposed Equation 3.1) should be highlighted:

1- The lag of inflation rate was included as an independent variable representing the expected rate of inflation on the assumption that the expected rate of inflation in the next period could be generated from current and past values. However, employing a form of distributed lag to generate the expected rate of inflation required a loss of observations. Because of the limited supply of data, the expected rate of inflation in the current period had to be approximated by means of the previous rate. Furthermore, this might be a legitimate approximation since the data employed in this study is annual. As a result of this, our proposed single - equation model of the Saudi inflation can be described as a partial adjustment model (a short-term dynamic adjustment model), a Koyck-type equation that uses a single lagged dependent variable. This kind of model (partial adjustment model) will allow us to distinguish between short and long-run behaviour of the inflation.

(14) See for example **Hafiz** and **Darrat** (1983), **Darrat** (1981), **Saini** (1981), **Crockett** and **Goldstein** (1976) and **Otani** (1975).

2- In this study, the money supply is assumed to be exogenous variable (policy controllable). This assumption is based on the fact that the behaviour of money supply in Saudi Arabia has been determined largely by fiscal operations (i.e. increasing or decreasing government expenditure). The empirical results that emerge from several empirical studies on the Saudi money market support the view that the money supply in Saudi Arabia is determined largely by the government expenditure (See for example, Al-Bassam (1990), Aljuhani (1990), Nagadi (1985), Darrat (1981))

3- As mentioned earlier, given a reasonably stable money demand function, substantial swings in the price level would likely be associated with similar movements in money supply. It is obvious, therefore, why monetarists have generally placed heavy emphasis on the role of monetary growth in explaining the inflation process. Moreover, the growth of money supply has been found to exert significant impact on the inflation process in many developed and developing countries(15) . In Saudi Arabia, the growth of money supply has been considered as a prime source of inflation(16) . In short, it is expected that the growth in money supply should exert positive and strong impact on the inflation process in Saudi Arabia.

4- According to the monetarist approach to inflation, rises in real income should lead to increases in money demand and, in turn, should exert negative pressures on inflation. The empirical results that emerge from several empirical studies on the inflation in Saudi Arabia revealed that the growth in real income exerts negative and strong impact on the inflation process in Saudi Arabia.

5- Since Saudi Arabia has a highly open economy, one would expect that an increase in U.S. Dollar interest rate and the exchange rate of the Saudi Riyal against U.S. Dollar exerts a positive and significant influence on the Saudi domestic inflation. These hypotheses can be explained as follow:

(a) An increase in the U.S. Dollar interest rate would induce Saudis to increase their holdings of foreign assets. This increase in foreign asset holding would be financed by drawing down domestic money holdings. Hence, it can be assumed that an increase in the U.S. Dollar interest rate should exert a negative impact on the Saudi money demand and, in turn, should exert positive impact on the Saudi domestic inflation.

(b) An increase in the Saudi Riyal exchange rate against the U.S. Dollar (i.e. the Saudi Riyal depreciates) would induce the holders of domestic assets to adjust their portfolio in favor of U.S. Dollar. Thus, one can postulate that an increase in the Riyal exchange rate against the U.S. Dollar should exert a negative impact on the demand for money in Saudi Arabia and, it turn, should exert a positive impact on inflation in Saudi Arabia.

6- In the case of highly open economy, such as the Saudi economy, where the

(15) See for example, **Haslag** (1990), **Karnosky** (1976) and **Harberger** (1963).

(16) See for example, **Aljuhani** (1990), **Hafiz** and **Darrat** (1983) and **Darrat** (1981).

total import represents a major component of domestic consumption, a noticeable increase in the prices of imported goods should increase the overall domestic price level. In addition, the cost of producing domestic goods should also increase leading to a marked rise in the prices of consumer goods that are domestically produced.

The imported inflation (*IP*) is generated using the following formula:

$$IP = \frac{RTI}{RGDP} \text{ x } SP$$

Where:

RTI = Real total import
RGDP = Real GDP
SP = Inflation of industrial countries

This formula measures the contribution of inflation in industrial countries to domestic inflation. This contribution is transfered to economy through the real import. Inflation of industrial countries is used in this formula, because in the last ten years the import from the industrial countries contributed about 75% of Saudi Arabia's total yearly import on the average. (See SAMA Annual Report 1996). This formula has been used by several researchers (See for example, Crockett (1976), Otani (1975) and Diz (1970)).

Empirical Results

Yearly data that run from 1970 to 1995 are employed for estimating the proposed single-equation model of inflation in Saudi Arabia (See Equation 4.1). The empirical results that emerge from estimating the proposed single-equation model are presented in the following estimated single-equation model (Equation 4.2).

$$\hat{p} = \underset{(1.21)}{0.012113} + \underset{(5.77)}{0.40276}\,\hat{M}^{s} - \underset{(1.85)}{0.19218}\,\hat{y} + \underset{(2.41)}{0.049867}\,\hat{IP} + \underset{(2.79)}{0.57034}\,\hat{E} - \underset{(1.20)}{0.030542}\,\hat{ID} + \underset{(2.00)}{0.23836}\,\hat{p}_{t-1} \quad (4.2)$$

$R^2 = 0.926$ $\quad \bar{R}^2 = 0.898$ $\quad F = 33.26$ $\quad D-h = 0.368$ $\quad SER = 0.0291250$

It can be seen from the above estimated single-equation model (See Equation 4.2) that coefficient of the U.S. Dollar short-term market interest rate (the U.S. Dollar interest rate on 3-month deposit) is found to be statistically insignificant with wrong sign. Therefore, this variable is excluded from the above estimated model. Its exclusion has no significant effect on the overall goodness of fit (See Equation 4.3). Accordingly the empirical analysis in the study will be based on the empirical results of the following estimated single-equation model:

$$\dot{p} = \underset{(1.42)}{0.014134} + \underset{(6.21)}{0.42401}\,\dot{M}_1^s - \underset{(2.07)}{0.21428}\,\dot{y} + \underset{(2.08)}{0.038601}\,\dot{IP} + \underset{(2.59)}{0.52710}\,\dot{E} + \underset{(2.02)}{0.22320}\,\dot{p}_{t-1} \quad (4.3)$$

$R^2 = 0.9193$ $\quad \bar{R}^2 = 0.896$ $\quad F = 38.73$ $\quad D-h = 0.4834$ $\quad SER = 0.0294642$

Key to Abbreviations

"." = A dot over a variable denotes its respective rate of growth
p = Consumer price index (CPI, 1988 = 100).
M_1 = Money supply defined as the currency in the hands of the non-bank public + demand deposits of the public at the commercial banks.
y = Real income (real GDP).
IP = Imported inflation.
E = The Saudi Riyal exchange rate against the U.S. Dollar.
P_{t-1} = lag of the dependent variable.

Notes:

(1) The number in parenthesis below the coefficient estimates are the absolute values of the t-ratios. R^2 is the determination coefficient $\bar{R}$ is the determination coefficient adjusted for degrees of freedom. SER is the standard error of the regression. D - h is the Durbin-h statistic to test for first order serial correlation when a lagged dependent variable appears among the regressors.

(2) TSP (Time-Series computer programme) is employed in estimating the above equations.

(3) The ordinary Least Squares Method (OLSQ) is used to estimate the above equations.

(4) Since all the variables of the above estimated single-equation model (Equation 4.3) are expressed in growth rate, their coefficients can be used as measures of the elasticities of inflation with respect to these variables.

Table (4.1) The short and Long-Run Elasticicties of inflation with respect to the explanatory variables of the above estimated equation (Equation 4.3).

	SRE	LRE
$\dot{M}_1$	0.42401	0.5458419
$\dot{y}$	0.21428	0.275896
$\dot{IP}$	0.038601	0.0496923
$\dot{E}$	0.527101	0.6785543
$\dot{AC}$	0.22320	

Key to Abbreviations:

SRE = Short-run elasticity
LRE = Long-run elasticity

ΔM_1 = growth-rate of money supply
Δy = growth-rate of real income (real GDP)
ΔIP = growth-rate of imported inflation
ΔE = growth-rate of the Saudi Riyal exchange rate against the U.S. Dollar
ΔC = adjustment coefficient (the coefficient of lagged independent variable)

The empirical results (See Equation 4.3) reveal a the following:

- All the explanatory variables bear the correct anticipated sign and all are statistically significant at the 5 percent level of significance.
- Adjusted R-Square is noticeably high ($\bar{R}^2$ = 0.896) and statistically significant (according to the F-test). Moreover, Durbin-h statistic (*D -h*) indicates that there is no sign of first - order autocorrelation between the residuals (error terms). SER (Standard error of the regression) is noticeably low (SER = 0.0294). All this indicates that the overall fit of the regression (the estimated equation 4.3) is very good with five explanatory variables explaining a very large proportion of the total variation in the Saudi inflation rate (around 0.896).
- The coefficient of lagged independent variable (the adjustment coefficient) is found to be statistically significant at the 5 percent level of significance. This indicates that the adjustment of the actual rate of inflation (the actual level) to the desired rate of inflation (the desired level) is not instantaneous in Saudi Arabia. Moreover, this coefficient (the adjustment coefficient) is relatively low which indicates there is a relatively long period of adjustment (around sixteen months) between the actual rate of inflation and the desired rate of inflation.
- The magnitudes of the long-turn elasticities of inflation with respect to the key variables (growth in money supply and growth in real income) are within the bounds postulated by the theoretical considerations and close to the empirical results obtained from similar empirical on inflation in Saudi Arabia and several developing countries(17). Moreover, the long - run elasticity of inflation with respect to the growth of money supply is noticeably high (0.55). This indicates that every 1.0 - percent increase in the growth of money supply would result in about 0.55 percent increase in the inflation rate. Such a considerable impact of monetary expansion on inflation in Saudi Arabia suggests that the growth of money supply is a prime source of inflation. Therefore, a serious anti-inflation monetary policy must consist of a reduction in the rate of monetary growth. In short, restrictive monetary policies in Saudi Arabia are a necessary anti-inflationary strategy. Real income growth, proposed by the monetary theory of inflation, was found to be statistically significant at the 5 percent level significance. The long - run elasticity of inflation with respect to the growth of real income is relatively high (around 0.28). This means that every 1.0 percent increase in the growth of real income would result in about 0.28 percent decrease in the inflation rate. Thus the rapid growth of Saudi economy would mitigate the inflationary pressures in Saudi Arabia.

(17) See for example, **Aljuhani** (1990), **Saini** (1982), **Saini** (1980), **Darrat** (1981), **Otani** (1975).

- The empirical results (See the estimated Equation 4.3) reveal that the external factors (i.e. the movement of the Riyal's exchange rate against the U.S. Dollar and the imported inflation) play an important role in explaining the changes in the inflation rate, particularly the movements of the Saudi Riyal exchange rate against the U.S. Dollar. This variable is found to be statistically highly significant (at the 5 percent level of significance) with noticeably high long - run elasticity (0.68). This means that every 1.0 percent increase in the Riyal exchange rate against the U.S. Dollar (i.e. the Saudi Riyal depreciates) would result in about 0.68 percent increase in the inflation rate. Thus, the depreciation of the Saudi Riyal against the U.S. Dollar is another important source of inflation in Saudi Arabia.

- Finally, the imported inflation is found to be statistically significant at the 5 percent level of significance. However, the long-run elasticity of inflation with respect to the imported inflation is noticeabley low. This means that this variable exerts a low impact on inflation in Saudi Arabia.

Summary and Conclusion

Saudi Arabia has a very open economy, with negligible restrictions on the movement of commodities and funds. This means that the inflation in Saudi Arabia is generated not only by domestic sources, but could also be generated by external factors such as, foreign interest rate, exchange rate and imported inflation. The main objective of this study is to determine the sources of Saudi inflation. For achieving this objective, a single-equation model of inflation in Saudi Arabia is specified and estimated. This model is based on the monetarist single-equation model of inflation. However, the model departs from the monetarist single-equation model of inflation by including the external factors, namely; the U.S. Dollar short-term market interest rate, the changes of Saudi Riyal exchange rate against the U.S. Dollar, and imported inflation. Our single-equation model of Saudi inflation includes three more explanatory variables beside the external variables. These variables are, nominal money supply, real income (real GDP) and the lagged dependent variable (p_{t-1}). The model (the single-equation model of Saudi inflation) can be described as a partial adjustment model (a short-term dynamic adjustment model), a Koyck-type equation that uses a single lagged dependent variable. This kind of model allows us to distinguish between long-run behavior, and short-run behavior.

The following general conclusions are derived from this study:

1- The empirical results that emerge from estimating our single-equation model of Saudi inflation reveal that all the explanatory variables except the U.S. Dollar short-market interest rate, bear the correct sign and are statistically significant at the 5 percent level of significance (See Equations 4.2 and 4.3). The overall fit of the regression (the estimated Equation No. 4.3) is very good with five explanatory variables jointly explaining large proportion of the total inflation rate ($R^2 = 0.92$). This means that our model fits the actual data remarkably well.

2- Among the various explanatory variables, three are found to exert especially strong effects on the Saudi inflation, namely, the growth rate of money supply, the growth rate of real income and the changes of the Saudi Riyal exchange rate against the U.S. Dollar.

3- The empirical results of this study support our expectation that the growth in money supply is an important source of inflation in Saudi Arabia. This suggests that a serious anti-inflation monetary policy must consist of a reduction in the rate of monetary growth. In short, restrictive monetary policies in Saudi Arabia are a necessary anti-inflationary strategy.

The depreciation of Saudi Riyal against the U.S. Dollar is another important source of Saudi inflation (its long-run elasticity = 0.68). Finally, the real economic growth is found to exert a relatively strong mitigating effect on inflation in Saudi Arabia.

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المصادر الداخلية والخارجية للتضخم في المملكة العربية السعودية : دراسة قياسية

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المستخلص: الهدف الرئيسي لهذه الدراسة هو تحديد مصادر التضخم (المصادر الداخلية والخارجية) في المملكة العربية السعودية خلال الفترة ما بين ١٩٧٠م إلى ١٩٩٥م. ولتحقيق هذا الهدف أعد نموذج قياسي مكون من معادلة واحدة أعتمد في وضع هذا النموذج على نموذج النقديين للتضخم ولكن نموذج هذه الدراسة يختلف عن نموذج النقديين من حيث إن هذا النموذج يشمل على متغيرات خارجية (عوامل خارجية) يعتقد بأنها تؤثر على المستوى العام للأسعار في المملكة العربية السعودية مثل التضخم المستورد وسعر صرف الريال بالنسبة للدولار وسعر الفائدة على الدولار بالإضافة إلى متغيرات رئيسية وهي عرض النقود والناتج المحلي الحقيقي (الدخل المحلي الحقيقي)، وتباطؤ المتغير التابع .

وتشير نتائج تقدير النموذج إلى أن جميع معامل المتغيرات التفسيرية، ما عدا سعر الفائدة على الدولار، ذات إشارات صحيحة ومعنوية إحصائية مرتفعة عند مستوى ٥٪ من المعنوية كما أن النتائج أشارت إلى ارتفاع قيمة معامل التحديد ($R^2 = 0.92$) وقيمة اختبار F وإلى انخفاض قيمة المربعات الصغرى للمتبقيات . وهذا يدل على ارتفاع القدرة التفسيرية للنموذج حيث إن خمسة متغيرات تفسيرية تفسر نسبة مرتفعة جداً من المتغيرات في التضخم في المملكة العربية السعودية، وذلك كله يعني حسن مطابقة النموذج للبيانات الحقيقية للتضخم . كما أن نتائج تقدير النموذج تشير إلى أن ثلاثة متغيرات تفسيرية، وهي نمو عرض النقود ونمو الناتج المحلي (الدخل المحلي) والمتغيرات في سعر صرف الريال السعودي بالنسبة للدولار، ذات تأثير قوي على التضخم في المملكة العربية السعودية .