Arab Journal of
Administrative Sciences

2007, Vol. 14, No. 3, 495 - 508

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PRICE LEVEL MOVEMENTS IN KUWAIT: A MULTIVARIATE COINTEGRATION ANALAYSIS

Key Words

Inflation;
Cointegration;
Vector Error Correction;
Unit Root Testing
Causality.

Abstract

This papers uses a multivariate cointegration analysis and a vector error correction model to investigate the sources of Price level movements in Kuwait, The paper adopts the monetary model of price determination where the roles of both money supply and money demand are explicitly recognized. The model departs from previous studies in that it allows for possible effects of external forces such as foreign prices. The empirical results reveal that domestic Price level is cointegrated with real income, money supply, and import prices by providing a direct long run equilibrium relationship.

Introduction

The Kuwaiti economy is small and very open with negligible restrictions on the movements of commodities and funds. The country depends almost entirely on imports for the supply of goods and services. In 1974, the government adopted a stabilization programme aimed at maintaining stable domestic prices and insulating the economy from imported inflation.

As a result, Kuwait has not experienced an acceleration of inflation since the 1970s relative to the rest of the world. Inflation measured by the rate of change in the consumer price index (CPI) has not reached a double-digit figure except in 1974 and 1980, following the sudden increase in oil prices, and in 1991, following the Iraqi invasion and occupation of Kuwait. The average inflation rate was about 8% during the 1970s and fell to about 5% in the 1980s and 1990s.

The evaluation of the stabilization programme requires full information regarding the sources of price level movements in Kuwait. In this respect, there have been several attempts (See AL-Sabah (1978), EL-Mallakh and

Submitted February 2006, accepted June 2006.

Atta (1981), Moosa (1986), Saleh et al. (1989), AL-Mutairi (1995), AL-Yousif (1996), and Eltony (2001)). However the findings are not uniform. For example, Moosa (1986) and Eltony (2001) find that import prices are the main determinant of domestic prices followed by monetary stimuli and government stimuli. Saleh et al. (1989), on the other hand, find that government stimuli significantly affect domestic prices and, most of the time, outweigh import price effects. AL-Mutairi (1995) provides additional support for Saleh et al.'s findings that government expenditures were the most important determinant of the variations in the price level, followed by import prices and money supply. AL-Yousif (1996), who examines the major determinants of inflation in Kuwait using a closed monetary model where external influences play no role in determining domestic inflation, finds that excessive money growth is the primary cause of inflation in Kuwait, followed by inflationary expectations.

The purpose of this paper is to re-investigate the sources of price level movements in Kuwait using more reliable and improved econometric techniques and an extended data base. Unlike previous studies, the paper adopts the monetary model of price level determination where the roles of both money supply and money demand are explicitly recognized. The model departs from previous studies which adopt this approach by allowing for possible effects of real income and external forces such as foreign interest rates and currency depreciation upon the domestic money holding. The model is also modified to incorporate the possible role of import prices to reflect the openness of the Kuwaiti economy.

The study uses cointegration analysis and a vector error correction model to investigate the sources of Price level movement in Kuwait. Unlike classical modeling techniques, the vector error correction model is able to overcome many of the problems associated with the time series model, hence enhancing the creditability of our results. The remainder of the paper proceeds as follows: Section II discusses the specification of monetary model, Section III describes the methodology, Section IV explains the data, Section V reports the empirical results, and finally Section VI presents the conclusion.

Model Specification

The monetary approach to price level determination in its simplest form starts with the usual equilibrium condition in monetary markets,

$$\frac{M_t^S}{P_t} = m_t^d \qquad (1)$$

where M^S is the nominal money supply, P is the price level, m^d is the

real money demand. Taking the log of equation (1) yields

$$Log\ P_t = LogM_t^S - Logm_t^d. \quad (2)$$

According to equation (2), prices are stable when money supply equals the real demand of money. However when the nominal supply is in excess of the real demand of money, an excess supply of money is created. This is eliminated by an increase in nominal demand for money through an increase in the price level. In most theoretical and empirical studies of inflation that have employed this approach, the money supply is assumed to be exogenous because it is determined by the central bank (policy controllable), whereas the money demand is assumed to be endogenous because it depends on the behavior of the public. This is because the public holds some of its wealth as money. People hold money, as a medium of exchange, and it is convenient for purchasing goods and services. Businesses also hold money to pay for the factors of production. The demand for such uses is called the transaction demand for money. This component of real money demand depends positively on the level of real income, and negatively on interest rates (Baumol/Tobin's inventory model).

The second motive for holding money is based on the belief that money serves as a store of value. People may hold their wealth in several assets besides money. These assets include corporate stocks, private or government bonds, or real assets. Therefore, there is an asset demand for money. This component of real money demand is determined by (a) interest rates which measure the opportunity cost of holding money balance relative to holding other financial assets and (b) the expected rate of capital gains which measures the opportunity cost of holding money balance relative to holding real assets. The expected rate of capital gains occurs when the prices of real assets rise and, hence, this rate becomes equal to the expected rate of inflation. Thus, one could conclude that asset demand for money varies inversely with the rate of interest and with the expected rate of inflation.

In view of our discussion above, a linear money demand function is specified as,

$$\log m_t^d = \beta_0 + \beta_1 \log y_1 + \beta_2 r_{t1}^d + \beta_3 \pi_t + v_t \quad (3)$$

where y_t is the real income, π_t is the expected rate of inflation measuring the yield foregone on real assets, r^d is the interest rate representing the yield foregone on financial assets, and v_t is zero-mean white noise error term.

Established theory predicts that $\beta_1 > o,\ \beta_2,\ \beta_3 < o$.

Most empirical studies on developing countries have omitted the interest rate variable from the money demand function on the basis that the financial assets in these countries are either absent or inadequate, or because the interest rates on available financial assets are government-controlled and not permitted to vary with market conditions. Thus, we omit the domestic interest rate from the model.

The deficiency of various applications of the monetarist approach to inflation is that they pay no attention to external factors which influence domestic money demand. As pointed out by Arango and Nadiri (1981), Darrat (1981), Bahmani-oskooee and Melixi (1992), and Bothassani, et al. (2003), among others, money demand in small open economies like Kuwait is influenced by external factors such as expected rate of currency depreciation or foreign interest rates, because capital movements are not completely controlled. Movements in US interest rate (r_t^f) and domestic exchange rate, particularly against the US dollars (e_t), could exert important influence on domestic money demand.

Thus, the augmented version of money demand function assumes that foreign currencies or foreign financial assets are alternatives to holding domestic money balance. Accordingly, the money demand function can be rewritten as,

$$\log m_b^d = B_0 + B_1 \log y_t + B_2 \pi_t + B_3 \log r_t^f + B_4 \log e_t + v_t \quad (4)$$

where r_t^f could have negative impact on the demand for money. Moreover, the effect of exchange, e_t depends on the strength of income and substitution effects.

Since Kuwait is an open economy with imports representing a significant share of domestic consumption, a noticeable increase in import prices could have important implications for domestic inflationary processes, especially given the relatively pegged nature of Kuwait's exchange rate with respect to the US dollar. Thus, following Keran and AL-Malik (1979), AL-Mutairi (1995), Darrat (1997), and AL-Bassin (1999), the monetary model of price level is modified to account for the effect of import prices.

The proposed single-equation of the model of price level is obtained after incorporating the possible role of import prices (P^m) and integrating (4) into (2) as,

$$\log p_1 = \log M_1^s - \beta_0 - \beta_1 \log y_1 - \beta_2 \pi_t - \beta_3 r_t^f - \beta_4 \log e_1 - \beta_5 \log p_t^m - v_t \quad (5)$$

where all variables are defined as before.

Cointegration and Vector Error-Correction Model

The dynamic interaction between the price level and its determinants in equation (5) can be analyzed by formulating an unrestricted VAR system with all variables as endogenous. This multivariate technique is more efficient than single equation modelling when the variables under consideration form more than one cointegrated relationship. Since this condition may be present in our data, the Johansen (1988) multivariate cointegration technique is used to test the existence of a long run equilibrium relationship among the variables specified in equation (5). A brief description of this technique is presented below.

Consider the vector autoregressive (VAR) model of order K,

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + ... + \Pi_k X_{t-k} + \mu_t \qquad (6)$$

$$(t = 1, ..., T)$$

where $X_t$is a column vector of 7 endogenous variables included in Price level model (5) and $\mu_t$is a vector of normally distributed error term. Since most economic time series are non-stationary and since the VAR system required the data to be stationary, the system in (6) should be estimated in the first-difference form. However, since first differencing removes much of the valuable information about the equilibrium relationship among the variables, we follow Johansen (1988), and Johansen and Juseluis (1990) by rewriting system (6) in its first-difference form as,

$$\Delta X_t = \Pi_0 + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-1} + ... + \Gamma_{k-1} \Delta X_{t-k-1} + \Pi X_{t-k} + \mu_t \qquad (7)$$

$$(t = 1, ..., T)$$

where ΔX_t is the vector of growth rates of the variables included in the model, $\Pi_0$is a vector of intercepts, the $\Gamma s$are estimable parameters, and $\Pi$is the long run parameter matrix. The above system is known as VEC (vector error correction) model, which is basically the first-difference version of a VAR model plus an error correction term ΠX_{t-k}. The matrix Πcontains information on the long-run relationship between the variables in X_t. If the rank of the Πmatrix r is o < r < 7, then there are two matrices, $\alpha$and β, each with dimension 7xr such as $\alpha\beta$,where $r$is the number of cointegrating vectors, and $\beta' X_t$is stationary.

The matrix βcontains r elements of the cointegrating vectors and matrix αcontains the coefficients that show the speed of adjustment to the long run equilibrium. The important issue is how to determine the number of cointegrating vectors r. There are two like-

lihood ratio test statistics to test for the number of r. The first likelihood ratio statistic for the null of exactly r cointegrating vector against the alternative of r + 1 vector is the maximum eigenvalue statistic. The second statistic for the hypothesis of at most r cointegrating vector against the alternative is the trace statistic (For more details, see Johansen (1991)).

Data

Quarterly data for the period 1979:I - 2004:IV are used for estimation. Prices are measured by the Consumer Price index (CPI). Money (M) consists of currency in circulation and demand deposits of the non-bank public. Foreign interest rate (r^f) is approximated by interest rate on dollar deposits at London market. Since quarterly data on GDP of Kuwait are not available, oil revenues are used as a proxy for real income (Y). Nominal oil revenues are deflated by the CPI (2000 = 100) to express them in real terms. For import prices (p^m), we use the weighted average of unit values of exports of major exporters to Kuwait. Actual inflation is used as a proxy for expected inflation.

All time series are obtained from various issues of the International Financial Statistics. All the series of the variables are transformed into their natural logarithm so that the first difference measures their growth rates.

Empirical Results

An important step before employing the Johansen multivariate technique is to determine the properties of time series of the data. This is an important issue since the VEC model specification in (7) requires that some or all the variables be integrated of order one.

It has been found in many empirical studies that most macro variables are integrated of order one or unit roots {denoted by I (1)}. Statistically speaking, a time series is said to be stationary if its mean, variance and covariance are all invariant with respect to time. Such a series is denoted by I (0), that is, integrated of order zero. A time series requiring first order differencing to achieve stationary is said to be I (1). In this study, the order of integration of the variables P, M, Y, Π, e, r^f, P^m is examined using both the augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests for unit roots. The null hypothesis tested is that the variable under consideration has a unit root which is lacking in the alternative. The Akaike Information Criterion (AIC) is used to determine the optimum lag lengths in the ADF equation, whereas the Newey-west using Bartlett kernel is used to determine the optimum lag lengths in the PP equation. The results of both tests are presented in Table 1. Based on the evidence given in this Table, the null hypothesis of a unit root is not rejected

Table 1
Test Results for Unit Roots

	ADF	PP
P	-2.17	-2.09
M	-0.52	-0.26
Y	-2.30	-2.44
Π^e	-1.58	-2.61
e	-0.98	-0.58
r^f	-1.54	-1.44
P^m	-1.15	-1.05
Δp	-8.40	-8.37
Δm	-3.81	-10.70
$\Delta \Upsilon$	-9.35	-9.36
$\Delta \Pi^e$	-2.89	-3.56
Δe	-9.46	-11.99
Δr^f	-6.36	-6.52
ΔP^m	-4.11	-7.90

Note: Testing The presence of a unit root with the ADF and PP involves estimating the following equations by OLS,

$$\Delta Y_t = \alpha + BY_{t-1} + \sum_{i=1}^{m} n\Delta Y_1 + Pt + e_t \quad \text{(ADF)}$$

$$\Delta Y_t = \alpha + BY_{t-1} + \phi\left(t - \frac{T}{t}\right) + \sum_{i=1}^{m} n\Delta Y_1 + e_t \quad \text{(PP)}$$

where Y_t is the relevant time series, Δ is the first difference operator and e_t is the stationary random error. The optimum lag length (m) in the ADF is determined by AIC and according to Newly-west using Bartlett kernel in the PP. The time trend t is allowed only when found to be significant. The critical value for ADF and PP at 5% level is 2.89 (Mackinnon 1990). Equations were estimated using E-views 5.1 programme.

for the log levels of all variables at the 5% significance level. Moreover, these tests are reapplied after differencing all series. The results shown in the same Table indicate the rejection of the null hypothesis, suggesting that all the variables are first difference stationary.

The long run relationship between price level and its determinants was examined using Johansen-Juselius technique as discussed earlier. The optimal lag length of the VAR representation has been determined as 2 by using "Akaike Information criterion" (AIC). We should note that the variables are kept in the model if they are statistically significant and bear the correct sign as suggested by the underlying theory. The estimates of the cointegrating vectors which represent the long run relationship between price level and its determinants show that the inflation ((Π), the foreign interest rate ($(r^f)$and the exchange rate of Kuwaiti dinar against the US dollar (e) are all found to be statistically insignificant and, also, bear incorrect signs contrary to underlying theory(1) Thus, these vari-

(1) These results are not reported here but are available from the author on request.

Table 2
Johansen-Juselius Cointegration Test Results

	Maximum eigenvalue statistics	Trace statistics	Eigenvalues
$r = 0$	29.45[24.16]	48.10 [40.1]	0.262
$r \leq 1$	11.54 [17.79]	18.64 [24.27]	0.115
$r \leq 2$	5.54 [11.22]	7.10 [12.32]	0.055
$r \leq 3$	1.56 [4.12]	1.56 [4.13]	0.015

Note: The values in brackets show the 5% critical value.

ables are omitted from the model. The new model consists of four variables, the price level, real income, money stock, and import prices.

The existence of cointegration is tested using the trace and maximum eigenvalue tests as suggested by Johansen-Juselius technique. The results are shown in Table 2. The hypothesis that "no cointegrating vectors exist" is rejected in favor of at least "one cointegrating vector" at the 5% significance level using both the trace and maximum eigenvalue tests. The reported values of eigenvalue associated with the first vector (0.262) is considerably higher than those corresponding to the other vectors, thereby confirming that the system has one cointegrating vector.

The long run parameters (β coefficients) presented in Table 3 are highly significant and consistent with signs suggested by the theory. The upper section of Table 3 shows the results of estimating the unrestricted cointegrating vector. Real income (Y) has a negative and important effect on the price level, whereas the effect of money supply (M) and import prices (P^m) is positive.

The α vector shows that the adjustment parameters for real income (Y), money supply (M) and import prices (P^m) are small and insignificant. The error-correction term, while highly significant for the price level (P), is not significant in the equations for Y, M, and P^m indicating that these variables Y, M and P^m are weakly exogenous. The Johansen method allows us to test for weak exogeneity by imposing separate or joint restrictions on the adjustment coefficients. The test that $\alpha_2 = o, \alpha_3 = o, \alpha_4 = o$ yields a likelihood ratio test = 0.421 which, compared with the 5% critical value, $X^2(3) = 2.815$, enables us to easily accept the null hypothesis. Based on the results in the lower section of Table 3, the cointegration vector representing the long run inflation equation is as below:

Table 3
Standardized Cointegrating Vector (β) and Corresponding Adjustment Coefficients (α)

Non-restricted model		
Variable	β	α
P	1	-0.035
		(-4,205)
Y	-0.187	-0.324
	(-3.693)	(-1.723)
M	0.421	0.038
	(3.527)	(0.723)
P^m	0.430	0.007
	(2.449)	(0.476)
Restricted Model		
P	1	-0.006
		(-5.32)
Y	-0.121	-
	(3.694)	
M	0.341	-
	(3.531)	
P^m	0.522	-
	(2.449)	

Note: The cointegrating vector is normatized on P. The figures in parentheses are t-statistics.

$$\hat{P} = -0.121\,Y + 0.341\,M + 0.522\,P^{m}$$

The empirical results show that all the determinants of the price level in Kuwait appear significant with correct signs. These results suggest that import prices are the prime source of price movements in Kuwait. Because these coefficients measure the long run elasticity, a 10% increase in import prices would result in about 5% increase in domestic prices in the long run. The above finding is in line with those obtained by Moose (1986) and Eltony (2001).

Besides, money supply is an important variable, explaining prices in Kuwait with about 0.341 long run elasticity Therefore, a restrictive monetary policy is a necessary anti-inflationary strategy in Kuwait. Higher production, associated with higher real income, has an adverse effect on the price level (the associated long run elasticity is - 0.121). A 10% increase in domestic output reduces domestic prices by 1.2%.

We are now in a position to examine the dynamics of price level determination using the VEC model. Table 4

Table 4
Estimates of the VEC Model

Variable	ΔP_t	ΔY_t	ΔM_t	ΔP_t^M
EC	-0.006 (-5.32)	0	0	0
ΔP_{t-1}	0.028 (0.25)	-2.902 (-1.11)	0.655 (0.90)	0.166 (0.75)
ΔP_{t-2}	-0.132 (1.17)	-0.74 (-0.29)	0.489 (0.68)	0.203 (0.930)
ΔY_{t-1}	0.005 (1.19)	0.055 (0.513)	-0.033 (-1.12)	-0.001 (-0.144)
ΔY_{t-2}	0.001 (0.32)	0.055 (0.50)	-0.004 (-0.16)	0.000 (0.02)
ΔM_{t-1}	0.009 (0.52)	-0.281 (-0.70)	-0.083 (-0.75)	-0.047 (-1.40)
ΔM_{t-2}	0.007 (0.45)	-0.010 (-0.02)	-0.068 (0.61)	0.025 (0.76)
ΔP_{t-1}^m	-0.08 (-1.44)	-1.074 (-0.78)	0.342 (0.892)	0.271 (2.32)
ΔP_{t-2}^m	0.025 (0.40)	-0.544 (-0.38)	0.101 (0.25)	0.011 (0.09)
R^2	0.62756	0.33180	0.65168	0.18290

Notes: Variables are as defined in the text. T-ratios are in parentheses. EC is error correction coefficient.

reports the OLS estimates of a four-variable VEC model as is specified by equation (7), where the optimal lag length has been determined as 2 by the Akaike Information Criterion. Table 5 reports the results of the Granger-Causality test. The flow of causality in this Table is running from the independent variables namely, real income, money supply and imports prices, to price level. These tests are performed using a joint F-statistics for the exclusion of the variables under examination from each equation. The F-statistics for the lag values of the independent variables reported in Table 5 indicate that there is no short run causal relation between real income, money supply, or import prices and price level.

However, with a higher lag length (l = 3, ...,7) the causality begins to be detected. The causality between real income and price level is detected at lag length three and between money supply and price level at lag length six,

Table 5
Test Results for Granger-Causality

Lag Length (l)	Real income does not Granger-cause inflation		Money supply does not Granger - cause inflation		Money supply does not Granger-cause inflation	
	Chi - sq	Prob.	Chi-sq	Prob.	Chi-sq	Prob.
2	1.559	0.458	0.446	0.799	2.134	0.344
3	42.535	0.000	4.698	0.195	5.650	0.129
4	50.989	0.000	5.978	0.201	7.367	0.117
5	49.447	0.000	7.480	0.187	8.390	0.136
6	59.867	0.000	12.425	0.053	10.348	0.110
7	60.425	0.000	16.752	0.019	15.474	0.030

while all three variables are found to Granger-cause price level at lag length seven. These results are consistent with the finding of a significant long run relationship between price level and its determinants.

Conclusion

Using multivariate cointegration and vector error correction modeling and adopting the monetary approach to price level determination in which the roles of both money supply and money demand are explicitly recognized, this paper empirically investigated the sources of price level movements in Kuwait during the period 1979:I - 2004:IV. The findings do support the view that a great portion of domestic price movements is imported. Based on cointegration results, the external factor (represented by import prices) is found to exert a significant influence upon domestic prices. Money supply is also found to be an important source of domestic price movements implying that restrictive monetary policy may be an important ingredient in any anti-inflation policy in Kuwait. Furthermore, real income proves statistically significant; thus, faster economic growth appears to mitigate inflationary pressures .

The short run dynamics of the variables derived from the results of the Granger Causality, in the environment of VEC model, fail to establish a causal relationship running from either real income, money supply, or import prices to domestic prices. However, this causal relationship is detected at higher lag lengths suggesting that two years or more may elapse for the changes in these variables before any noticeable impact on prices can be felt. The importance of this finding suggests that any government policy aiming to control prices either by restraining money supply or improving output requires a long time to produce its due impact on prices.

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الملخص

التغيرات في المستوى العام للأسعار في الكويت: تحليل التكامل المشترك المتعدد

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تستخدم هذه الدراسة أسلوب تحليل التكامل المشترك المتعدد، ونموذج متجه تصحيح الخطأ المتعدد للبحث في مصادر التغيرات في المستوى العام للأسعار. واستخدمت الدراسة نموذجاً نقدياً لتحديد السعر؛ حيث يظهر جلياً كل من عرض النقود والطلب على النقود. ويختلف هذا النموذج النقدي المستخدم عن غيره من النماذج المستخدمة في الدراسات السابقة في أنه يعطي أهمية للقوى الخارجية المؤثرة، مثل الأسعار الخارجية. وتؤكد النتائج التي تم التوصل إليها أن المستوى العام للأسعار في الكويت له ارتباط مع كل من الدخل الحقيقي وعرض النقود وأسعار الواردات؛ نظراً لوجود علاقة توازنية طويلة الأجل بين هذه المتغيرات.

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