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# LINKING CONSUMER PRICES TO WHOLESALE PRICES AND TO MONEY SUPPLY: SOME COINTEGRATION EXPERIMENTS FOR THE CASE OF GREECE

By

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**Abstract**

The purpose of this paper is to investigate and measure the extent to which consumer prices are affected by changes in wholesale prices and in money supply. The data used in the investigation are monthly, covering the period from 1973:1 to 2000:11, and refer to consumer price indexes, finished products wholesale price index, and Ml money supply index. Multivariate cointegration methods are used in order to investigate the transfer of changes from wholesale prices and money supply to consumer prices, or in other words to test the existence or not of **a** long-term equilibrium relationship between the three variables. The paper concludes that long-term relationships exist between consumer prices and money supply and between wholesale prices and money supply. Thus, error correction models (ECM) are developed and estimated using the restricted VAR methodology. (JEL: Classification: E31, E52).

***Keywords:*** *Consumer prices, wholesale prices, money supply, stationarity, cointegration, error correction models, Greece.*

## 1. Introduction

It is well accepted that the price level in an economy is determined by aggregate demand and aggregate supply. A major method in measuring this price level is the consumer price index (CPI). Furthermore, increases in the price level (inflation) are caused by various factors. Most text-books in economics categorise inflation according to the factors that cause inflation. The inflation that results from an increase in aggregate demand is categorised as "demand-pull" inflation, or "demand-side" inflation. Such an inflation may arise from any factor that increase aggregate demand. The most important factors that generate ongoing increases in aggregate demand are increases in the money supply, increases in government purchases and increases in the price level in the rest of the world. The inflation that results from a decrease in aggregate supply is categorised as "cost-push" inflation, or "supply-side" inflation. Such an inflation may arise from any factor that decreases aggregate supply. The most important sources that decrease aggregate supply are an increase in wage rates, and an increase in the prices of key raw materials (Lipsey, et al., 1993; Baumol and Blinder, 1994; Parkin and King, 1995; Kennedy, 1996; Griffiths and Stuart, 1997; Atkinson, 1998).

However, producers rarely sell their products directly to consumers. They often enter into various contractual relations with retailers or dealers (Katz, 1989). The price in consumer goods markets depends on the nature of contractual relations, which in turn depends on the structure of wholesale and retail markets. It has been argued that economic policies may be misleading if the link between wholesale and retail markets is not explicity considered (Bresnaham and Reiss, 1985). Furthermore, stuyding the determination of retail and wholesale prices, Choe (1999) concluded that the ratio of retail to wholesale margins increases (decreases) as the retail part of the market becomes less (more) competitive.

Although there is a strong correlation between money supply and CPI and between wholesale price indexes (WPI) and CPI, "monetarists" argue that inflation is mainly caused by changes in the money supply and "structuralists" argue that inflation is developed from pressures arising from various intermediate market transactions. The empiricl evidence suggests that not all inflation is from monetary expansion. The role of money supply cannot be rejected (Dalziel, 2000), and policies that rely solely on money supply contractions to control inflation ignore the possibility that the source of inflation may be structural, not monetary (Pinga and Nelson, 2001). Furthermore, Devados (1996) argues that there is a less than perfect link between the money supply and prices when prices adjust sluggishly and Pradhan and Subramanian (1998) argue that the WPI and CPI do no show a long run stable relationship with money supply, and that the use of WPI in trying to explain the causes of inflation will lead to spurious results as no long run relationship exists between WPI and money supply.

In the light of the discussion so far it is clear that the debate in the literature, between monetarists and structuralists, still holds strong. Therefore, the aim of this paper is to investigate the extent to which consumer prices are affected by changes in wholesale prices, assuming that incorporate all the chain of cost increments before the product reaches the market (Choe, 1999) - i.e.

the structuralists approach - and by changes in money supply (M1) - i.e. the monetarists approach.

Specifically, the purpose of the paper is to investigate the extent to which changes in wholesale prices and in money supply affect consumer prices in the economy of Greece. Thus the major hypothesis to be tested is the following.

Ho: Changes in wholesale prices and in money supply are proportionally transferred to consumer prices. In other words, there exists a long-term equilibrium relationship between consumer prices, wholesale prices and money supply.

Section 2 extends the theoretical introduction of the paper, relating theory to practice. Section 3, employing the Augmented Dickey-Fuller (ADF) tests, investigates the non-stationarity of all the data used. Multivariate cointegration analysis, employing the Johansen approach, between the various consumer price indexes, the wholesale price index, and the money supply index is presnted in section 4. The statistical estimates of the Error Correction Models (ECM) and discussion of the meaning of these estimates is presented in section 5. Finally, section 6 presents the conclusions and policy implications of the paper. All estimates have been carried out using E Views 3.1.

## 2. From theory to practice

While it is easy to theoretically put the causes of price change into two sides - demand-pull and cost-push - in practice is very difficult, if not impossible, to identify the causes of inflation. If one starts with the price side, demand-pull is suggested; looking at the wage increases suggests cost-push as the explanation. Often, both may be involved. A demand-pull inflation may create a cost-push inflation later, in that even though prices rise enough to eliminate the excess demand caused by the demand curve shift, the higher price level feeds with a lag into the labour-leisure choice or labour wage demands to induce the supply curve of labour and the aggregate supply curve to shift leftward, creating more excess demand and a future rise in price. Furthermore, if a policy of validation is followed on the demand side, then to avoid the fall in output from the upward shift in the aggreate supply curve, fiscal and monetary policies may be used to increase aggregate demand and prices further, thus inducing another upward shift in the labour supply curve, and so on (Ott *et al,* 1985).

The empirical estimation of price determination models in an expanding research area, because of theoretical as well as technical considerations. One type of these models is the so-called "Phillips curve models". The price equation that typically underlies a Phillips curve model is the following (Gordon, 1982, 1985; Stockton and Glassman, 1987; Mehra, 1994; Ghalli, 1999):

$$\Delta p_t = a_0 + a_1\Delta(w_t - q_t) + a_2x_t + a_3S_{pt} + \varepsilon_t \qquad (1)$$

where $p_t$ is the price level, $w_t$ is the nominal wage rate, $q_t$ is labour productivity, $x_t$ is a demand pressure variable, $S_{pt}$ is supply shocks affecting the price equation, and $\varepsilon_t$ is an error term.

The price equation (1) argues that prices (p) are marked up over productivity-adjusted labour costs (w-q) and are influenced by demand factors (x, such as an output gap and the unemployment rate) and relative price shocks ($S_p$, such as relative import prices).

Economists, such as Blinder (1997) argue that although Phillips curves models suffer from various estimation deficiencies they should continue to play a role in economics because these models summarise empirical relationships critical for policy making. Other economists such as Fair (2000) and Atkeson and Ohanian (2001) argue that economists have not produced a version of the Phillips curves models that makes more accurate forecasts than those from usual macro-econometric models.

Arguing that the main problem in the research referring to the estimation of Phillips curve models is the uncertainty surrounding the estimates of the equations involved, it is important any contribution to this area to be concentrated on new specifications of the equations and on new estimating techniques that will add to our knowledge. For this reason the main purpose of this paper is to estimate - using cointegration techniques - a new Phillips curve type price determination model for Greece. A simple version of the model of equation (1) may be the following:

$$\Delta p_t = a_0 + \alpha_1\Delta\omega_t + \alpha_2\Delta M_t + e_t$$

$$\alpha_1 >= 0, \quad \alpha_2 >= 0 \qquad (2)$$

where $\omega$ = wholesale prices, as a supply pressure variable (including any productivity-adjusted labour costs)
M = money supply, as a demand pressure variable
$a_t$ = parameters to be estimated

However, in the case that variables $p_t$, $\omega_t$ and $M_t$ are cointegrated these variables have an error-correction presentation of the form:

$$\Delta p_t = \alpha_0 + \alpha_1(L)\Delta p_{t-1} + a_2(L)\Delta\omega_{t-1} + a_3(L)\Delta M_{t-1} + \lambda v_{t-1} + \varepsilon_t \quad (3)$$

where $\lambda$ is the adjustment coefficient, taking values between - 1 and 0, indicating the speed of adjustment of each variable to the long-run equilibrium relationship, $v_{t-1}$ is the lagged value of the cointegrating vector and a(L) are polynomials in the lag operator. Comparing models (2) and (3) it is seen that in the case that a cointegrating relationship exists between $p_t$, $\omega_t$ and $M_t$ then, model (2) is imposing the incorrect restriction that $\lambda$ is equal to zero. Therefore, a further aim of this paper is to test and estimate the "standard model" of equation (2) versus the "error-correction model (ECM)" of equation (3) for Greece. Finally, we must note here that the theory assumed so far indicated that there is a unidirectional causation from all other variables to prices, making thus redundant any statistical tests of the Granger-causality type (Madala, 1992).

## 3. Testing the stationarity of data

The data used in the analysis are monthly, cover the period from 1973:01 to 2000:11 and are taken from various issues of the Monthly Statistical Bulletin of Greece (NSSG, 2001). Employing 1990 as base year, the identification of the 11 variables used in logarithms (L) is the following

LCPI1 = Consumer price index, food
LCPI2 = Consumer price index, alcoholic drinks and tobacco
LCPI3 = Consumer price index, clothing and footwear
LCPI4 = Consumer price index, housing
LCPI5 = Consumer price index, durable and consumption goods
LCPI6 = Consumer price index, health and personal care
LCPI7 = Consumer price index, education and recreation
LCPI8 = Consumer price index, transport and communication
LCPI9 = Consumer price index, other goods and services
LWPI = Wholesale price index, overall final demand of finished goods
LM1 = Money supply index.

We must note here that we used the nine different consumer price indexes, grouped by the Statistical Service of Greece above, because we wanted to investigate if different types of goods behave differently. It is obvious that to know which groups of goods behave differently it is important in terms of economic policy applications.

In examining the stationarity of these variables we used the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests as shown in Table 1 (Dickey and Fuller, 1979 and 1981; Dickey and Pantula, 1987; Dickey *et al,* 1984). The exact methodology followed is as follows (Seddighi *et al,* 2000): In order to find the proper structure of the DF/ADF equations, in terms of the inclusion in the equations of an intercept (c) and a trend (t), and in terms of how many extra augmented lagged terms to include in the ADF equations, for eliminating possible autocorrelation in the disturbances, the usua Akaikes's (1973) information criterion (AIC) and Schwartz's (1978) criterion (SC) were employed. We employed both AIC and SC criteria for verification purposes, because these criteria are rather sensitive in the structure of the various equations. The minimum values of AIC and SC indicated the 'best' structure of the ADF equations. With respect to testing autocorrelation in the disturbances, the usual Breusch (1978) and Godfrey (1978) or Lagrange multiplier LM(1), test was used.

The minimum values of the AIC and SC criteria indicated the 'best' specifications of the DF/ADF equations as shown in the last column of Table 1. Similarly, the corresponding numbers of the lagged terms used to eliminate possible autocorrelations in the disturbances are shown in the second column of Table 1. For all variables the LM(1) test shows that there is no serial correlation in the disturbances. The DF/ADF criteria in Table 1, using MacKinnon (1991) critical values, show that all the log-variables are non-statioary. However, these criteria show that all the corresponding firts differenced (D) log-variables are stationary. In other words all log-variables in Table 1 are integrated of order one, i.e. they are I(1).

TABLE 1

DF/ADF unit root tests for all the price and money supply indexes

| **- Variable - Differenced variable (D)** | **Lag terms** | **DF/ADF*** | LM(1)** | **DF/ADF equation specifications*** ** |
|---|---|---|---|---|
| LCPI1 | **1** | 0.22961 | 0.05764 [0.810] | c & t |
| DLCPI1 | **0** | -15.04154 | 0.04139 [0.8391 | c & t |
| | | | | |
| LCPI2 | **1** | -1.14427 | 0.45082 [0.5021 | c & t |
| DLCPI2 | **0** | -15.58770 | 0.59434 [0.4411 | c & t |
| | | | | |
| LCPI3 | **2** | 4.75906 | 0.30194 [0.583] | 0 |
| DLCPI3 | **1** | -18.26765 | 0.00001 [0.999] | 0 |
| | | | | |
| LCPI4 | **0** | 0.62050 | 0.13200 [0.7091 | c & t |
| DLCPII4 | **0** | -18.42734 | 0.45231 [0.5011 | c & t |
| | | | | |
| LCPI5 | **2** | 6.50865 | 0.22677 [0.634] | 0 |
| DLCPI5 | **1** | -13.55227 | 0.00001 [0.999] | 0 |
| | | | | |
| LCPI6 | **2** | 1.21067 | 0.25466 [0.6141 | c & t |
| DLCPI6 | **1** | -15.36870 | 0.06882 [0.7931 | c & t |
| | | | | |
| LCPI7 | **2** | 2.04524 | 0.91851 [0.3381 | c & t |
| DLCPI7 | **1** | -16.89941 | 1.71229 [0.1911 | c & t |
| | | | | |
| LCPI8 | **1** | -0.13714 | 0.00480 [0.9451 | c & t |
| DLCPI8 | **0** | -14.35711 | 0.00836 [0.9271 | c & t |
| | | | | |
| LCPI9 | **2** | 1.16740 | 0.28143 [0.5961 | c & t |
| DLCPI9 | **1** | -16.87126 | 0.12649 [0.7221 | c & t |
| | | | | |
| LWPI | **2** | -0.35770 | 1.41984 [0.2331 | c & t |
| DLWPI | **1** | -8.55406 | 1.48822 [0.2221 | c & t |
| | | | | |
| LM1 | **2** | -1.40313 | 2.64785 [0.104] | c |
| DLM1 | **1** | -18.45678 | 2.54379 [0.1111 | c |

* Critical values: -3.99 (1%); -3.42 (5%); -3.13 (10%).

** Numbers in brackets indicate significant levels.

*** c = intercept, t = time trend, 0 = none

## 4. Cointegration tests

We said in section 1 that the main hypothesis to be tested is that if changes in the wholesale prices and in money supply are all transferred to the consumer prices. In statistical terms this means that the wholesale price index, the money supply index and the consumer price indexes drift together, although individually these time series are non-stationary in the sense that they tend upwards or downwards overtime. This common drifting of variables makes linear relationships between these variables exist over long periods of time, thereby giving thus insight into long-term equilibrium relationships of these variables. In other words, if these linear relationships do hold over long periods of time wholesale prices, money supply and consumer prices are cointegrated; if these linear relationships do not hold over long periods of time wholesale prices, money supply and consumer prices are not cointegrated (Katsouli *et al,* forthcoming).

Because we refer in our case to multivariate cointegration analysis, we will consider the Johansen (1988) and Stock and Watson (1988) approaches to cointegration. These approaches make use of the vector autoregression models (VAR). Likelihood ratios (L.R.) are employed for testing the cointegration vectors.

Table 2 summarises the results of our cointegration tests. In order to reach these results we also relied on economic theory and the *a priori* knowledge that is associated with this theory in order to decide the number and the form of the cointegrating regressions. The theory, briefly presented in section one, advocates that

$$\frac{\partial LCPIJ}{\partial LWPI} \geq 0, \frac{\partial LCPIJ}{\partial LM1} \geq 0, \frac{\partial LWPI}{\partial LM1} \geq 0 \text{ for } J=1,2,...9 \tag{4}$$

Furthermore, in the experiments performed we assumed the following

1. Test assumes no deterministic trend in data:
   a. No intercept or trend in CE or test VAR (for LCPI7)
   b. Intercept (no trend) in CE - no intercept in VAR (for LCPI1, LCPI2, LCPI3, LCPI5, LCPI6, LCPI9)

2. Test allows for linear deterministic trend in data:
   a. Intercept (no trend) in CE and test VAR (for LCPI8)
   b. Intercept and trend in CE - no trend in VAR (for LCPI4)

TABLE 2.

Cointegration tests

| L.R. LCPI1 | L.R. LCPI2 | L.R. LCPI3 | 5 Percent Ctitical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|---|---|
| 104.3155** | 137.9891** | 289.6367** | 34.91 | 41.07 | None |
| 30.08461** | 28.18897** | 51.70249** | 19.96 | 24.60 | At most 1 |
| 6.694665 | 9.041891 | 5.717315 | 9.24 | 12.97 | At most 2 |

*(**) denotes rejection of the hypothesis at 5(%) (1%) significance level.
L.R. test indicates 2 cointegrating equation(s) at 5% significant level.

| L.R. LCPI5 | L.R. LCPI6 | L.R. LCPI9 | 5 Percent Critical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|---|---|
| 103.2763** | 152.1051** | 127.1112** | 34.91 | 41.07 | None |
| 25.44838** | 22.20656* | 28.04008** | 19.96 | 24.60 | At most 1 |
| 6.174636 | 5.300644 | 4.035083 | 9.24 | 12.97 | At most 2 |

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.
L.R. test indicates 2 cointegrating equation(s) at 5% significant level.

| L.R. LCPI4 | 5 Percent Critical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|
| 289.6367** | 42.44 | 48.45 | None |
| 51.70249** | 25.32 | 30.45 | At most 1 |
| 5.717315 | 12.25 | 16.26 | At most 2 |

*(**) denotes rejection of the hypothesis at 5% (1) significance level.
L.R. test indicates 2 cointegrating equation(s) at 5% significant level.

| L.R. LCPI7 | 5 Percent Critical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|
| 30.90216** | 24.31 | 29.75 | None |
| 10.96419* | 12.53 | 16.31 | At most 1 |
| 3.420414 | 3.84 | 6.51 | At most 2 |

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.
L.R. test indicates 2 cointegrating equation(s) at 5% significant level.

| L.R. LCPI8 | 5 Percent Critical Value | 1 Percent Critical Value | Hypothesized No. of CE(s) |
|---|---|---|---|
| 30.90216* | 29.68 | 35.65 | None |
| 10.96419 | 15.41 | 20.04 | At most 1 |
| 3.420414 | 3.76 | 6.65 | At most 2 |

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.
L.R. test indicates 1 cointegrating equation(s) at 5% significant level.

From the results in Table 2 it is seen that:

- There are two cointegrating vectors between the variables
  LCPI1, LWPI, LM1
  LCPI2, LWPI, LM1
  LCPI3, LWPI, LM1
  LCPI5, LWPI, LM1
  LCPI6, LWPI, LM1
  LCPI7, LWPI, LM1
  LCPI9, LWPI, LM1
- There is one cointegrating vector between the variables:

0 LCPI8, LWPI LM1

We see in fact that in all cases, but LCPI8, there are two cointegrating vectors among the corresponding three variables. In other words we could say that the hypothesis stated in this paper is not true, except for the case of LCPI8. This means that there is no any long-term equilibrium relationship between consumer prices, wholesale prices and money supply.

The estimated cointegrating vectors are shown in Table 3. Standard errors and t — ratios are shown in parentheses below the estimate coefficients.

From the results in Table 3 we may conclude the following:

- In all cases the cointegrating coefficients have the expected a priori signs. Money supply affects positively consumer prices and money supply affects positively wholesale prices.
- In all cases, but LCPI8, the wholesale price index is cointegrated with the money supply index.
- In all cases, but LCPI8, the consumer price indexes are not cointegrated wih the wholesale price index.
- In all cases, but LCPI8, the consumer price indexes are cointegrated with the money supply index.
- According to the long-term equilibrium relationships the long-term elasticities of consumer prices with respect to money supply indicate the following sensitivity in a decreasing order:

LCPI4(4.58) > LCP3(2.02) > LCPI1(1.77) > LCPI5(1.73) > LCPI9(1.63) > LCPI6(1.32) > LCPI7(0.95) > LCPI2(0.64) > LCPI8(0.22)

It is seen that CPI4 is the most sensitive in changes of money supply and CPI8 is the least sensitive.

TABLE 3

Cointegrating vectors

| | LCPI1 | | LCPI2 | | LCPI3 | |
|---|---|---|---|---|---|---|
| Cointegra-ting Eq: | CointEq1 | CointEq2 | CointEq1 | CointEq2 | CointEq1 | CointEq2 |
| LCPIJ | 1.000.000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 0.000000 |
| | | | | | | |
| LWPI | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 |
| | | | | | | |
| LM1 | -1.771011 | -1.750130 | -0.640208 | -0.832104 | -2.019562 | -1.827432 |
| | (1.65527) | (1.76047) | (0.17516) | (0.09434) | (1.32294) | (1.28646) |
| | (-1.06992) | (-0.99413) | (-3.65489) | (-8.82062) | (-1.52657) | (-1.42051) |
| | | | | | | |
| C | 6.607756 | 6.685404 | -2.591552 | -0.289319 | 8.075382 | 6.976029 |
| | (13.2095) | 914.0490) | (1.31629) | (0.70890) | (10.1232) | (9.84406) |
| | (0.50023) | (0.47586) | (-1.96884) | (-0.40813) | (0.79771) | (0.70865) |

| | LCPI4 | | LCPI7 | | LCPI8 |
|---|---|---|---|---|---|
| Cointegra-ting Eq: | CointEq1 | CointEq2 | CointEq1 | CointEq2 | CointEq1 |
| | | | | | |
| LCPIJ | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 |
| | | | | | |
| LWPI | 0.000000 | 1.000000 | 0.000000 | 1.000000 | -0.628086 |
| | | | | | (0.17157) |
| | | | | | (-3.66077) |
| | | | | | |
| LM1 | -4.580595 | -5.482278 | -0.954504 | -0.891294 | -0.223042 |
| | (1.87989) | (1.06424) | (0.01878) | (0.02147) | (0.14501) |
| | (-2.43663) | (-5.15136) | (-50.8163) | (-41.5228) | (-1.53808) |
| | | | | | |
| TREND | 0.052928 | 0.064732 | | | |
| | (0.02661) | (0.01507) | | | |
| | (1.98886) | (4.29664) | | | |
| | | | | | |
| C | 4.783830 | 6.234976 | | | -0.647116 |

| | LCPI5 | | LCPI6 | | LCPI9 | |
|---|---|---|---|---|---|---|
| Cointegra-ting Eq: | CoitEq1 | CointEq2 | CointEq1 | CointEq2 | CointEq1 | CointEq2 |
| LCPIJ | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 0.000000 |
| | | | | | | |
| LWPI | 0.000000 | 1.000000 | 0.000000 | 1.000000 | 0.000000 | 1.000000 |
| | | | | | | |
| LM1 | -1.728676 | -1.643334 | -1.321481 | -1.375069 | -1.630799 | -1.298198 |
| | (1.53344) | (1.40797) | (0.33438) | (0.44953) | (0.60204) | (0.47097) |
| | (-1.12732) | (-1.16716) | (-3.95209) | (-3.05894) | (-2.70878) | (-2.75642) |
| | | | | | | |
| C | 6.508717 | 5.845256 | 2.866060 | 3.643903 | 5.145191 | 3.123243 |
| | (12.2466) | (11.2446) | (2.61442) | (3.51476) | (4.78809) | (3.74567) |
| | (0.53147) | (0.51983) | (1.09625) | (1.03674) | (1.07458) | (0.83383) |

## 5. Error correction models

According to the generalisation of the Granger (1986) and Engle and Granger (1987) representation theorem, if some variables are cointegrated then there is a long-term relationship between them. Of course, in the short-term these variables may be in disequilibrium, with the disturbances being the equilibrating errors. The dynamics of this short-term disequilibrium relationship between these variables can always be described by an error correction model (ECM). For our case, where we have at most two cointegrating vectors, this error correction model which connects the short-run and the long-run behaviour of the three variables involved is given by the following equation

$$D(LCPIJ_t)=lagged(D(LCPIJt),\ D(LWPI_t),\ D(LMI1_t))+\lambda_1 e_{1,t-1}+\lambda_2 e_{2,t-1}+v_t$$

$$-1 < \lambda 1 < 0 \qquad (5)$$

where J = 1, 2, ..., 9, $e_1$ and $e_2$ = equilibrating errors, and $\lambda_1$ and $\lambda_2$ = short-term adjustment coefficients. In equation (5) the adjustment coefficient $\lambda_1$ is negative, indicating the speed of adjustment of an independent variable (LM1) to thelong-run equilibrium relationship of the dependent variable (LCPIJ). This is not the case for the adjustment coefficient $\lambda_2$, because this coefficient refers to two independent variables (LWPI and LM1).

Because all the variables (in differences) included in equation (5) ar stationary, the error correction model could be estimated using the corresponding restricted VAD models. In fact, all the experiments using the VAR model were performed in order to receive simultaneously the number of the cointegrating vectors, the estimated cointegrating vectors and the corresponding error correction equations.

Employing this restricted VAR methodology, Table 4 (a and b) presents the estimated error correction equations. In order to estimate these equations we took into account those terms only which were relatively significant and their estimated coefficients had the right sign.

From the results in Table 4 we may conclude the following

- All the short-term adjustment coefficients of the first cointegrating equation have the expected negative sign. These negative coefficients show the magnitude of the deviation of the actual consumer price from its long-term equilibrium level which is corrected each month.
- All the short-term adjustment coefficients of the first cointegrating equation, but LCPI1, are significant.
- All the short-term adjustment coefficients of the second cointegrating equation have positive sign and all are significant.
- All the other terms in all the error correction equations have the correct positive sign and are generally significant. This means that short-term changes in the wholesale prices and in the money supply affect positively short-term changes in consumer prices.
- In Table 4 the statistics RC and DC refer to the regression coefficient and the determination coefficient, corresponding to the regression of the predicted variables - derived from the dynamic simulation of each restricted VAR system to include the corresponding error correction equation - on the actual variables. These statistics being very close to one indicate a good adequacy of predictions.
- In all equations, but LCPI3 and LCPI7, D(LWPI) enters with one or two months lag indicating that short-term changes in D(LWPI) are transferred relatively quickly to D(LCPI)s.
- In all equations, but LCPI1, LCPI7 and LCPI8, D(LCPIJ) does not enter, indicating thus that the dynamic history of each of the consumer prices is relatively of low importance.
- In all equations, but LCPI3 and LCPI7, D(LM1) does not enter, indicating thus that short-term changes in D(LM1) are not very important in determining short-term changes in D(LCPI)s. Even in the cases of LCPI3 and LCPI7 where D(LM1) enters in the error corrections equations this term enters

with a time lag of three months, indicating the very slow transfer of changes to D(LCPI)s.

- Finally, comparing models (2) and (3) it is seen that in the case of Greece, the "standard model" of equation (2) is inferior compared with the "error-correction model (ECM)" of equation (3). This is because in almost all cases in Table 4 the adjustment coefficients are significant.

## 6. Conclusions

The purpose of this paper was to investigate the role of wholesale prices and money supply in determining consumer prices in the Greek economy.

For this purpose cointegration analysis was used in order to investigate the cost transfer from wholesale prices to consumer prices and in this respect the paper concluded that a long-term equilibrium relationship does not exist between the two prices, supporting thus that the hypothesis of the study is not true. On the contrary, the paper concluded that a long-term equilibrium relationship it does exist between consumer prices and money supply, supporting thus in this respect the hypothesis of the study.

Consequently, error correction models were developed and estimated employing the restricted VAR methodology. The econometric results were relatively very good for all equations. In all cases the variables were generally significant and the signs were the expected ones. In terms of the estimated short-term adjustment coefficients, which show the part of the deviation of the actual variable from its long-term equilibrium level that is corrected each month, the indexes of "clothing and footwear", "food" and "durable and consumption goods", indicated the largest monthly adjustment, the indexes of "other goods and services", "health and personal care" and "health and personal care", indicated a moderate monthly adjustment, and finally, the indexes of "transport and communication", "housing" and "alcoholic drinks and tobacco", indicated the smallest monthly adjustment. Generally, the standard price determination model explained in section 2 should not be used for forecasting because it has been proved to be inferior than the corresponding error correction model.

In terms of economic policies we believe that two are the most important conclusions of the paper

1. There is no any long-term equilibrium relationship between consumer prices and wholesale prices. This means that there is a "cost-price sqeeze"

between consumer prices and wholesale prices. In other words, wholesale prices respond more than consumer prices during inflationary periods and hence affect their equivalence ratio.

2. There exists a long-term equilibrium relationship between consumer prices and money supply. This means that there is no a "money-price squeeze" between consumer prices and money supply. This long-term equilibrium relationship proved to have different strength in terms of its effects. In other words, the transfer of increases in money supply is greatest for "housing" prices and it is least for "transport and communication" prices.

Finally, taking into account the debate between monetarists and structuralists we may say that our study generally supports the monetarists view in the long-term, but it cannot ignore the structuralists view in the short-term.

TABLE 4a

Error correction equations

| Error Correction: | D(LCPI1) | D(LCPI2) | D(LCPI3) | D(LCPI4) | D(LCPI5) |
|---|---|---|---|---|---|
| CointEq1 | -0.117920<br>(0.02920)<br>(-4.03875) | -0.000338<br>(0.00211)<br>(-0.15990) | -0.226720<br>(0.03479)<br>(-6.51696) | -0.014022<br>(0.00591)<br>(-2.37236) | -0.097134<br>(0.02169)<br>(-4.47.832) |
| CointEq2 | 0.112712<br>(0.02748)<br>(4.10086) | 0.020211<br>(0.00539)<br>(3.74891) | 0.236477<br>(0.03588)<br>(6.59080) | 0.011346<br>(0.00695)<br>(1.63296) | 0.106545<br>(0.02334)<br>(4.56454) |
| D(LCPIJ(-1)) | 0.161907<br>(0.06159)<br>(2.62895) | | | | |
| D(LWPI(-1)) | 0.276370<br>(0.10876)<br>(2.54106) | | | 0.313004<br>(0.08592)<br>(3.64279) | 0.228907<br>(0.14835)<br>(1.54299) |
| D(LWPI(-2)) | | 0.251003<br>(0.10646)<br>(2.35766) | | | |
| D(LM1(-3)) | | | 0.117442<br>(0.07935)<br>(1.48010) | | |
| C | | | | 0.007943<br>(0.00134)<br>(5.91755) | |
| R-squared | 0.141666 | 0.048346 | 0.124617 | 0.083421 | 0.085906 |
| Adj. R-squared | 0.133839 | 0.042561 | 0.119279 | 0.075063 | 0.080366 |
| F-statistic | 18.10016 | 8.356992 | 23.34647 | 9.981135 | 15.50657 |
| DC | 0.99100 | 0.95147 | 0.98385 | 0.97091 | 0.98408 |
| RC | 0.95151 | 0.96251 | 0.94473 | 0.92293 | 0.94200 |

TABLE 4b

Error correction equations

| Error Correction: | D(LCPI6) | D(LCPI7) | D(LCPI8) | D(LCPI9) |
|---|---|---|---|---|
| CointEq1 | -0.051874 | -0.039383 | -0.017087 | -0.060183 |
| | (0.01747) | (0.01050) | (0.00696) | (0.02237) |
| | (-2.96989) | (-3.75198) | (-2.45593) | (-2.69046) |
| CointEq2 | 0.042730 | 0.036440 | | 0.083420 |
| | (0.01295) | (0.00491) | | (0.02926) |
| | (3.29877) | (7.42024) | | (2.85093) |
| D(LCPIJ(-1)) | | | O.119450 | |
| | | | (0.05556) | |
| | | | (2.14996) | |
| D(LCPIJ(-3) | | 0.117277 | | |
| | | (0.05384) | | |
| | | (2.17825) | | |
| D(LWPI(-1)) | 0.171968 | | 0.422420 | 0.314157 |
| | (0.08545) | | (0.08746) | (0.12450) |
| | (2.01252) | | (4.82961) | (2.52333) |
| D(LM1(-3)) | | 0.039446 | | |
| | | (0.02556) | | |
| | | (1.54312) | | |
| C | | | 0.004797 | |
| | | | (0.00126) | |
| | | | (3.81767) | |
| R-squared | 0.095195 | 0.100303 | 0.177040 | 0.065725 |
| Adj. R-squared | 0.089711 | 0.092049 | 0.169535 | 0.060063 |
| D-statistic | 17.35976 | 12.15190 | 23.59208 | 11.60749 |
| DC | 0.98983 | 0.99899 | 0.98036 | 0.98606 |
| RC | 0.94653 | 0.99962 | 0.95231 | 0.922231 |

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