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Characteristics of inflation in Greece: Mean Spillover Effects among CPI Components

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ABSTRACT

The objective of this paper is to investigate the behaviour of various CPI components in terms of their spillover behaviour. This is the first study analyzing the causal relationship between CPI components in Greece. The empirical analysis uses data on different components of the Consumer Price Index (CPI) with 1995 as the base year (1995=100). Data covers the period 1981 to 2009. Our results indicated the primary price movements are transmitted from the energy price indices, i.e. the electricity price index, the energy price index and the fuels and gas price index, while a secondary role also comes from the food and vegetables price index along with the services price index. In terms of causality, the evidence indicates that there is a unidirectional transmission of energy prices disturbance to the remaining CPI components, while innovations (shocks) to the remaining CPI components did not have any significant effect on all indices.

Keywords: CPI inflation, disaggregated data, spillover effects, VAR models, Greece

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1. Introduction

The reaction of consumer prices and inflation to fuel price movements has been investigated by many authors, such as Hooker (2002), Barsky and Kilian (2004) and LeBlanc and Chinn (2004). While Barsky and Kilian (2004) argue that fuel prices increases generate strong inflationary shocks, LeBlanc and Chinn (2004) argue that fuel prices have only a moderate effect on inflation. Moreover, Ferderer (1996) argues that inflation has a negative impact on investment, through a rise in firms' costs and higher uncertainty, leading to postponement of investment decisions and, thus, to lower production and, through conditions of excess demand, to further higher prices. Van Den Noord and Andre (2007), however, provide evidence that the fact the knock-on effects from energy shocks onto core inflation appear weaker versus their counterparts in the 1970s, a fact attributed to the fall in energy intensity as well as to a persistent slack in the aftermath of the bursting of the dotcom bubble. Moreover, the literature argues that oil price shocks can partially pass through into inflation. The link between the two variables is highly important, especially from the front of monetary economic policy implementation, since monetary authorities attempt to keep inflation under control. In empirical terms, the statistical relationship between oil price shocks and the real economy, including the dynamics of inflation, has been estimated by a series of studies. In particular, Blanchard and Gali (2007) with data from the G7 economies provide evidence that suggests that a number of factors determine the impact of oil price shocks on inflation, such as the smaller share of oil in production, the higher flexibility in labour markets and improvements in monetary policy. Gregorio *et al.* (2007) display a substantial decline in oil pass-through, while Den Noord and Andre (2007) also provide evidence that the spillover effects of energy prices into core inflation are small to their counterparts in the 1970s. All these studies explain this diminishing influence of oil shocks through the fall in energy intensity. By contrast, Chen (2009) claim that this energy intensity varies across countries and is positively correlated with energy imports. The intensity depends on certain factors, such as the appreciation of domestic currencies and the higher degree of trade openness.

The use of highly aggregated data for causal inference is quite common in the applied econometric literature. On one side there are researchers who use Granger causality tests with mostly quarterly or annual data (Jung and Marshall, 1985; Rao 1989; Demitriades and Hussein 1996). On the other side are those who use cross-country regressions with data averaged over many years. Causality in these studies is pre-imposed and testing is done on the contemporaneous correlations (Grier and Tullock, 1989; Barro, 1991; Levine and Renelt, 1992; King and Levine, 1993; Levine and Zervos, 1993; Frankel and Roamer, 1999). A number of the above studies have focused on aggregation and the dynamic relationships between variables and shown that aggregation weakens the distributed lag relationships. In addition, they find that aggregation turns one-way causality into a feedback system, while it produces inconsistent estimates and induces endogeneity into previously exogenous variables. Although these studies have already pointed out some potential problems associated with aggregated data, a comprehensive study that focuses on Granger causality with disaggregated data would be of immense value because of the practical significance of causality testing based on aggregated data. Finally, Gulasekaran and Abeysinghe (2002) and Gulasekaran (2004) have derived quantitative results using an analytical framework to assess the nature of the problems created. Overall, the following conclusions emerge. Within a stationary framework, aggregation may (i) create a spurious feedback loop from a unidirectional relation, (ii) erase a feedback loop and create a unidirectional relation and (iii) erase the Granger-causal link altogether. The distortions magnify when differencing is used after aggregation to induce stationarity.

In Greece, some components of the price index exhibit a differentiated behaviour and the relationship with disaggregated price indices may differ among them. It is also clear that it is hard to predict the part of inflation that is not related to domestic economic variables. For instance, fuel prices, which are an important cause of inflation, cannot be predicted with an acceptable degree of accuracy. Because of these reasons we also look at this problem on a disaggregated basis. Hence, our main research question is: ‘What is the nature of the causality between price inflation indices?’ Our secondary research question is: ‘Are disaggregated data more informative about inflationary developments than the main macroeconomic variables?’

This study aims at estimating the nature of the links between the abovementioned variables. As a result, since inflation is a painful problem, we would like to give our contribution to investigating and forming the economic rationale behind the policy decisions affecting prices in the Greek economy. Therefore, the objective as well as the novelty of this paper is to investigate the behaviour of various CPI components in terms of their spillover behaviour. It is expected that certain CPI components would have not been so responsive to changes in other CPI components.

This is believed to be the first study analyzing the causal relationship between CPI components in Greece. Our analysis thus encloses the information from all available sectors of the price index. The research on commodities prices spillover effects has focused exclusively on the international transmission of such indexes movements. This paper, in contrast, tests whether movements in CPI components initially affect one another.

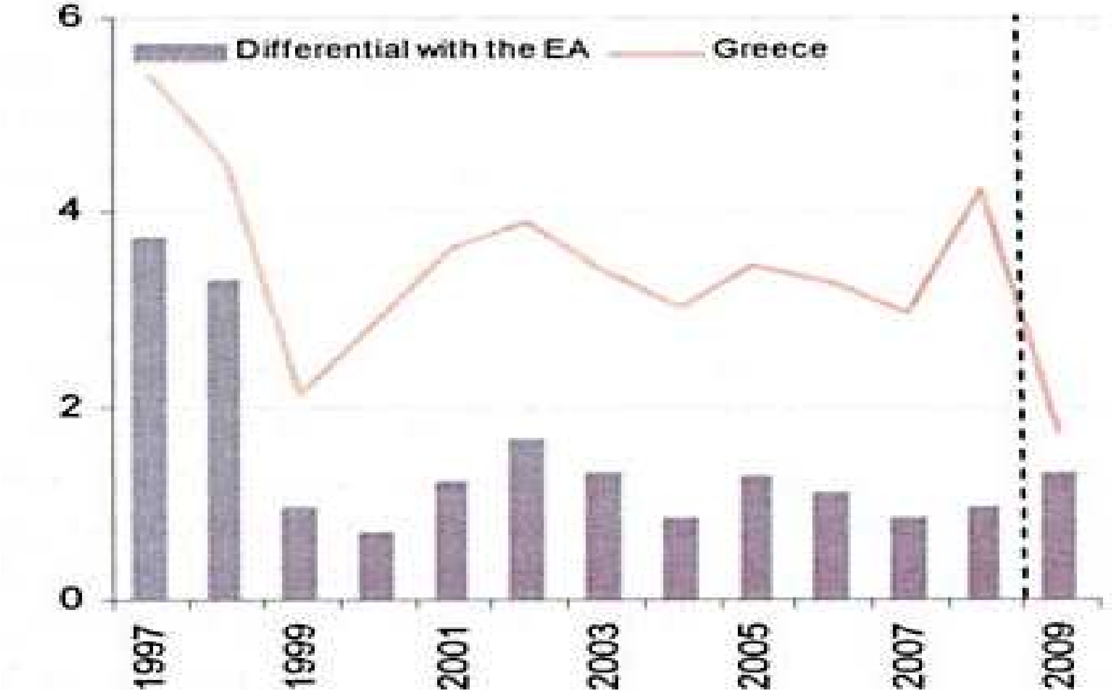
Among the time series approaches univariate measures are distinguished from multivariate methods. The univariate measures differ with respect to the smoothing techniques that are applied. Simple methods like taking moving averages. The multivariate methods basically comprise the vector autoregression (VAR) approach suggested to the measurement of any type of inflation by Quah and Vahey (1995).

2. Inflation and the Economy of Greece

Entry into the Eurozone provided Greece with an improved, stability-oriented environment. The establishment of the euro as the single currency constitutes a big step towards European integration. The European Central Bank was the guardian of monetary stability, while the Stability and Growth Pact was supposed to help ensure fiscal discipline. These changes were crucial benefits for a country carrying the experience of high inflation rates (being at double-digit levels from the early 80s to the mid 90s). In particular, inflation rates were reduced from above 5% in late 1990’s to 1.2% in 2009, though the trend has been upward again, due to unfavourable effects, such as higher oil and food prices and higher domestic consumption taxes.

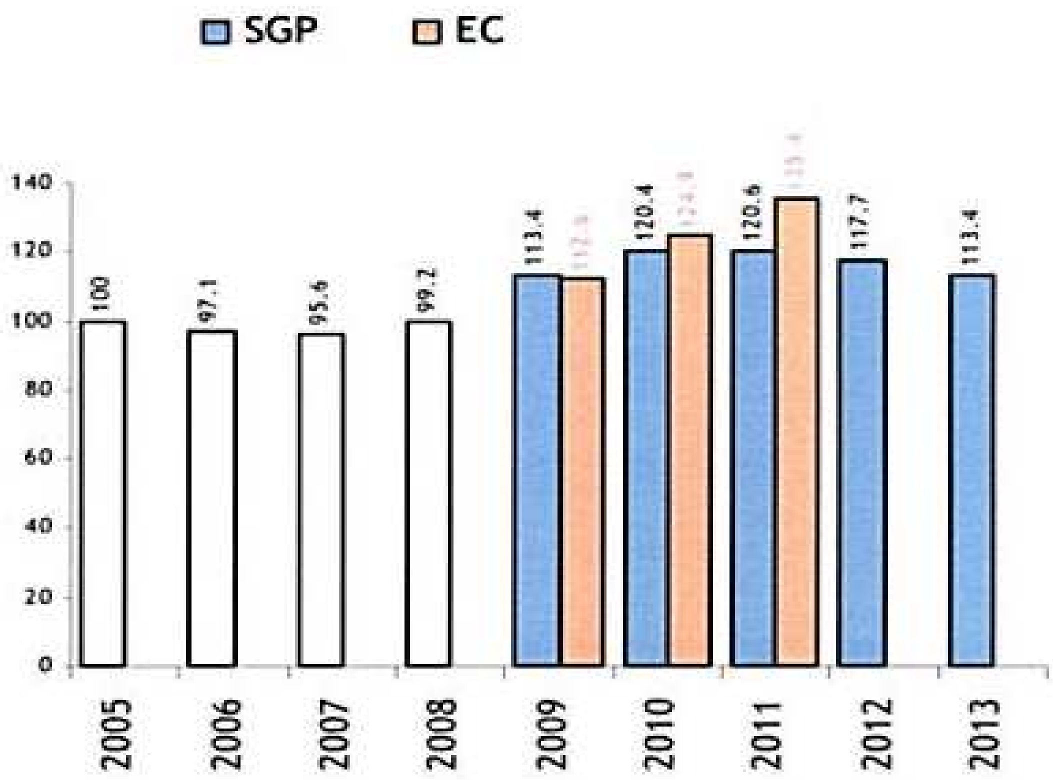
Although inflation in the Eurozone era was low by the country’s historical standards, inflation was relatively high by euro-area standards. The differential with the euro area still remained high (Figure 1). This was due not only to the so-called Balassa-Samuelson Effect (Apergis, 2010), but also to other factors, such as structural characteristics of the economy linked to the malfunctioning of domestic markets (labour market rigidities, i.e. long-term unemployment, low average job tenure, low gross labour flows between industries and sectors, wage-setting institutions, i.e. wage bargaining is highly centralised, wages increases in the public sector well above productivity growth, and imperfections in the functioning of product markets and the reduced degree of competition in many sectors, leading to fast-growing mark-ups), the persistent falling of national savings (primarily due to the presence of persistent public deficits, Figure 2) and the impact of energy costs on the performance of the majority of sectors in the economy (ECB, 2005).

Figure 1. Greek inflation and inflation differential with EU.



Source: ECB (2005)

Figure 2. General government deficit (% GDP)



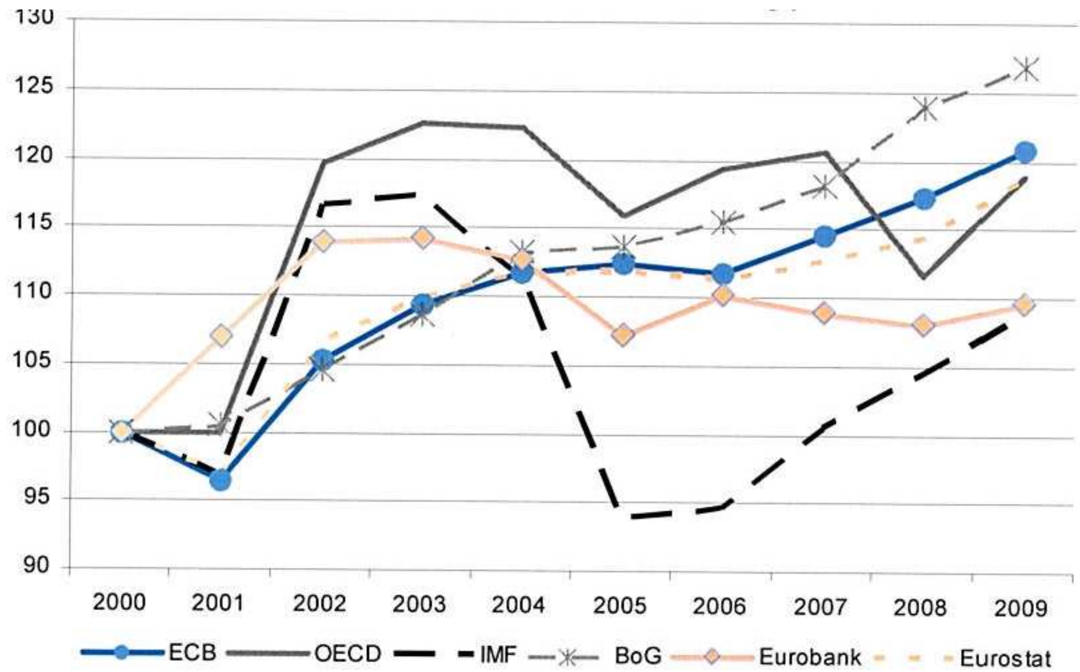
Source: Ministry of Economy: Greece
Notes: SGP shows the projected fiscal deficit under the new stability programme, while the EC shows the projected fiscal deficit prepared of the Greek Ministry of Economy in cooperation with European Committee research analysts.

Moreover, being a member of the Eurozone brought cheap loans and large inflows of capital. But those capital inflows also led to inflation. Wage increases, adjusted for productivity changes, also were much higher than average increase in the other Eurozone member economies. Thus, the rapid rise of wage costs and mark-ups in excess of productivity growth, has contributed to a wage-price spiral. With both prices and wages growing at high rates, competitiveness declined. Over the period 2001-2009, competitiveness, as measured by consumer prices, declined by 20 per cent, measured by unit labour costs, declined by 25 per cent. As a result, the current account deficit rose to about 14 per cent of GDP by the end of 2008.

As a result, along with the painful process of fiscal consolidation, the country needs a substantial ‘internal devaluation’, e.g. a decline in prices to restore competitiveness and rebalance the economy towards external demand, though the largest sector of the economy, i.e. the services sector, does not show any signals of competitiveness deterioration, while agricultural products, durables and semi-durables have witnessed the sharpest lost in competitiveness. The reason is the absence of any incentive in those sectors to increase productivity. Therefore, policy makers must address the overall competitiveness deterioration via structural reforms in product markets, which will weaken the pricing power of oligopolies and enhance price competitiveness.

Figure 3 displays relative prices of the three main sectors of tradable goods and services against major trading partners. The picture shows that prices for industrial and agricultural products have increased about 30% relative to the twelve major trading partners since 2000. By contrast, relative prices in the services sector (measured against the 6 major competitors in tourist services) have remained relatively stable, suggesting that price competitiveness in this sector has not deteriorated over the last decade.

Figure 3. Prices relative to major trading partners



Source: Bank of Greece, 2010 Governor's Annual Report
Notes: BoG = Bank of Greece, Eurobank – estimates by the research analysis department of the Eurobank, Greece.

Nevertheless, a reasonably high rate of inflation will have the positive side effect of making the reversal of the debt-to-GDP ratio easier than it is expected. Hence, of the ECB is forced to maintain a more expansionary stance in monetary policy to balance out the effects of painful fiscal consolidation, inflation might increase.

3. Empirical Analysis

3.1. Data and Methodological Issues

The empirical analysis uses data on different components of the Consumer Price Index (CPI) with 1995 as the base year (1995=100). Data covers the period 1981 to 2009. The index is Laspeyres chained. Data comes from the Datastream database and is based on a quarterly basis. Finally, we employ the RATS 6.1 software to serve the goals of our empirical analysis.

The short-run dynamic interactions among the variables are characterized by feedbacks going from one variable to the other or in both directions, depending on the causal relationship. This provides justification for examining the direction of the causal links among the variables under consideration through Granger causality tests.

Several time-series methods have been developed to study interrelationships among various variables, including commodities price indices. Vector Autoregression (VAR) models have extensively been used to study the contemporaneous correlations among various indices and to examine the dynamic response of certain markets to artificial shocks. We use a VAR model to study the interrelationships between the various components of the CPI index in Greece. The VAR model allows us to capture both the contemporaneous and lagged influence of the endogenous variables on each other. It is also well suited to study dynamic responses of the variables to shocks by way of the variance decomposition (VDCs) analysis. Another important property of VAR models is that it is not restrictive if error terms are serially correlated, because any serial correlation can be removed by adding more lags to the dependent variables.

To serve better our research goal and to overcome certain statistical deficiencies due to the lack of adequate observations, we aggregate (as a weighted average) certain CPI components. In particular, the following categories of CPI will be used in the analysis: Electricity (EL), Energy (EN), Fuels and gas (FG), Food and vegetables (FV), Services (SER), Beverages (BEV), Durables (DUR), Education (ED), Health (H) and Semi-durables (including clothing, footwear and furniture) (SDUR). Throughout the empirical analysis, lower case letters indicate variables in logarithms.

3.2. Unit Roots Tests

The results related to unit root tests are reported in Table 1. The ADF test is based on the following regression model, assuming a drift and linear time trend:

$$\Delta y_t = a_0 + \sum_{i=1}^{p} \Delta y_{t-1} + \beta\, t + \gamma\, y_{t-1} + \varepsilon_t$$

where t = time trend and ε_t = random error. The null hypothesis in the ADF test is that there is a unit root where $\gamma = 0$. For all the variables to be stationary, we must reject the null hypothesis in favour of the alternative hypothesis.

As suggested by Enders (1995), we carried out unit root tests on the endogenous variables. Table 1 reports that based on augmented Dickey-Fuller [1981] tests, the hypothesis that the variables el, en, fg, fv, ser, bev, dur, ed, h and sdur contain a unit root cannot be rejected at the 5 percent significant level. When first differences are used, unit root nonstationarity is rejected at the 5 percent significant level, suggesting that all the variables under study are I(1) variables.

Table 1. Augmented Dickey-Fuller unit-root tests

	Without Trend		With Trend	
Variables	Levels	First Differences	Levels	First Differences
el	-0.88(4)	-4.11(3)*	-0.99(3)	-4.36(2)*
en	-0.71(5)	-5.63(3)*	-1.74(3)	-7.14(2)*
fg	-0.34(4)	-4.71(3)*	-1.77(4)	-6.08(3)*
fv	-1.05(3)	-4.48(2)*	-1.93(4)	-5.11(2)*
ser	-1.54(3)	-4.56(2)*	-1.37(4)	-6.03(2)*
bev	-2.53(4)	-4.47(3)*	-2.84(4)	-4.93(2)*
dur	-1.78(4)	-4.84(3)*	-1.94(3)	-5.12(2)*
ed	-1.63(4)	-4.56(2)*	-1.85(4)	-4.88(2)*
h	-1.77(4)	-4.38(3)*	-2.10(4)	-4.69(3)*
sdur	-1.68(3)	-4.71(2)*	-1.90(4)	-4.93(3)*

Note: Figures in brackets denote the number of lags in the augmented term that ensures white-noise residuals. *denotes significance at the 5 percent level.

3.3. Granger-Causality Tests and Price Transmissions

To investigate the short-run interactions among the three prices under study, a VAR model is defined as:

$$\Delta Pt = C + \sum_{i=1}^{k} bi\Delta Pt-i + \upsilon t$$

where Δ is the difference operator; Pt is a vector of order 10 with elements el, en, fg, fv, ser, bev, dur, ed, h and sdur; Bi is a 10×10 coefficient matrix; υt is an error-terms vector; and C is a 10×1 constant vector. In this part of the study, we develop our ten-variable standard form Vector Autoregression (VAR) system, which includes the CPI price components series. Each variable is treated as endogenous and is regressed on lagged values of itself and the other variables. The intercept parameters are the only exogenous variables in the model. A VAR model is very appropriate because of its ability to characterize the dynamic structure of the model as well as its ability to avoid imposing excessive identifying restrictions associated with different economic theories. That is to say that such a model does not require any explicit economic theory to estimate various models. Moreover, its important feature is the employment of the estimated residuals, called VAR innovations, in dynamic analysis. These VAR innovations are treated as an intrinsic part of the system.

Table 2. Test results for the determination of the lag length in the VAR model

Null Hypothesis	Alternative Hypothesis	Acceptance Probability
4 lags	8 lags	0.999
4 lags	6 lags	0.658
2 lags	4 lags	0.003
3 lags	4 lags	0.007

Notes: Acceptance probability is based on the Chi-square distribution for the likelihood ratio test. Following the suggestions of Sims (1980), we take into account small sample bias by correcting the likelihood ratio statistic by the number of parameters estimated per equation. Thus, the likelihood ratio test = $T - C\{\log[\Sigma 0] - \log[\Sigma 1]\}$, where $\Sigma 0$ and $\Sigma 1$ are the variance covariance matrices of the residuals estimated from a VAR model with a constant and the number of lags under the null and alternative hypotheses, respectively. T is the number of used observations and C is the number of variables in the unrestricted equations. The degrees of freedom for the Chi-square test equal the number of restrictions implied by variation in the lag length.

The estimation of the VAR model requires that we determine the appropriate lag length of the variables in the model where the maximum lag length n is chosen such that the residuals υt are white noise. We use the likelihood ratio test, as outlined in Hamilton (1994). Table 2 presents the results of the likelihood ratio tests for lag determination. The null hypothesis that a set of variables is generated from a VAR system with n lags is tested against the alternative specification of n1 lags where $n < n1$. Based on the Chi-square significance level, there is a clear support for the null hypothesis of four lags. We do not allow for different lag length since it is common to use the same lag lengths for all equations in order to preserve the symmetry of the system (Bayoumi and Eichengreen, 1992; Blanchard and Quah, 1989). Finally, all ten equations include a dummy variable that considers the 1992 EMU event. This variable takes values of one for the last quarter in 1992 and zero otherwise.

3.4. Granger Causality Tests

Granger-causality is examined through Wald tests for block exogeneity, which allows us to examine whether the lag structure of an excluded variable adds to the explanatory power of the estimated equation. In other words, a test of causality is whether the lags of one variable enter the equation for another variable. Table 3 presents the most important Granger-causality test results. All equations support certain econometric diagnostics, such as absence of serial correlation (LM), absence of misspecification (RESET) and presence of homoskedasticity (HE).

In particular, electricity prices (el), energy prices (en) and fuel and gas prices (fg) Granger-cause all the remaining seven CPI components. Next, services prices (ser), education prices (ed) and health prices (h) Granger cause durables prices (dur) and semi-durables prices (sdur). Finally, Food and vegetables prices (fv) Granger cause education prices (ed) and health prices (h). The results do not support the presence of significant feedbacks between aggregate CPI components.

Table 3. Granger causality tests

Equation	Null Hypothesis	Wald-Statistic	p-value
Δfv	Electricity prices do not cause food and vegetables prices	22.35	0.00
LM = 6.54[0.52] RESET = 1.63[0.27] HE = 1.83[0.37]			
Δser	Electricity prices do not cause services prices	29.06	0.00
LM = 10.72[0.41] RESET = 1.42[0.34] HE = 0.81[0.49]			
Δbev	Electricity prices do not cause beverages and beer prices	21.36	0.00
LM = 16.33[0.27] RESET = 1.46[0.32] HE = 0.70[0.53]			
Δdur	Electricity prices do not cause durables prices	19.55	0.00
LM = 14.35[0.32] RESET = 1.49[0.31] HE = 0.93[0.47]			
Δed	Electricity prices do not cause education prices	35.82	0.00
LM = 13.27[0.37] RESET = 1.11[0.39] HE = 0.71[0.54]			
Δh	Electricity prices do not cause health prices	31.06	0.00
LM = 10.09[0.46] RESET = 1.16[0.44] HE = 0.49[0.69]			
Δsdur	Electricity prices do not cause semi-durables prices	21.28	0.00
LM = 5.43[0.67] RESET = 1.28[0.42] HE = 0.52[0.64]			
Δfv	Energy prices do not cause food and vegetables prices	24.71	0.00
LM = 15.49[0.37] RESET = 2.44[0.22] HE = 0.81[0.42]			
Δser	Energy prices do not cause services prices	17.11	0.00
LM = 13.29[0.43] RESET = 2.36[0.20] HE = 0.39[0.71]			
Δbev	Energy prices do not cause beverages and beer prices	25.46	0.00
LM = 17.40[0.27] RESET = 2.08[0.25] HE = 1.12[0.31]			
Δdur	Energy prices do not cause durables prices	18.89	0.00
LM = 16.44[0.30] RESET = 1.96[0.23] HE = 0.73[0.38]			
Δed	Energy prices do not cause education prices	39.76	0.00
LM = 3.58[0.81] RESET = 1.09[0.56] HE = 0.62[0.41]			
Δh	Energy prices do not cause health prices	28.93	0.00
LM = 14.42[0.26] RESET = 2.11[0.28] HE = 0.67[0.38]			
Δsdur	Energy prices do not cause semi-durables prices	23.28	0.00
LM = 11.07[0.33] RESET = 2.48[0.16] HE = 0.56[0.43]			

Equation	Null Hypothesis	Wald-Statistic	p-value
Δfv	Fuel prices do not cause food and vegetables prices	27.15	0.00
LM = 10.51[0.57] RESET = 1.36[0.24] HE = 0.72[0.39]			
Δser	Fuel prices do not cause services prices	18.88	0.00
LM = 9.37[0.68] RESET = 1.18[0.29] HE = 1.88[0.16]			
Δbev	Fuel prices do not cause beverages and beer prices	18.35	0.00
LM = 11.62[0.51] RESET = 1.72[0.21] HE = 0.52[0.42]			
Δdur	Fuel prices do not cause durables prices	17.24	0.00
LM = 12.35[0.48] RESET = 1.67[0.23] HE = 0.66[0.35]			
Δed	Fuel prices do not cause education prices	26.72	0.00
LM = 8.54[0.72] RESET = 1.19[0.18] HE = 0.62[0.45]			
Δh	Fuel prices do not cause health prices	26.33	0.00
LM = 9.11[0.53] RESET = 1.64[0.20] HE = 0.83[0.34]			
Δsdur	Fuel prices do not cause semi-durables prices	29.09	0.00
LM = 14.83[0.38] RESET = 2.06[0.13] HE = 0.62[0.44]			
Δdur	Services prices do not cause durables prices	37.19	0.00
LM = 13.72[0.50] RESET = 1.44[0.21] HE = 0.82[0.34]			
Δsdur	Services prices do not cause semi-durables prices	28.84	0.00
LM = 14.52[0.46] RESET = 1.72[0.19] HE = 0.75[0.35]			
Δdur	Education prices do not cause durables prices	34.48	0.00
LM = 7.38[0.68] RESET = 2.10[0.17] HE = 1.05[0.30]			
Δsdur	Education prices do not cause semi-durables prices	37.49	0.00
LM = 9.84[0.58] RESET = 1.81[0.20] HE = 0.82[0.34]			
Δdur	Health prices do not cause durables prices	36.82	0.00
LM = 17.48[0.28] RESET = 2.13[0.18] HE = 0.55[0.51]			
Δsdur	Health prices do not cause semi-durables prices	24.49	0.00
LM = 13.34[0.33] RESET = 1.66[0.24] HE = 0.84[0.40]			
Δed	Food and vegetables prices do not cause durables prices	41.01	0.00
LM = 11.92[0.46] RESET = 2.16[0.16] HE = 0.52[0.50]			
Δh	Food&vegetables prices do not cause semi-durables prices	34.58	0.00
LM = 11.32[0.47] RESET = 1.18[0.42] HE = 0.67[0.45]			

3.5. Variance Decompositions

To ascertain the importance of the dynamic relationship among the variables under study, we obtained forecast error variance decompositions. Variance decompositions tell us the percentage of the variance in a variable that is due to its own "shock" and the "shocks" of the other variables in the VAR system. If a shock explains none of the forecast error variance of a particular variable at all forecast periods, it means that this particular variable evolves independently of the series. In other words, this variable sequence is exogenous. On the other extreme, the variable would be endogenous if all of its error variance is explained by the shock. This analysis allows us to examine the relative importance of each random innovation to the variables in the VAR system. In standard VAR methodology the contemporaneous correlation among the variables involved in the system is purged by the Cholesky orthogonalization procedure.

Tables 4 through 10 capture the variance decompositions and the results indicate that each series explains a substantial proportion of its own past values. It is also interesting to note that as the time horizon expands, a particular variable accounts for smaller proportions of its forecast error variance. The followed results correspond to the following ordering of equations: fv, el, en, fg, ser, bev, dur, ed, h, sdur. Generally speaking, this ordering reflects the fact that fuel prices have an influence on all the remaining variables in their model, but their own behaviour is least determined by other variables included in the model. This is quite a plausible assumption, because fuel prices are largely determined by world market conditions, rather than conditions within the Greek economy (although, tax policy may put extra burden to those who make use of fuel prices as well as to the rest of the economy, through the indirect channel of the cost of production).

Table 4. Variance decompositions of food and vegetables price index (fv-%)

Period	fv	el	en	fg	ser	bev	dur	ed	h	sdur
1	41.1	16.2	10.3	9.0.	5.2	3.2	4.4	1.4	5.2	4
4	35.6	20.4	19.3	10.6	6.9	2.9	2.6	2.3	4.7	1
8	30.3	22.8	20.5	12.1	6.9	4.7	5.1	3.7	6.1	2
12	24.9	25.3	26.2	18.7	7.1	5.7	5.6	4.9	9.4	1

Notes: Numbers represent the percentage of the variance of the nth-period ahead forecast error for prices that are explained by the variables in the VAR model.

Table 4 indicates that the variance in the food and vegetables index could be explained mainly by itself and developments in the electricity, energy and fuels and gas indices. Over a 20 quarter time period, between 35% and 40% of the forecast error variance in this index could be traced to the shocks in the three indices mentioned above. In the first quarter following the shock, the food and vegetables index explains about 41% of its own variance, while 16%, 10% and 9% is explained by the electricity, energy and fuels and gas indices, respectively. Only after the fourth quarter do we observe a significant portion of the food and vegetables index variance that is explained more heavily by the remaining price indices.

Table 5. Variance decompositions of services price index (ser-%)

Period	fv	el	en	fg	ser	bev	dur	ed	h	sdur
1	4.5	15.7	10	8.0.	35.3	2.5	6.4	4.4	2.2	11
4	4.7	19.4	12.9	9.2	29.5	2.5	5.8	4.5	2.5	9
8	5.6	21.4	15.3	10.2	22.5	3.9	6.2	4.8	4.1	6
12	6.2	24.2	18	13.3	17.4	4.1	6.1	4.8	4.9	4

Notes: Similar to Table 4

Table 5 shows the variance decompositions of the services price index. It indicates that in the very short-run the services index is mainly explained by the electricity price index (16%), the energy price index (10%), the semi-durable price index (11%) and the fuel and gas price index (8%). All these four price indices explain a relatively significant proportion of the services price index forecast error variance. Their portion remains at high levels even after 20 quarters. The results suggest that there is a significant spillover effect between services prices and energy prices. This seems to support our premise that the services sector movements are significantly affected by the developments and the cost structure in the energy sector even in the long-run.

Table 6. Variance decompositions of beverages and beer price index (bev-%)

Period	fv	el	en	fg	ser	bev	dur	ed	h	sdur
1	5	17.3	11.1	10.0.	4.1	32	3.4	3.2	7.2	6.7
4	5.2	19	12.5	11.4	4.5	23.6	3.9	3.8	7.6	8.5
8	5	22.5	14.2	13.6	5.2	19.3	4.3	4.2	7.7	4
12	4.8	24.1	16.7	14.7	5.9	12.5	5	4.6	8.3	3.4

Notes: Similar to Table 4

Table 6 summarizes the forecast error decomposition of the beverages and beer price index. It seems that this index's movements are explained by a sizeable proportion of the three price indices related to the energy sector error variance both in the short- and in the long-run. This is an interesting finding as we expected that one more industrial sector's cost movements in Greece would be affected by energy sector's developments.

Table 7. Variance decompositions of durables price index (dur-%)

Period	fv	el	en	fg	ser	bev	dur	ed	h	sdur
1	5.1	15.3	10.5	12.4.	18.1	2.3	25.3	4.3	7.7	1
4	5.2	17.1	11	13.8	18.2	2.6	20.2	4.5	7.4	0
8	5.4	19.5	12.4	15.2	18.2	2.3	14.7	4.1	7.1	1.2
12	5.6	20.1	13.4	17.1	18.9	2.5	10.5	4	7.2	0.7

Notes: Similar to Table 4

Table 7 shows the variance decompositions of the durables price index. It indicates that in the very short-run the index is mainly explained by the electricity price index (15.3%), the energy price index (10.5%), the fuel and gas price index (12.4%) and the services price index (18.1%). All these four price indices explain a relatively significant proportion of the durables price index forecast error variance. Their portion remains at high levels even after 20 quarters, i.e. about 70%. The results suggest that there is a significant spillover effect between durables prices and energy and services prices. This seems to support our premise that durables industrial sector movements are significantly affected by the developments and the cost structure in the energy sector as well as by developments in the services sector even in the long run.

Table 8. Variance decompositions of education price index (ed-%)

Period	fv	el	en	fg	ser	bev	dur	ed	h	sdur
1	15.1	16.6	10.1	14.5.	4.1	2	5.6	24.1	7.3	0.6
4	16.2	17.6	11.5	15.4	4.2	2.3	5.7	19.2	6.4	0.5
8	16.6	20.3	12.7	17.5	4.2	2	5.9	13.7	6.2	0.9
12	17.1	21.5	13.4	18.3	3.2	2.4	6.3	12.4	6	0.4

Notes: Similar to Table 4

Table 9. Variance decompositions of health price index (h-%)

Period	fv	el	en	fg	ser	bev	dur	ed	h	sdur
1	14.2	17.5	10.5	15.8.	3.2	1.1	5.9	2	27.3	2.5
4	15.2	19.4	11.9	17	3.7	1.3	4.9	1.3	24.7	0.6
8	15.3	21.1	12.3	17.7	3.9	2.1	5.3	1.6	20.4	0.3
12	16.1	21.8	13.5	18.6	3.1	2.2	5.6	1.3	15.7	2.1

Notes: Similar to Table 4

Tables 8 and 9 summarize the forecast error decomposition of the education and the health price index, respectively. It seems that these indices' movements are explained by a sizeable proportion of the three price indices related to the energy sector error variance along with that from the food and vegetables sector both in the short- and in the long-run, 54% and 65%, respectively for the education sector and 46% and 64%, respectively for the health sector. This is an interesting finding as we expected that non-industrial sectors' cost movements would be mainly affected by energy sector's developments.

Table 10. Variance decompositions of semi-durables price index (sdur-%)

Period	fv	el	en	fg	ser	bev	dur	ed	h	sdur
1	2.1	24.1	15.6	20.1.	2.2	1.4	4.3	1.7	6.2	22.3
4	2.4	26.7	17.5	22.3	2.5	1.6	3.5	1.8	4.8	18.9
8	2.3	27.4	18.3	24.1	2.7	2	3.6	1.8	3.2	14.6
12	2.2	28.8	19.5	24.5	2.9	2	3.6	1.9	3.1	11.5

Notes: Similar to Table 4

Finally, Table 10 shows the variance decompositions of the semi-durables price index. It indicates that in the very short-run the index is mainly explained by the electricity price index (24.1%), the energy price index (15.6%) and the fuel and gas price index (20.1%). All these three price indices explain a relatively significant proportion of the durables price index forecast error variance. Their portion remains at high levels even after 20 quarters. The results suggest that there is a significant spillover effect between semi-durables prices and energy prices. This seems to support our premise that semi-durables industrial sector movements are significantly affected by the developments and the cost structure in the energy sector both in the short and in the long run.

4. Discussion of the Results

Our empirical analysis shows that the empirical findings have highlighted the causality running from fuel prices towards the other CPI components. In other words, any rises in fuel prices pass on to the remaining parts of the economy and from the consumer standpoint (households and industry) the energy bill grows, whereas from the production standpoint, firms have to content with a rise in unit costs, and, therefore, in their charging prices. Thus, such rises in fuel prices represent an inflationary shock that is accompanied by second-round effects. More particularly, our results show that in Greece, any oil price increases affect mainly the conditions of the supply side in the economy since energy is the primary input of the production process (Greece is heavily dependent on oil imports to satisfy their domestic needs for production and consumption). As a result, the cost of production increases. Thus, our empirical findings allow energy prices to affect the Phillips curve, which maps deviations of actual inflation from targeted inflation (set by the European Central Bank) to the current level of output gap, to capture inflationary effects in all sectors of the economy, and, in turn, to change the trade-off between inflation and unemployment in the Greek economy.

These empirical findings are also supported by the Real Business Cycle (RBC) theory whereby energy price shocks are considered as supply or technological regress. Moreover, following energy price rises, households may ask for increasing wages to restore their purchasing power, leading to price-wage loops. Next, turning to the firms, they can pass on such energy and wage rises to selling prices, which generate upward revisions of higher price expectations, which are diffused in all components of economic activity, especially in all manufacturing and service sectors.

The above findings imply that Greek economic authorities could not afford worrying only about growth and unemployment, but also about inflation, though the participation in the Euroland was supposed to alleviate the most part of this inflation burden. At the root of the inflation problem is the fact that prices and, consequently, wages rise much faster than the country's Eurozone competitors. This loss of competitiveness can no longer be compensated for by currency depreciation. Moreover, wage pressures and rigid labour laws characterizing the Greek labour market do not help the competitiveness problem either.

Over time, inflation must be kept at low levels; that means that the economy will see its debt burden worsened by deflation. However, deflation is rather a painful process, which invariably takes a toll on growth and employment, a fact that is expected to aggravate the debt burden in the future along with all the recent negative fiscal developments. The Greek inflation problem can been handled either through the channel of tax policy or, primarily, through the deregulation and the opening of certain sectors in the economy characterized by monopolistic or oligopolistic conditions as well as through a stronger labour market flexibility (the so called structural economic changes). In particular, the lack of open markets impedes competition from driving down prices. Greece is considered to be the least ‘trade open’ economy among the remaining European Union members, with trade covering only 15% of GDP. This feature of the economy makes the life of domestic monopolistic markets easier, as competition from abroad is restricted, leading to prices acceleration. As an alternative, the euro area members could adopt more expansionary economic policies. However, this policy option is an anathema as the followers of ‘inflation scepticism’ will never adopt such an option.

5. Conclusions and Policy Implications

This empirical study examined the relationship among various CPI components for the case of the Greek economy. The analysis covered the period 1981 to 2009 (on a quarterly basis) and considered the CPI components price indices. Our results indicated the primary price movements are transmitted from the energy price indices, i.e. the electricity price index, the energy price index and the fuels and gas price index, while a secondary role also comes from the food and vegetables price index along with the services price index.

In addition and in terms of causality, the evidence indicates that there is a unidirectional transmission of energy prices disturbance to the remaining CPI components, while innovations (shocks) to the remaining CPI components did not have any significant effect on all indices. The implication is that certain sectors are shielded from disturbances originating sectors excluding those related to energy prices. These empirical results are crucial for policy makers as well as for macroeconomists, since they support the pass-through effect of oil prices into inflation and, therefore, the efficiency of policy makers to keep inflation under control.

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