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Prices and Exchange Rate of Hellenic Drachma (GRD), during 1981-1995: Are they Dependent on those of EU-partners?

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Abstract
The paper presents empirical results on an import prices equation to the case of the small open Hellenic economy, during her course to the European Monetary Union, in the 1980s until mid-1990s. The analysis employs cointegration theory to examine the long-run co-movements of prices, effective exchange rate of GRD and unit labour cost of the European countries which export to Greece. Innovation accounting is also used so as to detect the dynamics of the data set. We found slight evidence to support long run equilibrium, however, it was only the Hellenic inflation rate which was adjusting to the deviations from this. The fragile stability of the system is confirmed by the impulse response functions examination where the exchange rate of the GRD do not converge to its long-run values, even after a 3 years period from the one unit-shock in various innovations. The determinant role of the growth rate of the unit labour cost and therefore of European countries' prices to the exchange rate of GRD, to the Hellenic inflation rate, and less to the growth rate of the import prices is (1) justified by its high proportion to their variance decomposition and (2) became apparent approximately after 9 months. The latter seems to amount to the "contract-period" in the Magee's terminology.

Keywords: Trade Balance Adjustment through exchange rate policies; European Monetary Integration; Unit Root Tests; Co-integration Analysis; Innovation Accounting;

JEL Classification: F310; F320; F360; C500.

1. Introduction.

Eventhough, Greece's accession to the EEC, in January 1981, was mainly a political decision, the economic consequences of this action proved to be decisive for country's future development. The most important economic effect is observed to be the structural change of the Hellenic production (Georgakopoulos, 1995). This concerns external as well as internal factors, the result of which was the country's des-industrialization. The latter combined with the rigid CAP led to the relative increase of services[1] (Lianos and Lazaris, 1995) which are mainly dependent from the foreign income (e.g. international trade, tourism, financial services etc). The aggregate supply's deficit was always true in the case of Greece, so that imports

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[1] In GDP's constant prices 1970, the parts of primary, secondary, tertiary production's sectors, for the years 1970, '80, '87, '90 and '93 was respectively 18,2%, 14,5%, 13%, 11% and 11,9% and 31,4%, 32,4%, 30,2%, 30,4%, 28,1% as well as 50,4%, 53,1%, 56,8%, 58,6%, 60%.

covered it. In their turn they were financed by the surplus of maritime or tourist services and the migrations' wires. Thus, the Hellenic economy didn't face Balance of Payments problems till the early 1980s. However, this des-industrialization (mostly, textile, clothes, footwear, agricultural industry, etc) as an outcome of the effects of Greece's accession into the EEC, as well as the incorrect extensive Hellenic economic policy during the international recession's period of the 1980's, has rapidly raised the current account deficit and furthermore the country's external debt (Georgakopoulos, 1995)[2]. The post World War II Hellenic model for economic development which has been in favour of protectionism for the domestic production (through exchange controls, imports substitution, exports subsidiaries, financial motives for investments etc) could not prepare the infant Hellenic industry to overcome the competition of the old European enterprises. Although, the Hellenic exports didn't face any obstacle in the European markets even since 1968, the respective protectionism instruments of Greece were suppressed only after 1981. Consequently, the deterioration of the Hellenic Trade Balance, should have been anticipated (Giannitsis, 1994). The free inflows of high quality European traded goods in Greece, joined by the wrong extensive economic policy practised[3] by the socialist governments of A.Papandreou, in the 1980s, as well as the diminishing demand of low income elasticity and value added Hellenic exports to the European markets, contributed to the des-industrialisation and the increase of the country's external des-equilibrium. For the latter an important factor has been the destination markets' switch of Hellenic exports, e.g., from East-European and Arab to the EEC's member countries.

Thus, from 1981 when Greece constitutes a full member state of EEC, it is normal to expect its main macro-economic indicators to be dependent from the European developments, for instance, the EMS, the Unified European Act, the Delhor's report, the Maastricht Treaty etc. The EEC's member countries in the 1980s confront the consequences of the deregulation, the financial globalisation and the international monetary system's titling which alter the global equilibrium to more fragile one (Cartapanis, 1996), looking forward with their decision attached to the unified market and furthermore to the EMU. The determinant lever (Pollin, 1996) in this direction was the EMS and Greece followed[4] its' particular phases (Commelin, 1997)[5] with a short delay. Thus, the European conjuncture first, from 3/1979 to 1/1987, with the relatively independent monetary policy of the member countries, allowed the Bank of Greece to continuing the sliding rate policy of the GRD; secondly, from 1/1987 to 7/1990 with the relative exchange rate stability and the gradual monetary policy co-ordination gave reasons for the shift to the strong GRD policy by the Bank of Greece while proceeding to the above co-ordination; thirdly, from 7/1990 to 8/1993 with the intra-Europe free capital flows gave reasons for suppressing any exchange control by the Hellenic authorities until March 1994. Briefly, European developments enabled Hellenic policymaker to follow as main policies, first, the sliding GRD-price-competitiveness till 1987 while between 1988 and 1995 (for our study) the des-inflation-price-competitiveness one.

[2] For the successive periods 1974-'80, 1981-'90 and 1991-'94, the Current Account deficit as GDP's percentage, on the average, rose from 7,3% to 9% and 9,7% respectively while as regards the debts figures these was 2,7%, 12,3% and 12,2% respectively.

[3] Mainly because of the so-called political cost, in the infantile Hellenic democracy (after 1967-'74 dictatorship and the effects of the Turkish invasion on Cyprus).

[4] Although the Greek Drachma (GRD) didn't participate to the European exchange rate mechanism till 1998 while was part of the ECU.

[5] Explained in terms of Mundell's incompatible trilogy theory.

In this paper we focus on the determinant role of the unit labour cost of the European partners which export to Greece (*ulcm*) and therefore the respective prices, to the effective exchange rate of the GRD and the domestic prices (*cpi, muv*).

The rest of the paper is organised as follows. In the next section we discuss methodological issues. Sections 3 and 4 present the empirical analysis for the variables of interesting. Finally, section 5 offers some tentative[6] conclusions.

2. Economic and Econometric Methodological Issues.

As a starting point we use the decomposition approach for the trade balance which constitutes part of the Elasticity's and/or (Niehans, 1984) monetary approach for the balance of payments. This approach can be distinguished in "Direct" and "Indirect" methods, depending on whether the exchange rate is or it is not included into the independent variables of the models.

We took elements mainly from Herd (1987) and Kravis and Lipsey (1977) as well as Spitaller (1980), adjusting their equations for our aggregate data set, not making any distinctions about the country of origin and the destination market. Thus, we construct weighted indices for the unit labour cost and the nominal exchange rate of the GRD (i.e., effective GRD) on the basis of the relative weight of the total Hellenic import trade. Our primitive "eclectic" model may be written as follows:

$$muv_t = \alpha + \beta_1\, ulcm_t + \beta_2\, cpi_t + \beta_3\, epi_t + \beta_4\, em_t + u_t \qquad (1)$$

where muv_t is the index of unit value of the total Hellenic imports; $ulcm_t$ is the weighted index of unit labour cost for the countries from which Hellenic imports originate; cpi_t is the Hellenic consumer price index; epi_t is the World energy price index (i.e., Saudi Arabia's crude oil export index); em_t is the effective nominal exchange rate of the Hellenic Drachma (GRD), weighted as the $ulcm_t$ variable; u_t is the disturbance term. All variables in minuscule denote their common logarithms.

It is easy understood that the information of this kind of macro-economic data is far from Herd's (1987) micro-structure formulations. Hence, given our interest in finding the dynamic interactions of the series, instead of searching for the determinants of an import price equation, we proceed: first, to pre-test these economic series so as to detect their statistical properties, i.e., we apply integration analysis using Doldado and al. (1990) unit roots methodology; secondly, to vector autoregressive (VAR) analysis so as to detect feedback effects among the variables used; thirdly, to co-integration analysis, through Engle and Granger (1987) two stages procedure using the already, identified VAR, to estimate a vector error correction model (VECM); fourthly, to trace out the time path of the various shocks on the variables contained in the VECM using its equivalent representation vector moving average model (VMA), and therefore the respective long-run impact multipliers, i.e., the impulse response functions, while searching which proportion of the series' movements is due to its "own" shocks rather than to the others, we investigate their forecast error variance decomposition.

In this empirical investigation we use quarterly data, over the period 1981q1-1995q4 from the databases of (1) IMF-IFS for Hellenic import unit value (muv_t), (2) OECD-MEI for the Hellenic consumer prices (cpi_t), the energy price index (epi_t) i.e., Saudi Arabia's export unit value for crude oil and the Exporters' in Greece unit labour cost in manufacturing ($ulcm_t$). The weights for this latter are Germany 38,1%, Italy

[6] Given the statistical limitations of the Engle-Granger (1987) methodology used instead of the Johansen's (1988) which offer more robust estimations.

25,4%, France 14,9%, Japan 11,6% and United Kingdom 9,9%, which represent more than half (50,1%) of the total Hellenic import trade this period, was calculated from the International Trade by Commodity Statistics data-bank of OECD (values in current USD). (3) From various issues of the Monthly Bulletin of the Bank of Greece was obtained the fixing rates of the GRD (end of period) vis-a-vis the main foreign exchanges for Hellenic imports, i.e. USD, DEM, ITL, FRF, JPY and GBP, accepting (Stamatopoulos, 1999, Bank of Greece/Foreign Exchange Division) that half of these are denominated in USD. For the other half we have used the weights already calculated for the unit labour cost ($ulcm_t$) for Exporters' to Greece.

3. Time Series Properties and VAR's Formulation.

The issue of over- versus underdifferencing was faced with Doldado, Jenkinson and Sosvilla-Rivero (1990) suggesting procedure to test for a unit root when the form of the data-generating process is unknown, instead of another one (e.g. McCallum, 1993). The following Table 1 presents our estimation results for this procedure, from which we conclude that all sequences are DSP (i.e., difference stationary processes), except the effective exchange rate of the GRD $\{em_t\}$, which seems to be TSP (i.e., trend stationary process).

Table 1

Univariate Single Unit Root Tests

	muv_t	$ulcm_t$	cpi_t	em_t	epi_t
Doldado et al. (1990)					
	Step 1				
$ô_{ô}$ (-3,45)	- 0,29	- 3,38	- 0,64	- 2,73	- 2,02
$ö_2$ (4,88)	7,69*	5,26*	1,25	5,87*	1,75
	Step 2				
$ô_{âô}$ (2,79)	- 3,88*	- 0,70	- 1,71	- 2,39	0,90
$ö_3$ (6,49)	7,41*	6,00	1,64	6,97*	0,40
$ô_{ô}$ using normal distrib.	- 0,29	___	___	___	___
	Step 3				
$ô_{ì}$ (-2,89)	___	- 1,02	- 1,75	- 3,08*	- 2,21
$ô_{áì}$ (2,54)	___	1,77	0,68	1,72	- 0,45
$ö_1$ (4,71)	___	2,09	1,78	6,49*	2,55
$ô_{ì}$ using normal distrib.	___	___	___	___	___
	Step 4				
ô (-1,95)	___	- 0,40	- 1,05	- 2,26*	- 1,01
Conclusions					
	I(1)	I(1)	I(1)	I(0)	I(1)

Note: The figures in parentheses of the first column indicate the critical values of Augmented Dickey-Fuller (ADF), for significance level á=5% sample size T=100. Sources: Fuller (1976), for statistics τ_{τ}, $\tau_{\beta\tau}$, $ô_{ì}$, $ô_{áì}$, ô and Dickey-Fuller (1981), for statistics $ö_2$, $ö_3$, $ö_1$. The optimal lag length for the ADF regression was choose by adding lags until a Lagrange Multiplier test fails to reject no residual serial correlation at level 0.05. * Designates significance on the predetermined level (95%).

Hence, all variables should enter the equations we are going to estimate, in first-differences (DSP) so as to use stationary series. This is not the case only for the trend stationary GRD, which should be used in levels.

Given that we are interested in dynamic interactions and in feedback effects we treat each variable symmetrically. This latter leads us to a vector autoregressive (VAR) analysis. Table 2 presents the results for three classes of VAR Hypothesis tests. Here, we follow Sims (1980) who recommends against differencing even if the variables contain a unit root, because our goal is to determine the interrelationships among the variables; we don't care about the parameter estimates; hence all variables enter the VAR in levels. The point is to detect (1) the appropriate lag length of the system, (2) the appropriate exogenous variables to incorporate, i.e., block exogeneity tests, and (3) how useful some variables are for forecasting others, i.e. Granger causality test. Formally the vector autoregression model in standard form, in our study, may be written

$$\begin{aligned} y_t &= \alpha + \sum_{s=1}^{L} \mathrm{B}_s y_{t-s} + \gamma_{1n} trend + \gamma_{2n} seas_{t-j} \\ &+ \gamma_{3n} D8385_{t-i} + \gamma_{4n} EMD88_{t-i} + \gamma_{5n} epi_{t-i} + u_t \end{aligned} \tag{2}$$

with $\underset{nx1}{u_t}$ ~ i.i.d. $N(0,\Sigma)$ and $\underset{nx1}{y_t} = \left(muv, ulcm, cpi, em\right)'_t$, t=1,2,...,T n=1,…,4 is the vector of endogenous variables; $\underset{nx1}{\alpha}$ is the vector of constant terms; $\underset{(nxs)xn}{\mathrm{B}'_s}$ is a matrix of parameters; *trend* is the linear time trend variable; $seas_{t\text{-}j}$ j=-2,-1,0 is the centred seasonal variable; $D8385_{t\text{-}i}$ is a pulse dummy variable to express the two abrupt devaluation of the GRD, and witch equals 1 if 1983q1 ≤ t ≤ 1983q2 while equals 0 otherwise; $EMD88_{t\text{-}i}$ is a level dummy variable used to represent the shift of the exchange rate policy by the Bank of Greece, and witch equals 1 if t ≥ 1988q1 and 0 otherwise; the parameters γ_{kn} express the deterministic or exogenous part of the model.

Table 2

Results of VAR Hypothesis Testing

Panel I: Lag lengths

Test 1: χ^2_{64}(c=37) = 46,92 [0,9464] H_0: L=4 (restricted model), H_1: eq. (2) (unrestr. model) with L=8 and $\gamma_{kn} = 0\ \forall\ k$=3,4,5
Test 2: χ^2_{32}(c=21) = 27,34 [0,7014] H_0: L=2 (restricted model), H_1: eq. (2) (unrestr. model) with L=4 and $\gamma_{kn} = 0\ \forall\ k$=3,4,5

Panel II: Block Exogeneity Tests

Test 3: χ^2_{4}(c=13) = 3,86 [0,4253] H_0: L=2 (restricted model), with $\gamma_{1n} = 0$ H_1: eq. (2) (unrestr. model) with L=2 and $\gamma_{kn} = 0\ \forall\ k$=3,4,5
Test 4: χ^2_{12}(c=12) = 71,56 [0,0000] H_0: L=2 (restricted model), with $\gamma_{2n} = 0$ H_1: eq. (2) (unrestr. model) with L=2 and $\gamma_{kn} = 0\ \forall\ k$=1,3,4,5

Test 5: χ^2_4(c=12) = 13,49 [0,0091] H_0: L=2 (restricted model), with $\alpha = 0$ H_1: eq. (2) (unrestr. model) with L=2 and $\gamma_{kn} = 0 \ \forall \ k$=1,3,4,5
Test 6: χ^2_{12}(c=15) = 20,28 [0,0620] H_0: L=2 (restricted model), with $\gamma_{3n} = 0$ H_1: eq. (2) (unrestr. model) with L=2 and $\gamma_{kn} = 0 \ \forall \ k$=1,4,5 i=0,-1,-2.
Test 7: χ^2_8(c=14) = 22,22 [0,0045] H_0: L=2 (restricted model), with $\gamma_{4n} = 0$ H_1: eq. (2) (unrestr. model) with L=2 and $\gamma_{kn} = 0 \ \forall \ k$=1,3,5 i=0,-1.
Test 8: χ^2_{12}(c=17) = 7,50 [0,8227] H_0: L=2 (restricted model), with $\gamma_{5n} = 0$ H_1: eq. (2) (unrestr. model) with L=2 and $\gamma_{kn} = 0 \ \forall \ k$=1,3 i=0,-1,-2.
Test 9: χ^2_8(c=16) = 15,92 [0,0435] H_0: L=2 (restricted model), with $\gamma_{3n} = 0$ H_1: eq. (2) (unrestr. model) with L=2 and $\gamma_{kn} = 0 \ \forall \ k$=1,5 i=0,-1,-2.

Panel III: Granger Causality Tests

Test 10: using

$$y_t = \alpha + \sum_{s=1}^{2} B_s y_{t-s} + \gamma_{2n} seas_{t-j} + \gamma_{3n} D8385_{t-i} + \gamma_{4n} EMD88_{t-i} + u_t \qquad (3)$$

with $EMD88_{t-i}$ (i=0, -1), $D8385_{t-I}$ (i=-1,-2)

H_0: $\beta_{1j} = 0, \forall j$=1,…,8	H_0: $\beta_{2j} = 0, \forall j$=1,…,8	H_0: $\beta_{3j} = 0, \forall j$=1,…,8
H_1: $\beta_{1j} \neq 0, \forall j$=1,…,8	H_1: $\beta_{2j} \neq 0, \forall j$=1,…,8	H_1: $\beta_{3j} \neq 0, \forall j$=1,…,8
(dep. var.: muv_t)	(dep. Var.: $ulcm_t$)	(dep. var.: cpi_t)
F-st.(*muv*) = 7,12 [0,0023]	F-st.(*muv*) = 7,16 [0,0022]	F-st.(*muv*) = 1,36 [0,2689]
F-st.(*ulcm*) = 0,89 [0,4193]	F-st.(*ulcm*) = 40,73[0,000]	F-st.(*ulcm*) = 0,43 [0,6581]
F-st.(*cpi*) = 0,98 [0,3858]	F-st.(*cpi*) = 5,34 [0,0088]	F-st.(*cpi*) = 608,63 [0,000]
F-st.(*em*) = 0,53 [0,5908]	F-st.(*em*) = 6,43 [0,0038]	F-st.(*em*) = 0,42 [0,6622]
H_0: $\beta_{4j} = 0, \forall j$=1,…,8		
H_1: $\beta_{4j} \neq 0, \forall j$=1,…,8		
(dep. var.: em_t)		
F-st.(*muv*) = 0,29 [0,7436]		
F-st.(*ulcm*) = 3,94 [0,0274]		
F-st.(*cpi*) = 5,69 [0,0067]		
F-st.(*em*) = 89,15 [0,0000]		

Notes: All tests are refereed to Likelihood Ratio {LR=(T-c)(log|Σ_r|-log|Σ_u|}, where c is Sims' (1980) small sample correction for LR tests, and |Σ_u| is the determinant of the variance/covariance matrix of the residuals for the unrestricted (r: restricted) model. Numbers in brackets express marginal significance level.

Based on the balance of the evidence presented in Table 2, we identify Model (3) as the one that we will use in the following Co-integration analysis. Model (3) is a 4-variate VAR(2) with constant and seasonal terms as deterministic components while the two dummies for the Hellenic exchange rate policy, are also found significant so as to be included as exogenous variables. Model (3) is also used for Granger causality tests (Panel III, Table 2), from which we detect, except from the obvious, i.e., each variable explains itself, that a feedback effect is present, e.g., from the foreign (*ulcm*) and domestic (*cpi*) prices to the exchange rate of the GRD (*em*) and vice-versa because the domestic (*cpi*) prices, the GRD and the import prices (*muv*) Granger cause the foreign (*ulcm*) ones. A vicious circle is maybe present here, i.e., inflation-imported inflation through the sliding policy of the GRD and so on, also taking into account the size effect of the Hellenic economy and its quality of international specialisation which both verify the qualification of one "price taker country".

4. **Co-integration and Innovation Accounting.**

Table 1 give the necessary information for us to proceed to the first step of the Engle-Granger (1987) testing procedure; that is, whether the identified set of I(1) variables is or it is not cointegrated. The OLS (Stock, 1988) estimates for this step are given in Table 3.

Table 3

Estimates of the long-run equilibrium relationship

Dependent Variable MUV - Estimation by Least Squares

Variables	Coeff.	t-statistics	p.v.
Constant	2,5859	8,1269	0,0000
Seasons	-0,0260	-1,0898	0,2805
Trend	-0,0685	-8,4638	0,0000
ulcm	0,1338	0,2053	0,8381
cpi	2,3229	8,5964	0,0000
R^2 = 0,9684 Q(15-0) = 79,0003 [0,0000]			

Where p.v. is the marginal significance level or p-value.

The residuals of this regression was used to estimate the autoregression

$$\Delta\hat{e}_t = \alpha_1\hat{e}_{t-1} + \sum_i a_{i+1}\Delta\hat{e}_{t-i} + \varepsilon_t \quad (4)$$

The results of testing the null hypothesis $\alpha_1 = 0 \text{ or } \nexists \text{CI}$ (i.e., Augmented Engle-Granger, AEG, unit root test) which are shown in Table 4, are in favour of cointegration.

Table 4

AEG Unit Root Tests

τ_τ	t-stat. = -3,6215	c.v. = -3,45
φ_2	F-stat. = 6,6256	c.v. = 6,49

Where c.v. are the critical values for this residual-based test, reported by the respective procedure of RATS software.

Thus, given the Granger representation theorem, we consider that for the components of the tested vector an error correction model exists,

$$\Delta y_t = \alpha_0 + \alpha_j\hat{e}_{t-1} + \sum_i a_{jk}(i)\Delta y_{t-i} + u_{jt} \quad (5)$$

where y_t is the vector of cointegrated variables; $\hat{e}_{t-1}$ are the residuals of the long-run regression (Table 3); α_j represent the so-called speed of adjustment coefficients.

Hence, we proceed to estimate the error correction VAR (ECVAR) including the cointegrated variables, the equilibrium error (Table 3) as well as the trend stationary exchange rate of the GRD (*em*). These estimates are shown in Table 5.

Table 5
Estimates of the ECVAR

	Dependend var. *Ämuv*			Dependend var. *Äulcm*		
	d.f. = 38 R^2=0,1314 DW=2,0002			d.f. = 38 R^2=0,5304 DW=2,0758		
	coeff.	t-stat.	p.v.	coeff.	t-stat.	p.v.
Ämuv{1}	-0,1852	-0,9986	0,3243	0,0000	0,429	1,000
Ämuv{2}	-0,0097	-0,0573	0,9546	0,0097	0,460	0,648
Äulcm{1}	0,3705	0,3047	0,7623	0,0364	0,240	0,812
Äulcm{2}	0,7438	0,6369	0,5280	0,2349	1,614	0,115
Äcpi{1}	0,6548	0,7397	0,4640	-0,1282	-1,162	0,253
Äcpi{2}	-0,7660	-0,8604	0,3949	0,1055	0,951	0,348
em{1}	-0,1129	-0,4798	0,6341	-0,0026	-0,089	0,929
em{2}	0,0977	0,4219	0,6755	-0,0046	-0,160	0,874
Constant	-0,0017	-0,0336	0,9733	0,0097	1,569	0,125
Res{1}	-0,2093	-1,3346	0,1900	0,0189	0,968	0,339
Seasons{-2}	0,0853	1,6239	0,1127	0,0054	0,824	0,415
Seasons{-1}	0,0130	0,3267	0,7457	-0,0053	-1,073	0,290
Seasons	0,0354	0,5984	0,5532	-0,0159	-2,154	0,038
D8385{1}	0,0488	1,2840	0,2069	0,0043	0,901	0,373
D8385{2}	-0,0394	-0,9935	0,3267	-0,0075	-1,517	0,137
EMD88	-0,2202	-0,8723	0,3885	0,0733	2,329	0,025
EMD88{1}	0,1078	0,4075	0,6859	-0,0698	-2,116	0,041
F-Tests	Dependent Variable *Ämuv*			Dependent Variable *Äulcm*		
Variable	F-Statistic	p.v.		Variable	F-Statistic	p.v.
Ämuv	0,6113	0,5479		*Ämuv*	0,1366	0,8727
Äulcm	0,2616	0,7712		*Äulcm*	13,5920	0,2691
Äcpi	0,5098	0,6047		*Äcpi*	0,8950	0,4170
em	0,1790	0,8368		*em*	14,2650	0,2527

	Dependend var. *Äcpi*			Dependend var. *em*		
	d.f. = 38 R^2 = 0,8148 DW = 1,8837			d.f. = 38 R^2 = 0,9946 DW = 1,9796		
	coeff.	t-stat.	p.v.	coeff.	t-stat.	p.v.
Ämuv{1}	-0,0596	-1,9467	0,0590	-0,0164	-0,1538	0,8786
Ämuv{2}	-0,0355	-1,2717	0,2112	0,0096	0,0984	0,9222
Äulcm{1}	0,1091	0,5438	0,5898	0,5475	0,7846	0,4376
Äulcm{2}	0,2807	1,4567	0,1534	-0,1106	-1,6500	0,1072
Äcpi{1}	0,3184	2,1797	0,0355	-0,2963	-0,5833	0,5632
Äcpi{2}	-0,0404	-0,2751	0,7847	0,3286	0,6433	0,5239

em{1}	-0,0393	-1,0116	0,3181	0,6521	4,8292	0,0000
em{2}	0,0293	0,7666	0,4481	0,3007	2,2627	0,0295
Constant	0,0107	1,3066	0,1992	0,0438	1,5345	0,1332
Res{1}	0,0633	2,4451	0,0192	0,0315	0,3505	0,7279
Seasons{-2}	0,0295	3,4068	0,0016	-0,0273	-0,9049	0,3712
Seasons{-1}	-0,0104	-1,5912	0,1199	-0,0250	-1,0955	0,2802
Seasons	0,0345	3,5326	0,0011	-0,0257	-0,7553	0,4547
D8385{1}	0,0256	4,0808	0,0002	0,0696	3,1915	0,0028
D8385{2}	-0,0148	-2,2547	0,0300	-0,0436	-1,9128	0,0633
EMD88	0,0216	0,5195	0,6064	0,3933	2,7150	0,0099
EMD88{1}	-0,0203	-0,4641	0,6452	-0,3642	-2,3980	0,0215
F-Tests	Dependent Variable *Äcpi*			Dependent Variable *em*		
Variable	F-Statistic	p.v.		Variable	F-Statistic	p.v.
Ämuv	19,7200	0,1532		*Ämuv*	0,0308	0,9697
Äulcm	12,6000	0,2952		*Äulcm*	15,9810	0,2156
Äcpi	24,2690	0,1019		*Äcpi*	0,2979	0,7441
em	17,7300	0,1836		*em*	1154	0,0000

It is of particular interest the insignificant speed of adjustment coefficients α_j except of α_3. The latter can be interpreted that only the Hellenic inflation rate (Δcpi) responds, even slowly, to the deviation from the long-run equilibrium, in period (*t-1*). Furthermore, it has to be pointed out that none of the Granger causality relations of Table 2 are confirmed by the estimated ECVAR (Table 5).

Given these poor results as well as our aim, i.e., the examination of the interactions between the cointegrated variables we proceed to the innovation accounting analysis. Thus the VMA representation of the equation (2)[7] can be written as

$$y_t = \mu + \sum_{i=0}^{12} \varphi_i \varepsilon_{t-i} \tag{6}$$

where $\underset{nx1}{y_t} = \left(muv, ulcm, cpi, em\right)'_t$, $\underset{nx1}{\mu} = \left(\mu_{muv}, \mu_{ulcm}, \mu_{cpi}, \mu_{em}\right)'$ is the vector of mean values; $\underset{4x4}{\varphi_i} = \left(\varphi_{jk}(i)\right)$ is the matrix of the impact multipliers which measures the effect of the shocks $\underset{nx1}{\varepsilon} = \left(\varepsilon_{muv}, \varepsilon_{ulcm}, \varepsilon_{cpi}, \varepsilon_{em}\right)'$ on each of the components of y_t.

The plots of the impulse response functions, i.e., the plots of 16 coefficients $\varphi_{jk}(i)$ against *i*, from the estimated ECVAR are presented in Figure 1. Working with Choleski factorisations, for the ordering problem, we have taken into account, first, the economy theory and second, the structure of the correlation matrix of the residuals (Table 6). From the latter it is obvious that only the ordering of ($ulcm_t$) and (cpi_t)

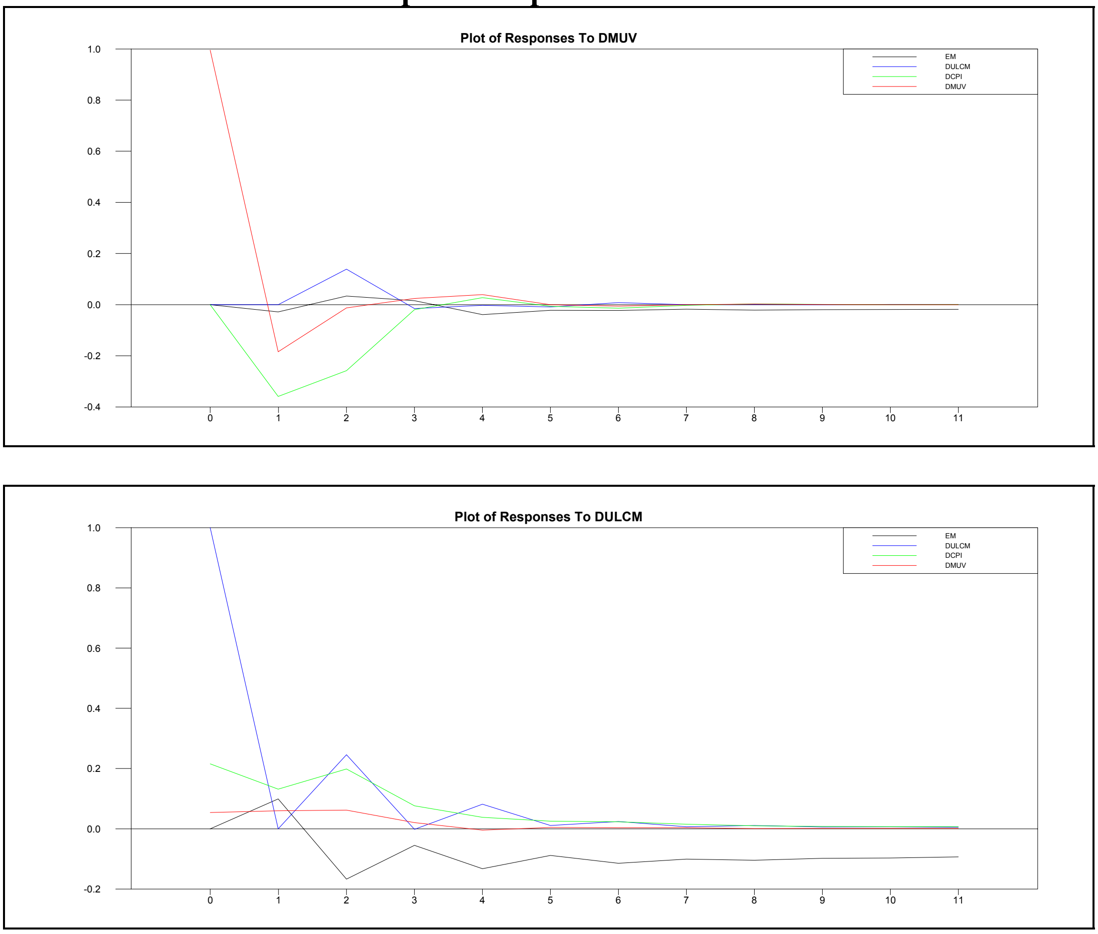
[7] without the deterministic or exogenous components.

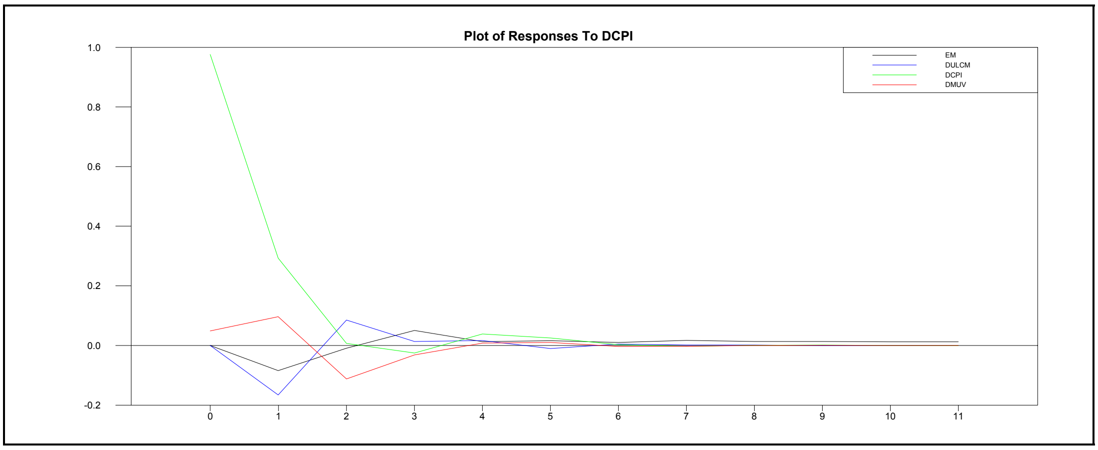
Table 6
Variance/Correlation Matrix of VECM's Residuals

	Ämuv	*Äulcm*	*Äcpi*	*em*
Ämuv	*0,0020*	0,0534	0,0608	0,0635
Äulcm		*0,0000*	0,2153	-0,0056
Äcpi			*0,0001*	0,0256
em				*0,0007*

innovations matters. This evidence coupled with the economic theory's (MABP) advice, i.e., to start from the foreign prices ($ulcm_t$) which affect the domestic ones (cpi_t) through the exchange rate (em_t), we decide on the ordering presented in Figure 1 and Table 7.

Figure 1
Impulse Response Functions





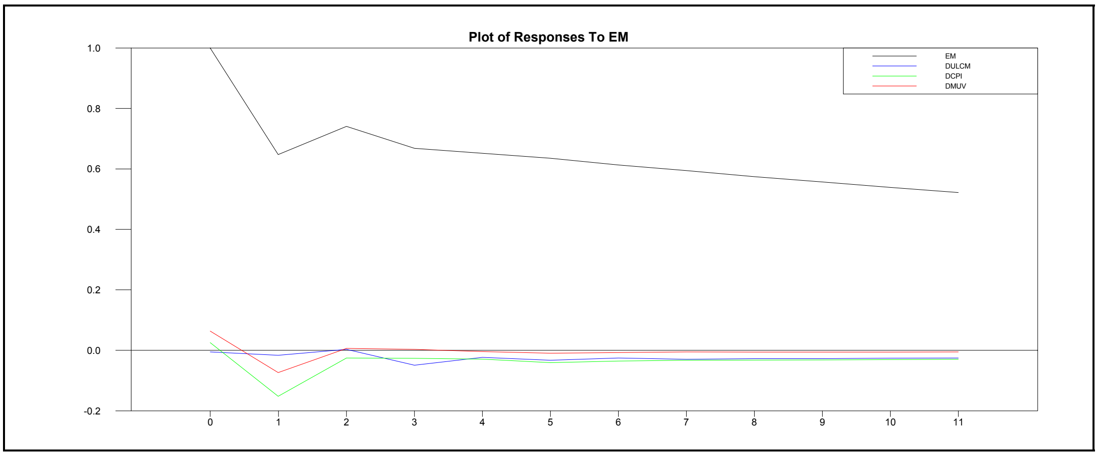


Table 7
Forecast Error Variance Decomposition

Decomposition of Variance for *Äulcm*					
Step	Std Error	*Äulcm*	*Äcpi*	*em*	*Ämuv*
1	0,02583	100,00	0,00	0,00	0,00
2	0,02586	99,92	0,08	0,00	0,00
3	0,02651	99,82	0,10	0,00	0,09
4	0,02651	99,82	0,10	0,00	0,09
5	0,02658	99,82	0,10	0,00	0,09
6	0,02659	99,82	0,10	0,00	0,09
7	0,02659	99,81	0,10	0,00	0,09
8	0,02659	99,81	0,10	0,00	0,09
9	0,02660	99,81	0,10	0,00	0,09
10	0,02660	99,81	0,10	0,00	0,09
11	0,02660	99,81	0,10	0,00	0,09
12	0,02660	99,81	0,10	0,00	0,09
Decomposition of Variance for *Äcpi*					
Step	Std Error	*Äulcm*	*Äcpi*	*em*	*Ämuv*
1	0,00561	0,00	100,00	0,00	0,00
2	0,00694	14,37	70,49	0,36	14,79
3	0,01005	55,45	33,66	0,18	10,71

4	0,01043	58,65	31,23	0,17	9,95
5	0,01048	58,96	30,97	0,17	9,89
6	0,01051	59,11	30,86	0,18	9,85
7	0,01054	59,32	30,69	0,19	9,81
8	0,01055	59,42	30,61	0,19	9,78
9	0,01055	59,46	30,58	0,19	9,77
10	0,01056	59,48	30,56	0,20	9,77
11	0,01056	59,50	30,54	0,20	9,76
12	0,01056	59,51	30,53	0,20	9,76
Decomposition of Variance for *em*					
Step	Std Error	*Äulcm*	*Äcpi*	*em*	*Ämuv*
1	0,00743	0,07	4,64	95,29	0,00
2	0,01675	72,16	1,07	26,58	0,19
3	0,02639	84,35	0,57	14,89	0,19
4	0,02803	82,56	1,06	16,19	0,19
5	0,03260	84,79	0,94	14,04	0,23
6	0,03466	84,63	0,98	14,17	0,23
7	0,03757	85,40	0,93	13,45	0,22
8	0,03978	85,70	0,93	13,16	0,21
9	0,04195	86,07	0,92	12,80	0,21
10	0,04380	86,30	0,91	12,59	0,20
11	0,04551	86,51	0,90	12,39	0,20
12	0,04706	86,68	0,90	12,23	0,20
Decomposition of Variance for *Ämuv*					
Step	Std Error	*Äulcm*	*Äcpi*	*em*	*Ämuv*
1	0,04502	0,40	0,29	0,24	99,07
2	0,04677	4,08	0,00	0,29	94,94
3	0,05028	16,39	1,20	0,25	82,17
4	0,05061	17,39	1,23	0,25	81,14
5	0,05067	17,44	1,23	0,25	81,08
6	0,05067	17,45	1,23	0,25	81,07
7	0,05068	17,47	1,23	0,25	81,05
8	0,05069	17,49	1,23	0,25	81,03
9	0,05069	17,49	1,23	0,25	81,03
10	0,05069	17,49	1,23	0,25	81,02
11	0,05069	17,50	1,23	0,25	81,02
12	0,05069	17,50	1,23	0,25	81,02

From the combined examination of the system's responses to particular initial shocks (Figure 1) and the forecast error variance decomposition into the part due to each of the innovation processes (Table 7), we can summarise: first, all endogenous variables converge rapidly (6-9 months) to their long-run time path, after an initial shock. However, this is not true for the effective exchange rate of the GRD (em_t) which doesn't converge even after a 3 years' period, from a unit change in its innovations.

Secondly, the expected role of the central variable of this study, i.e., the unit labour cost in manufacturing of those countries which export to Greece (*ulcm*), as the determinant for the rest of endogenous (*em*), (*cpi*) and (*muv*)[8], even from the 2nd or 3rd step variance, is confirmed in Table 7. Symmetrically speaking, from the latter table, the dependent of equation (2), i.e., the Hellenic import unit value (*muv*) is remarked to behave as exogenous.

Thirdly, the feedback effect between (*ulcm*) and (*em*) which was detected from the VAR analysis in Table 2 (Panel III), is now, in the Innovation analysis, clearly transformed to a causality relationship from the (*ulcm*) to the (*em*). Thus, from this latter analysis (Figure 1 and Table 7) the vicious circle of inflation-imported inflation through the exchange rate policy of the Bank of Greece, is rather confirmed than rejected.

5. **Conclusions**

The main points that emerge from the foregoing empirical analysis of quarterly data for the indices of Hellenic import (*muv*) and consumer (*cpi*) prices, the unit labour cost of the origin countries of these imports (*ulcm*) and the nominal effective exchange rate of the Hellenic Drachma, i.e., GRD (*em*), over the 1981q1-1995q4 period, seem to be the following:

As regards the economic theory on which our research is founded, this is the decomposition approach for the trade balance, which in its turn is taken in the elasticity's or (Niehans, 1984) monetary approaches to the balance of payments. Given the aggregate nature of our data set, instead of searching for the determinants of the (*muv*) we pay much more attention to the interrelationships among the system's variables.

As regards the pre-testing steps of our empirical analysis, applying the multi-level unit roots procedure of Doldado and al. (1990), in the former case, we detected all variables to be I(1) besides (*em*) which was found to be trend stationary I(0), while in a various VAR-hypothesis testing , in the latter, we identified (lag length, deterministic stationary variables, exogenous non-stationary, Granger-causality) the system which is to be estimated.

As regards the Engle and Granger (1987) two stages co-integration analysis, although we traced that our four variables, in the formulated vector error correction model (VECM), follow indeed the same long-run equilibrium path, however, only the Hellenic inflation rate (Δcpi) adjusts to deviations from their cointegrated trend. In addition, none of the system's variables is affected by lagged changes in the others, while several times the dummies, for the two abrupt devaluations of the GRD (*D8385*) as well as (*EM88*) expressing the shift of the foreign exchange policy of the Bank of Greece (since 1987), were confirmed to be significant.

The most interesting evidences came from the Innovation Accounting of the above ECVAR. The impulse response functions saw the fragile stability of the system, namely in a unit-shock to the innovations of (*Äulcm*) and (*em*) equations, where the effective exchange rate of GRD does not return to its long-run level, even after a 3 years' period. However, all the other variables in every equation of the system need 6 to 9 months to converge to their long-run values. In the forecast error variance decomposition we found strong evidences about (1) the exogeneity of the three Hellenic variables (*em, Äcpi, Ämuv*) against the growth rate of unit labour cost of the countries from which we import (*Äulcm*), (2) *Äulcm* and therefore the respective

[8] In particular in descending order from (*em*) to (*cpi*) and then to (*muv*).

European prices appear responsible for about the 85% of the GRD's time path due to its own (*em*) shocks after 9 months as well as for about 60% of the Hellenic inflation rate's movement again 9 months after *Δcpi*'s shocks; (3) the same variable (*Äulcm*) also explains approximately the 17% of the forecast error variance of the Hellenic import prices 9 months after their own shock. The latter seems to amount to the first of the three sub-periods of the *J*-curve, the so-called "contract-period", in the Magee's terminology.

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