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The Relationship Between Unemployment and Macroeconomic Determinants: An Empirical Research for Greece

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ABSTRACT

The current paper attempts to examine the relationship between unemployment and a number of macroeconomic determinants. More specifically it accounts for the impact of inflation, discount rate, government deficit, hourly wage and gross domestic product on unemployment for the case of Greek economy. The empirical analysis applied a Johansen cointegration test and a vector autoregression model to examine the causal relationship between the aforementioned variables. Granger causality results indicate a one-way causality between economic growth and unemployment, economic growth and inflation, inflation and hourly wages, unemployment and discount rates, whereas between inflation and discount rates they detect a bidirectional causal effect.

Keywords: *Unemployment rate, Growth, Cointegration, Causality.*

1. INTRODUCTION

Inflation and unemployment are two of the most serious problems developed economies are still facing. The first one is responsible for the smooth operation of the economic system and therefore has a great impact on every sector of the economy. In contrast with inflation, unemployment not only accounts for a number of economic consequences namely wage loss, government budget burden and productivity loss, but also induces social burdens. The decrease of social status and self-respect, family disputes and either political conflicts are some of them.

In the past, inflation and unemployment rarely coincided. During periods of economic increase, prices increased but also economic development and decrease in unemployment were reported. On the contrary, fall in economic activity and increase in unemployment and therefore decrease in inflation, were characteristics of recession economic periods. In other words, inflation and unemployment were following opposite trends. This is not the case though in modern developed economies. Unemployment and inflation coexist and/or could increase simultaneously.

Variation in employment demand is due to a number of macroeconomic determinants. Although a variety of factors seem to be responsible for unemployment, there is not a single one on its own more important that the rest. According to Pigou (1968), unemployment is not a result of an aggregate number of factors that act independently. Instead these factors manage to overlap and balance the effect of each other.

The classic approach to unemployment is imperfect due to the perception of null involuntary unemployment in the break even point. According to this view, the effect of economic cycles and innovations in unemployment are much more significant. Even full employment could lead to the decrease of labor production due to marginal utility in the successful stages of production and therefore decrease in marginal labor employment.

In economic cycles were prices are flexible and unemployment level occurs to the point were supply and demand for labor meet, high interest rates are responsible for the shift of labor demand. Having a relative stable labor supply, this shift could not impact on real wages, but only on employment. A fall in real interest rates shift labor supply curve to the left causing a fall in employment level and at the same time an increase in real wages (Hall and Taylor 1990).

Even quite accepted within economists, Phillips' statement (1967) regarding the negative association between unemployment and inflation, it does not consider the dynamic effect of technology and productivity. This effect could have shifted Phillips curve far from or towards the begging of the two coordinates.

Phelps (1995) explains the structural determinant of the physical unemployment rate. More specifically, he tries to demonstrate how a change in economic structure (as reflected by interest rates or government deficit) could alter the trend of unemployment and other macroeconomic variables. His main political references include a balanced budget, limited salaries and public expenditure together with a replacement of a mix of labor intensity rather than high capital intensity in public expenditure.

Some economists state that inflation is economy's worst "enemy", since it reduces the purchasing power and creates uncertainty even investment activities. Inflation seems to be rather under government control, but this not the case for unemployment. The latest is the consequence of poverty and income imbalance. During inflation cycle we face a rather "dichotomic" consumer behavior. On the one hand, there is a conservatism over consumer spending due to inflation with the hope that prices will fall, whereas on the other hand the rapidity of speculative buys induce price increases.

Government measures towards unemployment usually refer to either the increase of total demand or occupation guidance and training of labor force. The measures targeting total demand are divided into fiscal and monetary. The first ones basically include increase in government public expenditure as well as investment purposes. They both aim at direct increase of employment and salaries. Monetary measures target interest rates decrease so as to support private investment, productivity and therefore employment. Both fiscal and monetary means would reinforce total demand and consequently fall in unemployment.

The structure of the following paper is as follows. Section 1, discusses the role of unemployment and its determinants, whereas the data used in the analysis and specification of the model are described in section 2. Further down in Section 3, we initiate the unit root testing and stationarity of data used. Cointegration analysis is performed in the fourth section. The fifth section provides estimation of error correction models and section 6 develops causality tests by Granger. Finally, the last part of the current study summarizes the main outcomes of the analysis.

2. DATA AND MODEL SPECIFICATION

The causal analysis between unemployment and other macroeconomic variables includes the following variables:

$$UN = f(GDP, CPI, DR, BD, HW) \tag{1}$$

where

UN = Unemployment rate

GDP = Growth

CPI = Inflation rate

DR = Discount rate

BD = Budget Difit

HW = Hourly Wage

The hypothesis of model (1) presupposes that all variables are stationary and when stationarity is tested, we move on to examine cointegration and causality. The period of our analysis is 1961-2006 and the sources of our data include the Yearbook of International Financial Statistics (IMF), European Economy, and Bank of Greece.

3. UNIT ROOT TESTING

In order to analyze time series which include stochastic trends, the Augmented Dickey-Fuller (1979) unit root test is applied in order to obtain information on when variables become integrated.

Stationarity testing is performed by the Augmented Dickey-Fuller test, which is based on the following equation:

$$\Delta X_t = \delta_0 + \delta_1 t + \delta_2 X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-i} + u_t \qquad (2)$$

ADF regression tests for unit root in X_t meaning testing all variables of the model in time t. Variable ΔX_{t-i} expresses the first differences including k time lags and finally u_t is a white noise which adjusts integration errors. Coefficients δ_0, δ_1, δ_2, and α_i are to be estimated. The null and alternative hypotheses for unit root testing in variable X_t are:

$$H_o : \delta_2 = 0 \qquad H_\varepsilon : \delta_2 < 0$$

If the OLS estimator of δ_2 is negative and statistical significant following t distribution, then we could say that the time series is stationary or else it has a unit root. If this is not the case, the procedure is being repeated to test for unit roots in the first differences and if necessary second differences until they become stationary. Since t distribution can not be used as critical for the values of δ_2, critical values are provided by Fuller (1976) and Mackinnon (1990). For the purpose of this study, Mackinnon critical values are being used. Furthermore, Akaike (1973) (AIC)[1] and Schwartz (1978) (SC)[2]criteria are used for the definition of time lags as well as Breusch – Godfrey (BG) LM[3] to test for residual autocorrelation.

Table 1 shows that unit root cannot be rejected in variable levels, at the 1%, 5% and 10% level of significance. Therefore there is no stationary time series in the variable levels. In the next stage when time series are being transformed to their first differences, they become stationary and as a result relative variables are first order integrated I(0). Also, table 1 reports evidence of no residual autocorrelation when applying *B-G* test.

Table 1
Dickey-Fuller (ADF) Test for Unit Root Testing

Variables	*Augmented Dickey-Fuller* τ_μ	τ_τ	*k*	*B-G*
UN	–1.490	–2.212	1	0.710 [0.399]
GDP	–1.614	–1.424	2	1.263 [0.260]
CPI	–1.686	–1.581	0	0.382 [0.536]
DR	–1.491	–0.548	1	0.166 [0.683]
BD	–2.567	–2.528	0	0.422 [0.515]
HW	3.094	–1.896	0	2.971 [0.084]
ΔUN	–3.399	–3.261	0	1.487 [0.222]
ΔGDP	–7.097	–7.087	1	1.083 [0.297]
ΔCPI	–6.272	–6.382	0	1.080 [0.298]
ΔDR	–4.514	–4.662	0	0.007 [0.931]
ΔBD	–8.073	–7.998	0	1.183 [0.276]
ΔHW	–4.212	–5.199	0	3.210 [0.073]

τ_μ is the *t*-statistic for testing the significance of δ_2 when a time trend is not included in equation 2 and τ_τ is the *t*-statistic for testing the significance of δ_2 when a time trend is included in equation 2.
The critical values at 1%, 5% and 10% are –3.584, –2.928 and –2.602 for τ_μ and –4.175, –3.513 and –3.186 for τ_τ respectively.
Numbers inside the brackets indicate significant levels.

4. COINTEGRATION ANALYSIS

Having established that the underlying variables are first order integrated, we move on to define the number of cointegration vectors among the variable Granger (1986), applying the maximum likelihood approach by Johansen (1988), Johansen and Juselious (1990, 1992). The latest is testing for the number of cointegration vectors within the variables. Furthermore, it regards all variables as endogenous and hence avoids the arbitrary choice of an exogenous variable. Finally, it provides an unified framework of estimating cointegration relations within the error correction mechanism framework. Johansen and Juselious estimation method presupposes estimating the following:

$$\Delta Y_t = \mu + \Gamma_1 \Delta Y_{t-1} + \Gamma_1 \Delta Y_{t-2} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-p} + u_t$$

Where,

Y_t is a 6 × 1 vector of all variables.

μ is a 6 × 1 vector of constant terms

Γ_i (i =1, 2, …, p – 1) is a 6 × 6 matrix of constant terms

Π is a 6 × 6 matrix of constant terms

u_t is a 6 × 1 vector of noise terms

Provided that Johansen technique needs an adequate number of time lags, the well-known procedures of *LR* (Likelihood Ratio) statistics has been applied (Sims 1980). The results showed that the value $\rho = 1$ is the optimal specification for the aforementioned relationship. The next step is to determine the cointegration vectors of the model given that matrix Π is of rank $r < n$ ($n = 6$). The procedure of determining rank r has to do with estimating the following eigenvalues:

$$\hat{\lambda}_1 = 0.652653 \qquad \hat{\lambda}_2 = 0.382920 \qquad \hat{\lambda}_3 = 0.350323$$
$$\hat{\lambda}_4 = 0.256002 \qquad \hat{\lambda}_5 = 0.194288 \qquad \hat{\lambda}_6 = 0.012331$$

Table 2
Johansen and Juselious Cointegration Tests
Variables UN, GDP, CPI, DR, BD, HW

Eigenvalues			*Critical values*	
Null	*Alternative*	*Eigenvalue*	*95%*	*99%*
$r = 0$	$r = 1$	46.5270	39.37	45.10
$r = 1$	$r = 2$	21.2413	33.46	38.77
$r = 2$	$r = 3$	18.9763	27.07	32.24
$r = 3$	$r = 4$	13.0115	20.97	25.52
$r = 4$	$r = 5$	9.5052	14.07	18.63
$r = 5$	$r = 6$	0.5459	3.76	6.65

Trace statistic			*Critical values*	
Null	*Alternative*	*Eigenvalue*	*95%*	*99%*
$r = 0$	$r > 0$	109.8074	94.15	103.18
$r \leq 1$	$r > 1$	63.2804	68.52	76.07
$r \leq 2$	$r > 2$	42.0391	47.21	54.46
$r \leq 3$	$r > 3$	23.0627	29.68	35.65
$r \leq 4$	$r > 4$	10.0512	15.41	20.04
$r \leq 5$	$r > 5$	0.5459	3.76	6.65

Table 2 implies that the number of cointegration vectors is equal to one and is the following:

$$UN = 148.37 - 15.75\,GDP - 0.932\,CPI + 5.432\,DR + 0.023\,BD + 4.082\,HW \qquad (3)$$

According to the signs of cointegation vectors and based on economic theory, equation (3) can be used as an error correction mechanism in the VAR model.

5. VAR MODEL WITH AN ERROR CORRECTION MECHANISM

Now that we have determined that the variables of our model are cointegrated, we should move on to estimate a VAR model in which we detach an error correction mechanism. The error correction model is due to the long-term cointegration relationship and is given as follows:

$$DX_t = \mu + \Gamma_1 DX_{t-1} + \Gamma_2 DX_{t-2} + \Gamma_3 DX_{t-3} + AEC_{t-1} + u_t$$

where:

DX_t is the first differences of all variables

EC is the error correction term.

Table 3 presents the error correction model estimation for all variables. The negative sign of *EC* coefficients is consistent with the hypothesis that this term corrects the variations from the long-term equilibrium relationship. Moreover, Table 3 shows the significance of error correction mechanism coefficients for all the variables together with the standard error.

Table 3
Estimation of Error Correction Mechanism

Endogenous variables	*Estimation of ECC coefficients*	*T-statistics*	*Standard error*
DUN	0.004172	0.71225	0.00586
DGDP	0.072449	4.83018	0.01500
DCPI	–0.088949	–2.55684	0.03479
DDR	0.032311	2.15969	0.01496
DBD	–1.428567	–1.14163	1.25134
DHW	–0.000517	–0.20970	0.00247

The above Table shows that error correction mechanism coefficients do not display the expected signs and are neither statistically significant at the 5% level of significance. The only exception is DCPI, in which error correction mechanism coefficient is negative as well as statistically significant.

6. GRANGER CAUSALITY TESTS

The model estimated in the previous section was used in order to determine the Granger (1969) causal relations between the underlying variables. *F*-statistic was applied as a critical test to examine the statistical significance of endogenous variables. Table 4 below shows the results of this relationship between variables.

Table 4
Granger Causality Tests

Pairwise Granger Causality Tests
Sample: 1961 2006
Lags: 1

Null Hypothesis:	*Obs*	*F-Statistic*	*Probability*
GDP does not Granger Cause UN	45	20.33	5.2E-05
UN does not Granger Cause GDP		0.566	0.456
CPI does not Granger Cause UN	45	14.91	0.0003
UN does not Granger Cause CPI		5.704	0.0214
DR does not Granger Cause UN	45	17.90	0.0001
UN does not Granger Cause DR		12.57	0.0009
BD does not Granger Cause UN	45	0.148	0.7019
UN does not Granger Cause BD		0.102	0.7509
HW does not Granger Cause UN	45	2.779	0.1029
UN does not Granger Cause HW		1.093	0.3017
CPI does not Granger Cause GDP	45	7.764	0.0079
GDP does not Granger Cause CPI		1.672	0.2030
DR does not Granger Cause GDP	45	35.97	4.0E-07
GDP does not Granger Cause DR		0.686	0.41209
BD does not Granger Cause GDP	45	0.535	0.4682
GDP does not Granger Cause BD		1.650	0.2058

Table Contd...

Null Hypothesis:	*Obs*	*F-Statistic*	*Probability*
HW does not Granger Cause GDP	45	2.075	0.1570
GDP does not Granger Cause HW		2.364	0.1316
DR does not Granger Cause CPI	45	0.083	0.7742
CPI does not Granger Cause DR		8.575	0.0054
BD does not Granger Cause CPI	45	0.018	0.8919
CPI does not Granger Cause BD		4.138	0.0482
HW does not Granger Cause CPI	45	2.072	0.1573
CPI does not Granger Cause HW		6.904	0.0119
BD does not Granger Cause DR	45	0.0002	0.9866
DR does not Granger Cause BD		1.7104	0.1980
HW does not Granger Cause DR	45	2.7486	0.1047
DR does not Granger Cause HW	4.5918	0.0379	
HW does not Granger Cause BD	45	0.3366	0.5648
BD does not Granger Cause HW	4.0472	0.0506	

From the results of Table 4 we can infer that:

There is a unidirectional causal effect between unemployment and GDP and hourly wages respectively with direction towards unemployment. Also, unidirectional effects are reported from CPI to GDP, DR to GDP , CPI to DR, CPI to BD, CPI to HW, DR to HW and finally BD to HW. As for inflation rate and unemployment, we estimate a bidirectional effect as well as between Discount rate and unemployment.

7. CONCLUSIONS

Unemployment is regarded as the worst “enemy” of an economy since it leads the society towards poverty, it prevents salary dispersion and also may induce political and socioeconomic disputes. The current paper is aiming at defining the dynamic relationship between unemployment, development, inflation rate, discount rate, budget deficit and hourly wages using annual data for the case of Greece. The empirical analysis applied cointegration techniques, then specified an error correction model and finally identified any causal effects between the underlying variables. The presence of cointegration is a proof of long-term relationship. That implied that even if variables have temporarily short-term variations from their long term equilibrium, in the end due to various effects they found their equilibrium point. Furthermore, cointegration erases the possibility that the estimated relationship is dummy which means that there should be a Granger causality between variables.

The results show:

- Unemployment is inversely related to development; the higher the development the lower the unemployment level
- It is also inversely related to inflation
- Also, unemployment is positively related to the discount rate and wages level and
- Finally positively associated to budget deficit meaning that the more budget deficit increases the higher the unemployment level is expected to be.

Notes

1. Akaike's information criterion (*AIC*) is calculated from: $AIC = (2k/T) + \log(RSS/T)$, where k is the number of regressors, T is the number of total observations and *RSS* is the sum of squared residuals.
2. The Schwartz criterion (*SC*) is an alternative to the *AIC* with basically the same interpretation.
3. The *BG*-statistic is the Lagrange multiplier test for k^{th} order residual autocorrelation Godfrey (1978).

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