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Some further evidence upon testing hysteresis in the Greek *Phillips-type aggregate wage equation*

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CONTENTS

ABSTRACT

The aim of this paper is to test the significance of the hysteresis effect in an typical aggregated Phillips-type wage equation (curve). More specifically, using alternatively the theoretical specifications of *Setterfield* (1993) and *Blanchard and Summers* (1986), concerning the hyteresis/insider-outsider variable, we will try to test its effect upon the Greek *Phillips* wage curve for a prolonged period of time (1960-2007e). Our method of estimation will be twofold: the simple OLS process and the *Johansen* co-integration-based error-correction procedures (*ECM-GE*). The results favour the unemployment persistence hypothesis, in the simple *OLS* case, and the hysteresis effect in the *ECM-GE* approach.

J.E.L. Classification : E51.
Keywords : Hysteresis, Phillips curve, ECM-GE process.

1. Introduction

The basic aim of this paper is to test the significance of the hysteresis variable in an aggregated wage Phillips curve. More specifically, using alternatively the Setterfield (1993) and the Blanchard and Summers (1986) specification of the hysteresis/insider-outsider variable, we will try to test its effect upon the Greek Phillips curve for a prolonged period of time (1960-2007). In addition the method of estimation will be twofold: A simple OLS process and the co-integration procedure. In this way we will check whether the method of estimation affects the results produced.

The paper is constructed accordingly. Section 2 presents the standard Phillips wage curve which we will use[1]. Then the different hyteresis/insider-outsider variable specification is presented which will next be embedded –as a proxy of the labor market condition- in the typical Phillips curve. Section 3 presents the data we will use in our econometric estimation. Section 4 briefly presents the econometric methodology (in particular the specific co-integration process) and finally section 5 concludes upon the hysteresis significance in the wage determination process.

2. The typical Phillips curve

Following the existing literature on the nominal wage determination process, we can comment that the Coe (1985) specification is one of the most commonly used. More analytically :

$$\dot{W} = \alpha_0 + \alpha_1 * \dot{P}_t^e - a_2 * (U - U^*) + a_3 Z_t \qquad (1)$$

where : $\dot{W}$, stands for the nominal wage changes,

$\dot{P}^e$, stands for the expected inflation,

U^*, stands for the natural rate of unemployment

U , stands for the actual rate of unemployment

Z, stands for exogenous variables e.g. productivity etc.

[1] Apart from the standard Phillips-type wage equation in the international literature we also have the reduced form (non-wage) Phillips curve. In this reduced form a different specification of hysteresis appears (see Gordon (1989) and Burger and Marinkov (2006)). But this form is beyond the main aim of this paper.

Given the aforementioned wage determination process, there are many different proxies for the labor market effect [e.g. the $(U-U^{*})$ term] which were implemented in the literature. Such proxies usually represented different labor theories. However, in the theoretical area of the "hysteresis/insider-outsider effect" we have two famous proxies: That of *Setterfield (1993)* and that of *Blanchard and Summers (1986).* The first one is an unemployment specification of hysteresis in the wage determination process and the second an employment one.

2.1. The Hysteresis/ insider-outsider specification

In the economic literature, the idea of an *hysteresis effect* was actually linked with the existence of "multiple equilibria" in the labor market. In other words, the perception behind *hysteresis* is that there are serious doubts on whether a unique and long run Walrasian "natural" level of unemployment rate exists in the economy. So in a typical Phillips-type wage curve, this hysteresis idea was mainly proxied by the following two alternatives[2] :

The Setterfield's specification

This specification of the phenomenon of hysteresis originates from its strict scientific definition. More analytically, according to Cobham and Williams (1998) "*Hysteresis is defined as a phenomenon whereby changes in some property of a physical system lag behind changes in the factor causing it. It implies that the present state of the system is dependent upon its past behaviour*." Alongside with this definition, Setterfield (1993) treats hysteresis as a "random walk" process relative to the co-called "natural" level of unemployment rate (e.g. the U^{*} variable in the wage model 1). In algebraic terms this is interpreted as :

$$U_t^{*} = \eta * U_{t-1} + Z_t \qquad (2)$$

Substituting now (2) into (1) we end up with :

$$\dot{W} = \alpha_0 + \alpha_1 * \dot{P}_t^{e} - b_1 * U_t + b_2 \Delta U_t + b_3 Z_t \qquad (3)$$

where :

[2] Another form of hysteresis specification in a Phillips-type wage curve was proposed by Coe (1988) with sort term and long term differentiation of the unemployment variable. Unfortunately Greece constructed such data only recently (1998 onwards). Therefore we do not have enough observations for testing econometrically such hysteresis specification.

$b_1 = a_2 * (1-\eta)$

$b_2 = a_2 * \eta$

$b_3 = a_3 + a_2$

The alternative interpretation regarding the unemployment effect is :

1. If $\eta = 1$ and consequently $b_1 = 0$ then the hysteresis effect exists and is expected to affect the wage determination process in equation (3),

2. If $\eta < 1$ and consequently $b_1 \neq 0$ then unemployment persistence[3] will be the case in equation (3) and finally

3. If $\eta = 0$ and consequently $b_1 = 1$ then a walrasian "natural" level of unemployment exists in the examined economy.

The Blanchard and Summers' specification

The determination of the hysteresis/insider-outsider effect in this case is based on the employment variable ($Empl$). Since it is a more complicated case than the previous one, we only present the final stage of the wage determination process which in algebraic form is[4] :

$$\dot{W} = \alpha_0 + \alpha_1 * \dot{P}_t^e + b_1 * Empl_{t-1} + b_2 Empl_{t-2} + a_3 Z_t \qquad (4)$$

where :

$Empl$, stands for the level of employment

expecting $b_1 > 0$ and $b_2 < 0$.

According to the authors, the only hypothesis to be tested here is whether $b_1 = -b_2$. If such a restriction is valid then hysteresis exists in the examined wage equation.

We now move to the data description of our study and the time period selected for testing hysteresis effect.

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[3] With the term "*unemployment persistence*" we describe the case where the labor market [the unemployment level] take some time to return to its "natural" level, after an adverse negative shock in the economy (see Coe, 1988).

[4] For an analytical presentation of how we end up with the wage equation 4, see section 3.2 of the Blanchard and Summers (1986) paper or section IV in Moghadam and Rijckeghem (1994) paper.

4. The Data

The estimation period is from 1960 to 2007[5]. So it is considered as a prolonged period of time. Regarding the data, our main source was *Eurostat.* More analytically, the nominal wages (w: nominal compensation per employee in euro), the unemployment (U) and the employment ($Emplo$) variables where taken from *Eurostat*. From *AMECO [Macroeconomic Series Data Base (European Commission, Directorate General Economics and Finance)]* we got the consumer price index variable (*C.P.I.*) in order to create the inflation term (π). Finally, the productivity term ($Q = \frac{GDP_{2000}}{Employment}$) was constructed with the help of both *AMECO* (regarding GDP) and *Eurostat* (regarding Employment). Note that GDP_{2000} implies that the nominator of the productivity variable is at constant prices of 2000. Finally, apart from the aforementioned variables there is also a dummy variable ($Dummy$) which takes the value one (1) for the time period of 1980, 1983, 1984 and 1986 when income policies were applied (see diagram 2) for the nominal wage changes (ΔW). Finally, it is important to mention that we use annual data.

4. The econometric methodology and the empirical Results

4.1. The econometric methodology

As mentioned before, the methods of estimation employed will be the simple O.L.S. method and the *Johansen* co-integration-based error-correction (ECM-GE) method. More specifically, with the OLS method we will directly estimate the wage equations (3) and (4) according to their theoretical structure, while in the ECM-GE case we will follow the co-integration process. This implies that in the second method of estimation, unit root tests will be initially implemented for all variables included [e.g. will test whether our variables are I(1) or I(2)].

Then, before the final implementation of the ECM-EG process, the existence of the number of co-integrated vectors (r) between the participating variables will be traced. In other words, using the *Johansen's* methodology (Johansen and Juselius, 1990), we will implement a *k*-dimensional Vector Autoregressive Model (VAR) of the following form:

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[5] The 2006 and 2007 data are estimations given from the data sources.

$$P_t = \mu + \sum_{j=1}^{k} \Pi_i P_{t-1} + e_t \qquad (5)$$

where P_t is a (n×1) vector and e_t are Gaussian residuals. The VAR in equation (5) will be reparameterized into a Vector Error Correction (VECM) form:

$$\Delta P_t = c + \Pi P_{t-1} + \sum_{j=1}^{k-1} \mathrm{B}_j \Delta P_{t-j} + \varepsilon_t \qquad (5a)$$

where Π is a (n×n) matrix of long-run and adjustment parameters, B_j is a (n×n) matrix of the short-run parameters, ε_t is the vector of i.d.(0, Σ) and j is the number of lags. Following the typical Johansen procedure, the *Trace* and *Maximum Eigenvalue* statistics are implemented in order to determine the rank of Π in equation (5a) and to reach a conclusion on the number of co-integrating vectors (r) in our EVAR system.

However it is crucial to mention here that the number of the existing co-integrating vectors (e.g. if $r = 1,2...p \; with \; p < n$) are very sensitive to the number of lagged variables (n) of the initial vector (5) [see Karfakis, 2004].

For that reason five (5) different lag's selection criteria will be implemented. These are : The *modified LR* test statistic (*LR*), the *Final Prediction Error* test (*FPE*), the *Akaike* Information Criterion (*AIC*), the *Schwarz* Information Criterion (*SC*) and finally the *Hannan-Quinn* information criterion (*HQ*). Of course in most of the examined empirical cases the aforementioned selection criteria do not all agree among the optimal lag length. In that case the majority view will be selected as a kind of sub-optimal solution to the number of lagged variables for our E.V.A.R. (n) model.

After the crucial issue of determining the number of the existing co-integrated vectors (r) among the participating variables, we will proceed to the implementation of the ECM-EG process in our aggregate wage equations. Then, as a final stage, we will compare the results produced –regarding hysteresis effect on wage model- from the two econometric methodologies.

4.2. The empirical results

The labour market condition

Before we proceed to our econometric results, it is necessary to present and discuss briefly the way unemployment was evolved these 48 years (almost half a century) in the Greek labour market. As we can see from diagram 1, it is very difficult, after all those years, to accept the existence of a "natural" level of unemployment in the economy.

As reported in Panagopoulos (2000 and 2007), unemployment in Greece can be separated in different periods of fluctuation. More analytically, we have the first period of relatively low unemployment back in '60s, when its level was around 5% and GDP growth was about 6-7%. Then we have the second period of '70s with the lowest reported level of unemployment (about 2%) which was accompanied by investments mainly in (public) services and a GDP growth of 5%. As it is obvious from diagram 1, the period of low unemployment ended in the early '80s and it peaked at 1999 with a double digit level (almost 12%).

Nevertheless, the latter prolonged period (1983-1999) can separated in two parts: the first part, 1983-1991, where unemployment -after an explosive increase- stabilised around 7%[6] and the second part, 1993-1999, when it reached 12%. The interesting point is that in both sub-periods the GDP growth was about 2.5%. The basic reason for this differentiation, regarding the unemployment rate, is that in the second sub-period we have, first, the inflow of immigrants from both the ex-communist countries plus the immigrants from the developing world and second, the positive technological shock (e.g. the extensive operation of PCs in the economy) which, due to the insider-outsider theory, was not considered so beneficiary to the outsiders of the labour market.

From that year onwards (1999-), we have a decline of unemployment -taking into consideration that the 2006 and 2007 data (9.7%) are estimates- accompanied by relatively high GDP growth (3-4%).

Regarding now the employees' real wage performance (see diagram 2) we can comment the following: during '60s and up to 1972 we have an increase of the employees' real income. Then, for a substantial time period (1978-1996), the employees' real wage was declining. Finally, from that period onwards we have a small improvement of their real income (taking into consideration that the 2006 and 2007 data are estimates).

The empirical results

[6] For an analytical presentation of the reasons that caused this explosive increase of unemployment in that period see OECD Economic Surveys (1996).

Turning now to the empirical results, we will begin our discussion from the simple OLS results. More analytically, in Table 1a and 1b, we present the results of a typical Phillips-type aggregate wage equation (1960-2007e) in non-log and log form respectively. In both Tables equations (1) and (2) incorporate *Setterfield's* definition of the labor market proxy, while equations (3) and (4) incorporate the *Blanchard and Summers* corresponding definition. From the first two equations it is obvious that apart from the income policy variable [$Dummy$], both the level [U_{t-1} or LU_{t-1}] and the change [ΔU_{t-1}(%) or ΔLU_{t-1}] of unemployment are statistically significant terms. This is a strong indication for a *persistence* rather than an *hysteresis* effect in the Greek labor market.

On the other hand, in equations (3) and (4) of Table 1a, the *Blanchard and Summers* definition of hysteresis is tested. From the values of the employment lagged coefficients [$Empl_{t-1}$ and $Empl_{t-2}$] it is obvious that their hysteresis hypothesis is accepted in both equations. On the other hand, the corresponding logged estimations of Table 1b [equations (3) and (4)] give different coefficients on employment variables [$LEmpl_{t-1}$ and $LEmpl_{t-2}$]. In that case *Wald* tests were implemented in both models of Table 1b, in order to get a clear picture on whether the hysteresis hypothesis can be accepted. Both $X^2(1)$ Wald test results favor the existence of an hysteresis effect in the two *Blanchard and Summers* type wage equations [$X^2(1)$=4,07 in equation (3) and $X^2(1)$=1,43 in equation (4)]. Nevertheless, it is not negligible to report that all tested lagged employment variables were not statistically significant.

As an overall comment, regarding Table 1a and 1b, we consider important to report that equations (1) and (2) of Table 1a are the best performing wage models of our OLS estimation. More specifically, in these two equations there is no autocorrelation problem in the residuals of the regressions and moreover the labor market proxies are statistically significant. Moreover, the non-logged regressions "fit" better the data than the logged one since we do not loose information regarding the inflation variable[7]. For this last reason the co-integration and error correction methodology which is applied next will not be logged.

[7] In early '60s we have some years with recorded zero level of inflation.

We now turn to the second part of our econometric work which is the implementation of more co-integration techniques for testing the hysteresis alternative specifications. However before the error correction estimations, in Table 2, we present the Unit root A.D.F. tests for all variables included in our wage models. According to the results produced, productivity, the nominal wage and the employment variables are integrated of order one [e.g. $Py, W, Emplo \sim I(1)$]. On the other hand, the consumer price index and the unemployment variables are integrated of order two [e.g. *C.P.I.* and $U \sim I(2)$[8]].

The above Unit root A.D.F. result and in particular that of the *C.P.I.* variable, compel us to test for the existence of two alternative *Johansen* co-integrating vectors (r) among our variables [see Tables 3a and b] : One which strictly follow the rule that all the re-parameterized variables of our Vector Error Correction model (VECM) will be $I(0)$ and one where –for the sake of the economy theory- the *CPI* term will not be. More specifically, the two tested alternative *Johansen's* co-integrating vectors are [$W, \Delta U, \pi, Py, Dummy$] and [$W, \Delta U, C.P.I., Py, Dummy$] respectively.

In addition and in accordance with the *Blanchard and Summers* view on hysteresis effect specification, we also tested the [$W, Empl, C.P.I., Py, Dummy$] and the [$W, Empl, \pi, Py, Dummy$] vectors. However, the first vector was rejected by the five VAR lag length criteria (a strong indication for the rejection of any co-integrating vector) while the second vector, although accepted only by the *Max-Eingenvalue* test of the *Johansen's* procedure, had a statistically insignificant[9] error correction term (E.C.T.).

From *Johansen's* co-integration tests (Tables 3a and 3b), we realize that the vectors [$W, \Delta U, \pi, Py, Dummy$] and [$W, \Delta U, C.P.I., Py, Dummy$] are accepted from the data and therefore only for them we can continue in the error correction implementation process. In economic terms, only the Setterfield's type of wage equation qualified for the final ECM-GE procedure.

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[8] The ADF test result upon the unemployment variable is a further indication that there is no "natural" level of unemployment in the Greek labour market. In other words, borrowing the Setterfield terminology, even the change of unemployment might behave as a "random walk" process.

[9] All the above results are available upon request.

Table 4 presents the ECM-GE results for the two different cases (Case 1 and 2 related to the different inflation specification) of the *Setterfield's* wage model. In the first ECM-GE wage model (case 1) -where we use the inflation variable (π) in the long-run model- we can observe that the hysteresis effect is positive and significant (as expected) while the productivity (ΔPy) and the income policy term ($Dummy$) were also significant with the expected signs.

In the second ECM-GE wage model (case 2) we got almost the same results with the first case. In other words, despite the different treatment of the *C.P.I.* variable -in the co-integrating vectors of Table 3 (a and b)- the results where not seriously affected in the error correction process. Both inflation (π) and change of inflation ($\Delta\pi$) terms in cases 1 and 2 respectively were proven statistically insignificant.

5. Concluding comments

In this paper we have actually extended the work done back in 2000, both in terms of data and in terms of econometric methodology. This time the new set of data and the more sophisticated econometric techniques allow us to be more analytical concerning the results produced.

Therefore we can report here that the simple OLS methodology qualifies the existence of unemployment persistence in the Greek labor market. Moreover it appears that the data "fit" better with the Setterfield's wage model. On the other hand, the ECM-GE methodology seems to favor the existence of an hysteresis effect in Setterfield type aggregate wage equation.

In economic terms, if we accept the simple OLS results, the existence of unemployment persistence in the Greek labor market implies that a Walrasian "natural" level of unemployment may exist in the long run. However, due to the relatively small size of the Greek economy, even a small negative shock can drive unemployment away from that level. In other words, in small economies –like the Greek one- relative small negative economic shocks may prohibit the labor market from returning to its long run "natural" level. Moreover, we have to consider that in such [small] economies the line between hysteresis and unemployment persistence is not so clear.

On the other hand, if we accept the ECC-EG results, then the importance of the hysteresis effect (the positive sign of the $\Delta^2 U$ variable in the dynamic model) in the wage determination process is obvious and it should be interpreted according to the insiders-outsiders theory. More analytically, it signifies that in the Greek public driven economy (for the bigger part of the examined time period) any insider who, for some reason, turned out to be an outsider, creates an awkward beneficiary effect for the remaining insiders. In other words, the smaller group of remaining employees were in a better off position for negotiating (with their employers which in the most of the cases was and still is the Greek state) their wages. In addition, the smaller remaining group of insiders, even in the private sector, were and still are "protected" by state legislation that prohibits any lay off above 2% of the employed force.

Overall, regardless of the econometric method of estimation, -in other words regardless if the labor market "suffers" from unemployment persistence or hysteresis- for the Greek economy it is rather difficult to accept first, the existence of a "natural" level of unemployment and second, that the different labor market proxies are insignificant for the wage determination process.

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Diagram 1
The Unemployment rate (1960-2007e)

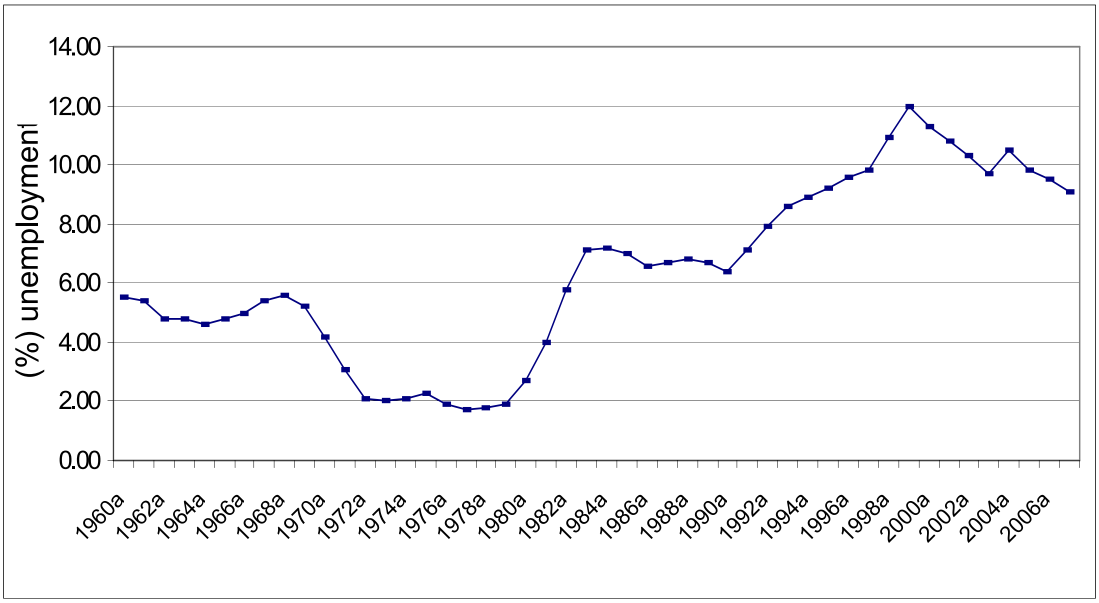

Diagram 2
The long run relationship between
nominal wage changes (ΔWages) and inflation

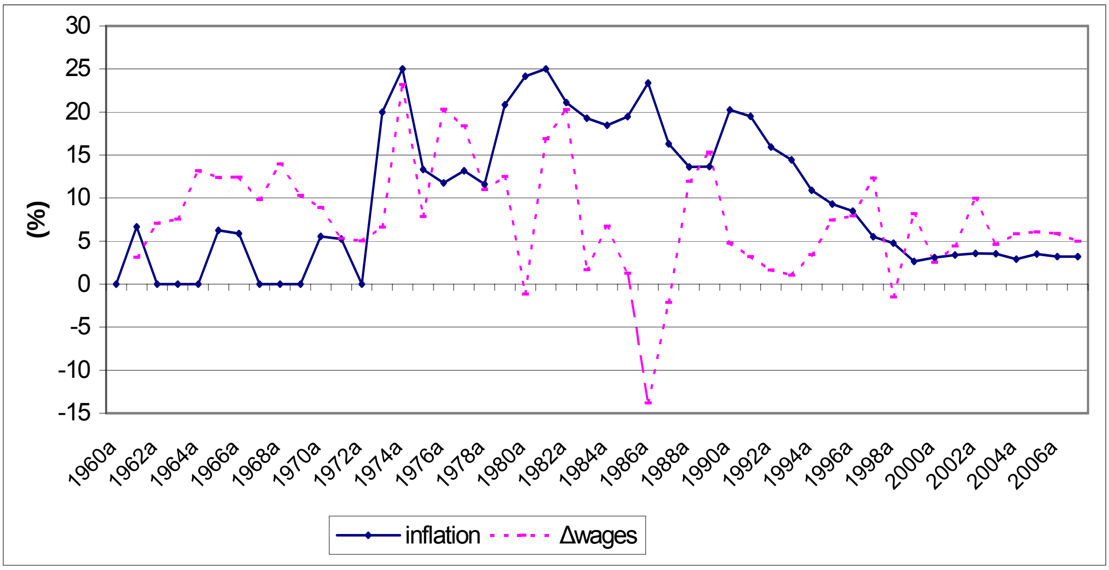

Table 1a[э]

A simple OLS Phillips-type aggregate wage equation (1960-2007e)

Dependent variable : $\Delta W_t (= \frac{w_t - w_{t-1}}{w_{t-1}})$

	(1)	(2)	(3)	(4)
$constant$	19.3	17.9	40.6	29.49
	(5,15)	(3,91)	(2,94)	(1,99)
ΔW_{t-1}	-	0.06	-	0.23
		(0,51)		(1,82)
$\Delta \pi_{t-1}$	-0.25	-0.22	0.03	0.09
	(-1,68)	(-1,40)	(0,24)	(0,60)
U_{t-1}	-1.31	-1.22	-	-
	(-4,39)	(-3,58)		
ΔU_{t-1} (%)	0.22	0.21	-	-
	(4,03)	(3,74)		
$Empl_{t-1}$	-	-	0.02	0.02
			(1.17)	(1,42)
$Empl_{t-2}$	-	-	-0.03	-0.03
			(-1,63)	(-1,77)
ΔQ_{t-1}	-0.01	0.008	0.09	0.19
	(-0,04)	(0,03)	(0,30)	(0,62)
$Dummy^{\partial}$	-12.6	-12.6	-11.3	-11.7
	(-4,71)	(-4,69)	(-3,56)	(-3,79)
R^2	0,57	0,57	0,38	0,43
$L.M.(4)$	3,66	3,32	8,68	5,32

∂. The dummy variable takes the value of one (1) for the time period of 1980, 1983, 1984 and 1986 when income policies were applied.
э. t-statistics appear at the parentheses.

Table 1b

A simple OLS Phillips-type aggregate wage equation (1962-2007e)

Dependent variable (L=log)* : $\Delta LW_t (= LW_t - LW_{t-1})$	(1)	(2)	(3)	(4)
$cons\tan t$	0.23	0.21	2.76	1.73
	(3,76)	(2,90)	(2,00)	(1,17)
ΔLW_{t-1}	-	0.05	-	0.24
		(0,43)		(1,67)
$\Delta \pi_{t-1}$	-0.02	-0.01	0.0006	0.01
	(-1,26)	(-1,03)	(0,03)	(0,51)
LU_{t-1}	-0.06	-0.06	-	-
	(-4,06)	(-3,21)		
ΔLU_{t-1}	0.22	0.21	-	-
	(3,34)	(3,17)		
$LEmpl_{t-1}$	-	-	0.90	1.12
			(1.12)	(1.41)
$LEmpl_{t-2}$	-	-	-1.23	-1.33
			(-1,58)	(-1,74)
ΔLQ_{t-1}	0.09	0.11	0.05	0.18
	(0,40)	(0,44)	(0,14)	(0,51)
$Dummy^{\partial}$	-0.12	-0.12	-0,10	-0.11
	(-4,49)	(-4,46)	(-3,46)	(-3,68)
R^2	0,57	0,57	0,39	0,44
$L.M.(4)$	12,6	11,4	6,4	3,1

*in logs

∂. The dummy variable takes the value of one (1) for the time period of 1980, 1983, 1984 and 1986 when income policies were applied.

Table 2

A.D.F. Unit root tests

Hypothesis testing[ψ]	$I(0)$	$I(1)$	$I(2)$
W	-0.99	-5.32	
U	-2.88	-2.84	-6.30
$C.P.I.$ (π)	-2,17	-1.90	-7.06
$Emplo$	-2.60	-6.86	
Py	-3.56	-5.01	

ψ. The lag length selection in the unit root test is the *Schwarz Information Criterion*

Table 3a

The Johansen's Co-integration test results for the long-run relationship among the (n) variables of the wage equation (1960-2007e)

Selected co-integrated Vector, (r) :
$(W, \Delta U, \pi, Py, Dummy)$

Hypothesis: Ho	**H1**	**No. of *lags* (*lag selection- k*)**[f]	**λ Max eigenvalue test**	**Critical Value 5%**
$r = 0$	$r = 1$	1	37.83	33.87
$r \leq 1$	$r = 2$	1	25.31	27.58
$r \leq 2$	$r = 3$	1	20.42	21.13
$r \leq 3$	$r = 4$	1	10.72	14.26
$r \leq 4$	$r = 5$	1	03.88	3.84

* number of cointegrating Vectors, $r = 1$

Hypothesis: Ho	**H1**	**No. of *lags* (*lag selection- k*)**[f]	**λ Trace eigenvalue test**	**Critical Value 5%**
$r = 0$	$r = 1$	1	98.19	47.21
$r \leq 1$	$r = 2$	1	60.35	29.68
$r \leq 2$	$r = 3$	1	35.03	15.41
$r \leq 3$	$r = 4$	1	14.61	3.76
$r \leq 4$	$r = 5$	1	03.88	3.76

* number of cointegrating Vectors, $r = 3$

f. The lag selection criterion was based on the agreement of all the lag length selection tests (i.e. *L.R.*, *F.R.E.*, *A.I.C.*, *H.Q.* tests).

Table 3b

The Johansen's Co-integration test results for the long-run relationship among the (n) variables of the wage equation (1960-2007e)

Alternative selected co-integrated Vector, (r):
$(W, \Delta U, C.P.I., Py, Dummy)$

Hypothesis: Ho	H₁	**No. of *lags*** ***(lag selection- k)*** [f]	**λ Max eigenvalue test**	**Critical Value 5%**
$r = 0$	$r = 1$	2	38.42	33.87
$r \leq 1$	$r = 2$	2	29.53	27.58
$r \leq 2$	$r = 3$	2	22.56	21.13
$r \leq 3$	$r = 4$	2	8.61	14.26
$r \leq 4$	$r = 5$	2	4.79	3.84

* number of cointegrating Vectors, r =3

Hypothesis: Ho	H₁	**No. of *lags*** ***(lag selection- k)*** [f]	**λ Trace eigenvalue test**	**Critical Value 5%**
$r = 0$	$r = 1$	2	103.94	69.81
$r \leq 1$	$r = 2$	2	65.51	47.85
$r \leq 2$	$r = 3$	2	35.98	29.79
$r \leq 3$	$r = 4$	2	13.41	15.49
$r \leq 4$	$r = 5$	2	04.79	3.84

* number of cointegrating Vectors, $r = 3$

f. The lag selection criterion was based on the agreement of all the lag length selection tests (i.e. *L.R.*, *F.R.E.*, *A.I.C.*, *H.Q.* tests).

Table 4

The E.C.M.-GE aggregate wage equation

Case 1 : with co-integrated Vector (r): $W, \Delta U, \pi, Py, Dummy$

The *ECM-GE* dynamic model :

$$\Delta W = 5.66 + 0.16\Delta W_{t-1} - 0.13\Delta\pi_{t-1} + 0.20\Delta^2 U_{t-1} + 0.42\Delta Py_{t-1} - 0.13 Dummy -$$

(4,28) (1,34) (−0.17) (3.42) (2.14) (−4.67)

$$- 0.99 ECT_{t-1}$$

(−2.68)

$X^2_{Normality} = 1.04$ $LM(2) = 1{,}48$ $ARCH(1) = 0.01$ $R^2 = 0.51$

Case 2 : with co-integrated Vector (r): $W, \Delta U, CPI, Py, Dummy$

The *ECM-GE* dynamic model :

$$\Delta W = 2.57 + 0.23\Delta W_{t-1} + 0.16\pi_{t-1} + 0.17\Delta^2 U_{t-1} + 0.61\Delta Py_{t-1} - 0.11 Dummy -$$

(1,16) (1,93) (1.24) (2.78) (2.57) (−3.48)

$$- 1.43 ECT_{t-1}$$

(−2.01)

$X^2_{Normality} = 0.04$ $LM(2) = 2{,}36$ $ARCH(1) = 0{,}06$ $R^2 = 0.49$

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