European Research Studies
Volume VI, Issue (3–4), 2003, pp. 281–290

A Behavioral Analysis of Greek Strike Activity

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Abstract

This work deals with the analysis of Greek strike activity during the period 1975–1994 based on the data collected by the National Statistical Service of Greece. The work is distinguished into two parts as follows:

a. For the industry sector

b. For all the sectors

Conventional strike equations are specified and estimated using the data for all strikes and the effects of the explanatory variables are compared. The study includes several explanatory variables, which have been used by many investigators of strikes. To analyze the aforementioned data, the ARIMA procedure was also used to estimate and forecast models using the methods prescribed by Box and Jenkins (1976). The logarithmic transformation of the data has demonstrated a better behavior of the respective models, fact that it was expected since in a previous work, which was presented in the Fourth Statistical Conference of Greece in Patras 1991, the goodness of fit of the data in the lognormal distribution has been proved.

Keywords: Greek strike activity, empirical models, Box and Jenkins ARIMA modeling

JEL Classification: C22, C53

Introduction

This study is concerned with the investigation of strike activity in Greece. Previous investigations of strike activity to the world–at–large have produced many interesting results. Next section describes a very reliable data set of Greek strike activity during the period 1975–1994, which is collected by the National Statistical Service of Greece and Center of Planning and Economic Research. The strike measures: number of strikes (N), lost hours due to strikes (L), and participation rate of labourers in strikes (P), are used as dependent variables. Several economic variables are used as explanatory variables. Such variables are the gross domestic product (GDP), the rate of unemployment (U), the capital investment per worker (CIPW), the real wages (RW) and the industrialization index (I). The appropriate models, using multiple regression theory, are selected.

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Then a set of monthly taken observations during the period 1984–1994 is analyzed due to the ARIMA procedure. The data have been collected from National Statistical Service of Greece and Center of Planning and Economic Research. Box and Jenkins forecasting methodology is used to predict the future values of number of strikes.

Finally follows a discussion of the obtained results, as well as some thoughts about how these results may contribute to the efforts for prediction of Greek strike activity. A comparison of strike activity between Greece and other countries has also been made.

The Data and the Empirical Models

This section describes the basic data and variables we use and the specification of the strike equations to be estimated. The National Statistical Service of Greece annually collected the data for the period 1975–1994 including the following sectors and their code numbers:

0. AGRICULTURE – LIVESTOCK BREEDING – FORESTS – HUNTING – FISHERY
1. MINES (SILVER – MINES, QUARRIES – SALT MINES)
2–3. INDUSTRY – CRAFT
4. ELECTRICITY – GAS – STEAM – WATER SUPPLY
5. BUILDING CONSTRUCTIONS AND PUBLIC WORKS
6. TRADE – RESTAURANTS – HOTELS
7. CARRYING TRADE (TRANSPORTS) – STORAGE – COMMUNICATIONS
8. BANKS AND OTHER INSTITUTIONS, INSURANCE, DISPATCH SERVICE – HIRING OF MOVABLE PROPERTY AND RENTING OF REAL PROPERTY
9. OTHER SERVICES

The dependent variables to be used are three major measures of strike incidence. These are: the number of strikes (N), the lost hours due to strikes (L), and the participation rate of labourers in strikes (P) which is defined as the number of strikers divided with the number of employees.

The study includes several explanatory variables (using data which have been collected from Center of Planning and Economic Research), that have been used by many researchers of strikes. Such variables are: the gross domestic product (GDP), the rate of unemployment (U), the capital investment per worker (CIPW), the real wages (RW) and the industrialization index (I).

The rate of unemployment (U) is defined, as the number of unemployed people divided with the total number of civilian labour forces.

The industrialization index (I) is defined, as the percentage of workforce not engaged in agricultural employment.

Then, we study the effects of all independent variables to the three measures of strike incidence, in order to find the appropriate strike model. The method of multiple regression was chosen and the work is distinguished into the following two parts:

a. For the industry sector 2–3

The data, in this part, derived exclusively from the sector of industry. Stepwise variable selection was applied using forward selection to control entry of variables into the model. The two models with the best fit to the data are displayed in Tables 1 and 2.

Table 1: *Regression results for strike model in industry using annual data for Greece between 1975–1994*

L	$RW_{IND^{t-1}}$	$CIPW_{IND^{t-1}}$	$GDP_{IND^{t-1}}$	Const	R^2(adj.)	D–W
	–3.6 E4***	5.07 E4***	120.8*	–1.6 E6	0.66	1.59
	(–3.42)	(4.07)	(1.84)	(–0.31)		

*t–statistic in parentheses; significance levels: *<0.10, **<0.05, ***<0.01 (two tailed test). Where L = the lost hours due to strikes;* $RW_{IND^{t-1}}$ *= the lagged annual real wages (industry);* $CIPW_{IND^{t-1}}$*= the lagged annual capital investment per worker (industry);* $GDP_{IND^{t-1}}$ *= the lagged annual gross domestic product (industry); Const = constant; D–W = Durbin–Watson.*

The estimated regression line is:

$$L = -1.6*10^6 - 3.6*10^4 * RW_{IND^{t-1}} + 5.07*10^4 * CIPW_{IND^{t-1}} + 120.8 * GDP_{IND^{t-1}}$$

The model explains 66 percent of the variation in lost hours. The regression coefficients are all statistically significant (except the constant) and we notice that the number of lost hours has a negative association with the real wages but a positive one with the capital investment per worker and the gross domestic product.

Table 2: *Regression results for strike model in industry using annual data for Greece between 1975–1994*

N	$RW_{IND^{t-1}}$	$CIPW_{IND^{t-1}}$	Const	R^2(adj.)	D–W
	–3.14	7.94	628.9	0.58	2.45
	(–1.99)	(3.72)	(1.18)		

*t–statistic in parentheses; significance levels: *<0.10, **<0.05, ***<0.01 (two tailed test). Where N = the number of strikes;* $RW_{IND^{t-1}}$ *= the lagged annual real wages (industry);* $CIPW_{IND^{t-1}}$ *= the lagged annual capital investment per worker (industry); Const = constant; D–W = Durbin–Watson.*

The estimated regression line is :

$$N = 628.9 - 3.14 * RW_{IND^{t-1}} + 7.94 * CIPW_{IND^{t-1}}$$

The model explains 58 percent of the variation in number of strikes. The regression coefficients are again statistically significant (except the constant) and we conclude that the number of strikes in industry has a negative association with the real wages but a positive one with the capital investment per worker.

b. For all the sectors

The data, in this part, derived from all the sectors of economy. Stepwise variable selection was applied again. The two models with the best fit to the data are displayed in Tables 3 and 4.

Table 3: *Regression results for total strike model using annual data for Greece between 1975–1994*

L	*U*	*I*	GDP^{t-1}	Const	R^2(adj.)	*D–W*
	–2.73 E6*** (–3.3)	–2.97 E4** (–2.51)	356.6*** (3.01)	8.4 E7** (1.97)	0.41	2.8

*t–statistic in parentheses; significance levels: *<0.10, **<0.05, ***<0.01 (two tailed test). Where L = the lost hours due to strikes; U = the rate of unemployment; I = industrialization index;* GDP^{t-1} *= the lagged annual gross domestic product; Const= constant; D–W = Durbin–Watson.*

The estimated regression line is:

$$L = 8.4 * 10^7 - 2.73 * 10^6 * U - 2.97 * 10^6 * I + 356.6 * GDP^{t-1}$$

The model explains 41 percent of the variation in lost hours. The regression coefficients are all statistically significant (including the constant) and we notice that the total number of lost hours due to strikes has a negative association with the rate of unemployment and the industrialization index but a positive one with the gross domestic product.

Table 4: *Regression results for total strike model using annual data for Greece between 1975–1994*

P	*U*	*I*	GDP^{t-1}	Const	R^2(adj.)	*D–W*
	–0.056*** (–3.12)	–0.073** (–2.94)	8.3*** (3.23)	2.18** (2.35)	0.42	2.1

*t–statistic in parentheses; significance levels: *<0.10, **<0.05, ***<0.01 (two tailed test). Where P = the participation rate of labourers in strikes; U = the rate of unemployment; I = industrialization index;* GDP^{t-1} *= the lagged annual gross domestic product; Const = constant; D–W = Durbin–Watson.*

The estimated regression line is:

$$P = 2.18 - 0.056 * U - 0.073 * I + 8.3 * 10^{-6} * GDP^{t-1}$$

The model explains 42 percent of the variation in participation rate. The regression coefficients are all statistically significant (including the constant) and we conclude that the participation rate of labourers in strikes (as the total number of lost hours in Table 3) has a negative association with the rate of unemployment and the industrialization index but a positive one with the gross domestic product.

Box and Jenkins ARIMA Modeling

The data, in this section, are monthly collected during the period 1984–1994 by the National Statistical Service of Greece. They describe the number of strikes in industry sector and the total number of strikes. The logarithmic transformation of the data has demonstrated a better behaviour to the estimation of the appropriate SARIMA model. This fact is expected since it was proved the goodness of fit of the data in the lognormal distribution (see reference Damianou, Katsi, Sfakianakis and Tziafetas).

a. For the industry sector 2–3

The data, in this part, are 120 observations that describe the monthly strikes of industry sector from January 1985 till December 1994. The selected model by Box and Jenkins methodology is the SARIMA $(2,0,0)\times(0,1,1)_{12}$ model and the corresponding forecasting equation is:

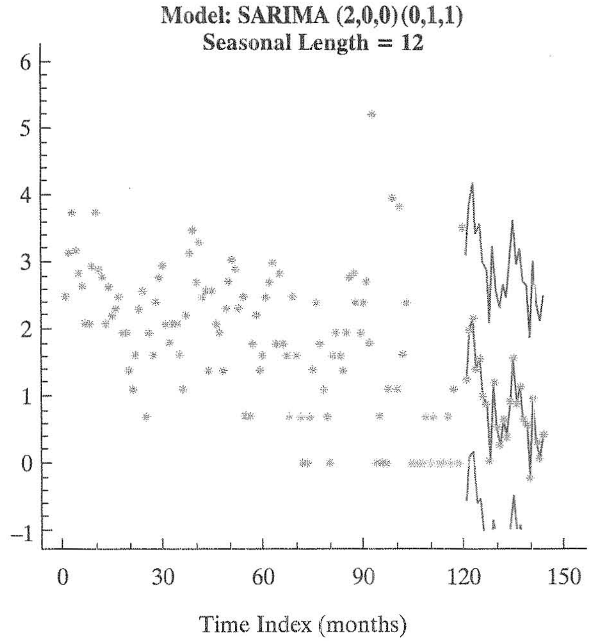
$$W_t = -0{,}08860 + 0{,}29392 * W_{t-1} + 0{,}24627 * W_{t-2} + Z_t - 0{,}83547 * Z_{t-12}$$

where $W_t = LOG(X_t) - LOG(X_{t-12})$.

The twenty fourth–month–ahead forecasts are shown in Figure 1:

Figure 1

Plot of Forecast Function for Industries



**In the Y–axis the logarithm of number of strikes is represented.*

b. For all the sectors

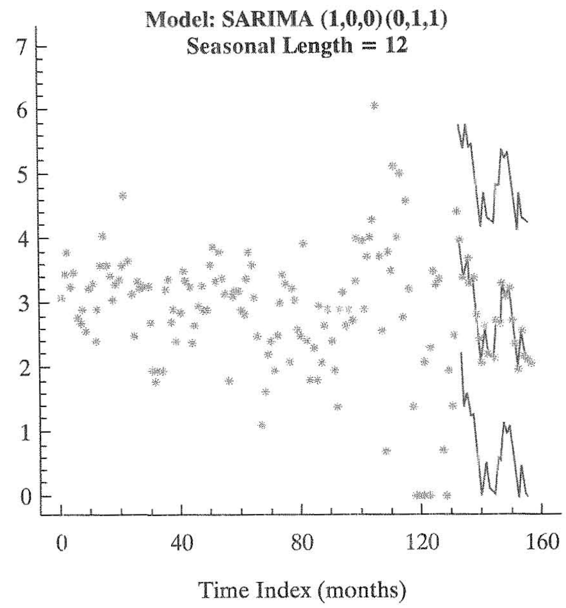
The data, in this section, are 132 observations that describe the monthly strikes at the total of sectors from January 1984 through December 1994. The selected model is the SARIMA $(1,0,0)\times(0,1,1)_{12}$ model and the corresponding forecasting equation is:

$$W_t = -0{,}02026 + 0{,}54618 * W_{t-1} + Z_t - 0{,}84954 * Z_{t-12}$$

where $W_t = LOG(X_t) - LOG(X_{t-12})$.

The twenty fourth–month–ahead forecasts are shown in Figure 2:

Figure 2
Plot of Forecast Function for all Codes



**In the Y-axis the logarithm of number of strikes is represented.*

Discussion of the Results

The use of variables lagged by one year (t–1) is necessary, because it provides better fitting to the models, and is defended by the empirical findings of Snyder (1975) and Skeels (1982). This shows that the changes to the economic variables of a specific year affect the strike activity of the next year. Intuitively speaking, a "bad" economic year causes great strike activity for the next year. Respectively, a "good" economic year causes reduction to strike activity for the next year.

The study of Greek strike data in comparison with other European countries for the period 1975–1994 reveals that the number of strikes is large but their duration is short. However, in other European countries (for example Great Britain) the strike duration is much longer than Greece. This is the reason that the Lognormal distribution shows a better fit for the Greek strike data, since Inverse Gaussian distribution is better fitted for Great Britain strike data(see *Damianou, Katsi, Sfakianakis, Tziafetas* (1991)).

For the period 1975–1994 the annual mean number of strikes in Greece is 468. Segalla (1995) reports a ranking of 41 countries according to their annual mean number of strikes during the period 1953–1984. Greece has similar number of strikes with Portugal and Peru. The countries with the smaller annual mean number of strikes (less than 20) are Switzerland, Sierra Leone, Mauritius, Singapore, Malawi and Norway. The countries with the greater annual mean number of strikes (over than 2000) are India, United Kingdom, France, Italy and United States.

Another significant remark to be made is the increase of strike frequency during the pre–election periods and the corresponding decrease during the post–election periods. The explanation of this fact may be that the workers hope that the government will satisfy their demands before the elections, because it needs their vote. On the contrary, the workers don't have such hope during the post–election periods.

The results per sectors may be summarized as follows:

a) For the industry sector

i) The lost hours due to strikes (L) and the number of strikes (N) have a negative association with the real wages. This result is similar with the findings of A&J (1969), Hibbs (1976), Gramm (1986), and Vroman (1989), all of whom report a significant negative real wage coefficient, but it contradicts the findings of Scoville (1979), Blejer (1981), and P&P (1982).

ii) The capital investment per worker (CIPW) and the annual gross domestic product (GDP) are positively correlated with the measures of strike incidence. Thus, an increase of capital investment per worker or of annual gross domestic product leads to a decrease of strike frequency.

b) For all the sectors

i) The three major measures of strike incidence, namely the number of strikes (N), the lost hours due to strikes (L), and the participation rate of labourers in strikes (P) are negatively associated with the level of industrialization (I). This result is in agreement with the findings of Kerr, Dunlop, Harbison and Meyers (1962) that strike frequency is negatively associated with higher levels of industrialization. It also coincides with the findings of Tracy (1986) that higher industry employment reduces the probability of strikes.

ii) The three measures of strike incidence are also negatively associated with the rate of unemployment. This result is in agreement with the findings of Ashenfelter and Johnson, (1969) and Vroman (1989). The study by Vroman (1989) follows contract negotiations of 250 bargaining pairs over the period 1957–1982. Her estimates indicate a 2–3 percentage point reduction in the probability of strikes for each 1 percentage point increase in the prime–age male unemployment rate. Similar estimates are reported by Gunderson et al. (1986) using Canadian data, while somewhat smaller (but still negative and statistically significant) estimates emerge from the study by McConnell (1987). Katsanevas (1995), as well, reports a strong negative relationship between unemployment rate and strike frequency in Ireland, Italy, Portugal and Holland. This relationship is more weak in Denmark, France, and Spain and inexistent in Belgium, Germany and Great Britain.

iii) The annual domestic product (GDP), as in industry sector, is positively correlated with the measures of strike incidence.

Finally, the selected models by Box and Jenkins methodology predict a decline of strikes in the next 24 months (see Figures 1 and 2). This decline is confirmed in practice, according to strike tables of National Statistical Service of Greece.

References

Ashenfelter, O. and Johnson, G.E. 1969. "Bargaining Theory, Trade Unions and Industrial Strike Activity", *American Economic Review,* Vol. 59, No. 1, pp. 35–49.

Box, G.E.P. and Jenkins, G.M. (1976). Time Series Analysis: Forecasting and Control, Holden–Day, San Francisco.

Cameron, S. 1985. "Historical Variations in the Impact of Union Density on Strike Frequency: Some U.K. Evidence", *Industrial Relations,* vol. 40, No 2, pp. 367–370.

Card, D. and Olson, C. A. 1995. "Bargaining power, strike duration, and wage outcomes: An analysis of strikes in the 1880s", *Journal of Labor Economics,* vol. 13, No 1, pp. 32–61.

Damianou, H., Katsi, P., Sfakianakis, M. and Tziafetas, G. 1991. "The distribution of the duration of strikes in Greece", *Proceedings of the 4th Greek Statistical Conference*, pp. 51–52.

Gramm, C.L. 1986. „The Determinants of Strike Incidence and Severity: A Micro–Level Study", *Industrial and Labor Relations Review*, Vol. 39, No. 3, pp. 361–376.

Gunderson, M., Kervin, J., and Reid, F. 1986. 'Logit Estimates of Strike Incidence from Canadian Contract Data", *Journal of Labor Economics,* 4, pp. 257–276.

Hibbs, D.A. 1976. "Industrial Conflict in Advanced Industrial Societies", *American Political Science Review*, Vol. 70.

Katsanevas, T. 1995. The Greek strike activity in relation with the European Union countries, *Centre of Planning and Economic Research* (in Greek).

Kaufman, B.E. 1983. „Interindustry Trends in Strike Activity", *Industrial Relations,* vol. 22, No 1, pp. 45–57.

Kendall, M.G. 1961. "Natural law in the social sciences", *J. R. statist. Soc. A,* 124, 1–16.

Kerr, C., Dunlop, J.T., Harbison, F.H. and Myers, C.A. 1962. "Industrialism and Industrial Man", London: Heinemann.

McConnell, S. 1987. "Cyclical Fluctuations in Strike Activity", Princeton University *Industrial Relations Section Working Paper* No. 215.

Segalla, M. 1995. "Industrial Conflict in Developed and Developing Countries: Extending a Western Strike Model", *Industrial Relations,* 1995, Vol.50, No 2.

Sfakianakis, M. 1994. "The duration of strikes in Greece", Seminaire European de Statistiques: Likelihood, Time series with Econometric and other applications, Oxford.

Skeels, J. W. 1982. "The Economic and Organizational Basis of Early United States Strikes, 1900–48", *Industrial and Labor Relations Review,* Vol. 35, No. 4, pp. 491–503.

Snyder, D. 1975. "Institutional Setting and Industrial Conflict: Comparative Analyses of France, Italy, and the United States", *American Sociological Review,* Vol. 40, No. 3, pp. 259–278.

Vroman, S.B. 1989. "A Longitudinal Analysis of Strike Activity in U.S. Manufacturing: 1957–1984", *American Economic Review,* Vol. 79, No. 4, pp. 816–826.