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UNEMPLOYMENT BY EDUCATION STATUS, PRICES AND CRIME RELATIONSHIP: EVIDENCE FROM TURKEY

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ABSTRACT

In this study, the events related to official crime that have taken place in Turkey between 2005:01 and 2011:12, in monthly frequency, are tried to be explained. The effects of Consumer Price Index (CPI) and Unemployment (UNE) disaggregated by level of education on to the number of crimes were discussed. It has been observed that there is no long-run relationship among the number of crimes, Consumer Price Index and total unemployment when they are considered together. However, we observe a bivariate cointegration between the number of crimes and the total unemployment. Then, the analysis was repeated with the total number of unemployed status arranged in eight different levels of education. It has been observed that the level of education is an important factor determining the number of committed crimes. In the study; the long-term relationship has been tested with Engle-Granger (1987) and Johansen cointegration methods. Another finding of the analysis is that the seasonality has significant effects on the results. For this reason, seasonal dummies were added as exogenously to the models.

Key Words: *Long-Run Relationship, Cointegration, Crime Economics, Security.*

EĞİTİM DÜZEYİNE GÖRE İŞSİZLİK, FİYATLAR VE SUÇ İLİŞKİSİ: TÜRKİYE ÜZERİNE BİR UYGULAMA

ÖZ

Bu çalışmada Türkiye aylık 2005: 01 ve 2011: 12 dönemi veri seti ile resmi suç olayları açıklanmaya çalışılmaktadır. Tüketici Fiyat Endeksi (TÜFE) ve eğitim düzeyine göre İşsiz (UNE) sayılarının suç sayıları üzerindeki etkileri incelenmektedir. Suç sayısı, Tüketici Fiyat Endeksi ve Toplam İşsizlik arasında uzun dönem ilişki bulunamamıştır. Hâlbuki suç sayısı ve toplam işsizlik arasında ikili kointegrasyon ilişkisi gözlenmiştir. Daha sonra analiz sekiz farklı eğitim düzeyine göre ayrıştırılmış işsizlik rakamlarıyla tekrarlanmıştır. Eğitim düzeyinin işlenen suç sayısını açıklarken önemli bir değişken olduğu gözlenmiştir. Uzun dönem ilişki Engle-Granger (1987) ve Johansen kointegrasyon yöntemleriyle ele alınmıştır. Çalışmadaki bir diğer bulgu mevsimselliğin sonuçlar üzerindeki anlamlı etkileridir. Bu sebeple modele dışsal olarak mevsimsel kukla değişkenleri ilave edilmiştir.

Anahtar Kelimeler: *Uzun Dönem İlişki, Kointegrasyon, Suç Ekonomisi, Güvenlik.*

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INTRODUCTION

Creating a more peaceful community structure and ensuring people to live in safety by preventing crimes is one of the essential tasks of every country. Crime is an important issue for every country especially for developing countries. Turkey is one of the developing countries and there is an increasing trend in the number of committed crimes. For this reason, we examine possible factors affecting crimes.

There are studies in which panel and linear methods are applied to different types of crime data. As a general evaluation, studies were largely carried out in order to contribute to applied econometrics literature. The vast majority of the studies are related to identifying the relations between the society's economic, social, demographic, justice and security features with various crimes. Questions whose answers investigated are: What is the relationship between social structure and crimes? How can the effects of economic development to a particular crime be modeled? What are the effects of the demographic structure to the crime types? How do unemployment rates affect crime amounts? What are the effects of income inequality to crime rates?

Identifying and modeling elements of the crime help to produce more effective policies to combat with crime. Modeling crime economically has being studied for many years and the studies become increased in the recent years in the field of crime analysis since new data and methods become available in the literature.

The contribution of this paper is as follows: We have examined the amount of crimes in rural areas, whereas most of the studies have been conducted for urban areas for different countries. Secondly, unemployment levels have been considered by eight education status. The effects of seasonality become an important issue in this study. While previous studies have been conducted only by using yearly panel data, this study uses monthly data which allow observing the motivation and opportunity effects on crime better.

1. LITERATURE REVIEW

There is variety of studies trying to analyze the determinants of crime for different countries. Beki, Zeelenberg, and Montfort (1999) look at the relationship between economic growth and crime and analyzed the tendencies of various types of crimes using the data for the period 1950-1993 in

Netherlands. Deadman (2000) examined burglary in urban areas for England in the period of 1998-2001 using econometric and time series analysis to estimate the trend of burglary from houses. Econometric and time series models have been constructed for predicting recorded residential burglary.

Andrienko (2001) studies the effects of income inequality, real income and unemployment rate on property crimes by GMM method for the period 1990-1998 in Russian. Sookram *et al.* (2010), using the time series data obtained from Trinidad and Tobago, examined the major crime rates and long-term cointegration relationship between the various socio-economic indicators.

Raphael and Winter-Ebmer (2001) found a positive effect of unemployment on crime rates for the urban areas. Adding instruments to the effect of unemployment on crime (see Raphael and Winter-Ebmer, 2001) may alter the magnitude of the coefficients. Although there is a positive effect of unemployment as of their paper, instrumental variables may also dampen the possible omitted variable bias.

Ivaschenko, Nivorozhkin and Nivorozhkin (2012) claim that real income, unemployment and income inequality explain the crime rate best. Yoon and Joo (2005) state that unemployment increases the crime rates. Altındağ (2012) investigates a positive effect of unemployment on property crime and vehicle theft in Europe. Andersen (2012) explores a positive effect of unemployment on property and claims that burglary logged automotive, theft logged theft, logged violent crime and logged rubbery crime in the long-run but negative in the short-run. Burdett, Lagos and Wright (2003) benefit from the research models to analyze the crime inequality and unemployment relationship.

Cantor and Land (1985) question the relation between crime and unemployment. They explain the negative effect of unemployment on crime by guardianship effect and system activity effect. They emphasize the diminishing circulation of people when they are unemployed by system activity. This explains partly our results with and without considering seasonality. The seasonal dummies eliminate the opportunity effect and identify the motivation effects. Carmichael and Ward (2001) also question the positive motivational and negative opportunity effects. They investigate a higher motivational effect for youth. Phillips and Land (2012), by using a county data for US between 1978-2005, investigate the opportunity and motivation effects. Phillips and Land (2012) use different types of crime in their analysis by fixed effects panel models. They investigate a strong opportunity and crime motivation effects for the period 1978-2005.

Edmark (2005) finds a positive effect of unemployment on property crimes by fixed effects model by Swedish data. According to Greenberg (2001), unemployment increases crime in the long-run but not in the short-run. Halıcıoğlu, Andres and Yamamura (2012) use ARDL approach to test for short and long-run effects of unemployment on crime. They find a positive effect of unemployment on crime. Hojman (2004) uses annual data for Latin America cities and does not find a common effect of unemployment on crime.

Hooghe, Vanhoutte, Hardyns and Bircan (2011) investigate a stronger effect of unemployment than income by spatial regression for Belgian municipalities. They claim that the crime is an urban phenomenon. They investigate a positive effect of unemployment on property crime and violent crime.

Kapuskinski, Braithwaite and Chapman (1998) distinguish between female and male unemployment. When they include female employment to the relationship, the effect of unemployed on crime turns to be positive. Laspa (2013) uses stepwise regression analysis and investigate the effects of population, growth, wage, and unemployment to each particular crime for the period 1991-2010. Lee and Holoviak (2006) use Johansen cointegration to investigate the long-run relationship between unemployment and crime for Korea, Australia and Japan.

Levitt (2001) benefited from OLS for the period 1950-1990 to identify the effect of unemployment and crime. Mcdonald (2000) stresses the role of economic cycles on the difference between true crime and recorded crime rate and uses MLE method. Narayan and Smyth (2004) used multivariate cointegration and VEC and found that in the long-run real income and unemployment might have caused fraud for the period between 1964-2001 in Australia. Neustrom and Norton (1995) use Box-Jenkins model to investigate the relationship between unemployment and crime for the period 1982-1990.

Poutvara and Priks (2011) investigate a relationship between unemployment and gang crime. Justus and Kassouf (2013) obtain a positive effect of unemployment to serious crime and negative to real wages by VAR for the period between 1997-2010. Saridakis and Spengler (2012) use dynamic panel data model and find a positive effect of male unemployment on the criminal activity but this effect is negative for female by using GMM for the period between 1991-1998. Wu and Wu (2012) stress the economic side of crime and claim that income inequality and unemployment have an essential role on crime. Yearwood and Koinis (2011) use stepwise regression to test the efficacy of the unemployment concerning the crime rates for the period 1977-2007.

There are also studies dealing with Turkey. For example, İçli (1993) uses survey method to find the determinants of crime for Turkey. Şanlı (1998) studies the structure of criminality in Turkey according to socio-economic factors and group the provinces according to crime regions. Aslan and Öcal (2012) investigate the convergence of crime rates in 81 Turkish provinces during the 1998–2006 periods by applying "unit root persistence" methodology.

Some previous studies also mentioned the role of seasonality in crime data. Quetelet (1842) investigates the seasonal changes in crime and explains the seasonal effects in terms of types of crimes. The seasons have such a great influence in crimes that in summer seasons more crimes against people are committed and the fewer against property, while in winters vice versa. After his study, a great amount of study related with effects of seasons to crimes has been done. In another study, Sutherland and Cressey (1978) examine seasonality in terms of committed crimes. The study indicates that some types of crimes are more severe than others in urban areas. The following section presents the data and methodology. The third section gives the results. The results are discussed in the fourth section while conclusion is presented in the last one.

2. DATA AND METHODOLOGY

The crime data in amounts have been obtained from Turkish Gendarmerie. The data is confidential due to official regulations. Since the source of the data and its characteristics are unique, the results of the study will contribute to the literature. The earlier literature had primarily worked police data which deals with urban areas. Many of the previous studies dealt with the yearly or quarterly based data. But, there is an essential difference between them in terms of urban-rural differentiation. The responsibility area of gendarmerie is rural area; whereas the responsibility area of police is urban area.

The time span of the data set used in this study is the monthly number of crimes occurred between the years 2005-2011 in the responsibility area of the gendarmerie. Nearly 81% of total number of crimes consists of 6 types of crime: murder, assault and battery, theft and burglary, offence against property, coercion and blackmail, forgery.[*] Figure-1a shows the yearly number of committed crimes and the number of unemployment between 2005-2011 and Figure-1b is for the distribution of total number of crimes. During the economic crises of 2008-2009, it is apparent that both the number of committed crimes and unemployment had increased together.

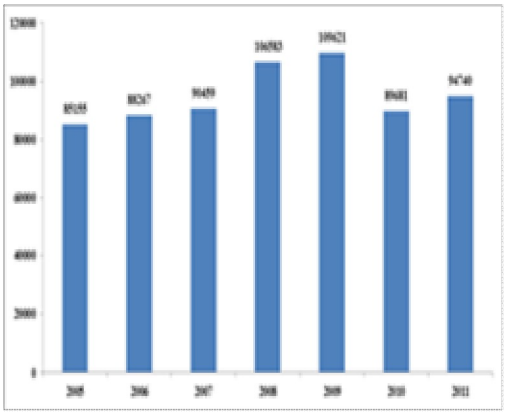

Figure-1a: Number of Crimes

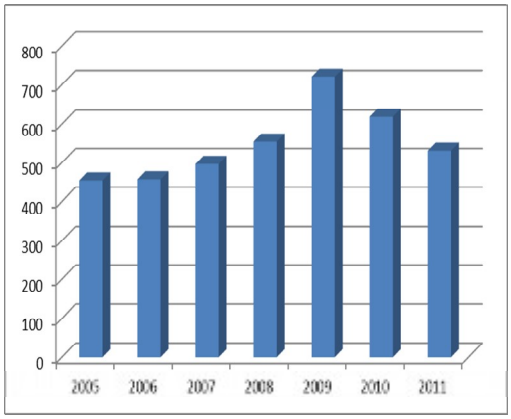

Figure-1b. Number of Unemployment*1000

Figure-2: Distribution of types of committed crimes

The type of six events occurred most commonly are murder, assault and battery, offence against property, theft and burglary, coercion and blackmail and forgery. For compiling the crime data, we took these six events as a whole.

The other two aggregate variables are related with the price and unemployment data. Consistent with the crime data we took the unemployed population over the age 15. The monthly price data is gathered from the Turkish Statistical Institute (TurkStat). Since we do not have general prices for rural areas, we used consumer price index. For the monthly number of unemployed for the rural settlements we gathered data from the Labour Force Statistics database of the TurkStat.

There are *eight sub-categories* of the unemployment data in terms of education status. Figure-3 shows the distribution of the unemployment by educational status.

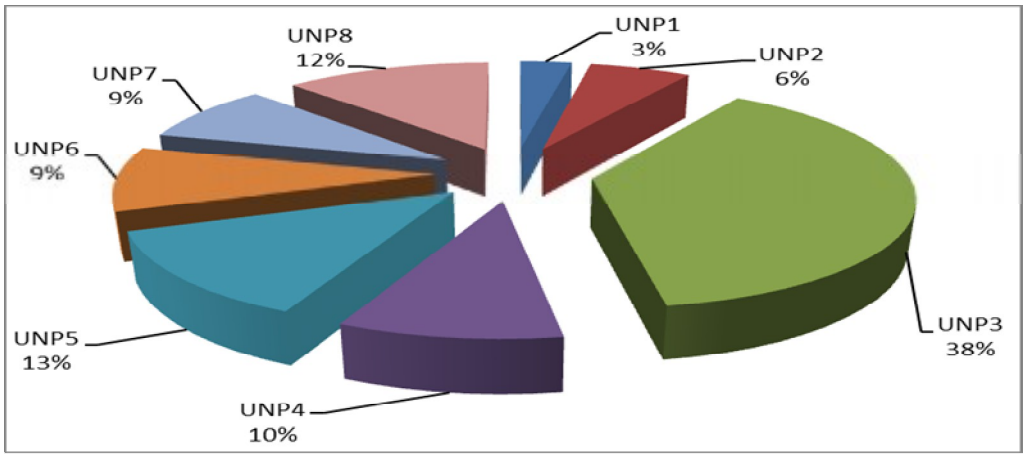

Figure-3: Distribution of Unemployment by educational status given in Table 1

The *eight sub-categories* of the unemployment data in terms of education status are;

a. *illiterate*,

b. *Literate but no school completed*,

c. *Primary school*,

d. *Junior high school or equivalent vocational school*,

e. *High school*,

f. *Vocational school at high school level*,

g. *Universities and other higher educational institutions* and

h. *Primary education*.

More than 65% of unemployed people in the rural areas (15+) has high school education or lower level of education than this. Table-1 presents the variables and the data sources used in the paper. The order of the variables in the table was arranged according to the TurkStat classification.

Table-1: Definitions and Sources of the Variables.

Variables[†]	Explanation	Source
Crm	Crime	General Command of Gendarmerie
Cpi	Consumer Price Index, Real, 2003=100	TurkStat, Labour Force Statistics
Unp_1	Illiterate	TurkStat, Labour Force Statistics
Unp_2	Literate but no school completed	TurkStat, Labour Force Statistics
Unp_3	Primary school	TurkStat, Labour Force Statistics
Unp_4	Junior high school or equivalent vocational school	TurkStat, Labour Force Statistics
Unp_5	High school	TurkStat, Labour Force Statistics
Unp_6	Vocational school at high school level	TurkStat, Labour Force Statistics
Unp_7	Universities and other higher educational institutions	TurkStat, Labour Force Statistics
Unp_8	Primary education	TurkStat, Labour Force Statistics
Unp_9	Total unemployment	TurkStat, Labour Force Statistics

3. RESULTS

We initially searched whether the series are stationary or not. For this purpose we applied Augmented Dickey Fuller (ADF) and Phillips Perron (PP) methods to test the null hypothesis of a unit root. Table-2 provides the results of ADF and PP tests. All the variables are integrated in order one, $I(1)$. Since the variables are integrated at the same order, we concluded that the conventional cointegration analysis can be applied for the long-run relationship.

Following conventional methods, we also applied Hylleberg, Engle, Granger and Yoo (1990) seasonal unit root test that is modified for monthly data by Beaulieu and Miron (1993). We mostly failed to reject the unit root for most of the series. Last, we applied minimum LM unit root test proposed by Lee and Strazicich (2003 and 2004). We determined one structural break in level and trend endogenously and allowed a shift in intercept and a change in the trend parameter. The results appear in Table A2 in the Appendix. The LM type unit root with break test rejects the unit root for all the variables. The break dates are within the years 2007-2010.

Table-2: Augmented Dickey Fuller and Phillips Perron Unit Root Results.[‡]

	ADF		PP		Order of Integration
Variable	**Level**	**First Difference**	**Level**	**First Difference**	
Crm	-2,6607	-7,3411	-3,1104	-6,5989	I(1)
Cpi	-3,3259	-1,1864	-2,7756	-7,5043	I(1)
Unp_1	-2,7403	-6,4028	-3,0323	-11,7381	I(1)
Unp_2	-2,8978	-5,5027	-2,6417	-9,2163	I(1)
Unp_3	-3,2714	-4,9061	-2,2862	-5,7919	I(1)
Unp_4	-2,9577	-5,1476	-2,8723	-7,7423	I(1)
Unp_5	-3,0617	-5,1507	-2,9936	-8,7049	I(1)
Unp_6	-3,1606	-5,2169	-3,2278	-7,9087	I(1)
Unp_7	-3,4561	-5,2862	-3,3488	-6,4892	I(1)
Unp_8	-2,1745	-5,6057	-1,9286	-8,2818	I(1)
Unp_9	-2,0569	-5,6407	-2,3915	-5,946	I(1)

In order to test whether these $I(1)$ series are cointegrated or not, we applied Engle-Granger (1987) cointegration method. The main equation considered in the analysis is given in equation (1). Here, Crm denotes the total crime commitments, Unp is the number of unemployed people, Cpi is the Consumer price index and M_i's denotes monthly 11 seasonal dummies. We also considered a trend variable in the model in order to capture a time trend in the data.

$$Crm = Constant + \beta_1 Trend + \beta_2 \sum_{i=1}^{11} M_i + \beta_3 Unp + \beta_4 \log Cpi + resid_i \qquad \textbf{(1)}$$

From the main equation, we obtain the residuals denoted by $resid$ in the auxiliary equation given in (2)

$$\Delta resid_t = \alpha_1 resid_{t-1} + \sum_{j=2}^{q} \alpha_j \Delta resid_{t-j} + u_t . \qquad \textbf{(2)}$$

If the residual series obtained from (1) are stationary, then we can conclude that they are cointegrated. We initially searched for a possible cointegration relationship among crime, prices and unemployment by EG cointegration method. We cannot reject any cointegration when we considered 3 variables in the equation (1). That is, these three variables are not cointegrated to each other. However, a bivariate cointegration has been obtained between crime and total number of unemployment. Moreover, we search for a possible cointegration between crime and the sub components of unemployment in terms of eight education status.

Since the first stage equations inherit eleven monthly seasonal dummy variables, constant and trend, we can also interpret the seasonality in crime. As it is seen from Table-1, the estimate of constant term is very low for illiterate educational level which indicates heterogeneity of data in terms of educational level.

From the available set of data charts it can be seen that the amounts of crimes have increased in June, July and August. Accordingly, public order offenses that occurred between the years 2005-2011 show the seasonality. The seasonality of crimes committed in rural areas can be explained by the increased movement from urban areas to the rural in the specified time period.

After 2008, the population and employment increased (Cengiz, Şahin and Atasever, 2012) in the agricultural sector in the rural areas. This shows that inverse migration movements from urban to rural areas increased the population density and the probability of committing a crime. Secondly; during the harvest time in the summer, seasonal workers move to the rural areas. Students who are resuming their education in the urban areas back to their home which is also another movement from urban areas to the rural.

Next we also applied Johansen (1988) cointegration method to search for a possible cointegration relationship among crime and total unemployment, crime and sub-status of unemployment. Johansen cointegration method allows us to find more than one cointegrating equations. These results support the residual based cointegration test results. Since this method uses MLE estimator rather than OLS, results of the estimated values may differ. During the estimation stage, we included seasonal dummy variables as exogenous variables. Model-1 has one cointegrating equation which strengths the sole long-run relationship between the unemployment and the crime. The sub-components of the unemployment also indicate a long-run relationship. Table-5 represents the estimated eigenvalues and related values of Johansen test statistics. Table-6 shows the summary of the two types of cointegration tests results.

Following conventional methods, we also considered the possible break in the cointegrating equations. Gregory Hansen cointegration test results are presented in Table A3 and Table A4. The specification in Table A3 has a constant as a deterministic term, break in all the coefficients, T-test for the lag selection, this specification is the same as the Gregory and Hansen (1996)'s original paper. Table A4 provides the results when trend is used as a deterministic variable. This residual based test allows cointegrating vector to change by the time-being. Therefore allowing a change in the constant or in the trend may change the results. The findings of the cointegration results indicate for the Model (1) that no cointegration results are valid for all the specifications. Model (2) indicates a cointegration relation between total unemployment and the crime. These are coherent also by the previous conventional estimates.

Table-4: Engle-Granger (1987) Cointegration Test Results, Second Stage Equation.

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
U_{t-1}	-0.6729*	-0.7597***	-0.7604***	-0.7099***	-0.7295***	-0.7131***	-0.7498***	-0.5983***	-0.5067***	-0.6621***
	(0.2311)	(0.1495)	(0.1498)	(0.1488)	(0.1475)	(0.1749)	(0.1479)	(0.1656)	(0.1565)	(0.1718)
DU_{t-1}	-0.2370	-0.0500	-0.0445	-0.0936	-0.0632	-0.1709	-0.0508	-0.2755**	-0.3343***	-0.2083
	(0.2139)	(0.1159)	(0.1157)	(0.1159)	(0.1159)	(0.1536)	(0.1157)	(0.1521)	(0.1486)	(0.1539)
DU_{t-2}	-0.1630					-0.1077		-0.1468	-0.1926*	-0.1165
	(0.1915)					(0.1170)		(0.1180)	(0.1164)	(0.1178)
DU_{t-3}	-0.0811									
	(0.1679)									
DU_{t-4}	-0.0951									
	(0.1264)									
EG Test Stat	-2.9119	-5.0806***	-5.0776***	-4.7706***	-4.9455***	-4.0769***	-5.0691***	-3.6129**	-3.2368*	-3.8541**

Table-5: Johansen Cointegration Test Results[iv]

	Eigenvalue	Trace Stat	5% Crit. Val.	Max-Eigen Stat.	5% Crit. Val.
Rank	**Model (1)**				
0	0.4625	72.4925	42.9153	50.2826	25.8232
1	0.1700	22.2099	25.8721	15.0945	19.3870
2	0.0841	7.1154	12.5180	7.1154	12.5180
	Model(2)				
0	0.2460	28.5421	25.8721	23.1636	19.3870
1	0.0634	5.3784	12.5179	5.3784	12.5179
	Model(3)				
0	0.2957	35.1639	25.8721	28.7492	19.3870
1	0.0752	6.4147	12.5179	6.4147	12.5179
	Model(4)				
0	0.4887	63.3882	20.2618	54.3408	15.8921
1	0.1056	9.0473	9.1645	9.0473	9.1645
	Model(5)				
0	0.2389	27.1994	25.8721	22.3880	19.3870
1	0.0569	4.8114	12.5179	4.8114	12.5179
	Model (6)				
0	0.2382	31.7593	25.8721	22.0461	19.3870
1	0.1130	9.7136	12.5179	9.7136	12.5179
	Model (7)				
0	0.2460	32.9602	25.8721	23.1549	19.3870
1	0.1127	9.8052	12.5179	9.8052	12.5179
	Model (8)				
0	0.2254	32.1737	25.8721	20.9439	19.3870
1	0.1279	11.2298	12.5179	11.2298	12.5179
	Model (9)				
0	0.3472	49.9568	25.8721	34.9774	19.3870
1	0.1669	14.9793	12.5179	14.9793	12.5179
	Model (10)				
0	0.2310	24.5567	15.4947	21.5459	14.2646
1	0.0360	3.0107	3.8414	3.0107	3.84146

Table-6: Summary of the Results

Models	Model Specifications	Engle-Granger Cointegration	Johansen Cointegration
Model (1)	CPI + Unp_9	No Cointegration	One Cointegrating Equations
Model (2)	Unp_9	Cointegration	One Cointegrating Equations
Model (3)	Unp_1	Cointegration	One Cointegrating Equations
Model (4)	Unp_2	Cointegration	One Cointegrating Equation
Model (5)	Unp_3	Cointegration	One Cointegrating Equation
Model (6)	Unp_4	Cointegration	One Cointegrating Equation
Model (7)	Unp_5	Cointegration	One Cointegrating Equation
Model (8)	Unp_6	Cointegration	One Cointegrating Equation
Model (9)	Unp_7	Cointegration	One Cointegrating Equation
Model (10)	Unp_8	Cointegration	One Cointegrating Equation

4. DISCUSSION AND CONCLUSION

The amount of crime varies among countries which are explained by modernization, civilization, opportunity and world system theories (see Paulsen and Robinson, 2004, pp. 15-42). There is also a difference between rural and urban settlements concerning the amounts of crime elements such as crime, law, offender, target and place (Paulsen and Robinson, 2004, pp. 30-33) and social stratification such as economic conditions and social control try to explain the difference between urban and rural crime rates (Paulsen and Robinson, 2004, pp. 34-38).

The heterogeneity among the people committed crime in terms of schooling is also another issue we stress on. It is obvious that when the education level increases; that is when they become more qualified through education it may be expected the number of committed crimes to be decreased. Labour force finds a job easier and paid better when they are educated and they earn an opportunity to be wealthier. Besides its economic advantages and benefits to the society, education also prevents some socially undesirable activities such as crime. Therefore as we expected, number of crimes decreases by the increasing education level among the unemployed population in rural areas.

The first stage equation of the Engle-Granger (1987) cointegration test indicates heterogeneous effects of unemployment on crime. The first term of the second stage of the Engle-Granger (1987) cointegration test indicates persistent level of the shocks on crime.[v] Our results are consistent by the crime data of TurkStat providing that the numbers of total prisoners are the highest by nearly 70 percent, for primary school graduates (Soyaslan, 2003, pp. 128-129). Instantaneous opportunity effect is negative because of the less opportunity to disturb law but motivation effect may increase this tendency that is a lagged effect (Greenberg, 2001). Consequently when the education status increases the income level also improves. These studies are based on urban areas generally obtained from Ministry of Internal Affairs.

Besides the unemployment as an explanatory variable, the role of seasonality is apparent in our results. When we include seasonal dummy variables, the explanatory variables vary. The seasonality seen in the crime data is also valid for the unemployment. Therefore the seasonality is also an explanatory variable in our specification. However, we did not add seasonal dummies in the second stage equation because it is sufficient from the residual graphs to eliminate seasonality from the mean equation. There is a negative correlation between unemployment and crime during the January, February, March, September, October and it is positive for others. This seems plausible because we analyzed the rural data where the population density increases because of the seasonal migration from urban areas. Vito and Holmes (1994, pp. 149-150) also mentioned that the crimes increase in

summer season where the weather becomes warmer. When we included a dummy variable, we have chance to analyze seasonal internal migration movements. Since the crime structure of the rural areas in terms of intent and attempts are not the same with the urban areas, the dummy variables let the identification of the long-run relations. Our interpretation of seasonality also matches with Soyaslan (2003, pp.143) whom provides a police data, and claims that the number of crime diminishes between May and September in urban areas because of the migration from the urban to the rural settlements.

As a summary, when the seasonality captured in both of the cointegration specifications the number of committed crimes decreases when the level of education increases among the unemployed people in the rural areas. Moreover, the number of committed crimes shows seasonal movements because of the changes in the population density.

The more micro and spatial knowledge about the amount, types, characteristics and the area where it occurs of the crime would let the authorities for taking more effective measures to prevent crime in the society. The preventive services are more important than solving the crime.

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APPENDIX

Table A1: Seasonal Unit Root Test Results.

		θ	π	$\pi/2$		$2\pi/3$		$\pi/3$		$5\pi/6$		$\pi/6$		$\pi/2$	$2\pi/3$	$\pi/3$	$5\pi/6$	$\pi/6$
	Lags	π_1	π_2	π_3	π_4	π_5	π_6	π_7	π_8	π_9	π_{10}	π_{11}	π_{12}	$F_{3,4}$	$F_{5,6}$	$F_{7,8}$	$F_{9,10}$	$F_{11,12}$
Crm	11	-1.78	0.87	2.08	-1.03	-0.69	2.42**	0.34	-0.58	-0.24	3.31***	1.43	-0.54	2.54	3.49	0.21	5.95*	1.35
Cpi	1	-1.49	1.06	2.27	-1.25	-2.54	1.22	1.26	-0.82	-1.42	3.18***	-0.11	1.59**	3.04	4.23	1.04	7.92**	1.36
Unp_1	3	-3.06*	0.43	1.11	-0.72	-1.19	4.18***	1.15	-1.63	-1.98	2.46**	4.69***	-1.32	0.82	10.45***	1.83	4.83	14.68***
Unp_2	1	-0.96	-0.46	1.29	0.22	-0.84	2.61***	0.97	0.89	-1.41	-0.08	1.42	-0.27	0.89	3.64	1.09	0.99	1.02
Unp_3	3	-2.63	-2.91**	-0.58	-0.03	0.34	3.98***	-2.33	1.04	-3.28	2.56**	1.6	-0.18	0.17	7.95***	3.25	7.29**	1.35
Unp_4	1	0.41	-0.49	0.53	1.89	0.13	2.15**	1.39	1.43	-0.53	-0.44	0.82	-1.73	2.12	2.35	2.28	0.21	2.64
Unp_5	1	-0.71	-0.70	1.04	0.29	-1.25	1.28	0.81	0.37	-1.35	1.17	1.52	-0.95	0.63	1.69	0.44	1.58	2.08
Unp_6	1	-1.54	1.11	1.25	0.05	-1.28	2.23**	2.11	-1.14	-1.22	1.82*	2.79	-0.97	0.8	3.28	2.51	2.71	5.09
Unp_7	2	-2.82	-0.33	0.96	0.47	-1.24	4.76***	2.25	-0.47	-1.52	2.15**	4.36***	-2.41**	0.66	12.56***	2.55	3.88	13.05***
Unp_8	4	-1.38	-1.92	-0.25	1.55*	-0.05	3.77***	1.13	0.45	-1.89	0.17	3.44**	-1.62*	1.21	7.14**	0.82	1.94	8.11**
Unp_9	4	-0.94	-2.39	-0.13	1.67*	0.39	2.99***	-0.85	0.95	-1.96	1.03	0.62	-1.19	1.40	4.53	0.81	3.41	0.80

Notes: Null hypothesis is the unit root. We included constant, trend, deterministic seasonal as deterministic components.
****, **and *indicates rejection of the null at 1%, 5% and 10% levels. We used the Beaulieu and Miron (1993, Table A1, p. 40) for the critical values.*

Table A2: LM Unit Root with Break.

Variables	S_{t-1}	*Constant*	Break Level Stat.	Break Level Date	Break Trend Stat.	Break Trend Date
Crm	-0.3524**	0.0843	-0.1097	2007:01	0.0012	2007:01
t-stat	-5.1482	2.8395	-0.8761		0.0408	
Cpi	-0.3685**	0.0019	0.0018	2008:10	-0.0036	2008:10
t-stat	-4.6209	1.1324	0.2433		-2.2224	
Unp_1	-0.3696*	-0.1022	0.3074	2008:11	0.0417	2008:11
t-stat	-4.2335	-2.5611	1.5450		0.8800	
Unp_2	-0.4014*	-0.0814	-0.0254	2008:09	0.1738	2008:09
t-stat	-4.4867	-2.3266	-0.1344		2.8713	
Unp_3	-0.3287**	-0.0940	0.0319	2008:10	0.1462	2008:10
t-stat	-4.9356	-3.8445	0.2900		3.5084	
Unp_4	-0.3150**	-0.0040	-0.6237	2010:12	0.0922	2010:12
t-stat	-4.8536	-0.2829	-5.0021		2.2307	
Unp_5	-0.3998**	-0.0438	0.1357	2008:10	0.0416	2008:10
t-stat	-4.5378	-2.2080	1.1660		1.4760	
Unp_6	-0.3598*	-0.0409	0.2177	2008:12	0.0121	2008:12
t-stat	-4.4516	-1.9969	1.7344		0.4281	
Unp_7	-0.4058***	-0.0777	0.2620	2008:07	-0.0051	2008:07
t-stat	-5.5354	-2.6592	1.6906		-0.1514	
Unp_8	-0.3315*	0.0132	0.1473	2008:09	0.0530	2008:09
t-stat	-4.1808	0.7609	1.2584		1.7354	
Unp_9	-0.3599***	-0.0683	0.0901	2008:10	0.0903	2008:10
t-stat	-5.2543	-3.7806	1.0968		3.3756	

Notes: Null hypothesis is the unit root with break.
****, ** and * indicates rejection of the null at 1%, 5% and 10% respectively.*
The number of lags is selected as one.

Table A3: Gregory Hansen Cointegration Test Results with Constant.

Models	Lag	Minimum Test Statistics	Result	Breakpoint
Model (1)	2	-3.6090	No Cointegration	2010:02
Model (2)	2	-4.8000	No Cointegration	2008:05
Model (3)	2	-5.3240	Cointegration	2007:08
Model (4)	2	-4.8730	Cointegration	2008:06
Model (5)	2	-4.6010	Cointegration	2010:09
Model (6)	2	-5.6080	Cointegration	2010:09
Model (7)	2	-4.8880	No Cointegration	2010:07
Model (8)	2	-4.5270	No Cointegration	2010:09
Model (9)	2	-4.7040	No Cointegration	2009:01
Model (10)	2	-6.2190	Cointegration	2008:05

Notes: Null is no cointegration against the cointegration in the presence of regime shift.

Critical values are -5.470 and -4.950 respectively for 1% and 5% levels.

Table A4: Gregory Hansen Cointegration Test Results with Trend.

Models	Lag	Minimum Test Statistics	Result	Breakpoint
Model (1)	*12*	-4.3750	No cointegration	2009:03
Model (2)	*2*	-6.1970	Cointegration	2009:02
Model (3)	*2*	-6.9170	Cointegration	2009:08
Model (4)	*4*	-5.2950	No cointegration	2008:07
Model (5)	*2*	-5.3690	No cointegration	2009:02
Model (6)	*5*	-5.8510	Cointegration	2009:01
Model (7)	*3*	-6.2770	Cointegration	2008:12
Model (8)	*6*	-5.2390	No cointegration	2008:10
Model (9)	*5*	-5.9300	Cointegration	2010:02
Model (10)	*2*	-6.2710	Cointegration	2008:10

Notes: Null is no cointegration against the cointegration in the presence of regime shift.

Critical values are -6.020 and -5.500 respectively for 1% and 5% levels.