Impact of Unemployment on Crime in Europe

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This study discovers how unemployment rate explains the changes in the crime rate tendency in Europe by the two-stage-least square regression. The crime rate in the Economic and Monetary Union (EMU) area is found evidently more sensitive to unemployment than the non-EMU countries. The adoption of a common currency also strengthens the connections of the criminal problem among the EMU countries. We found the seriousness of the endogenous bias involved using the OLS methodology, so previous findings on the small effect of unemployment on crime rate obtained by employing the OLS methodology could be unreliable. Empirically, a one-percentage-point increase in unemployment increases the property crime by nearly 9% on average. The large unemployment effect implies that the increase in the unemployment rate that occurred after the financial crisis in 2008, followed by the European sovereign-debt crisis, may account for the trending increasing tendencies of the crime rate in Europe. The high unemployment effect revealed markedly different policy implications than those that have previously been considered in the literature. These findings suggest that the key determinants for governmental authorities in the EMU area successfully mitigating crime would greatly depend on how the governments resolve their economic recession.

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INTRODUCTION

This study focused on determining the crime rate in Europe. In contrast to its long-term tendencies, the crime rates in certain European countries have increased in recent years. For example, in 2000, 458 property crime offences per 100,000 population occurred in Greece and steadily decreased to the lowest level of merely 239 in 2004. However, the declining tendency was reversed, and property crime offences increased to 411 in 2008 and to 471 in 2009. A similar tendency exhibiting a slightly slower rate was observed in Germany. The changes in the crime rate tendencies have attracted our attention.

In economic literatures, Becker (1968) introduced the concept of opportunity costs for committing a crime, the first researcher to propose that the reason a person becomes a criminal essentially depends on a comparison of the benefits and costs involved in the criminal activity, in addition to motivation. Based on Becker's theory, few legal opportunities in the employment sectors, indicated by the increases in unemployment rate, may make committing crime more appealing regarding opportunity cost (see also Ehrlich (1973)). This consideration could be even crucial nowadays due to the deteriorating unemployment problem in Europe caused by the global financial crisis in 2008, followed by the European sovereign-debt crisis. The unemployment rate reached 11.3% in Spain, for instance, and 7.7% in Greece, which was much higher than the 5.8% in the United States at the same time. The unemployment rate in Spain even increased to 59.3% between 2008 and 2009. A large unemployment effect on crime rate will imply different policy implications than those that have previously been considered in the literature. It motives this study.

To answer the above question, there is an estimation problem that should be addressed, namely the plausible causal relationship between crime rate and unemployment. It is because bad criminal environment could discourage firms from establishing (or expanding) businesses and encourage them to relocate to other countries exhibiting safer living environment. The causality could pose a severe problem of endogenous bias when the crime rate determination equation is estimated using ordinary least squares (OLS) methodology (Raphael and Winter-Ebmer, 2001; Gould et al., 2002; Lin, 2008). To the best of our knowledge, with regard to the European studies, remarkably few studies have focused on the relationship between crime rate and economic environment and only Altindag (2012) considered the endogenous problem. [3] However, the variable of earthquakes employed by Altindag as one of the instrumental variables could be problematic. The major concern is that severe natural disasters such as earthquakes typically cause negative supply shock and thus economic downturn. The instrumental variables proposed by Altindag could then be invalid, involving an endogenous problem itself.

The first contribution of this study is thus to propose appropriate instrumental variables (IVs) for measuring the European unemployment rate. The instrumental variables used in this study, including R&D, TFP, and R&D personal, passed the endogeneity and weak instrumental variable tests. The associated F-statistics for the instrumental variable test were substantially higher than 20, evidently larger than those reported in Altindag (2012) and highest among those reported in relevant literature.

Empirically, our estimates in the Economic and Monetary Union (EMU) area are more than twice the size of those of Altindag (2012). The magnitude of our estimations is also higher than that reported in

[3] By employing the European Sourcebook of Crime and Criminal Justice Statistics (ESCCJS), the same database as ours, Altindag investigated the crime problem in 33 European countries, instead of merely the EMU countries, during the period from 1996 to 2003.

the United States, as well as that obtained using the OLS methodology on Europe in the literature. In the literature, a one-percentage-point increase in unemployment increases crime by merely 1% to 4% in European countries, compared with the 2.3% to 12.7% increases in our empirical findings. Our results indicate that the same amount of change in unemployment increases the property crime by nearly 9% on average. Take Greece as an example. The unemployment rate in Greece increased from 7.7% in 2008 to 9.5% in 2009. Based on our estimate, the 1.8-percentage-point increases in the unemployment rate (= 9.5 - 7.7) would have increased property crime by as much as 16.0%, indicating a large unemployment effect. [4] The large unemployment effect implies that the increase in the unemployment rate that occurred after the financial crisis in 2008 may account for the trending increasing tendencies of the crime rate stated above.

Consequently, our result has revealed markedly different policy implications than those that may have previously been considered in the literature. Namely, the key determinants for governmental authorities successfully mitigating crime would greatly depend on how the government resolves their economic recession. One plausible explanation for the high unemployment effect might be that the introduction of the EMU of the European Union, the Euro, has enabled many European countries to be comprehensively integrated (Bun & Klaassen, 2002; Rose & Stanley, 2005; Dyson, 2008)[5]. The adoption of a common currency could encourage capital reallocation across countries in the EMU area, making causality between unemployment and crime more notable and hence leading to severe endogenous bias involved in the OLS regression in the most

[4] 16.02% = 1.8×8.9%, where 8.9% is the average of the unemployment effect obtained from the coefficient estimates on unemployment, shown in Table 4, that are statistically significant.

[5] For instance, the abolition of border checks (Schengen Agreement), large trading volume (Bun & Klaassen, 2002; Rose & Stanley, 2005; De Nardis et al., 2008), integrated financial market (Dyson, 2008), and well- expanded tourism markets (Gil-Pareja et al., 2006) have been reported in the literature.

European literature. This mechanism could be in particular crucial during high unemployment era, such as that in Europe where the average rate of unemployment was as high as 7.45% and the unemployment rates were significantly trended up in the end of the sample period for most countries in our sample. As such, previous findings on the small effect of unemployment on crime rate could be unreliable, which might indicate incorrect policy implications.
Furthermore, our estimation results for the non-EMU countries showed a considerably small unemployment effect on crime in these countries. Finally, we confirmed that unemployment does not significantly affect (or even shows a negative effect) violent crime in general, echoing the related findings in the literature.
The reminder of this paper is organized as follows: Section 2 presents a review of pertinent literature and Section 3 discusses the setup of the econometric models. Section 4 describes the data and variables, and Section 5 presents the empirical results. Finally, Section 6 concludes this paper.

LITERATURE REVIEW

The problem of crime rate is not only a concern in sociology and criminology but also economics. In economics, criminal opportunity costs have been addressed in Becker (1968) and Ehrlich (1973). These researchers have claimed that the reason a person becomes a criminal depends on motivation and the benefits and costs involved in engaging in criminal activities. People decide to commit a crime as long as the expected utility of committing a crime is greater than the utility of participating in the legal market. The payoff for participating in a legal market activity (i.e., wages) declines for an unemployed worker, making illegal activity more appealing. In addition, the unemployment effect has been shown to be more relevant to property crime than to violent crime in the literature, possibly because of the direct financial gains (Levitt, 2004; Ehrlich, 1996).

In the literature, a high crime rate has been reported to discourage corporate investments and lead to capital outflow, suggesting a causal relationship between crime and unemployment and causing bias in the OLS estimation results. To the best of our knowledge, Cullen and Levitt (1999) were the first to address the aforementioned endogenous consideration. Although recent studies have modeled the crime determination equation by extensively involving additional independent variables in the model setup and have used panel data at a country or city level, attempts to control for endogeneity remain rare. Until recently, economists, such as Raphael and Winter-Ebmer (2001), Gould et al. (2002), and Lin (2008) have addressed the problem of endogenous bias and have employed the 2SLS method to correct for the causality. These studies involved using different instruments for the unemployment rate, such as Military contract, Exposure to oil shocks, etc.

With regard to the European studies, remarkably few studies have focused on the relationship between crime rate and economic environment. Among those studies, Entorf and Spengler (2000) focused on the crime problem in Germany, Machin and Meghir (2004) used data on England and Wales, and Hooghe et al. (2011) investigated Belgian data.[6] Altindag (2012) was the only European research in which the endogeneity of unemployment rate was considered and exchange rate, manufacturing GDP, industrial accidents, and earthquakes were employed as the instrumental variables for the unemployment rate. As mentioned in the previous section, the earthquake variable used in Altindag (2012) is problematic because it could be endogenous to the crime rate, making the instrumental variable invalid in the estimation.

[6] Entorf and Spengler (2000) claimed that the youth unemployment rate, not the overall unemployment rate, positively influenced crime rate. See also Fougère et al. (2009) for the youth unemployment effect on crime rate in France. Machin and Meghir (2004) determined that the decrease in the wages of unskilled workers caused an increase in the crime rate. Moreover, Hooghe et al. (2011) indicated that the unemployment effect was more critical than the income effect.

Based on empirical findings on the United States, a one-percentage-point increase in unemployment generally increases crime by 1% to 6% (Raphael & Winter-Ebmer, 2001; Gould et al., 2002; Corman & Mocan, 2005; Lin, 2008). The increase in crime is approximately 1% to 4% in European countries with respect to the same amount of change in unemployment rate, depending on the econometric methodology employed. For examples on Sweden, see Edmark (2005) and Oster and Agell (2007), and for Italy, see Buonanno (2006). Studies that did not consider the causal link between crime and unemployment tended to find nonsignificant or weak positive effect of unemployment on property crime. In addition, the unemployment effect on the violent crime tended to be nonsignificant. Based on the OLS results obtained in the aforementioned studies, a one percentage point increase in unemployment rate generally increased property crime by merely 1% to 2% in the United States, and by approximately the same percentage in European countries. The increase in property crime was merely 0.5% in Germany (Entorf & Spengler, 2000).

To the best of our knowledge, most of the 2SLS estimation results in the related research tended to be significantly large (2.4% to 6.0%). Among these studies, the estimation results reported in Lin (2008) seem to be the largest at 4.0% to 6.0%. According to the findings presented in Lin (2008), the effect of unemployment on crime determined using the 2SLS method was two to three times larger than that determined using the OLS method. Lin instrumented unemployment by using exchange rate changes, manufacturing employee numbers, manufacturing GDP, state union membership, and oil as the instrumental variables and obtained higher F-statistics compared with other studies by conducting a weak instrumental variable test.

This research contributes to the literature by proposing legitimate instrumental variables for measuring the European unemployment rate for solving the endogeneity bias for Europe. We identified valid

instrumental variables related to the European unemployment rate, but not directly to the European crime rates, for obtaining consistent estimates.

MODEL SETUP AND EMPIRICAL STRATEGY

The 2SLS regression model was specified for each crime as follows. Two equations, the crime rate determination equation and unemployment rate equation, were used for each crime rate model.

$$\ln(crime_{it}) = \rho \widehat{Unemployment}_{it} + \beta X_{it} + \alpha_i + year_t + \gamma Euro_{it} + \varepsilon_{it}$$
$$Unemployment_{it} = \delta X_{it} + \sigma IV_{it} + \alpha_i' + year_t' + \lambda T_i + \mu T_i^2 + \nu_{it} \quad (1)$$

where i and t index country (i = 1, 2, 3, …13) and year (t = 1993 to 2009), respectively. The 13 EMU countries include Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia, and Spain. Greece and Slovenia entered the EMU group in 2001 and 2007, respectively. We considered only the EMU countries that have used the Euro for at least 2 years, and thus, our data consisted of countries that joined the EMU group before 2007.[7] We investigated the unemployment effect according to the types of crime, as in the related literature. According to the classification of the Federal Bureau of Investigations, published by the Department of Justice in the United States, we classified the types of crime into two major categories: violent crime and property crime. Violent crime includes assault, rape, robbery, and intentional homicide; property crime comprises theft, motor vehicle theft, burglary, and domestic burglary. Thus, eight crime categories were included in this study.

The variable $\widehat{Unemployment}$ is the fitted unemployment rate from the first stage of the 2SLS regression, and ρ denotes the effect of unemployment on crime, which is the primary focus of this paper. X

[7] Slovakia and Estonia entered the EMU group in 2008 and 2011, respectively, and because of their short use of the Euro, the two countries were not included in our EMU sample for analysis.

represents the independent variable matrix, including government expenditure on welfare and health, economic condition, education, population structure, deterrence effect, and crime-related goods. Our empirical model controls the country-fixed effect α (α') and the year effects *year* (*year*'). In addition, T_i and T_i^2 are the country-specific time trend and quadratic time trend, respectively.

Regarding the common currency effect, the dummy variable $Euro_{it}$ is set to 1 if country *i* joined the EMU group at year *t*, and γ captures the EMU effect on crime rate. In the empirical section, in addition to the discrete specification, we consider an additional continuous variable *EuroDuration* in the crime determination equation for measuring the common currency effect. As mentioned, the European countries adopted a common currency at different time periods. In our sample, 11 of the countries joined the EMU group as early as 1999. However, Greece and Slovenia did not adopt the common currency policy until 2001 and 2007, respectively. Thus, focusing on the duration effect of the common currency effect and investigating whether the effect also relies on the length of time that a country has been part of the EMU group are worthwhile. The inclusion of the continuous variable *EuroDuration* then facilitates our discussion on how the duration of a country being part of the EMU group affects the crime rate. Furthermore, σ captures the marginal effect of the IV variables on unemployment, and ν represents the residuals in the unemployment equation.

As mentioned in the previous section, the results for the effect of the unemployment rate on crime rate might be biased because of the causal relationship between crime rate and unemployment rate. To perform 2SLS regression for correcting for the problem of endogeneity, appropriate IV variables that can pass both the weak IV test and the over-identification test must be identified. The goal of this study was to attain the corresponding F-statistics higher than 10 for

the weak IV test (Stock & Watson, 2003). In addition, the over-identification test was used to test for the exogeneity of the IVs.

This study proposes using variables measuring the skill-biased technological changes (SBTC) for the IV variables. The instruments used in this study are research and development (R&D) expenditures, percentage of R&D personnel, and total factor productivity (TFP). The reason for choosing SBTC measurement as the IV variables is mainly because SBTC has been blamed for being one of the principal causes of the increase in the unemployment rate in Europe during the recent decades. For example, Nickell (1998) stated that SBTC increased the European unemployment rate. Similarly, Mortensen and Pissarides (1999) contended that SBTC increased the spread of labor productivities between workers exhibiting different skills, causing high unemployment. Subsequent research, such as that by Acemoglu (2001) and Moreno-Galbis (2012), indicated the relationship between SBTC and unemployment rate. Moreover, the IV variables should not be directly related to the crime rate in order to guarantee the exogenous feature. For determining the exogeneity of the instrumental variables, we conducted a hypothesis test, which is presented in the empirical section. In addition, to provide a comparison between the United States and Europe, we conducted another 2SLS regression by employing the instrumental variables used in Lin (2008) which focused on the United States.

Moreover, for the empirical analysis, we also used data on non-EMU countries and conducted corresponding OLS and 2SLS regressions. The non-EMU countries investigated in this study included the Czech Republic, Denmark, Hungary, Poland, Sweden, and the United Kingdom. Because of few data, some of the non-EMU countries were not included in this study. The comparison of the estimation results for both the EMU and non-EMU groups provided another angle for investigating the common currency effect. The unemployment effect on the EMU group (ρ) was expected to be larger than that on the

non-EMU group, based on the consideration of the opportunity cost proposed by Becker (1968) and the criminal spill-over mechanism.

DATA AND BASIC STATISTICS

The primary data sources for this study were the European Sourcebook of Crime and Criminal Justice Statistics (ESCCJS), Eurostat, World Development Indicator (WDI), and OECD databases. The structure of the ESCCJS data consists of five parts: police statistics, prosecution statistics, conviction statistics, correctional statistic, and survey data. The primary data used in this paper were police statistics, which includes data on offences per 100,000 population for each type of crime. The Council of Europe has confronted the difficulties involving the differences in the definitions of crimes in the participating countries by standardizing the definition of crime rate. The participating countries are requested to follow the standardized crime definitions when providing the relevant data. In addition, the Council of Europe requested that the questionnaire correspondents of each country be restricted to experts in crime and criminal justice statistics to ensure the quality of the data. Thus, the merit of the ESSCJS dataset is based on agreeable and homogeneous definitions for crime rate among all of the countries.

For this empirical study, we used the data on 19 countries, 13 EMU countries and 6 non-EMU countries, for the period from 1993 to 2009 because of data availability from all of the aforementioned data sources.

In the category of property crime, the mean theft rate was 3,572.1 offences per 100,000 population; the minimum was 345 offences and maximum was 16,853 offences (see TableA1 of the Appendix). Moreover, except for robbery, all of the types of crime in the non-EMU category yielded higher mean values than did those in the EMU category, meaning that countries in the non-EMU group experienced rather severe criminal problems. Regarding violent crime, intentional

homicide was relatively low, whereas the crime rate of assault was the highest at a mean of 373.9. The average unemployment rate in our sample was 7.45% (Table A2 of the appendix). The lowest unemployment rate (1.8%) was in Luxembourg in 2001, and the highest (18.6%) was in Spain in 1998.

Regarding the two measures for the common currency effect (Table A2), *Euro* and *EuroDuration,* the dummy variable *Euro* yielded a mean value of 0.67, and that of the variable measuring the duration of being part of the EMU group *EuroDuration* was 3.8 years in our sample. Table A2 also summarizes basic statistics for other independent variables and instrumental variables. The expected signs are presented in the final column of Table A2.

EMPIRICAL RESULTS

In this section, we first present the OLS and then the 2SLS regression results for property crime, followed by the results for the non-EMU countries, and finally those of violent crime.

Ordinary Least Squares Regression Results

Table 1 presents the OLS regression results. The first panel in Table 1 presents the empirical results obtained using the model in which the EMU effect was not considered, and panels B and C present the regression results obtained when the two measures for the EMU effects, the discrete variable and then the duration effect, were added into the model specifications. According to the simplest model in panel A, the coefficients of unemployment on all types of property crime were positive, and two of them were significant (motor vehicle theft and domestic burglary). These results are similar to recent findings concerning the United States obtained using OLS methodology (Lin, 2008; Raphael & Winter-Ebmer, 2001). Similar to those findings, the magnitude of the coefficient estimation obtained in this study was also considerably low. A one-percentage-point increase

in the unemployment rate, for instance, increased the motor vehicle theft and domestic burglary rates by 2.7% and 5.0%, respectively.
Adding *Euro* or *EuroDuration* into the model (see panels B and C) only slightly changed the estimation results, both in the magnitude and significance of the coefficient estimate of unemployment. However, the coefficients of *Euro* and *EuroDuration* yielded opposite signs. Joining the EMU group tended to increase the motor vehicle theft significantly by as much as 23.5%, complying with our expectation. Moreover, a low theft and burglary crime rate was observed for countries that were part of the EMU group for a long time, which is an unexpected finding. This finding is explained further later.

Two-Stage Least Squares Regression Results

Based on the endogenous test, most of the p values of tests on various crime categories were larger than 0.10, suggesting the emergence of the causality problem. For the sake of space, we present only the regression results for property crime when R&D and TFP were used to instrument European unemployment rate because they yielded the highest F-statistics for the weak IV test among several IVs.[8]
First-stage regression results. Table 2 presents the first-stage regression result of the 2SLS method. All of the coefficients on R&D and TFP in the unemployment equation were significantly positive among the various types of property crime. The coefficient estimates on R&D were between 3.35 and 4.52, whereas that of TFP were markedly low, approximately 0.2. The magnitudes and signs of the coefficient estimates were remarkably consistent with those reported

[8] For the sake of space, the detailed p values are not presented; however, they are available from the authors by request. Moreover, the instrumental variables used in this study included R&D, TFP, RDP, any two of the three variables, and all three variables, where RDP represents total R&D personal, measured as the percentage of R&D employment to total employment. The empirical results obtained using these instrumental variable specifications are also available from the authors.

in the European unemployment literature (see Mortensen & Pissarides, 1999; Moreno-Galbis, 2012).

Second-stage regression results. Table 3 presents the second-stage regression results for specifications without the EMU effect. As shown in Table 3, the four property crimes indicated positive coefficients on unemployment. Noticeably, the magnitudes and statistical significance of the coefficient estimate were much higher than those obtained using the OLS methodology (Table 1). A one-percentage-point increase in unemployment significantly increased theft by 3.2% (column 1 of Table 3), compared with the nonsignificant 1.8% increase shown in the OLS results (column 1 of Table 1). Moreover, the estimated coefficients on the unemployment rate in this study were significantly larger than those obtained in Lin (2008) and Raphael and Winter-Ebmer (2001) concerning the United States. These findings suggest that unemployment condition plays a more crucial role in determining the property crime rate in the Europe than in the United States.

In addition, the model of theft passed the weak IV test and yielded a significantly high F-statistic of 36.107. The p value for the corresponding over-identification test was 0.9064, implying the exogeniety and validity of the IV variables. In addition, unemployment rate affected both motor vehicle theft and domestic burglary substantially, deviating from the OLS results. In particular, a one-percentage-point increase in unemployment rate significantly increased motor vehicle theft by 10.5% and domestic burglary by 12.7%. The corresponding F-statistics for the weak IV test for the two crimes were also high at 30.44 and 20.49. Although the corresponding p values for the over-identification test of the two aforementioned crimes were, 0.064 and 0.084, the endogeneity of the unemployment rate in all of the crime categories was not rejected at the 10% significance level.

Moreover, the deterrence effect was evidently crucial in determining the crime rate. As shown in Table 3, two measures for the deterrence effect, the number of police and prisoners, were significant. The number of police is particularly crucial with regard to statistical significance.

EMU effect. Table 4 presents the regression results obtained when the EMU dummy variable and EMU duration were included in the model. First, the variable *Euro* was added to the model specification. The coefficients on *Euro* were positive for all of the property crimes; two crimes, theft and motor vehicle theft, were statistically significant. Theft and motor vehicle theft yielded coefficient estimates of 0.185 and 0.432, respectively. The positive coefficient estimates support our hypothesis that the usage of a common currency may have reduced the opportunity cost of committing property crime in the EMU area, and thus, theft and motor vehicle theft increased.

As mentioned, all of the types of the property crime passed the weak IV test and yielded high F-statistics. The over-identification tests revealed that the exogeneity of the instrumental variables proposed in this research exhibited a 10% significant level. The positive unemployment effect, shown in panel A of Table 4, ranging from 0.023 to 0.127 among the various types of property crime was significantly larger than that obtained using the OLS methodology. For the significant coefficient estimates on unemployment rate, the average unemployment effect was approximately 9% (8.9% = (3.3% + 10.8% +12.7%) / 3). This means that, on average, a one-percentage-point increase in unemployment increased the crime rate by 9%. The unemployment effect remained insignificant for burglary, which was the same as the estimation results without the *Euro* variable, as shown in Table 3. Panel B in Table 4 presents the EMU duration effect on crime rate. The coefficients on *EuroDuration* were positive, meaning that the longer a country has adopting euro money, the higher the crime rate. However, the coefficient estimates were not statistically

significant. Except for the *EuroDuration*, the other estimation results were similar to those shown in panel A of the table.[9] These findings imply that whether a country is part of the EMU group matters in determining the crime rate, not the length of common currency experiences. Thus, our empirical finding shows that the crime rate of countries that have been a part of the common currency program increased.

As mentioned, we attempted to use several different instrumental variables for measuring unemployment in the empirical analysis. We also used the instrumental variable proposed by Lin (2008), namely $REER \times MF$, and performed 2SLS regression in which *REER* and *MF* represented the real effective exchange rate and GDP percentage for the manufacturing sector, respectively.[10] The corresponding regression results are not presented but they are available from the authors upon request. By using the IVs proposed by Lin (2008), the unemployment effects were still fairly large, according to the empirical results. The coefficient estimates on unemployment were statistically significant at magnitudes ranging from 0.057 to 0.165 among all of the types of property crime. The unemployment effect observed in this study was considerably large. The results, however, also indicated that the EMU group yielded considerably low F-statistics for most of the weak IV tests among the various types of crime, generally lower than 10 among the criminal types, except for burglary. As a consequence, the values of these F-statistics were much lower than those obtained using the IVs proposed in this study (Tables 6 and 7), which reinforces the appropriateness of our IVs for instrument the European unemployment rate.

[9] In addition to employing $Euro$ and $EuroDuration$ as the measurements for economic integration in the EMU area, we also attempted to use the number of tourists as a measurement. However, insignificant coefficients on tourists were obtained among the various crime categories.

[10] Other instrumental variables used in Lin (2008) were not included in this study due to the lack of the data for certain countries.

Furthermore, the F-statistics for the weak IV test in this study were evidently higher than those reported in Altindag (2012) in which different IVs and the same database were used to investigate the European criminal problem. In Altindag, the F-statistics for weak IV tests among different crime types involving various model specifications were generally lower than 10. The high F-statistics obtained in this study indicated that the instrumental variables are valid for studying the crime problem in the EMU countries. One plausible explanation for the high unemployment effect might be that the adoption of a common currency could encourage capital reallocation across countries in the EMU area, making causality between unemployment and crime more notable. Thus, the endogenous bias involved in the OLS regression in the most European literature could be severe. Previous findings on the small effect of unemployment on crime rate could thus be unreliable, which might indicate incorrect policy implications.

Non-EMU countries. This study then conducts the 2SLS and OLS estimation for countries in the non-EMU group, respectively[11]. Two findings are worth mentioning.

First, most of the over-identification tests were rejected at the 5% significance level, and the F-statistics for the weak IV test were low. In the empirical analysis, we attempted several combinations of instrumental variables as stated in the Literature Review. The results, however, remained the same. These experiments revealed that the endogeneity of the unemployment rate in the crime determination equation for the non-EMU countries should not be a critical concern. Thus, the empirical results provided evidence suggesting the nonsignificant causality between the unemployment rate and crime rate for the non-EMU countries. This conclusion is consistent with our expectation that the currency transaction costs in the non-EMU

[11] For the sake of space, the regression results for non-EMU countries and violent crime are not presented; yet, they are available from the authors upon request.

countries could discourage (or slow down) capital flight to other countries. This mechanism could lead to the disconnection of the causality between unemployment and crime rate, causing the endogenous bias in the crime determination equation insignificant for the non-EMU countries. Accordingly, the OLS methodology is sufficient for analyzing non-EMU countries.

Second, according to the OLS estimation results for the non-EMU countries, a low unemployment effect on the crime rate in the non-EMU countries was obtained. In addition, merely one type of property crime, domestic burglary, yielded a significant unemployment effect. However, its estimated elasticity was as low as 0.07, compared with 0.127 for the same type of crime for the EMU countries presented in Table 3. Thus, the two primary findings on the difference between the EMU and non-EMU countries reinforce the negative common currency effect on the crime problem in the EMU area.

Violent crime. The 2SLS effects of unemployment on assault, rape, and robbery were evidently negative. The negative unemployment effect, against economic intuition, was observed; however, this agrees with previous findings in the literature related to the United States and Europe (e.g., Lin, 2008; Altindag, 2012).[12]

Regarding the effect of the variable *Euro*, the coefficients showed significantly negative and positive signs for assault and robbery, respectively, suggesting that joining the EMU decreases assault and increases robbery. Based on such inconsistent findings, we concluded that the effect of joining the EMU on violent crime is relatively mixed.

In summary, three main findings should be mentioned. First, the estimated coefficients on the unemployment rate obtained in this study were significantly higher than those obtained in the United States studies. By using the same econometric methodology (2SLS) used in this study, those researchers obtained at most a 6% increase in property crime with respective to an additional percentage point

[12] In Altindag (2012), unemployment negative affected assault but positively affected rape.

increase in the unemployment rate, compared with an average of 9% increase observed in this study (Table 4). This implies that economic condition might play a more crucial role in determining the property crime rate in the EMU area than in the United States. Thus, the unemployment effect on crime rate deserves further attention in the EMU area, in particular those countries suffering severe unemployment problems after the 2008 financial crisis. Second, the F-statistics for the weak IV test in this study were much higher than that reported in Altindag (2012) in which Europe was investigated by using the same database, but pooling both the EMU and non-EMU countries together for analysis. The high F-statistics obtained in this study indicated that the instrumental variables were valid for studying the unemployment problem in EMU countries. Finally, the empirical findings confirm the suspicion argued in the Introduction that the adoption of a common currency could promote capital reallocation across countries in the EMU area, causing a notable causal relationship between unemployment and crime. This finding also suggests the seriousness of the endogenous bias involved using the OLS methodology for analysis in the European literature.

CONCLUSION

This study focused on determining the crime rate in Europe and corrected for the simultaneous bias caused by the causality between the crime rate and unemployment rate by employing the 2SLS methodology for empirical analysis. In addition, the effect of the Euro adoption on crime rate was considered in this study, because the common currency policy in many European countries could promote capital reallocation across countries in the EMU area, causing the simultaneous bias to become severe. The bias may have become even larger during economic downturns caused by the European sovereign-debt crisis. We aimed at identifying innovative instrumental variables for measuring European unemployment. Based on the finding on

skill-biased technological change in determining the unemployment rate in European literature, we propose using R&D and TFP as the instruments. According to the empirical results of this study, the instrumental variables used in this study passed the endogeneity and weak instrumental variable tests. The F-statistics obtained in this study were substantially high, generally higher than 20 and higher than those obtained in relevant literature.

Three main findings were obtained in this study. First, in the EMU area, the unemployment rate has a significantly adverse effect on the property crime. Based on our estimate, a one-percentage-point increase in unemployment increases the property crime by nearly 9% on average. These effects are larger than those obtained in the literature on Europe and the United States. Moreover, the unemployment effect on property crime is much larger in the EMU group than in the non-EMU group. For example, a one-percentage-point increase in unemployment causes a 12.7% increase in domestic burglary in the EMU group, but merely a 7% increase in the non-EMU group. This implies that the increase in the unemployment rate that occurred after the financial crisis in 2008 may substantially account for the trending increasing tendencies of the crime rate in several EMU countries.

Furthermore, identifying the causal link between crime and unemployment is crucial for discussing the determination of crime rate in the EMU area. For the non-EMU countries, the above endogeneity was rejected. In addition, joining the EMU was determined to increase the property crimes significantly. This EMU effect is not related to how long a country has been a part of the EMU group. These findings indicate the importance of the EMU effect in determining the crime rate, which has been neglected in the literature on crime rate in Europe.

Thus, we concluded that the key determinants for governmental authorities successfully mitigating the crime problem in the EMU area

depend on how well they resolve the economic recession. Based on the magnitude of the unemployment effect, we contend that the crime rate in Europe is more sensitive to economic conditions than the United States. In other words, to mitigate the increasing crime problem efficiently, governmental authorities in the EMU area must exert their efforts on improving economic environments. The unemployment effect on crime rate should be particularly addressed during economic downturns. In addition, considering the unemployment effect could be even more crucial for countries in the EMU group, based on our results for the crucial EMU effect. Finally, the deterrence effect is also critical. Increasing the numbers of police force can effectively deter potential criminals. Nevertheless, the ability to increase police force essentially depends on the financial status of the country, which also depends on how well the economy is functioning.

REFERENCE

Acemoglu, Daron (2001), "Technical Change, Inequality, and the Labor Market", *Journal of Economic Literature* 40, 7-72.

Altindag, Duha Tore (2012), "Crime and Unemployment: Evidence from Europe", *International Review of Law and Economics* 32, 145-157.

Becker, Gary (1968), "Crime and Punishment: An Economic Approach", *Journal of Economic Perspective* 15, 169-217.

Buonanno, Paolo (2006), "Crime and Labor Market Opportunities in Italy (1993-2002)", Labour 20(4), 601-624.

Bun, Maurice J.G. and Franck Klaassen (2002), "Has the Euro Increased Trade?", *Tinbergen Institute Discussion Papers* .

Corman, Hope and Naci Mocan (2005), "Carrots, Sticks, and Broken Windows", *Journal of Law and Economics* 48, 235-266.

Cullen, Julie and Steven D. Levitt (1999), "Crimes, Urban Flight and the Consequences for Cities", *Review of Economics and Statistics* 81, 159-169.

De Nardis, Sergio, Roberta De Santis, and Claudio Vicarelli (2008), "The Euro's Effects on Trade in a Dynamic Setting", *The European Journal of Comparative Economics* 5, 73-85.
Dyson, Kenneth (2008), "The Euro at Ten: Europeanization, Power, and Convergence", *Oxford University Press, USA*.
Edmark, Karin (2005), "Unemployment and Crime: Is there a Connection?" *Scandinavian Journal of Economics*, 107 (2), 353-73.
Ehrlich, Isaac (1996), "Crime, Punishment, and the Market for Offenses", *Journal of Economic Perspectives* 10, 43-67.
(1973), "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation", *Journal of Political Economy* 81, 521-565.
Entorf, Horst and Hannes Spengler (2000), "Socioeconomic and Demographic Factors of Crime in Germany: Evidence from Panel Data of the German States", *International Review of Law and Economics* 20, 75-106.
Fougère Denis, Julien Pouget and Francis Kramarz (2009), "Youth Unemployment and Crime in France", *Journal of the European Economic Association* 7, 909-938.
Gil-Pareja, Salvador, Rafael Llorca-Vivero and José A. Martínez-Serrano (2006), "The Effect of EMU on Tourism", *Review of International Economics* 15, 302-312.
Gould, Eric D., Bruce A.Weinberg and David B. Mustard (2002), "Crime Rates and Local Labor Market Opportunities in the United States: 1979-1997", *The Review of Economics and Statistics* 84, 45-61.
Hooghe, Marc, Bram Vanhoutte, Wim Hardynx and Tuba Bircan (2011), "Unemployment, Inequality, Poverty and Crime Spatial Distribution Patterns of Criminal Acts in Belgium, 2001-06", *British Journal of Criminology* 51, 1-20.
Levitt, Steven D (2001), "Alternative Strategies for Identifying the Link between Unemployment and Crime", *Journal of Quantitative Criminology* 17, 377-390.

_____(2004), "Understanding Why Crime Fell in the 1990s: Four Factors that Explain the Decline and Six that Do Not", *Journal of Economic Perspective* 18, 377-390.
Lin, Ming-Jen (2008), "Does Unemployment Increase Crime? Evidence from U.S. Data 1974-2000", *The Journal of Human Resources* 43, 413-436.
Machin, Steve and Costas Meghir (2004), "Crime and Economic Incentives", *Journal of Human Resources* 39, 958-979.
Moreno-Galbis, Eva (2012), "The Impact of TFP Growth on the Unemployment Rate: Does on-the –job Training Matter?", *CEPREMAP Working Papers* 1207.
Mortensen, Dale T. and Christopher A. Pissarides (1999), "Unemployment Responses to 'Skill-Biased' Technology Shocks: The Role of Labor Market Policy", *Economic Journal* 455, 242-265.
Nickell, Stephen (1998), "Unemployment: Questions and Some Answers", *Economic Journal* 108, 802-816.
Oster, Anna, and Jonas Agell (2007), "Crime and Unemployment in Turbulent Times", *Journal of the European Economic Association*, 5(4), 752-775.
Raphael, Steven and Rudolf Winter-Ebmer (2001), "Identifying the Effect of Unemployment on Crime", *Journal of Law and Economics* 44, 259-283.
Rose, Andrew K. and Tom D. Stanley (2005), "A Meta Analyses of the Effect of Common Currency on International trade", *Journal of Economic Survey* 19, 347-365.

APPENDIX

TableA1

Summary statistics for crime rates

Proper Crime (Offences per 100,000)						
Variable	Definition		Mean	Std. dev.	Min	Max
Theft	Depriving a person/organization of property without force with the intent to keep it.	Overall*	3572.05	2810.69	345	16,853
		EMU	2799.08	1292.11	509	6,179
		non-EMU	5178.63	4139.25	345	16,853
Motor Vehicle Theft	Depriving a person/organization of a motor vehicle with the intent to keep it or to use it.	Overall	367.95	376.67	16	2,572
		EMU	275.24	174.95	34	879
		non-EMU	560.64	565.86	16	2,572
Burglary	Gaining access to a closed part of a building or other premise by use of force with the intent to steal goods.	Overall	1087.20	909.40	192	5,581
		EMU	885.78	699.90	239	3,445.9
		non-EMU	1468.31	1118.88	192	5,581
Domestic Burglary	Gaining access to private premises by use of force with the intent to steal goods.	Overall	395.73	431.13	27	3,075
		EMU	316.67	176.28	27	829
		non-EMU	532.92	653.84	66	3,075
Violent Crime (Offences per 100,000)						
Assault	Inflicting bodily injury on another person with intent.	Overall	373.88	507.67	12	3,855
		EMU	286.21	213.44	12	771
		non-EMU	553.53	805.44	43	3,855
Rape	Sexual intercourse with a person against his/her will.	Overall	11.88	13.06	1.5	74
		EMU	8.95	6.06	1.5	28
		non-EMU	18.17	20.06	2	74
Robbery	Stealing from a person with force or	Overall	102.14	83.84	12	450
		EMU	102.48	70.32	12	266

	threat of force.	non-EMU	101.43	107.60	23	450
International Homocide	Intentional killing of a person.	Overall	6.53	7.12	0.7	48.5
		EMU	5.46	4.14	0.7	22.5
		non-EMU	8.83	10.77	0.8	48.5

Note: 1. Data source: the European Sourcebook of Crime and Criminal Justice Statistics, Council of Europe, 1993-2009.
2. *: There are 13 EMU countries in this study, which includes Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Slovenia and Spain. The non-EMU countries consist of Czech, Denmark, Hungary, Poland, Sweden and U.K.

Table A2

Summary statistics for independent variables and instrument variables

A. Independent Variables	Variable (Data source)	Definition	No. of obs.	Mean	Std. Dev.	Min	Max	Expected Sign
Government Expenditure on welfare and health (% of GDP)	Public Welfare Expenditures (OECD)	Social expenditure - aggregated data (% of GDP)	186	23.41	4.01	13.40	32.1	(-)
	Health Expenditures (WDI)	Health expenditure, total (% of GDP)	186	8.86	1.42	5.39	11.98	(-)
Economic Condition	Annual Wage (USD PPPs) (OECD)	2011 USD PPPs and 2011 constant prices	186	36,281	7,868	18,967	52,039	(-)
	Unemployment Rate (WDI)	Unemployment, total (% of total labor force)	186	7.45	3.08	1.80	18.6	(+)
	Income Inequality (Eurostat)	Inequality of Income Distribution (s80/s20)	186	4.56	1.07	3.0	8.1	(+)

	Poverty Rate (Eurostat)	Relative median poverty risk gap by age group	186	20.61	4.24	12.0	31	(+)
Education	Educational Attainment (%) (Eurostat)	Persons with upper secondary or tertiary education attainment by age and sex (%)	186	58.39	14.89	19.3	79.2	(-)
Population Structure	Age Structure (Eurostat)	Proportion of population aged 0-14/15-24/25-49/50-64/65-79 — 0-14	186	17.10	2.20	13.6	24.8	(?)
		15-24	186	12.89	1.56	10.2	17.5	(+)
		25-49	186	36.97	1.61	32.5	40.1	(+)
		50-64	186	17.37	1.56	12.8	21.6	(?)
		65-79	186	12.01	1.57	8.2	15.4	(-)
	Metropolitan (WDI)	Urban population (% of total)	186	71.74	12.66	50.06	97.42	(+)
Deterrence Effect	Local Police (Eurostat)	Police officers (% of total population) *100	186	0.34	0.10	0.15	0.61	(-)
	Prisoners (Eurostat)	Prison population (% of total population)	186	0.09	0.02	0.05	0.16	(-)
	Death Penalty (Wikipedia)	If country i has death penalty, dummy=1	186	0.09	0.29	0	1	(-)
Crime Related Goods	Alcohol Consumption (OECD)	Alcohol consumption in liters per capita (age 15+) in one year	186	11.63	2.29	6.90	17.90	(+)

Euro Effect	*Euro*	Equals 1 if the country entered to the EMU at year t	186	0.67	0.47	0	1	(+)
	EuroDuration	The period the EMU countries entered	186	3.77	3.67	0	11	(+)

B. Instrumental Variables	Definition (Data source)	No. of obs.	Mean	Std. Dev	Min	Max
TFI	Total Factor Productivity Growth (In difference, percent) (The conference Board)	151	0.23	1.89	-7.95	6.2
R&D	Research and Development Expenditure(% of GDP) (WDI)	151	1.78	0.77	0.45	3.96
REER × MF	Real effective exchange rate ×manufacturing sector GDP (%) (Eurostat)	151	17.89	4.80	8.28	28.77

Table 1

OLS results of unemployment on EMU property crime rate
No EMU effect

Endogenous Variable: Crime rate	Theft	Motor Vehicle Theft	Burglary	Domestic Burglary
Unemployment	0.018	0.027*	0.006	0.050***
	(0.012)	(0.011)	(0.013)	(0.016)
Adjusted R-squared	0.9265	0.9502	0.9222	0.8641
No. of obs.	186	185	169	158
Linear trends	Yes	Yes	Yes	Yes
Quadratic trends	Yes	Yes	Yes	Yes
EMU effect --- *Euro*(Dummy)				
Endogenous Variable: Crime rate	Theft	Motor Vehicle Theft	Burglary	Domestic Burglary
Constant	46.085	37.706	29.317	10.884
Unemployment	0.018	0.027**	0.006	0.052***
	(0.012)	(0.011)	(0.013)	(0.017)
Euro	0.102	0.235**	0.156	-0.039
	(0.094)	(0.105)	(0.107)	(0.210)
Adjusted R-squared	0.9266	0.9516	0.9229	0.8629
No. of obs.	186	185	169	158
Linear trends	Yes	Yes	Yes	Yes
Quadratic trends	Yes	Yes	Yes	Yes
EMU effect --- *EuroDuration*				
Endogenous Variable Crime rate	Theft	Motor Vehicle Theft	Burglary	Domestic Burglary
Constant	36.632	42.334	21.36	10.766
Unemployment	0.009	0.028**	-0.003	0.051***
	(0.012)	(0.012)	(0.013)	(0.017)
EuroDuration	-0.096***	0.014	-0.089**	0.007
	(0.031)	(0.036)	(0.036)	(0.051)
R-squared	0.9479	0.9624	0.9457	0.9022
Adjusted R-squared	0.9307	0.9499	0.9252	0.8629

No. of obs.	186	185	169	158
Linear trends	Yes	Yes	Yes	Yes
Quadratic trends	Yes	Yes	Yes	Yes

Note: 1.The dependent variable crime rate is the log of the number of offences per 100,000 population. The explanatory variables include all the independent variables described in Table A2.
2. Standard errors are in the parentheses. ***: 1% significance level. **: the 5% significance level. *: the 10% significance level.
3. The difference between the number observations in the table is due to the lack of the crime data for certain countries in some time periods.

Table 2

First stage result of the 2SLS regression on unemployment rate --- No EMU effect

Endogenous Variable Unemployment	Theft	Motor Vehicle Theft	Burglary	Domestic Burglary
R&D	4.086***	3.760***	4.520**	3.352***
	(0.557)	(0.634)	(0.789)	(0.616)
TFP	0.187***	0.261***	0.230***	0.196***
	(0.059)	(0.072)	(0.069)	(0.072)
No. of obs.	151	153	134	129
Linear trends	Yes	Yes	Yes	Yes
Quadratic trends	Yes	Yes	Yes	Yes

Note: 1. See the table note under Table 1.
2. The first-stage of the 2SLS regression includes all the independent variables described in Table A2, in addition to the instrumental variables $R\ \&\ D$ and TFP.

Table 3

The second stage result of the 2SLS regression on EMU property crime rate
--- No EMU effect

	Theft	Motor Vehicle Theft	Burglary	Domestic Burglary
Unemployment	0.032**	0.105**	0.023	0.127***
	(0.013)	(0.022)	(0.022)	(0.036)
Government Expenditure				
Public Welfare	-0.000	-0.094***	-0.029	-0.098***
	(0.015)	(0.029)	(0.028)	(0.037)
Health	-0.003	-0.029	-0.083*	-0.112
	(0.004)	(0.057)	(0.049)	(0.099)
Economic Condition				
Wage	-6.13e-07	1.26e-06	-0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Income Inequality	0.081***	0.102*	0.005	-0.037
	(0.031)	(0.055)	(0.052)	(0.068)
Poverty	0.004	-0.012	-0.011	-0.011
	(0.004)	(0.008)	(0.07)	(0.010)
Education				
Educational Attainment	-0.007	0.0038	-0.012	0.016
	(0.007)	(0.013)	(0.012)	(0.019)
Population Structure				
y0-y14	-0.157**	-0.790***	-0.043	-0.435**
	(0.075)	90.134)	(0.111)	(0.188)
y15-y24	-0.189**	-0.590***	0.151	-0.376
	(0.082)	(0.141)	(0.113)	(0.251)
y25-y49	-0.189**	-0.413***	0.234**	-0.248
	(0.075)	(0.129)	(0.109)	(0.213)
y50-y64	-0.247***	-0.386***	0.239*	-0.324
	(0.083)	(0.138)	(0.129)	(0.216)
y65-y79	-0.360***	-0.567***	0.047	-0.430**
	(0.076)	(0.128)	(0.111)	(0.188)
Urban	-0.037***	-0.008	0.004	-0.004
	(0.011)	(0.019)	(0.018)	(0.03)

Deterrence Effect				
Police	-2.183***	-3.126***	-3.806***	-2.877
	(0.656)	(1.208)	(1.094)	(1.811)
Prisoners	-0.202	-0.460	1.645	-5.870*
	(0.980)	(1.673)	(2.05)	(3.251)
Death	-0.078	0.086	0.093	0.125
	(0.052)	(0.107)	(0.082)	(0.182)
Crime-Related Goods				
Alcohol	-0.033*	-0.034	-0.073***	-0.056
	(0.019)	(0.029)	(0.028)	(0.044)
R-squared	0.6628	0.7356	0.6749	0.3860
No. of obs.	151	153	134	129
F-statistics for weak IV test	36.107	30.437	26.177	20.491
P-value for overidentification test	0.9064	0.0639	0.4631	0.0836
Linear trends	Yes	Yes	Yes	Yes
Quadratic trends	Yes	Yes	Yes	Yes

Note: 1. See the table note under Table 1.

Table 4

The second stage results of the 2SLS regression on EMU property crime rate

EMU effect --- *Euro*(Dummy)

	Theft	Motor Vehicle Theft	Burglary	Domestic Burglary
Unemployment	0.033**	0.108**	0.023	0.127***
	(0.015)	(0.020)	(0.019)	(0.031)
Euro	0.185*	0.432**	0.031	0.097
	(0.098)	(0.193)	(0.147)	(0.077)
R-squared	0.6695	0.7393	0.6750	0.3860
No. of obs.	151	153	134	129
F-statistics for weak IV test	35.599	29.76	26.232	20.491
P-value for Overidentification test	0.9825	0.0701	0.4652	0.0836
Linear trends	Yes	Yes	Yes	Yes
Quadratic trends	Yes	Yes	Yes	Yes
EMU effect --- *EuroDuration*				
	Theft	Motor Vehicle Theft	Burglary	Domestic Burglary
Unemployment	0.032**	0.106***	0.026	0.127***
	(0.012)	(0.020)	(0.019)	(0.031)
EuroDuration	0.017	0.21	0.136	0.046
	(0.065)	(0.141)	(0.102)	(0.122)
R-squared	0.6628	0.7341	0.6780	0.386
No. of obs.	151	153	134	129
F-statistics for weak IV test	35.631	29.349	24.959	20.491
P-value for overidentification test	0.8644	0.0655	0.5250	0.0836

Linear trends	Yes	Yes	Yes	Yes
Quadratic trends	Yes	Yes	Yes	Yes

Note: 1. See the table note under Table 1.
2. The first-stage of the 2SLS regression includes all the independent variables described in Table A2, in addition to the instrumental variables $_{R\ \&\ D}$ and $_{TFP}$.