行政院國家科學委員會專題研究計畫 成果報告

犯罪與經濟誘因：以美國州資料 1970-2000 為例
研究成果報告(精簡版)

計 畫 類 別 ：個別型
計 畫 編 號 ：NSC 95-2415-H-002-019-
執 行 期 間 ：95 年 08 月 01 日至 96 年 07 月 31 日
執 行 單 位 ：國立臺灣大學經濟學系暨研究所

計 畫 主 持 人：林明仁

計畫參與人員：學士級-專任助理：游嵐婷

處 理 方 式 ：本計畫可公開查詢

中 華 民 國 96 年 09 月 14 日

Does Unemployment Increase Crime? Evidence from 1974-2000 US State Data

Ming-Jen Lin*

Abstract

OLS may understate the effect of unemployment on crime because of the endogeneity problem (Raphael and Winter-Ember 2001). In this paper, we use changes in the real exchange rate, state manufacturing sector percentage and state union membership rates as novel instrumental variables to carry out 2SLS estimations. We find a 1 percentage point increase in unemployment would increase property crime by 1.8 percent under the OLS method, but that the elasticity goes up to 4 percent under 2SLS. The larger 2SLS effect has significant policy implications since it explains 30 percent of the property crime change during the 1990s.

Keywords: Crime; Unemployment; Instrumental variables; Real exchange rate.

JEL Code: K4.

* Ming-Jen Lin is an associate professor at the Department of Economics, National Taiwan University. The author thanks Steven Levitt, David Mustard, Tom Miles, Mark Duggan, and two anonymous referees for their help comments. Financial support from National Science Council, Taiwan is greatly acknowledged. The data used in this article can be obtained beginning August 2007 through July 2010 from Ming-Jen Lin, Department of Economics, National Taiwan University, mjlin@ntu.edu.tw.

I. Introduction

Crime imposes enormous economic costs on society,[1] with unemployment also being thought to have an important role to play in the supply function of crime.[2] The coincidence between the longest economic expansion since World War II and the overall reduction in crime rates in the 1990s seems to confirm this argument. Between 1991 and 2000, there was a significant fall in the annual unemployment rate in the US, from 6.8 percent to 4.8 percent. Furthermore, as noted by Levitt (2004), according to calculations based upon the 'Uniform Crime Report' (UCR), over the same period, there were considerable reductions in acts of murder (-42.9 percent), violent crime (-33.6 percent) and property crime (-28.8 percent). Such a strong correlation provides policymakers with confirmation that reducing the level of unemployment is one of the most effective ways of fighting crime.

Economists typically conclude that unemployment (or a decline in labor market conditions) can lead to an increase in crime, because the worsening opportunities in the legal employment sectors make committing crime more attractive (Becker 1968). And such propensity is expected to have more relevance to property crime because of its pecuniary nature (Levitt 2004). In terms of empirical evidence, recent studies reach consensus that unemployment does have a positive, significant, but only small effect on property crime, and no significant effect on violent crime. In numerical terms, a 1.0 percentage point increase in

unemployment increases property crime by 1.0 to 2.0 percent (Freeman 1995; Bushway and Reuter 2002; Levitt 2004). This trend is seen more clearly when, as opposed to the average unemployment rate, better measures are used to identify those who are on the margin of committing crime.[3]

This paper contributes to the existing knowledge in this area by providing a better means of identifying the causal link between labor market conditions and crime. We focus on breaking down the endogeneity between unemployment and crime, and on how the policy implications of the magnitude of the 2SLS estimations differ from those in the prior literature obtained under OLS estimations. Adopting US state panel data, we use changes in the exchange rate, state union membership percentage and state manufacturing percentage as novel instrumental variables in unemployment, and find that although a 1.0 percentage point increase in unemployment would increase property crime by 1.8 percent under OLS estimation, this elasticity goes up to between 4.0 and 6.0 percent under the 2SLS method. We also confirm that unemployment has no significant effect on violent crime.

Our results contribute to the existing literature in three ways. First of all, and quite surprisingly, although the more recent studies have shown that changes in labor market conditions can affect property crime with regard to those who are more likely to be on the margin of committing crime, attempts to control for endogneity remain rare.[4] As argued by

Levitt (2001), when using panel data, the instrumental variable approach is a preferable means of identifying the link between crime and unemployment, since simultaneity, omitted variables and measurement error can all lead to bias in the OLS results. To the best of our knowledge, only Raphael and Winter-Ember (2001) and Gould, Weinberg, and Mustard (2002) attempt to explore the instrumental variable (IV) method, although the measures they obtained are quite different.[5]

Given that our 2SLS estimates are twice the size of the OLS estimates, this also confirms the suspicions of Raphael and Winter-Ember (2001), that the available evidence understates the effects of unemployment on crime.[6] The 2SLS results obtained in this study consequently contribute to the literature by better controlling for endogeneity, and thereby providing more precise estimations than those reported in the prior literature.

Secondly, the magnitude of our 2SLS estimations also points to very different policy implications than may have previously been considered. As opposed to the traditional results of 1.0 to 2.0 percent under the OLS method, there is a two- to three-fold increase in the 2SLS estimates of the effect of unemployment on property crime, rising to about 4.0-6.0 percent. This indicates that the 2 percentage point reduction in unemployment in the 1990s would reduce property crime by between 8.0 and 12.0 percent. This would also explain about 33 percent of the property crime change (10/30) over the same period.[7] The effect is about the same size as the

effect of the legalization of abortion (Levitt and Donohue 2001). However, if, as suggested in the prior OLS literature, elasticity is only 1.0-2.0 percent, then unemployment may have only a minor role to play, if any role at all, in the reduction in crime in the 1990s (Levitt 2004).

Finally, although the recent literature shows that average unemployment may not be an appropriate measure – in terms of identifying those who are at the financial margins of committing crime – our results show that such a positive effect can still be identified if endogeneity is properly controlled. This may be because the variations picked up in the present study through the IV method are for those people working in manufacturing who are thus more likely to be substituted by foreign competition. [8] Our study adds support to the growing opinion within the literature that, when better measures are obtained, there is increasing evidence of labor market conditions affecting crime.

The remainder of this paper is organized as follows. Section 2 reviews the extant literature, followed in Section 3 by a description of the data and a discussion of the identification problem. The empirical results are presented in Section 4, where we justify the use of the instruments by building up a causal link between exchange rate fluctuations, union membership and unemployment. We then undertake a comparison of the 2SLS and OLS results in Section 5, and Section 6 concludes.

II. Literature Review

The theoretical approach to the ways in which economic incentives affect criminal behavior can be seen in Becker (1968), Ehrlich (1973) and various later works. When unemployment, the opportunity cost of committing a crime, namely, the legal wage, declined, which makes illegal income more appealing. A graphic version of this argument can also be seen in Grogger (2000) and Raphael and Winter-Ember (2001). This prediction is also likely to be more relevant for property crime which leads to direct financial gain (Levitt 2004).

As to the empirical evidence, the early studies on the positive effect of unemployment on crime are described as 'inconsistent, insignificant and weak' (Chiricos 1987). Furthermore, there is surprisingly little evidence to support the proposition that crime rates are driven by economic conditions (Piehl 1998); this has, however, changed over the past ten years, with the more recent articles consistently reporting the positive, significant and small effects of unemployment on property crime, but not on violent crime.

Using the OLS method and US panel data on states, counties and cities, a number of studies find that a 1 percentage point increase in the unemployment rate increases property crime by just 1.0 to 2.0 percent.[9] Using time series data on New York City, Corman and Mocan (2005) finds that elasticity was about 1.8-2.2 percent for only burglary and motor theft, while Papps and Winkelmann (2002) also finds the elasticity of unemployment on property crime to be 2.0 percent in their examination of data on New Zealand. Nevertheless, Entorf and

Spengler (2000) calculates that the elasticity of unemployment on total crime in Germany is around just 0.5 percent.[10]

Such significant changes can be attributed to three factors. Firstly, the recent studies are better at identifying the more relevant variables, since the average unemployment or wage measures may not be appropriate, in terms of identifying those on the margin of committing crime. From their focus on young, unskilled and low-educated males, Gould, Weinberg, and Mustard (2002) finds that a 1.0 percentage point increases in the unemployment rate of this 'at-risk' group would increase property crime by only 1.0 to 2.0 percent. Machin and Meghir (2004) also found strong evidence to support the effect on crime from conditions in the low-wage labor market.[11] The second factor for consideration is recognition of the need for controlling the potential problems caused by endogeneity; however, to the best of our knowledge, only Raphael and Winter-Ember (2001) and Gould, Weinberg, and Mustard (2002) make such attempts by using 2SLS. The third factor is that we are now at a much better stage in terms of extensively controlling for the independent variables, as well as in the usage of panel data, given that the periods under examination are now much longer.

The overall picture from the above literature and many of the survey articles is that unemployment has a small, positive and significant effect (of about 1.0 to 2.0 percent) on property crime only; however, most of the results have been generated under the OLS method

which does not control for endogeneity. In the only two studies which adopt the use of instrumental variables, the magnitude of the effects obtained, and hence the policy implications, are very different.[12]

This research therefore sets out to add to the literature by using a set of novel instruments as the means of solving the rarely-discussed problem of endogeneity, and by discussing the differences in the estimations, as well as their impact on crime policy.

III. The Data and the Problem of Identification

III-A. The Data

The data used in this paper comprise of a panel of 49 US states with observations covering the period from 1974 to 2000.[13] Following Levitt (1996), seven crime categories from the UCR are included. These are: murder, rape, assault and robbery, collectively referred to as 'violent crime', and burglary, larceny and auto theft, collectively referred to as 'property crime'. The overall numbers of local and state police forces are also listed in the UCR.

The total number of prisoners and details on the use of the death penalty are obtained from the Criminal Justice Statistics Source Book produced by the Bureau of Justice, while the figures for the total consumption of ethanol per person are taken from the website of the National Institute of Alcohol Abuse and Alcoholism. The remaining demographic and

economic incentive variables, which include state income per capita, hourly wages, unemployment rates, state public aid, health and education expenditure, the proportions of metropolitan and African-Americans, poverty levels, age structure and the AFDC (TANF) per recipient family per year, are taken from various issues of the *Statistical Abstract of the United States*.

As to the instrumental variables, the real exchange rates are taken from the historical data archives at the Federal Reserve Bank of New York, and the oil price series can be found in the *Annual Energy Review* published by the Department of Energy within the US Central Government. The percentages of employees in manufacturing, manufacturing value and union membership are also taken from various issues of the *Statistical Abstract of the United States*.

The summary statistics provided in Table 1 show that between 1974 and 2000, there were approximately 5,000 crimes committed each year for every 100,000 persons in the US, albeit relatively minor property crimes in the great majority of cases. The table also shows that there were approximately 237 prisoners, 250 local police and 30 state police per 100,000 of the population. The average state expenditure per capita per year was $380 on public welfare, $540 on education and $130 on health, while the average hourly wage was $9.76. Approximately 76 percent of the population lived in urban areas, with African-Americans accounting for about 12 percent of the total population.

<Table 1 is inserted about here>

As to the key variables, the average unemployment rate was 6.30 percent and the price of oil was $24.93 per barrel. The manufacturing sector accounted, on average, for 20.01 percent of state total employees and 19.25 percent of all state GDP, with 21.8 percent of the workers holding union membership at state level.

III-B. The Problem of Identification

In general, there are three factors which can explain bias in the OLS results, the first of which is the problem of omitted variables. If, for example, any pro-cyclical crime-related commodity consumption is omitted, then the OLS method would underestimate the true effects (Raphael and Winter-Ember 2001).[14] Cook and Zarkin (1985) suggests that legitimate employment opportunities, criminal opportunities, crime-related commodities and the responses by the criminal justice system are all important variables in the crime supply function. In this paper, we use unemployment rates, state income per capita, hourly wages and poverty rates as independent variables to represent the economic incentive factors. Special attention should be paid to hourly wage and poverty rates, since wages and the economic conditions of lower percentile workers are very important to the determination of crime (Grogger 1998; Gould, Weinberg, and Mustard 2002; Machin and Meghir 2004).[15]

Other control variables include state education, public aid and health expenditure (government spending), prisoner and police numbers,[16] the death penalty (deterrence), alcohol (crime-related goods), age structure and metropolitan percentages. To further control for unobserved variables that do not follow a specific trend or that do not change overtime, we add in state, year and state-specific linear and quadratic trends as control variables to fully explore the advantages of our state panel data.[17] Although it is not possible to prove that all the relevant independent variables have been included in the specifications, our main conclusions hold, both with and without state trend dummies, and also remain insensitive to the inclusion or exclusion of particular control variables.

The second possible explanation for bias in OLS estimations is the problem of simultaneity between crime and unemployment. The overall effect of unemployment may be underestimated under OLS if criminal activity reduces the employability of offenders (Raphael and Winter-Ember 2001) or if crime increases unemployment as a result of the flight of employers (Cullen and Levitt 1999). The third explanation is that the OLS method would underestimate the effect if there is random measurement error in unemployment.

Overall, as noted by Raphael and Winter-Ember (2001), omitted variables and simultaneity lead to some suspicion that the available evidence understates the effect of unemployment on crime. If this is true, then we should see the 2SLS estimates of the effect of

unemployment on property crime being both positive and consistently larger than the OLS estimates, and indeed, this is the major finding in our empirical results section.

IV. Empirical Results

IV-A. OLS Regression Results

In the first instance, we report the OLS results as a reference point under the following specifications:

$$\ln(\text{Crime}_{ijt}) = \rho\,\text{Unemployment}_{it} + \beta X_{it} + \varphi_i + \text{Year}_t + \varphi_i * \text{Year}_t + \varphi_i * \text{Year}_t^2 + \xi_{ijt} \quad (1)$$

where the dependent variables are different crime rates, j indicates the crime category, i is state, t is year, Xit represents all the independent variables outlined earlier in Table 1, φi and Year t represent state and year dummies, and the final two terms are state specific linear and quadratic linear trends.

For each crime category, we present three different specifications by gradually adding in linear and quadratic linear trends. The results are presented in Table 2.

<Table 2 is inserted about here>

As can be seen from Table 2, for property crime, the effects of the unemployment rate

are positive and significant at the 99 percent level. When state and year dummies and other independent variables are added, the elasticity is 0.026, or 2.6 percent. After adding in the linear and quadratic linear trends, the respective estimates become 1.1 percent and 1.8 percent. It is clear, therefore, that unemployment has a positive and significant, but relatively small, effect on property crime. However, its effects on violent crime are insignificant since economic incentives often play a much smaller role in violent crime vis-à-vis property crime.

Alcohol consumption is positively related to violent crime, and we also find that more prisoners, more police, higher per capita income, the death penalty and fewer young people all result in crime reduction. Overall, the standard specification shows that a 1.0 percentage point increase in unemployment can increase property crime by around 1.1 to 1.8 percent, although it has no significant impact on violent crime. This result is similar to those reported in the prior literature.

IV-B. Instrumental Variables and the First Stage Results

As noted earlier, the OLS results may contain bias stemming from omitted variables, simultaneity or simple measurement error. To obtain a consistent estimator, we need to find an instrumental variable, Z, which will only affect crime rates through unemployment. Hence the

two conditions for a valid IV are relevance, namely Cov (Z, Unemployment) $\neq 0$, and exogeneity, Cov (Z, μ) $= 0$. According to Levitt (1997) and Angrist and Krueger (2001), the three criteria that must be met are: (i) detailed knowledge of the economic mechanisms and institutions for the instrumental variables selected; (ii) an over-identification test if there are more IVs than endogenous variables; and (iii) a weak IV test.

In this paper, we use the changes in the real exchange rate between adjacent years, $RERCt = \frac{RER_t - RER_{t-1}}{RER_{t-1}}$, multiplied by the percentage of state manufacturing sector employees or GDP value (that is, $RERCit = RERCt * Manufacturing\ percentit$) to instrument unemployment. It should be noted that the real exchange rate (RER) is calculated by the average foreign exchange rates of all trade partners weighted by trade volume. By weighting the manufacturing employee percentage, we can measure the specific RERC shock (dollar appreciation or depreciation) to which each state is exposed in any given year. This is the strategy adopted by Raphael and Winter-Ember (2001), in which oil costs are used as the instrumental variable.

The effects of exchange rate movement and unemployment, particularly in the manufacturing sector, are well documented in the prior literature. As argued by Revenga (1992), the link between dollar appreciation and industry employment is ‘straightforward’, since any change in import competition which leads to a shift in industry product demand will

tend to shift employment in the same direction. In theory, currency appreciation can affect the domestic labor market by altering profit (Sheets, 1992; Clarida 1997), investment (Campa and Goldberg 1999) or production location (Goldberg 1993). As to the prior empirical estimations, Branson and Love (1988) finds that the US manufacturing sector lost over one million jobs as a direct result of the 1981-1985 appreciation of the US dollar.

Using industry level manufacturing sector data covering the period between 1977 and 1987, Revenga (1992) finds that import prices appeared to have a sizable effect on employment. A number of other studies also reports that most of the adjustments to an adverse trade shock came through employment.[18] In addition, since exchange rate equilibrium is determined in the global money market, although the US is a relatively large economy within that market, it is unlikely that any state-specific unemployment rate change (the variation used in our 2SLS estimations) would affect overall US exchange rates.

Furthermore, using macro-level variables as instruments for micro-level decisions is not uncommon within the literature (see for example, Evans and Ringel 1999; Currie and Moretti 2003); however, there is a need to take into account whether exchange rates are correlated with certain omitted variables which may affect crime, but which may not have been controlled within the regression. To mitigate this issue, we control for the economic variables such as hourly wages, per capita income, state education, public aid and health expenditure,

each of which may be correlated with exchange rate shocks, and which may also affect crime rates. We also include state, year and trend dummy variables to identify those variables that are not included in the independent variables. Of course, the list cannot be exhaustive, and we acknowledge the possible pitfall in our analysis here.

In addition to using the percentage of state employees and the percentage of GDP accounted for by the manufacturing sector, we also use the percentage of state union membership as our weighting for real exchange rate movements. As noted by Freeman and Medoff (1984), unions are simply "organizations [that] have monopoly power which they can use to raise wages above competitive levels". As a consequence, an excess supply of labor is created due to the deviation from the competitive market equilibrium, resulting in unemployment.[19]

We have so far introduced three weighting methods, the percentage of state manufacturing sector employees, the percentage of state manufacturing sector GDP and the percentage of state union membership, as the real exchange rate change variables. We also add in oil price (weighted by these three variables) as the instrumental variables for comparison with Raphael and Winter-Ember (2001). The justification for the impact of oil shocks on unemployment can be seen in Davis and Haltiwanger (1999), in which they document the effect of oil shocks on the US manufacturing sector.

We can now begin our 2SLS analysis. In the first stage we run:

$$\text{Unemployment it} = \sigma IVit + \beta Xit + \varphi i + \text{Year t} + \varphi i*\text{Year t} + \varphi i*\text{Year t}^2 + \xi it \quad (2)$$

where Xit refers to all of the state expenditure and social economic variables used in equation (1). Our instrumental variables are the two macroeconomic variables weighted by the three different procedures: (i) RERC * state manufacturing sector employee percent; (ii) RERC * state manufacturing sector GDP percent; (iii) RERC * state union membership percent; (iv) Oil price * state manufacturing sector employees percent; (v) Oil price * state manufacturing sector GDP percent; and (vi) Oil price * state union membership percent. Once the first stage results are obtained, the predicted value of unemployment will replace the observed unemployment rates in stage 2, namely, Equation (3):

$$\ln(\text{Crime}ijt) = \rho\text{Unemployment it} + \beta Xit + \varphi i + \text{Year t} + \varphi i*\text{Year t} + \varphi i*\text{Year t}^2 + \xi ijt \quad (3)$$

Table 3 presents the first stage results using real exchange rate movements. The positive and highly significant coefficient estimates indicate that dollar appreciation, along with manufacturing and union membership percentages, are positively correlated with the unemployment rate, which accords with our discussion in the previous section.

<Table 3 is inserted about here>

By carrying out a simple calculation, we can determine whether our estimation results are comparable with those of the earlier studies. We know that from 1980-1985, there was appreciation of about 33 percent in the real exchange rate, and, as column (1) of Table 3 indicates, the coefficient estimate of $RERC_t$*manufacturing employee $_{t-1}$ percent is 54, which means that the unemployment rate increase due to this appreciation would be 55*0.33 (dollar appreciation) * 0.2(mean of manufacturing employee percent) = 3.63 percent, or roughly four million unemployed people. This number is similar to the 4.0-7.5 percent unemployment estimated by Revenga (1992).

We also use state manufacturing percentage (GDP or employee numbers) plus union membership as a set of instrumental variables for the first stage when subsequently carrying out the over-identification test, with both the sign and significance of the coefficient estimates all fitting our prediction. Furthermore, as argued by Bound, Jaeger, and Baker (1995), Staiger and Stock (1997) and Stock and Yogo (2004), the first stage joint F test value should be large enough to pass the weak IV tests. Table 3 shows that the F-statistics for the null hypothesis, namely that all of the coefficient estimates of the instrumental variables in the first stage regression are not jointly different from zero, range from 21 to 58, significantly larger than the rule of thumb, 10, suggested by Stock and Watson (2003).

For the purpose of comparison, oil prices weighted by the three different methods are also used as instrumental variables. It should be noted that we do not put oil price and exchange rate together because these two variables have high collinearity. The procedure is the same as that in Table 3. The results, which are presented in Table 4, indicate that oil price shocks weighted by manufacturing or union percentages lead to an increase in the unemployment rate; the weak IV test is also passed, with the single exception of column (1).

<Table 4 is inserted about here>

IV-C. 2SLS Regression Results

The final step in the 2SLS regression is to enter the predicted value of the unemployment rates obtained from Equation (2) into our second stage regression, namely Equation (3). We first use 'Real exchange rate change * state manufacturing employees percent' to perform a single IV 2SLS regression. To test the sensitivity of the model specifications, we report the regression results by gradually adding in the state specific linear trend and quadratic trend dummy variables. The results are reported in Table 5.

<Table 5 is inserted about here>

As we can see, the OLS estimation of the elasticity of unemployment on property crime for the full model specifications is 1.62 percent. When the 2SLS method is used, the results

range between 4.4 and 6.5 percent, consistently greater than the OLS results, and dependent on whether or not state specific linear or quadratic trends are included. Unemployment appears to have no significant effect on violent crime, in both the OLS and 2SLS estimations.

To further investigate this issue, we first use the six instrumental variables to obtain the first stage prediction value of unemployment. We then use all seven UCR crime categories (murder, rape, assault, robbery, burglary, larceny and auto theft) as the dependent variables to perform a single IV 2SLS regression using the full model specifications of Equation (3). The results are presented in Table 6.

<Table 6 is inserted about here>

It is clear that for property crime, the 2SLS estimations of unemployment elasticity for the six different single instrumental variables range between 2.5 and 5.5 percent, much greater than the OLS estimation (1.6 percent). Furthermore, the ranges of the respective 2SLS results for the property crime category (burglary, larceny and auto theft) were 2.1-6.6 percent, 1.6-5.4 percent and 4.1-15.8 percent. These are consistently greater than the OLS results (2.5 percent, 1.1 percent and 1.7 percent). The unemployment effect on violence is also insignificant, except for its negative relationship with rape (strong) and murder (much weaker).

Since we have six different IVs, we can use more than one IV in our 2SLS regression to

perform an over-identification test. This can be carried out by regressing the predicted residuals of the 2SLS on all of the exogenous and instrumental variables, and then calculating the χ^2 value of n (the number of observations) x R^2. The results presented in Table 7 show that, with the exception of larceny, all of the crime categories pass the over-identification test, with most of the statistics being less than 2. This indicates that the 2SLS method remains insensitive to the instrumental variables chosen.

<Table 7 is inserted about here>

As to the estimation of unemployment elasticity, it is also clear that the 2SLS method produces 2.9-5.4 percent for property crime, 3.0-6.7 percent for burglary, 2.5-5.0 percent for larceny and 4.7-8.0 percent for auto theft. Again the effects of unemployment on violent crime are unclear, with the exception of the negative effects for both rape and murder. These numbers are similar to the single IV results presented in Table 6, and also similar to those reported by Raphael and Winter-Ember (2001).

So far, we show a greater effect of unemployment on property crime under the 2SLS method than under the OLS method. However, we can find no significant effect of unemployment on violent crime. Our results also pass the first stage weak IV test and the over-identification test, and remain robust across different model specifications. There are,

however, several issues in need of further attention; these are discussed in the following section.

V. Discussion

The first issue of importance is the negative sign of unemployment on violent crime, although some of them are insignificant. In some model specifications, unemployment also has a significant negative effect on murder (weak) and rape (very strong). Although unemployment can basically increase property crime, the negative correlation between unemployment and violent crime is not immediately obvious from the theory. Furthermore, the positive effect of unemployment on robbery is also generally weak, which is somewhat strange, since the motivation for committing robbery, namely, economic gain, is similar to that for property crime. We offer two alternatives for reconciliation of this point.

Firstly, the overall unemployment rate may not be capable of identifying those people who are on the margin of committing a particular crime, even after controlling for endogeneity. For example, since almost all rape offenders are male, the gender specific unemployment rate should be a better measurement than the overall unemployment rate. Indeed, Raphael and Winter-Ember (2001) shows that while overall unemployment has a significant negative impact on rape, this effect became positive (although not significant)

when the male unemployment rate is used.

Secondly, as pointed out by Raphael and Winter-Ember (2001), the failure to control for crime-related commodity variables, such as alcohol, guns and drugs, each of which demonstrate pro-cyclical pressure, can lead to underestimation of the true effects of unemployment. Levitt (2004) also argued that since most crime-related commodities, such as alcohol and cocaine, were normal goods, improvements in economic conditions can have a negative impact on crime. It is likely that the reason we obtain a negative unemployment effect on violent crime is because we do not control variables which are pro-cyclical and have particularly profound effects on violent behavior; cocaine appears to be one of them.[20]

To explore this point further, we include the 'state crack cocaine index' calculated by Fryer et al. (2005) – which includes data from 1980 to 2000 only – as a control variable into all of our OLS and 2SLS regressions. The process is essentially the same as those outlined in Equations (2) and (3). The results presented in Table 8 show that when adding in the crack index and using data from 1980 to 2000, the effect of unemployment on violent crime (including both murder and robbery) becomes positive (although not significant). Furthermore, the estimates of unemployment on robbery are about 5.0 to 7.0 percent under the 2SLS method, which is similar to the effect on property crime. This shows when a proper measure of crime related commodity is used as a control variable the effect of unemployment on

violent crime becomes positive, small and insignificant. Nevertheless, the positive, significant, and larger estimates of unemployment on property crime under the 2SLS method remain.

<Table 8 is inserted about here>

Finally, we also attempt to introduce as many combinations of the independent variables as possible, and find that the results are not at all sensitive to the inclusion or exclusion of any particular controls; that is, unemployment has a significantly positive effect on property crime, with the magnitude of the effect larger under the 2SLS methods. Nevertheless, one might suspect that it may be the employment conditions among certain particular demographic groups that drive our results. This direction may well be worthy of further investigation if more detailed data were to become available.[21]

IV. Conclusions

Obtaining a precise measure of the impact of unemployment on crime is very important, insofar as it facilitates a cost benefit analysis for the assessment of possible public policy interventions. Although economic theories predict that unemployment should have a positive effect on property crime, most of the prior literature has reported that a 1.0 percentage point increase in the unemployment rate is associated with a 1.0 percent increase in property crime, but not violent crime (Levitt 2004). However, most estimates are obtained under the OLS

method, which does not control for endogeneity.

In this paper, we begin with a discussion of the ways in which the problems of omitted variables and simultaneity can lead to bias in the OSL estimations. We control for an extensive set of independent variables, including deterrence, economic conditions, demographics, year and state dummies, and state-specific linear and quadratic trends, so as to mitigate the problem of omitted variables. We then use a set of novel instrumental variables, namely changes in the real exchange rate, state union membership percentage, oil price and state manufacturing employee percentages to mitigate the problem of simultaneity.

Our first stage regression shows that appreciation in the US dollar and in oil prices, together with union membership and manufacturing employee percentages, have a strong positive effect on unemployment. Furthermore, the results of the first stage easily pass the weak IV test. In the second stage analysis, we show that the 2SLS estimation of the elasticity of unemployment on property crime is 4.0 to 6.0 percent for the full model specifications, as compared to the 1.8 percent obtained under the OLS method. The fact that the 2SLS results are consistently greater than those obtained under the OLS method indicates that the two major sources of bias stemming from the OLS method are the positive response of unemployment to the problem of crime, and the omitted variables which cause crime, but which are negatively correlated with unemployment (pro-cyclical).

As for violent crime, there is no apparent significant effect attributable to unemployment, in either the OLS or 2SLS estimations. We also use the over-identification test in an attempt to reveal the sensitivity of the choice of instrumental variables; however, with the single exception of larceny, all of the 2SLS results hold. Finally, our results remain insensitive to both the different model specifications and the choice of independent variables.

The 4.0 to 6.0 percent estimates obtained in this study on the effect of unemployment on property crime have important policy implications, since they indicate that roughly one-third of the reduction in property crime during the 1990s may have been attributable to changes in unemployment, a conclusion that is very different to those drawn in much of the prior literature.

References

Anderson, David. 1999. "The Aggregate Burden of Crime." *Journal of Law and Economics* 42(2): 611-42.

Angrist, Joshua, and Alan Krueger. 2001. "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiment." *Journal of Economic Perspective* 15(4): 69-85.

Becker, Gary. 1968. "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76(2): 169–217.

Belman, Dale, and Thea Lee. 1995. "International Trade and the Performance of US Labor Markets." In *US Trade Policy and Global Growth, ed.* Robert Blecker, 61-107. Armonk, New York: ME Sharpe.

Blumstein, Alfred, and Richard Rosenfeld. 1998. "Explaining Recent Trends in US Homicide Rates." *Journal of Criminal Law and Criminology* 88(1): 1175-216.

Branson, William, and James Love. 1988. "United States Manufacturing and the Real Exchange Rate." In *Misalignment of Exchange Rates: Effects on Trade and Industry,* ed. R. Marston. Chicago Ill: University of Chicago Press.

Bound, John, David Jaeger, and Regina Baker. 1995. "Problems with Instrumental Variables Estimation when the Correlation between the Instruments and the Endogenous Explanatory Variable is Weak." *Journal of the American Statistical Association* 90(430): 443-50.

Burgess, Simon, and Michael Knetter. 1998. "An International Comparison of Employment Adjustment to Exchange Rate Fluctuations." *Review of International Economics* 6(1): 151-63.

Bushway, Shawn, and Peter Reuter. 2002. "Labor Market and Crime." In *Crime: Public Policies for Crime Control,* James Wilson, and Joan Petersilia, eds. San Francisco, CA: ICS Press.

Campa, Jose, and Linda Goldberg. 1999. "Investment, Pass-through and Exchange Rates: A Cross-Country Comparison." *International Economic Review* 40(2): 287-314.

_____. 2001. "Employment versus Wage Adjustment and the US Dollar." *Review of Economics and Statistics* 83(3): 477-89.

Chiricos, Theodore. 1987. "Rates of Crime and Unemployment: An Analysis of Aggregate Research Evidence." *Social Problems* 34(2): 187-212.

Clarida, Richard. 1997. "The Real Exchange Rate and US Manufacturing Profits: A Theoretical Framework with Some Empirical Support." *International Journal of Finance and Economics* 2(3): 177-88.

Cook, Philip, and Gary Zarkin. 1985. "Crime and the Business Cycle." *Journal of Legal Studies* 14(1): 115-28.

Corman, Hope, and Naci Mocan. 2005. "Carrots, Sticks and Broken Windows." *Journal of Law and Economics* 48(1): 235-66.

Cullen, Julie, and Steven Levitt. 1999. "Crimes, Urban Flight and the Consequences for Cities." *Review of Economics and Statistics* 81(2): 159-69.

Currie, Janet, and Enrico Moretti. 2003. "Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Opening." *Quarterly Journal of Economics* 118(4): 1495-532.

Davis, Steven, and John Haltiwanger. 1999. " NBER Working Paper No.7095. Cambridge, MA: National Bureau for Economic Research.

Donziger, Steven. 1996. *The Real War on Crime.* New York: Harper Collins.

Donuhue, John, and Steven Levitt. 2001. "Legalized Abortion and Crime." *Quarterly Journal*

of Economics 116(2): 379-420.

Ehrlich, Isaac. 1973. "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation." *Journal of Political Economy* 81(3): 521-65.

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(1): 75-106.

Evans, William, and Jeanne Ringel. 1999. "Can Higher Cigarette Taxes Improve Birth Outcomes?" *Journal of Public Economics* 72(1): 135-54.

Friedberg, Leora. 1997. "Did Unilateral Divorce Raise Divorce Rates? Evidences from Panel Data." *American Economic Review* 88(3): 608-27.

Freeman, Richard. 1995. "The Labor Market." In *Crime,* James Wilson, and Joan Petersilia, eds. San Francisco, CA: ICS Press, 171-92.

Freeman, Richard, and Morris. Kleiner. 1990. "The Impact of New Unionization on Wages and Working Conditions." *Journal of Labor Economics* 8(1), Part 2: S8-S25.

Freeman, Richard, and James Medoff. 1984. *What Do Unions Do?* New York: Basic Books.

Fryer, Richard, Paul Heaton, Steven Levitt, and Kevin Murphy. 2005. "Measuring the Impact of Crack Cocaine." NBER Working Papers No.11318. Cambridge, MA: National Bureau of Economic Research.

Goldberg, Linda. 1993. "Exchange Rates and Investment in United States Industry." *Review of Economics and Statistics* 75(4): 575-88.

Goldberg, Linda, and Joseph Tracy. 2000. "Exchange Rates and Local Labor Markets." In *The Impact of International Trade on Wages,* ed. Robert Feenstra. Chicago, Ill: University of Chicago Press.

Gould, Eric, Bruce Weinberg, and David Mustard. 2002. "Crime Rate and Local Labor Market Opportunities in the US: 1979-1997." *Review of Economics and Statistics* 84(1): 45-61.

Gourinchas, Pierre. 1998. "Exchange Rates, Job Creation and Job Destruction." In *NBER Macroeconomics Annual,* Ben Bernanke, and Julio Rotemberg, eds. Cambridge, MA: MIT Press.

Grogger, Jeff. 1998. "Market Wage and Youth Crime." *Journal of Labor Economics* 16(4): 756-91.

_____. 2000. “An Economic Model of Recent Trends in Violent Crime.” In *The Crime Drop in America,* Alfred Blumstein, and Joel Wallman, eds. Cambridge, MA: Cambridge University Press, 266-87.

Grogger, Jeff, and Michael Willis. 2000. “The Emergence of Crack Cocaine and the Rise in Urban Crime Rates.” *Review of Economics and Statistics* 82(4): 519-29.

Jarrell, Stephen, and T. D. Stanley. 1990. “A Meta-analysis of the Union/Non-union Wage Gap.” *Industrial and Labor Relation Review* 44(1): 54-67.

Kletzer, Lori. 2000. “Trade and Job Losses in US Manufacturing, 1979-1994.” In *The Impact of International Trade on Wages*, ed. Robert Feenstra. Chicago, Ill: University of Chicago Press.

Layard, Richard, and Steven Nickell. 1986. “Unemployment in Britain.” *Economica* 53(Supplement): S121-170.

Lewis, Gregg. 1985. *Union Relative Wage Effect.* Chicago, Ill: University of Chicago Press.

Levitt, Steven. 1996. “The Effect of Prison Population Size on Crime Rate: Evidence From Prison Overcrowding Litigation.” *Quarterly Journal of Economics* 111(2): 319-51.

_____. 1997. “Using Electoral Cycles in Police Hiring to Estimate the Effect of Police

on Crime." *American Economic Review* 87(3): 270-90.

_____. 1998. "Juvenile Crime and Punishment." *Journal of Political Economy* 106(6): 1156-85.

_____. 2001. "Alternative Strategies for Identifying the Link between Unemployment and Crime." *Journal of Quantitative Criminology* 17(4): 377-90.

_____. 2004. "Understanding Why Crime Fell in the 1990s: Four Factors that Explain the Decline and Six that Do Not." *Journal of Economic Perspective* 18(1): 163-90.

Lin, Ming-Jen. 2006. "Does Unemployment Increase Crime? Evidence from County Data of Taiwan 1978-2003 (In Chinese)." *Taiwan Economic Review* 34(4): 445-483.

Linneman, Peter, Michael Wachter, and William Carter. 1990. "Evaluating the Evidence on Union Employment and Wages." *Industrial and Labor Relations Review* 44(1): 34-53.

Marvell, Thomas, and Carlisle Moddy. 1996. "Police Levels, Crime Rates and Specification Problems" *Criminology* 24(3): 606-46.

Meghir, Costas, and Steve Machin. 2004. "Crime and Economic Incentives." *Journal of Human Resources* 39(4): 958-79.

Miller, Ted, Mark Cohen, and Brian Wiersema. 1996. "Victim Costs and Consequences: A New Look." National Institute of Justice Research Report, NCJ-155282, available at website: http://www.ncjrs.org/pdffiles/victcost.pdf.

Papps, Kerry, and Rainer Winkelmann. 2002. "Unemployment and Crime: New Evidence for an Old Question." *New Zealand Economic Papers* 34(2): 53-72.

Piehl, Anne. 1998. "Economic Conditions, Work and Crime." In *Handbook of Crime and Punishment,* ed. Michael Thorny. New York: Oxford University Press.

Piehl, Anne, and Kristin Butcher. 1998. "Cross-city Evidence on the Relationship between Immigration and Crime." *Journal of Policy Analysis and Management* 17(3): 457-93.

Raphael, Steven, and Rudolf Winter-Ember. 2001. "Identifying the Effect of Unemployment on Crime." *Journal of Law and Economics* 44(1): 259-83.

Revenga, Ana. 1992. "Exporting Jobs? The Impact of Import Competition on Employment and Wages in US Manufacturing." *Quarterly Journal of Economics* 107(1): 255-84.

Ruhm, Cristopher. 1995. "Economic Conditions and Alcohol Problems." *Journal of Health Economics* 14(5): 583-603.

_____. 2000. "Are Recessions Good for Your Health?" *Quarterly Journal of Economics*

115(2): 617-750

Sheets, Nathan. 1992. "The Exchange Rate and Profit in Developed Economies: An Inter-sectoral Analysis." Working paper, Board of Governors of the Federal Reserve System.

Stock, James, and Douglas Staiger. 1997. "Instrumental Variables Regression with Weak Instruments." *Econometrica* 65(3): 557-86.

Stock, James, and Mark Watson. 2003. *Introduction to Econometrics*, Addison-Wesley, 348-372.

Stock James, and Yogo Motohiro. 2004. "Testing for Weak instruments in Linear IV Regression?" In *Identification and Inference in Econometric Models: Essays in Honor of Thomas J. Rothenberg,* Donald Andrews, and James Stock, eds. Cambridge: Cambridge University Press.

US Department of Energy, Annual Energy Review (various issues), available at website: http://www.eia.doe.gov/emeu/aer/contents.html

Table 1 Summary statistics, weighted by population, 1974-2000

Summary Statistics	Mean	Std. Err.
Instrumental Variables		
Change in real exchange rate (percent)	0.13	4.98
State manufacturing employee numbers (percent)	20.01	0.07
State manufacturing GDP (percent)	19.25	6.92
State union membership (percent)	21.84	11.12
Oil price (per barrel)	24.93	11.40
Dependent Variables		
UCR Crime Rate (per 100,000 population)		
Violent crime	573	265
Murder	8.44	4.05
Rape	33.7	12.8
Assault	319	157
Robbery	210	134
Property crime	4,516	1241
Burglary	1,214	433
Larceny	2,792	808
Auto theft	503	226
Independent Variables		
State Expenditure [a]		
State public welfare expenditure	0.38	0.29
State educational expenditure	0.54	0.29
State health expenditure	0.13	0.11
Socio-economic Variables		
Unemployment (percent)	6.30	2.01
Local police (per 1,000 population)	2.50	0.71
State police (per 1,000 population)	0.30	0.11
Prisoners (per 1,000 population)	2.37	1.57
AFDC [b]	5,881	2726
ln income per capita	9.91	0.36
Hourly wage	9.27	3.51
African-American (percent)	12.06	8.08
Metropolitan (percent)	76.74	17.51
Poverty (percent)	13.45	3.75
Age 15-17 (percent)	4.83	0.80
Age 18-24 (percent)	11.43	1.59
Age 25-34 (percent)	15.71	1.89
Ethanol [c]	1.95	0.40
Death penalty (Yes = 1)	0.68	0.47
Crack index	1.11	1.27

Notes:

[a] State education expenditure, state public welfare expenditure and state health expenditure are US$1,000 per capita, and are adjusted by the CPI.

[b] AFDC is per recipient family per year (TANF after 1997).

[c] Ethanol is gallons consumed per capita per year.

Table 2 OLS results of unemployment and state demographic variables on property and violent crime, 1974-2000 [a]

Variables	Coefficient	Std. Err.	Coefficient	Std. Err.	Coefficient	Std. Err.
Panel A: Property Crime			ln Property Crime [b]			
Unemployment	0.026***	0.003	0.011***	0.002	0.018***	0.002
ln Income per capita	-0.533***	0.106	-0.441***	0.131	-0.199**	0.097
ln Hourly wage	0.130**	0.066	0.093	0.061	0.000	0.019
ln Local police rate t-1	-0.047	0.039	-0.149***	0.043	-0.049	0.032
ln State police rate t-1	-0.005	0.008	-0.002	0.003	-0.001	0.002
ln Prisoner rate t-1	-0.210***	0.018	-0.180***	0.021	-0.130***	0.020
ln AFDC (or TANF)	0.031	0.022	0.009	0.017	0.025	0.018
Poverty Rate (percent)	-0.010***	0.002	-0.004	0.001	0.000	0.001
Metropolitan (percent)	0.001***	0.000	0.001**	0.000	0.001**	0.000
African-American (percent)	0.961	0.612	3.203***	0.963	-3.186***	1.115
ln Ethanol per capita	0.938***	0.071	0.037	0.085	-0.145**	0.072
ln State education expenditure	0.070***	0.025	0.119***	0.028	0.004	0.017
ln State public expenditure	0.040**	0.019	-0.012	0.022	0.012	0.019
ln State health expenditure	0.011	0.010	0.007	0.007	0.002	0.004
Age 15-24 (percent)	3.035***	0.598	4.303***	0.593	2.089***	0.717
Age 25-34 (percent)	3.409***	0.540	5.580***	0.707	3.653***	0.772
Death Penalty	-0.096***	0.017	-0.069***	0.017	-0.035***	0.013
State and year dummies	Yes		Yes		Yes	
Linear trend dummies	No		Yes		Yes	
Quadratic trend dummies	No		No		Yes	
F statistics	199.49		264.43		397.13	
Adjusted R^2	0.9280		0.9618		0.9775	
No. of observations	1323		1323		1323	

Table 2 (Contd.)

Variables	Coefficient	Std. Err.	Coefficient	Std. Err.	Coefficient	Std. Err.
Panel B: Violent Crime			ln Violent Crime [b]			
Unemployment	0.005	0.004	-0.007**	0.004	-0.004	0.003
ln Income per capita	-0.227	0.171	-0.188	0.166	-0.065	0.142
ln Hourly wage	-0.263	0.198	0.076	0.048	0.013	0.042
ln Local police rate t-1	-0.051	0.048	-0.131***	0.050	-0.012	0.047
ln State police rate t-1	0.018*	0.010	0.001	0.005	0.003	0.004
ln Prisoner rate t-1	-0.091***	0.023	-0.143***	0.029	-0.131***	0.027
ln AFDC (or TANF)	-0.024	0.033	-0.036	0.033	-0.032	0.030
Poverty Rate (percent)	0.001	0.003	-0.004*	0.002	0.002	0.002
Metropolitan (percent)	0.001	0.001	0.000	0.001	-0.000	0.000
African-American (percent)	-1.939***	0.794	2.155	1.832	-3.060	2.253
ln Ethanol per capita	0.766***	0.102	0.426***	0.029	0.331***	0.127
ln State education expenditure	-0.001	0.041	0.071*	0.038	-0.097***	0.030
ln State public expenditure	0.010	0.026	0.048	0.029	0.035	0.027
ln State health expenditure	0.043***	0.014	0.016**	0.009	0.012*	0.008
Age 15-24 (percent)	2.863***	0.700	3.974***	0.869	2.257*	1.296
Age 25-34 (percent)	6.703***	0.872	6.508***	1.154	4.874***	1.099
Death Penalty	-0.134***	0.028	-0.083***	0.022	-0.095***	0.022
State and Year Dummies	Yes		Yes		Yes	
Linear Trend Dummies	No		Yes		Yes	
Quadratic Trend Dummies	No		No		Yes	
F statistics	346.97		434.69		528.54	
Adjusted R^2	0.9496		0.9685		0.9785	
No. of observations	1323		1323		1323	

Notes:

[a] Regressions are weighted by population.

[b] *** indicates significance at the 99percent level; and ** indicates significance at the 95 percent level.

Table 3 First stage results of the effect of changes in real exchange rates on unemployment [a,b]

Real Exchange Rate Changes (RERC)	(1)	(2)	(3)	(4)	(5)
$RERC_t$* State manufacturing employee $_{t-1}$ (percent)	53.96*** (8.64)	–	–	22.00*** (8.64)	–
$RERC_t$* State manufacturing GDP $_{t-1}$ (percent)	–	47.49*** (7.90)	–	–	26.53** (8.47)
$RERC_t$* State union $_{t-1}$ (percent)	–	–	1.37*** (0.18)	1.15*** (0.19)	0.78*** (0.19)
Adjusted R^2	0.9065	9288	0.9103	0.9108	0.9246
F-statistics	63.54	63.39	68.33	68.59	69.40
No. of observations	1323	1323	1323	1323	1323
F-statistics for Weak IV test (Prob>F)	39.00 (0.0000)	36.07 (0.0000)	58.43 (0.0000)	30.95 (0.0000)	20.95 (0.0000)

Notes:
[a] Standard errors are in parentheses.
[b] *** indicates significance at the 99 percent level; and ** indicates significance at the 95 percent level.

Table 4 First stage results of the effect of oil price on unemployment

Oil Price Effect	(1)	(2)	(3)	(4)	(5)
Oil Price $_t$* State manufacturing employee $_{t-1}$ (percent)	0.09** (0.04)	–	–	0.01 (0.05)	–
Oil Price $_t$ * State manufacturing GDP$_{t-1}$ (percent)	–	0.23*** (0.04)	–	–	0.15*** (0.04)
Oil Price $_t$*State union $_{t-1}$ (percent)	–	–	0.01*** (0.00)	0.01*** (0.00)	0.004*** (0.001)
Adjusted R^2	0.8989	0.9135	0.9014	0.9014	0.9152
F-statistics	60.25	90.22	65.31	65.68	–
No. of observations	1323	1323	1323	1323	1323
F-statistics for weak IV test (Prob>F)	4.43 (0.0355)	31.27 (0.0000)	27.81 (0.0000)	13.90 (0.0000)	23.23 (0.0000)

Notes:
[a] Standard errors are in parentheses.
[b] *** indicates significance at the 99 percent level; and ** indicates significance at the 95 percent level.

Table 5 OLS and 2SLS results of the effect of unemployment on property and violent crime

Variables	OLS	2SLS	2SLS	2SLS
Panel A: Property Crime		ln Property Crime		
Unemployment	0.018*** (0.002)	0.065*** (0.018)	0.056*** (0.017)	0.045*** (0.011)
Other independent variables	Yes	Yes	Yes	Yes
State and year dummies	Yes	Yes	Yes	Yes
Linear trend	Yes	No	Yes	Yes
Quadratic trend	Yes	No	No	Yes
Adjusted R^2	0.9775	0.9099	0.9452	0.9737
No. of observations	1323	1323	1323	1323
F-statistics	397.13	133.92	164.95	–
Panel B: Violent Crime		ln Violent Crime		
Unemployment	-0.004 (0.004)	-0.017 (0.020)	-0.011 (0.019)	-0.021 (0.015)
Other independent variables	Yes	Yes	Yes	Yes
State and year dummies	Yes	Yes	Yes	Yes
Linear trend	Yes	No	Yes	Yes
Quadratic trend	Yes	No	No	Yes
Adjusted R^2	0.9785	0.9473	0.9681	0.9776
No. of observations	1323	1323	1323	1323
F-statistics	528.54	340.35	426.51	–

Notes:

[a] The instrumental variable is 'Real Exchange Rate Change*State manufacturing employees percentage'; standard errors are in parentheses.

[b] *** indicates significance at the 99 percent level.

Table 6 Single instrumental variable results on the effect of unemployment on different crime categories [a]

Variables	OLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Property Crime	0.018***	0.045***	0.038***	0.025***	0.116**	0.030***	0.055***
	(0.002)	(0.011)	(0.010)	(0.009)	(0.057)	(0.010)	(0.016)
Burglary	0.025***	0.027*	0.039***	0.038***	0.038	0.021*	0.066***
	(0.003)	(0.014)	(0.013)	(0.012)	(0.040)	(0.013)	(0.021)
Larceny	0.011***	0.054***	0.038***	0.016**	0.161**	0.032***	0.055***
	(0.002)	(0.012)	(0.010)	(0.008)	(0.078)	(0.009)	(0.016)
Auto Theft	0.017***	0.056***	0.041*	0.046**	0.158*	0.049**	0.081**
	(0.005)	(0.022)	(0.023)	(0.021)	(0.096)	(0.025)	(0.036)
Violent Crime	-0.004	-0.021	-0.002	-0.021**	-0.064	-0.035*	-0.109***
	(0.004)	(0.015)	(0.016)	(0.015)	(0.059)	(0.019)	(0.033)
Murder	-0.002	-0.018	-0.014	-0.040**	-0.136	-0.058**	-0.022
	(0.005)	(0.021)	(0.022)	(0.018)	(0.088)	(0.026)	(0.025)
Rape	-0.007**	-0.056***	-0.033**	-0.060***	-0.289**	-0.073***	-0.091***
	(0.004)	(0.016)	(0.014)	(0.014)	(0.137)	(0.019)	(0.026)
Assault	-0.004	-0.029	-0.001	-0.039***	-0.056	-0.034*	-0.016
	(0.004)	(0.018)	(0.018)	(0.015)	(0.062)	(0.020)	(0.025)
Robbery	0.008*	0.025	0.021	0.002	0.051	-0.002	-0.023
	(0.005)	(0.023)	(0.023)	(0.021)	(0.074)	(0.024)	(0.033)
Instrumental Variables [b]	No	(A)	(B)	(C)	(D)	(E)	(F)

Notes:

[a] Instrumental variables are: (A) Real exchange rate change* state employee percentage in the manufacturing sector; (B) Real exchange rate* state GDP percentage in the manufacturing sector; (C) Real exchange rate change* state union membership percentage; (D) Oil price * state employee percentage in the manufacturing sector; (E) Oil price* state GDP percentage in the manufacturing sector; (F) Oil price* state union membership percentage.

[b] All crime rates are in log form; Standard errors are in parentheses; *** indicates significance at the 99 percent level; ** indicates significance at the 95 percent level; and * indicates significance at the 90 percent level.

Table 7 Multiple instrumental variable and over-identification test results on the effect of unemployment on different crime categories

Variables	OLS	2SLS	2SLS	2SLS	2SLS
Property Crime	0.016***	0.030***	0.030***	0.028***	0.054***
	(0.002)	(0.009)	(0.009)	(0.009)	(0.016)
Burglary	0.025***	0.036***	0.037***	0.031***	0.067***
	(0.003)	(0.011)	(0.012)	(0.012)	(0.021)
Larceny	0.011***	0.024***	0.025***	0.026***	0.053***
	(0.002)	(0.008)	(0.008)	(0.008)	(0.016)
Auto Theft	0.017***	0.048**	0.044**	0.055**	0.080**
	(0.005)	(0.020)	(0.022)	(0.024)	(0.036)
Violent Crime	-0.002	-0.021	-0.006	-0.017	-0.021
	(0.004)	(0.014)	(0.015)	(0.015)	(0.025)
Murder	-0.002	-0.036**	-0.027	-0.078***	-0.109***
	(0.005)	(0.017)	(0.020)	(0.023)	(0.033)
Rape	-0.007**	-0.059***	-0.039***	-0.054***	-0.087***
	(0.004)	(0.013)	(0.013)	(0.016)	(0.026)
Assault	-0.004	-0.037**	-0.019	-0.017	-0.015
	(0.004)	(0.015)	(0.016)	(0.015)	(0.025)
Robbery	0.008*	0.007	0.016	-0.008	-0.025
	(0.005)	(0.020)	(0.022)	(0.023)	(0.033)
Instrumental Variables [b]	No	(A)	(B)	(C)	(D)
Rejection of over-identification test at the 5 percent level [c]	No	Property, Larceny	Larceny	None	Rape, Larceny

Notes:

[a] Instrumental variables are: (A) Real exchange rate change* state employee percentage in the manufacturing sector + Real exchange rate change* state union membership percentage; (B) Real exchange rate* state GDP percentage in the manufacturing sector + Real exchange rate change* state union membership percentage; (C) Oil price* state GDP percentage in the manufacturing sector + Oil price* state union membership percentage; (D) Oil price* state employee percentage in the manufacturing sector + Oil price* state union membership percentage.

[b] All crime rates are in log form; Standard errors are in parentheses; *** indicates significance at the 99 percent level; ** indicates significance at the 95 percent level; and * indicates significance at the 90 percent level.

[c] The over-identification test $[\chi^2] = nR^2$. The critical value of χ^2 (1) = 3.84 at the 5 percent significance level, and 6.63 at the 10 percent significance level.

Table 8 US state data on the effect of unemployment on different crime categories with the inclusion of the cocaine index as an independent variable, 1980-2000 [a]

Variables	OLS [b]	2SLS [b]		
	(1)	(2)	(3)	(4)
Property Crime	0.018***	0.093***	0.083***	0.060**
	(0.002)	(0.023)	(0.022)	(0.025)
Burglary	0.025***	0.093***	0.074***	0.061***
	(0.003)	(0.025)	(0.023)	(0.030)
Larceny	0.015***	0.015***	0.094***	0.065***
	(0.002)	(0.002)	(0.024)	(0.024)
Auto Theft	0.013***	0.102***	0.066***	0.035
	(0.005)	(0.054)	(0.035)	(0.047)
Violent Crime	0.006	0.011	-0.019	0.016
	(0.004)	(0.025)	(0.026)	(0.035)
Murder	0.004	0.020	-0.022	0.002
	(0.006)	(0.041)	(0.033)	(0.046)
Rape	-0.002	-0.028	-0.083***	-0.028
	(0.004)	(0.024)	(0.027)	(0.030)
Assault	0.149	-0.018	-0.028	0.007
	(0.242)	(0.029)	(0.027)	(0.040)
Robbery	-0.020***	0.074*	0.049	0.057
	(0.006)	(0.042)	(0.0413)	(0.052)
Other Independent Variables [b]	Yes	Yes	Yes	Yes
Cocaine Index	Yes	Yes	Yes	Yes
State and Year Dummies	Yes	Yes	Yes	Yes
Linear Trend	Yes	No	Yes	Yes
Quadratic Trend	Yes	No	No	Yes

Notes:

[a] The instrumental variable is Exchange rate change * state manufacturing GDP percentage; All crime rates are in log form; Standard errors are in parentheses; *** indicates significance at the 99 percent level; ** indicates significance at the 95 percent level; and * indicates significance at the 90 percent level.

[b] All other independent variables used in the previous tables are included.

Endnotes

[1] Miller, Cohen, and Wiersema (1996), for example, estimates that the annual cost of crime in the US is about $450 billion, while Anderson (1999) subsequently raises the estimation to $1,100 billion; these respective figures are equivalent to $1,800 and $4,000 per capita per year.

[2] For example, in the leading newspapers, 'a strong economy' is the No.6 explanation (ranked by frequency of citing) between 1991 and 2001 (Levitt 2004). In a report to the National Criminal Justice Commission, Donziger (1996) suggests that $1billion should be spent to generate jobs for the disadvantaged in the inner city to reduce crime.

[3] See for example, Freeman (1995), Grogger (1998) and Gould, Weinberg, and Mustard (2002), where young, unskilled and low-educated males are the main groups of interest.

[4] As noted by Piehl (1998), most of the prior literature treats the economy as 'exogenous'.

[5] Raphael and Winter-Ember (2001) finds that the elasticity of unemployment on property crime was around 2.8-5.0 per cent under 2SLS; however, the 2SLS estimations found by Gould, Weinberg, and Mustard (2002) are very close to those under OLS (1.8-2.0 per cent).

[6] The two reasons suggested are "a failure to control for those variables which exert pro-cyclical pressure on crime rates (the problem of omitted variables) … to the extent that criminal activity reduces the employability of offenders (the problem of simultaneity)". Measurement error in unemployment would also induce the same result (see Section 3 of this paper for a more detailed discussion).

[7] In numerical terms, according to the 2SLS estimations, reducing unemployment by 1.0 percentage point would save about $20 billion to $100 billion in crime costs.

[8] That is, the male, low-wage, low-education workers.

[9] See for example, Levitt (1996, 1997, 1998, 2001), Levitt and Donohue (2001), Raphael and Winter-Ember (2001) and Gould, Weinberg, and Mustard (2002)

[10] However, Butcher and Piehl (1998) could not reject the hypothesis that unemployment had no effect on any crime. Ruhm (2000) even found that unemployment was negatively correlated with murder. Lin (2006) found a larger effect of unemployment on theft using Taiwan's data.

[11] See also, Freeman (1996), Grogger (1998).

[12] Raphael and Winter-Ember (2001) uses oil price shock weighted by a state's percentage of manufacturing employees as an instrumental variable and find that the elasticity of unemployment on property crime under 2SLS was around 2.8-5.0 per cent. Gould, Weinberg, and Mustard (2002) uses the initial industrial composition and the national composition trend in state employment as the instrumental variables; however, the 2SLS estimations are very close to those under OLS (2.0 per cent).

[13] The District of Columbia and Hawaii are excluded since they do not have state police numbers; however, the results are basically the same when the observations of these two states are included (by omitting the state police variable).

[14] The finding by Ruhm (1995), that there is a positive relationship between alcohol consumption and economic conditions, legitimizes this concern.

[15] Within our sample, the average wage is around $9 per hour, which can be used, to some extent, to represent the wage of low skill workers.

[16] As argued Levitt (2004), the impact of the economy on crime is indirect (through state and local government budgets, both of which are highly correlated with macroeconomic performance). Including state-expenditure variables, such as expenditure on education, prisons, police, welfare and health programs, can avoid any bias of this nature.

[17] See Marvel and Moody (1996), Friedberg (1997) and Raphael and Winter-Ember (2001).

[18] See for example, Belman and Thea (1995), Gourinchas (1998), Burgess and Knetter (1998), Kletzer (2000), Goldberg and Tracy (2000) and Campa and Goldberg (2001)

[19] Lewis (1985), Layard and Nickell (1986), Freeman and Kleiner (1990), Linneman, Wachter, and Carter (1990) and Jarrell and Stanley (1990) each report the existence of the large union wage premium and its negative effect on employment.

[20] Blumstein and Rosenfeld (1998), Grogger and Wills (2000), Levitt (2004) and Fryer et al. (2005) all argue that cocaine is a major explanatory variable in violent crime in the US.

[21] We replace the overall unemployment rates by 'age 16 to 19', 'male', 'manufacturing sector' and 'African-American' unemployment rates; however, none of the results are significant.