UNEMPLOYMENT AND THE ALLOCATION OF TIME BY CRIMINALS

by

D.C. Weller, M.K. Block and F.C. Nold*

June 1978

Technical Report CERDCR-3-78

*The authors are members of the staff of the Center for Econometric Studies of Crime and the Criminal Justice System at the Hoover Institution, Stanford University.
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The purpose of this paper is to investigate the nature of the relationship between unemployment and crime. This question is of interest to makers of macro-economic policy as well as to designers of programs to rehabilitate offenders. We choose to consider the problem in the context of a model of rational choice, in which the individual allocates his time among alternative uses according to the relative costs, returns, and risks of each, and his own preferences.

Such a model was first applied to criminal behavior by Becker [1968], and has since been refined in contributions by Ehrlich [1970, 1973, 1975], Block and Lind [1975] and Block and Heineke [1975]. Empirical estimates have been made, using aggregate data, of several aspects of the criminal choice problem. Measures of unemployment have appeared as variables in several of these models,

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Such a model was first applied to criminal behavior by Becker [1968], and has since been refined in contributions by Ehrlich [1970, 1973, 1975], Block and Lind [1975] and Block and Heineke [1975]. Empirical estimates have been made, using aggregate data, of several aspects of the criminal choice problem. Measures of unemployment have appeared as variables in several of these models,

with mixed results. While some investigators have found unemployment to have a significant and positive effect on crime, others, notably Ehrlich [1973], have not.

The use of aggregate data has imposed some limitations upon these studies, both in terms of the assumptions needed to generalize the models and in the specification of the variables. Witte [1978] has attempted to avoid these difficulties by using information on individuals drawn from a work-release program in North Carolina. She has not been able, however, to obtain very strong results from these data; in particular, her employment measure was not significant.

In this paper we will estimate a model of criminal behavior, using data collected for this purpose by the Center for Econometric Studies of Crime and the Criminal Justice System. These data, drawn from the files of state and local agencies in California, provide observations on the legal and illegal activities of a sample of individual criminals over a period of 23 years. Although this source of information has certain weaknesses and limitations of its own, it does permit us to obtain statistically significant results using data on individuals.

In Section 2 we will discuss the theoretical framework upon which our estimation is based. In Section 3 we will describe the data set we have used. The results of our estimation will be presented in Section 4.

Section 2 - The Model

We will consider a model of criminal behavior in which each individual seeks to maximize his utility by allocating his time between productive activity and leisure, and his productive activity between legal and illegal endeavors.[1] Deferring, for the moment, the question of the determination of the leisure margin, we will assume that the amount of time devoted to leisure is fixed. The individual's utility, then, will be a function of the time spent in legal activity (L), the time spent in illegal activity (I), and his wealth (W):

$$U = U(L, I, W) \tag{1}$$

The number of offenses committed in any period is assumed to be θ, a monotonically increasing function of I, the time spent in illegal activity. While the individual expects to obtain a monetary return i from each crime, he must also expect that some proportion a of the offenses he commits will lead to his capture by the authorities. For each of these "failures" a penalty will be exacted.[2] The individual forms a subjective probability distribution over the range of possible values for this arrest, or failure, rate (from one to zero).

For a formal analysis of a model of this type, the reader is referred to Block and Heineke [1975]. These authors have shown that few unambiguous results can be derived from such a general model without making restrictive assumptions concerning 1) the individual's attitude toward risk, and 2) the nonpecuniary returns to time spent

in legal and illegal activity. Thus, while the model provides a useful framework within which to interpret the available data on criminal behavior, Block and Heineke point out that, "in the area of law enforcement as in taxation, policy recommendations do not follow from theory but rather require empirical determination of relative magnitudes." We will attempt, in this paper, to provide some of the evidence required for such a determination.

The formulation used in the Block and Heineke paper assumes that the time spent in legal activity, L, is rewarded, with certainty, by the legal wage ℓ. Since this paper is primarily concerned with the effect of unemployment on criminal choice, we will introduce this source of uncertainty into the model by postulating that only some proportion $1 - u$ of legal activity earns the rate ℓ; the remaining time is spent in job search. This formulation then becomes analogous to the illegal side of the model: the individual forms a subjective probability density over the range $(0 \leq u \leq 1)$ of u.[3]

It is evident that we cannot observe L or I directly. We observe only that an individual is employed or not employed, or that he is arrested or not arrested, within a given period. Since both activities involve a stochastic failure rate, we have the difficulty of separating intention from realization. If we see that an individual is unemployed, we cannot tell if he is engaging in illegal activity, and unemployed by choice, or in

legal activity, and unemployed by necessity. We have the further difficulty of separating realization from expectation. We cannot infer from the fact that a person is employed that his subjective estimate of u is equal to one; his estimate is rather more likely to be based upon his experience over a longer term and his observation of the experience of others.

In dealing with this problem of measurement, we are aided by the assumption that the leisure margin is fixed. This leaves a fixed amount of time to be divided between I and L. We may then estimate either side of the choice problem; the other will be the residual. We will begin our empirical work by estimating legal employment as a function of the returns and risks of legal and illegal activity, and a set of personal characteristics. We choose this approach for the following reasons:

1) We measure employment more directly than we can measure crime. On the employment side, we have a direct measure of "success." On the illegal side, criminal activity produces offenses at some unknown rate θ, and of these offenses we observe only the "failures." If published arrest rates are any guide, failure is a low probability event.

2) Both θ and a are likely to vary widely across individuals, through time, and by type of offense. We are better equipped with theory to explain variations in u than to predict shifts in θ and a.

3) The employment decision of offenders is a matter of intrinsic interest.

Section 3 - Description of the Data

The ideal data set on which to test our model would contain detailed information on the time budget of each individual in a large random sample of the population. Some of these individuals would, of course, have engaged in criminal activity during the period of observation. Unfortunately, no such information is available, nor it is likely to be. Our only source of data on crime is the criminal justice system, and our knowledge of any individual's experience with crime is proportional to his contact with that system. We must, therefore, utilize a data set composed of individuals who are known to be criminals. In fact, any data set drawn from criminal records may be a biased sample even among the group of offenders in the population, since offenders with high failure rates are more likely to be included.

The use of data on criminals can be justified in two ways. First, a large proportion of offenses is committed by a relatively small portion of the population. The behavior of this group is, therefore, of special interest. Second, the members of our group are more likely to be sensitive to changes in relative returns than might other individuals with a strong aversion to criminal activity.

Our information was collected for a sample of 92 individuals drawn at random from the files of the California Department of Corrections and the California Bureau of Criminal Statistics. These agencies provided data on each individual's record of arrests and

incarcerations over a period from the second quarter of 1953 to the third quarter of 1975. Information concerning personal characteristics, employment, income, and assets was pieced together from prison, parole, and probation reports. Since every member of our sample has been arrested at least once for a felony in Los Angeles County, we were able to supplement our information from state agencies with reports prepared by the Los Angeles Parole Department. Although a great many pieces of information were assembled, errors, omissions, and conflicts were common in the data, particularly with respect to economic variables such as employment status and wage rate. Only by a careful comparison of our state data with information supplied by the Social Security Administration were we able to construct a series which provides an indicator of employment by quarter. It was not possible to obtain a series on wage rates by individual. For a full description of our data collection procedure, see Moore [1978].

The choice of an appropriate period as a unit of observation is one which frequently arises in economic research. We have chosen, in our case, to examine the data by quarter, for these reasons:

1) While it may appear that one quarter in an individual's employment record is not an independent trial, the assumption of independence may not be so unrealistic for the members in our sample, who change or lose employment more frequently than most workers.

2) Taking account of the effects of previous quarters would require the stringing together of a consistent story across several consecutive quarters of each individual's career. We fear that such a procedure would tax the strength of the underlying data, preferring the atomistic, quarterly approach as a means of isolating any errors and minimizing their effect.

3) Our employment variable tells us only whether an individual has earned some positive amount in employment covered by Social Security during the quarter. Even one day's work would fulfill this requirement. We have no measure at all of casual or other employment not covered by Social Security. This hardly gives us blanket coverage of the individual's activity as it is; a longer period would only make the problem worse.

We wish to include in the data set only those quarters during which the individual may properly be said to be at risk. We have taken pains, therefore, to remove quarters during which an offender was incarcerated. Quarters during which the individual is less than eighteen years or age are also excluded. Several individuals were dropped from the data set because of irregularities or deficiencies in their records. This leaves us with 69 individuals and a total of 3227 quarters.

The variables we have constructed are explained in Table 1, and some characteristics of the variables are shown in Table 2.

TABLE 1

These variables have been used in the estimation:

EMPLOYED	EMPLOYED takes on the value 1 if the individual earned a positive amount during the quarter by working in a job covered by Social Security. If he earned nothing, EMPLOYED = 0.
ARRESTP	ARRESTP is our indicator of the illegal activity engaged in by the individual. It is based upon entries in the individual's police record. ARRESTP = 2 if the individual was arrested for a property crime during the quarter. If he was not arrested, ARRESTP = 1. Misdemeanors are not counted.[4]
PREP	The number of quarters, previous to the current one, for which ARRESTP = 2.
URNWK	The average earnings per week, in 1967 dollars, for production workers in manufacturing industries in Los Angeles County. These figures are computed annually. They have been deflated using the CPI for Los Angeles.
UNEMP	The annual unemployment rate for Los Angeles County. These figures are computed according to the old method, used until 1972, which was based upon place of employment, rather than residence. The figures for 1973-75, which were computed according to the new method, have been adjusted to make them compatible with the older series.
ARATE	The number of arrests for Part One crimes in each year, as reported by the Los Angeles Police Department, divided by the number of Part One Crimes. Homicide, rape, robbery, aggravated assault, burglary, larceny, and auto theft are Part One crimes.
RETURN	The average dollar amount reported stolen each year in Part One property crimes (robbery, burglary, and larceny). Auto theft is not included. Converted to 1967 dollars using the CPI for Los Angeles.

MILDIS	MILDIS takes the value 1 if the individual had a less than honorable discharge from the military. If the individual received an honorable discharge, if the type of discharge was unknown, or if he had never been in the military, MILDIS = 0.
IQ	The tested IQ of each individual. IQ figures were not available for some individuals. The average value of 98 was used in those cases.
GRADE	Highest grade in school recorded for each individual.
RACE	RACE = 1 if the individual is white, and RACE = 2 if he is not.
AGE	The individual's age in years. AGE is incremented each year in the quarter after the one in which his birthday falls.
YEAR	The calendar year (1953 to 1975).
PRISON	The number of persons entering state prison with sentences for robbery, burglary, or grand theft, by year, divided by the number of complaints filed for those crimes by police in California.

TABLE 2

Description of the Data

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
RACE	3227	1.54942671	0.49762811	5000.00000000	1.00000000	2.00000000
GRADE	3227	9.94824915	1.99272994	32103.00000000	3.00000000	13.00000000
MILDIS	3227	0.19956616	0.39973619	644.00000000	0	1.00000000
IQ	3227	98.51162070	10.16250957	317897.00000000	68.00000000	124.00000000
YEAR	3227	66.02014255	5.76986019	213047.00000000	53.00000000	75.00000000
AGE	3227	29.36070654	9.63571024	94747.00000000	18.00000000	62.00000000
EMPLOYED	3227	0.47350480	0.49937489	1528.00000000	0	1.00000000
ARRESTP	3227	0.09792377	0.29725761	316.00000000	0	1.00000000
URNNK	3227	125.20968392	7.84912701	404051.64999998	100.16000000	134.11000000
ARATE	3227	0.15910133	0.03121131	513.42000000	0.13000000	0.25000000
UNEMP	3227	5.24212271	1.06933567	16916.33000000	2.90000000	7.17000000
PREP	3227	2.49364735	2.77155755	8047.00000000	0	14.00000000
RETURN	3227	230.33244500	38.66282863	743282.79999998	153.36000000	284.38000000
PRISON	3227	0.09771819	0.04554877	315.33660000	0.04590000	0.17940000

Section 4 - Estimation

In this section we will present Logit estimates of our model, using the variables described in Table 1.

In Table 3, observed employment is explained as a function of the returns (URNWK and RETURN) and risks (UNEMP and ARATE) to legal and illegal activity, and a set of variables to describe both the individual's value in the labor market and his tastes. The results confirm, in general, our prior expectations. An increase in average

TABLE 3

Logit Run to Explain Employment

-2*LN(L) = 4313.47 NORM OF GRADIENT = 2.202D-07

STATE: EMPLOYED

		ESTIMATED COEF	EST. STD. ERR.	EST. T-VALU
(1)	(1) RACE	0.14130	0.07952	1.77686
(2)	(2) GRADE	-0.00726	0.01934	-0.37552
(3)	(3) MILDIS	-0.41150	0.09264	-4.44191
(4)	(4) IQ	-0.00273	0.00389	-0.70055
(5)	(5) AGE	-0.00450	0.00461	-0.97783
(6)	(6) URNWK	0.03514	0.00940	3.73760
(7)	(7) ARATE	-2.55929	2.52318	-1.01431
(8)	(8) UNEMP	-0.12457	0.03541	-3.51814
(9)	(9) PREP	-0.10770	0.01687	-6.38383
(10)	(10) RETURN	-0.00695	0.00187	-3.71380
(11)	(11) CONSTANT_1	-1.25199	1.49522	-0.83733

legal earnings, URNWK, has a positive and significant effect on the probability that an individual will be employed. The effect of RETURN is significant and negative, as one would expect.

The regional unemployment rate, UNEMP, can be expected to operate on observed employment in two ways, both negative. High unemployment will discourage individuals from allocating time to legal pursuits; for any given allocation of time, it reduces the probability that an individual will find employment. UNEMP is, in fact, negative and significant in the regression.

The one variable which does not perform as expected is ARATE, the arrest rate in Los Angeles, which is not significant. A possible explanation for this result may be found in the policies of the Los Angeles Police Department. During some of the years in our sample, police in Los Angeles made a practice of arresting large numbers of suspects on suspicion. To the extent that these arrests were carried out at random, it is not clear that the deterrent effect was diminished in those years when this practice was discontinued.

Turning to our measures of personal characteristics, we find that the two measures, MILDIS and PREP, which we might have signed a priori are both significant. Individuals with less than honorable discharges, or with long arrest records, are likely to have a stronger preference for illegal activity, given any set of relative returns. Employers are also reluctant to hire people with these characteristics.

It might seem surprising that measures of intelligence and education (IQ and GRADE), which are usually important variables

in explaining the demand for an individual's labor, are not significant here. However, since we are estimating a choice between legal and illegal activity, it is not clear what effect IQ and GRADE should have. A high IQ, for example, may confer the same advantage to an individual in either activity.

If our model is correct, and individuals do allocate a fixed amount of time between L and I, then our estimation in Table 3 of the employment decision is also, in mirror image, an estimation of the decision to engage in illegal activity. The fact that the probability of employment is sensitive to illegal returns is evidence of this. As a check on the validity of the model, we ought to be able to use the probability of employment estimated in Table 3 to explain arrests. If our variables were perfect measures, and if the offense function, θ, and the arrest rate, a, were stable, this would be a purely mechanical relationship. In fact, of course, none of these conditions hold.

To perform this check, we have first estimated the employment regression again, using only significant variables. This run is shown in Table 4. The imputed value for employment generated by this equation is the variable EMP.IMP in Table 5, where ARRESTP is the dependent variable. Our estimated employment probability is significant, with the expected negative effect. The other variables in Table 5, some personal characteristics and a time trend, were included in an attempt to control for shifts in θ and a.

TABLE 4

Logit Run to Explain Employment

(Insignificant variables have been dropped.)

-2*LN(L) = 4315.78 NORM OF GRADIENT = 1.374D-07

STATE: EMPLOYED

		ESTIMATED COEF	EST. STD. ERR.	EST. T-VALUE
(1)	(1) RACE	0.17841	0.07278	2.45138
(2)	(2) MILDIS	-0.40447	0.09197	-4.39795
(3)	(3) URNWK	0.04026	0.00791	5.09125
(4)	(4) UNEMP	-0.13012	0.03502	-3.71568
(5)	(5) PREP	-0.11466	0.01504	-7.62508
(6)	(6) RETURN	-0.00613	0.00166	-3.69949
(7)	(7) CONSTANT_1	-2.97469	0.74279	-4.00476

TABLE 5

Logit Run to Explain Arrests

-2*LN(L) = 2050.20 NORM OF GRADIENT = 2.348D-07

STATE: ARRESTP

		ESTIMATED COEF	EST. STD. ERR.	EST. T-VALUE
(1)	(1) RACE	0.28159	0.13186	2.13557
(2)	(2) GRADE	0.03114	0.03380	0.92126
(3)	(3) IQ	0.01315	0.00656	2.00291
(4)	(4) YEAR	-0.00136	0.01110	-0.12289
(5)	(5) AGE	-0.01577	0.00782	-2.01514
(6)	(6) EMP.IMP	-1.51671	0.65288	-2.32309
(7)	(7) CONSTANT_1	-3.01800	1.14539	-2.63491

These results, then support our basic hypothesis that legal and illegal activity are two sides of the same allocative decision. We have shown, on the one hand, that a group of known criminals is sensitive to changes in legal opportunities, as measured by the rate of unemployment and the level of earnings. On the other hand, we have presented evidence that their illegal activity varies inversely with their choice of legal employment. Since the magnitudes of these effects cannot easily be judged from the Logit coefficients, we list in Table 6 the elasticities of EMPLOYED and ARRESTP with respect to some of the independent variables.

TABLE 6

Elasticities at the Mean

Dependent Variable:	EMPLOYED	ARRESTED
Independent Variables:		
URNWK	2.66	
UNEMP	-.36	
PREP	-.15	
RETURN	-.74	
GRADE		.28*
IQ		1.17
YEAR		-.98*
AGE		-.42
EMP.IMP		-.65

*Insignificant.

The reader will note that the variable PRISON, which was described in Section 3, has not appeared in the regressions. The reason for this is illustrated in Table 7, where PRISON and RETURN are both used. The result demonstrates a difficulty which confronts any investigation of the criminal justice system. Both RETURN and PRISON have strong time trends, one positive, the other negative.

TABLE 7

(The variable PRISON is included.)

-2*LN(L) = 4301.60 NORM OF GRADIENT = 2.570D-08

STATE: EMPLOYED

			ESTIMATED COEF	EST. STD. ERR.	EST. T-VALUE
(1)	(1)	RACE	0.19130	0.07303	2.61963
(2)	(2)	MILDIS	-0.39577	0.09221	-4.29193
(3)	(3)	URNWK	0.05532	0.00889	6.22465
(4)	(4)	UNEMP	-0.10411	0.03571	-2.91524
(5)	(5)	PREP	-0.10882	0.01514	-7.18627
(6)	(6)	RETURN	-0.00042	0.00225	-0.18632
(7)	(7)	PRISON	7.99255	2.12643	3.75867
(8)	(8)	CONSTANT_1	-7.12984	1.33422	-5.34383

The correlation coefficient between these two variables is -.903. This is not a relative shift of returns and costs in the marketplace (in fact, one would expect returns and penalties to move together to preserve equilibrium in the market); rather it is evidence that the market for criminal activity has grown steadily more lucrative during our sample period. Arrest rates have fallen; penalties have been reduced; returns have increased. Since each of these changes has taken place more or less monotonically over

time, a collinearity problem arises. We can say that crime now pays better than it did in 1953; it is difficult, however, to separate the effects of different variables, such as returns, failure rates, and penalties.

Another difficulty we have encountered is related more specifically to the nature of our data, and the way we have chosen to organize it. By dividing our series into quarters, we have produced a large number of observations from a relatively small (69) sample of individuals. Each individual's experiences, however, are related from one quarter to the next. This leads us to ask two closely related questions: are our residuals so correlated as to invalidate our results? and are the coefficients registered by our external variables such as URNWK and RETURN influenced by differences among individuals in our sample which have not been property captured by the personal characteristics in the regressions? These are two different ways of asking: Do we have 3227 observations, or 69? To answer this question we have, first of all, estimated the employment regression using a dummy for each of our 69 individuals. The external variables in the model were essentially unchanged. We also examined the residuals generated by our models. While it is true that our individuals change jobs often, it is also true that quarters of employment and unemployment do tend to appear in clumps. Since this correlation of the residuals is not

systematic over time, it is not clear what bias, if any, is introduced by it. Nonetheless, the development of some method, such as a distributed lag structure, should be a topic for future research.

NOTES

[1]We will consider in this paper only property crimes, i.e., those committed for the purpose of generating income. Some investigators have chosen to view all other crimes as a consumption activity (see, for example, Witte [1978]). Since we cannot offer any useful model to explain variations in this activity, we have chosen to ignore non-property crimes.

[2]In fact, of course, the penalty structure is more complex. Once arrested, the offender faces the conditional probabilities of prosecution, given arrest; of conviction, given prosecution; and of a variety of possible penalties, given his conviction. No richness would be added to the model by including these considerations. However, different segments of the penalty structure will be considered in the empirical estimation.

[3]When this modification is incorporated into the Block and Heineke model, the time allocation is determined by:

$$\max_{L,T} \int\int U[L,\ I,\ W^0 + (1 - u)\ell L + (i - aF)\theta(I)]f(u)p(a)du\ da$$

where W^0 is initial wealth, i is the return to illegal activity, a is the arrest rate, u is the unemployment rate, p(a) and f(u)

are the individual's subjective probability densities for a and u, and θ is the number of offenses committed in time I. See Sjoquist [1976] for a discussion of a model of labor supply under uncertainty where the uncertainty is caused by the possibility of unemployment.

[4]Police records classify crimes according to a three-digit BCS code. We have arbitrarily divided these codes into two types of felonies, property and non-property, and misdemeanors. Only the first category was used to construct ARRESTP. For a listing of this partition, see Moore [1978].