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The Effects of Unemployment on Property Crime: Evidence from a Period of Unusually Large Swings in the Business Cycle

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The Effects of Unemployment on Property Crime: Evidence from a Period of Unusually Large Swings in the Business Cycle

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Abstract

This paper uses a panel of Swedish counties over the years 1988-99 to study the effects of unemployment on property crime rates. The period under study is characterized by great turbulence in the labor market – the variation in the unemployment rates is unprecedented in the second half of the century. The data hence provides a unique opportunity to investigate unemployment effects. According to the theory of economics of crime, increased unemployment rates lead to higher property crime rates. A fixed effects model is estimated to investigate this hypothesis. The model includes time- and county-specific effects and a number of economic and socio-demographic variables in order to control for unobservables and covariates. In addition the model is estimated with linear and quadratic time trends to control for county-specific unobserved trends. The result gives strong evidence that unemployment has a positive and significant effect on burglary, car theft and bike theft.

JEL Codes: C230, J290, J390, J690

Keywords: Economics of Crime, Unemployment, Panel Data, Fixed Effects Estimation

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1 Introduction

During the deep recession of the early 1990's Sweden experienced the worst economic crisis since the 1930's. Unemployment rates rose dramatically and public spending on unemployment benefits soared. In addition to such direct expenses, high unemployment is costly as it keeps parts of the labor force out of production and, if persistent, is likely to decrease the skills and know-how of the labor force. According to the theory of economics of crime that has been developed during the last decades, unemployment has yet another cost: increased property crime.

Several studies have treated the effects of the massive rise in unemployment during the early 1990's – but none yet the impact on crime. This study investigates the effects of Swedish unemployment on crime using county panel data for 1988-99. Since the theory of economics of crime is first and foremost applicable on property crime the study focuses on these. The great variation in the unemployment rates characterizing the period under study is unprecedented in the late century. During the five first years of the period the unemployment rates more than quadrupled – from 2 percent in 1988 to 10.4 percent in 1993, from where it gradually declined to 6.4 percent in 1999. In comparison to other studies these substantial swings greatly facilitate the identification of the supposed effects of unemployment on crime.

An increasing amount of empirical research treating the connection between unemployment and crime has been performed in recent years. Several of these use panel data: see for example Raphael & Winter-Ebmer [2001]; Doyle, Ahmed & Horn [1999]; Levitt [1996]; and Gould, Weinberg & Mustard [2002] for American state- and county-level investigations; Entorf & Spengler [2000] for a German state level survey; and Papps & Winkelmann [1998], for a study on regional data from New Zeeland. The four American studies all find support for the hypothesis that worsened conditions on the labor market are associated with higher property crime rates.[1] The results presented by Papps & Winkelmann and by Entorf & Spengler are, however, significantly weaker. The former imply that the unemployment rates only affect some kinds of damage crimes (for example littering and trespassing), and the results presented by Entorf & Spengler on the Bundesländer of the former West Germany are weak and ambiguous (even *negative* estimates are reported for

[1] While Raphael & Winter-Ebmer; Gould, Weinberg & Mustard; and Levitt investigate the effect of the unemployment rate on crime, Doyle, Ahmed & Horn measure the effect of changes in the over-all labor market situation by constructing a measure that includes wage levels, unemployment rates and unemployment benefits.

some theft crimes). When the united Germany is investigated the connection between unemployment and property crime is however stronger and positive for all crimes.

Scorcu & Cellini [1998] use Italian time series data and find unemployment to be a significant explanatory variable for theft. Schuller [1986] also gains support for the positive relation between unemployment and crime using time series data on Sweden (for the years 1966-82), while a community-level cross sectional analysis on the average of the years of 1975 and 1976, yields insignificant results.

Studies on individuals often focus on youths, since younger individuals, especially young men, tend to be over-represented in criminal records. For example Witte and Tauchen [1994] use American panel data on young men, and find that individuals who are employed tend to commit fewer crimes than those who are unemployed.

The empirical evidence is thus ambiguous. The American studies mentioned above all support the positive relation between unemployment and crime, while studies on other countries in general obtain significantly weaker results. Further research, especially from countries other than the USA, is thus motivated. The insignificant results may be due to insufficient variation in the unemployment rates. In this light, the case of Swedish during the 1990's is especially interesting.

2 Theoretical Framework

2.1 The Individual's Choice between Work and Crime

The theory of the economics of crime, with the fundaments laid out by Becker [1968], considers crime as a type of work, i.e. as an activity that takes time and yields economic benefits. The theoretical model is thus foremost applicable on property crime, and when in the following "crime" is mentioned without any closer definition, it is in reference to property crime. This section describes a simple model for the supply of crime, which is based on models that have been presented by Ehrlich [1973] and Freeman [1999].

The model describes an individual's choice between work and crime as source of income during one period. Work and crime are regarded as alternative activities that cannot be

combined.[2] In the model, W denotes the individual's wage from honest work, W_b the returns from crime, A unemployment benefits and u the unemployment rate. u shall be interpreted as the probability that the individual is unemployed during the period. If the individual chooses crime, p denotes the probability that he/she gets caught and S the cost of punishment. It is assumed that all individuals are risk neutral and equal in moral considerations that might affect the willingness to commit crime.

The individual chooses crime if the expected returns from crime is higher than the expected returns from work, that is if equation (1) is fulfilled:

$$E(W_b) > E(W) \qquad (1)$$

Equation (1) thus implies that crime pays, in the sense that the individual chooses to commit crime only if the expected returns from crime exceeds that from honest work. An increase in the left-hand side increases the individual's propensity to commit crime, while a higher value in the right-hand side increases the probability that honest work is chosen. I assume that the representative individual, ceteris paribus, prefers to be honest, so that work is chosen in the case that $E(W_b) = E(W)$.

The left-hand side, the returns from crime, is a probability weighed average of the returns in case the individual is caught for a committed crime, p, and is not caught (1-p), respectively. If the individual chooses crime but is caught, the returns, W_b, is reduced by the cost of punishment, S. The expected returns from crime can thus be written as:

$$E(W_b) = (1-p)W_b + p(W_b - S) \qquad (2)$$

The expected returns from work is affected by the unemployment rate and the unemployment benefit. The unemployment rate affects the individual's possibilities of getting employed and hence also the expected wage, $E(W)$. If the individual is employed in the period, he/she obtains wage W, while if unemployed he/she obtains the unemployment benefit A:

$$E(W) = (1-u)W + uA \qquad (3)$$

[2] Dynamic models as well as models that allows for the combination of work and crime have been developed (see for example Lochner (1999) or Witte and Tauchen (1994)), but the simple static model that is presented here is sufficient for the argumentation that will be conducted in this paper.

The restriction in equation (1) for the individual to choose crime can now be written as:

$$(1-p)(W_b) + p(W_b - S) > (1-u)W + uA \qquad (4)$$

Equation (4) shows how different variables affect the relation between the expected returns from work and crime. It is assumed that the risk of being unemployed in the period is less than the risk of getting caught for a committed crime, that is $u<p$.[3] Furthermore, it is assumed that the average cost of punishment, S, is higher than the cost of being unemployed, W-A. If these assumptions are fulfilled, it is more risky to commit crime than to choose an honest living. The returns from crime, Wb, thus has to be higher than the returns from work, W, to compensate for the increased risk associated with criminal activity. For the individual to choose crime, equation (4) thus stipulates that the returns from crime, W_b, increases if the risk of getting caught, p, or the cost of punishment, S, rise. Correspondingly, the compensating difference in returns that is demanded for the individual to choose crime instead of work, W_b-W, decreases as the unemployment rate, u, or the cost of being unemployed, W-A, increase.

In sum, higher levels of W_b and u make it more favorable for the individual to commit crime, while higher levels of W, p and A raise the probability that the individual chooses honest work.

2.2 The Aggregate Supply of Crime

From the individual model above a function for the aggregate supply of crime can be derived. The fact that the model is estimated with aggregate data implies that the conclusions that could be drawn from the individual-based theoretical model need some modification.

In equation (4) the individual's choice between crime and work is affected by the wage, W, the returns from crime, W_h, the risk of getting caught, p, the unemployment rate, u, the cost of punishment, S, and the unemployment benefits, A. In equation (5) below the aggregate supply of crime, $\overline{B}$, is described as a function of the aggregate correspondences to these variables. The aggregate levels of the variables are denoted as $\overline{W}$, $\overline{W}_b$ and $\overline{A}$. Following Ehrlich (1973) an additional vector of variables, p, is included in order to capture the effect of other variables that affect the aggregate crime rates.

[3] This is a reasonable assumption – the total clear up rate, which can be seen as a measure of the risk of getting caught, during 1988-99 averaged 30% (The National Council for Crime Prevention), while open unemployment at most barely exceeded 8% (The National Labour Market Board).

$$\overline{B} = F(p, \overline{W}, \overline{W_b}, S, \overline{A}, u, p) \qquad (5)$$

From equation (5) hypotheses regarding the influence of economic variables on aggregate crime can be developed. The expected effects on crime of changes in the aggregate levels of the returns from crime, $\overline{W_b}$, the risk of getting caught, *p*, the cost of punishment, *S*, and the unemployment benefit, $\overline{A}$, respectively, do not differ from the individual model in section 2.1. Higher levels of $\overline{W_b}$ and lower levels of p and S increase the expected returns from crime, and can thus be assumed to contribute to higher crime rates. Correspondingly, higher levels of $\overline{A}$ make it more profitable to choose an honest living.

The derivation of expected effects of unemployment, u, and wage levels, $\overline{W}$, at the aggregate level is somewhat more complicated: An increase in the unemployment rate, *u*, can be expected to affect crime through two channels: First, the expected returns from choosing an honest living decrease when the chances to find a job decline. Second, high unemployment rates put a downward pressure on the wages for those who do find work. Both of these effects contribute to lower the expected returns to work, making crime relatively more profitable. Thus we can expect a positive effect of unemployment on crime rates also at the aggregate level.

When it comes to income, however, an increase in the aggregate income, $\overline{W}$, not only implies higher returns to work, but also increased opportunities to commit crime through a higher supply of goods that are especially liable to be stolen. The expected effect of a change in aggregate income thus depends on which of these effects is the dominating: increased returns from honest work through higher income, or increased returns from crime through a higher supply of crime.

The effect of p naturally depends on what factors are included in the vector. The variables to be included in p will be discussed in Section 4.

3 Method

In order to investigate the supposed connections between unemployment and crime a fixed effects-model is estimated. In accordance with the theoretical discussion above the following explanatory variables are included: unemployment, *u*, honest income, $\overline{W}$ (measured as deflated average income), and the risk of getting caught, p (measured as the overall clear

up rate, i.e. the proportion of crimes cleared by the police)[4].[5] The unemployment benefits, $\overline{A}$, are included in the measure of average income and the variable is thus not included separately in the model. The returns from crime, $\overline{W}_b$, and the cost of punishment, S, are excluded because of lack of data. It can however be assumed that the effects of these variables are, at least partly, incorporated by the average income.

As Freeman [1999] points out, an estimated positive relation between unemployment and crime need not necessarily imply that unemployment *causes* crime, but may merely reflect that both are affected by a third factor that has been omitted from the analysis. It is hence important to, in addition to the variables that are motivated by the theory of economics of crime, control for other factors that may affect this relation. By specifying a model that includes a relatively long list of control variables, dummy variables and time trends, we attempt to control for a variety of observable as well as unobservable covariates. Initially, a vector p_{kit} of socio-demographic variables is added to the model (see section 4 for the definitions of these variables), and region- and time-specific effects (a_i and t_t respectively) are estimated to control for unobserved, county-specific effects and national shocks that affect the crime rates in the counties similarly. The resulting model is stated in equation (6):

$$\ln B_{it} = a_i + b_1 \ln u_{it} + b_2 \ln \overline{W}_{it} + b_3 \ln p_{it} + \sum_{k=4}^{10} b_k \ln p_{kit} + t_t + e_{it} \qquad (6)$$

Models similar to that specified in equation (6) – i.e. fixed effects models including region- and/or time-specific effects – have generally been used in previous research (see Entorf & Spengler [2000]; Ahmed, Doyle & Horn [1999]; Papps & Winkelmann [1998]; and Gould, Weinberg & Mustard [2002]). Since we specify a log-log model, the coefficients are interpreted as elasticities.

Some of the variation in the crime rates may, however, be caused by trends in unobserved, county-specific factors. The availability of drugs and guns, as well as different policy decisions regarding for example crime-preventing measures, may constitute such

[4] The same measure, the overall clear up rate, is used for all crimes. This shall not be interpreted as a direct measure of the risk of getting caught for the specific crime in question, but rather as a general measure of the resources of the police- and justice system. (Since the clear up rate varies greatly between crimes, in order to use *p* as a direct measure of the risk of getting caught one would need to use the clear up rates for the specific crimes).

[5] See Appendix for a closer definition of data.

factors. Hence, in addition to the model specified in equation (6), we want to control for county-specific time trends. The model in equation (6) is thus also estimated with linear and quadratic county-specific time trends ($y_i time_t$ and $w_i time_t^2$ respectively). The resulting model is stated in equation (7):

$$\ln B_{it} = a_i + b_1 \ln u_{it} + b_2 \ln \overline{W}_{it} + b_3 \ln p_{it} + \sum_{k=4}^{10} b_k \ln p_{kit} + t_t + y_i time_t + w_i time_t^2 + e_{it} \quad (7)$$

The model in equation (7) accounts for a variety of possible sources of bias – stemming from observable as well as unobservable factors and trends. The risk that the estimates of the model suffer from an omitted variable bias is hence minimized.

The risk of an endogeneity bias stemming from a simultaneous causality between unemployment and crime however still needs to be considered. The possibility of simultaneous causal effects between unemployment and crime is discussed in many of the articles referred to above.

Raphael & Winter-Ebmer [2001] discuss the possibility that high or increasing crime in an area has a deterrent effect on the setting up of new industries or even scare existing companies away, something that naturally restrains employment in the region. It can also be assumed that individuals with a criminal record have fewer opportunities to find work, which may lead to lower employment in areas with many ex-criminals. Gould, Weinberg & Mustard [1998] furthermore discuss the hypothesis that companies in areas with high criminality are disadvantaged through having to pay higher wages in order to compensate their employees for the bad area.

Raphael & Winter-Ebmer's instrumental variable analysis (with instrumental variables for unemployment based on contracts for the defense industry and oil prices), however gains support for a causal direction from unemployment to crime. The instrumental variable estimations moreover yield higher coefficient values than the ordinary OLS regressions, something that implies that it could even be the case that the OLS regressions that are being used in this study underestimate the effect of unemployment on crime.

It can also be discussed how probable the possible effects of crime on unemployment discussed above are in this context. That companies avoid areas with a high criminality is a plausible assumption, but probably this is a problem at the community rather than at the

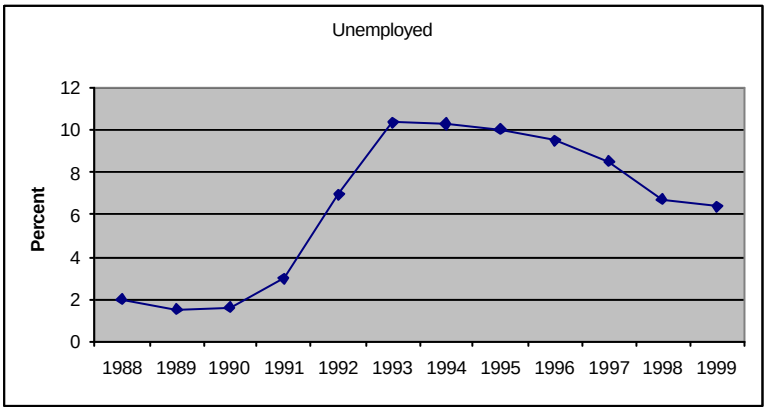
county level. Hence there are good reasons to believe that the results of this study will reflect a causal direction from unemployment to crime.

The reasoning on causality also applies to the clear up rates. Unlike unemployment, in this case we do expect to find effects in both directions – i.e. it is reasonable to believe that the crime rate has some influence on the proportion of crimes that are cleared. A straightforward attempt to isolate the effect of the clear up rate on the crime rate would be to replace the regressor with its lagged values. It is, however, possible that policy decisions that aim to increase the clear up rate are in general combined with crime preventive measures – i.e. that measures to decrease crime are focused both on preventive programs and on strengthening the police resources. If so, merely lagging the variable is not enough to isolate the effect of the clear up rate on crime, but the inclusion of crime preventive measures is also needed. In addition, the main purpose of this study is to investigate the effects of unemployment – not the clear up rate – on crime. Unless we have a significant correlation between clear up rates and unemployment, the possible simultaneity bias will not affect this. Since the individual is likely to base her/his decision on whether or not to commit crime on the *current* risk of getting caught, current instead of lagged clear-up rates are used here.

4 Data

The data consists of a panel of Swedish counties over the years 1988-99 – a period of great turbulence in the labor market. As can be seen in *Figure 1* below, from 1990 until 1993 the unemployment rate more than quadrupled. The large swings in the business cycle during the period provide a unique opportunity to study the effects of unemployment on crime, especially when using a fixed effects estimator, where the identifying variation comes from county-specific deviations in each time period from a county-specific time average.

Figure 1 Unemployment rates 1988-99



Since the crime rates for the most turbulent period – the first years of the 1990's – are only available at the county level[6], being able to cover this period in the analysis is a major advantage of choosing county-level, instead of community-level, data. If we were instead to use community level data we would miss the great increase in unemployment that takes place during the first half of the decade.

The use of county level data, compared to data at the community level, has more advantages. One is that county level data minimizes the risk that the estimates are biased because of "the mobility of criminals" – i.e. that criminals may commit crimes in areas other than their residence district. This is not an unlikely phenomenon at the community level - especially in larger cities such as Stockholm where it is easy to move between communities and where the supply of crime may differ substantially between districts. The problem may to some extent also exist at the county level, but surely to a far smaller degree. In addition, as discussed in the previous section, county level data is less likely to be influenced by simultaneity bias stemming from the influence of the crime rates on the unemployment of an area. Finally, Swedish clear up rates are only available at the county level, and theory implies that this is an important variable to include in the analysis. Hence, unless other measures to capture the probability of getting caught are included, a community level analysis might suffer from an omitted variable bias.

Data on crime rates is collected from The National Council for Crime Prevention and "crime" is defined as number of reported crimes per 100 000 persons.[7] Property crime consists of burglary, robbery, car theft, bike theft, theft/pilfering from motor vehicle and shop respectively, and fraud.[8] The distribution of these in 1999 is shown in *Figure 1*. Property crime (as defined in this study) in 1999 constituted around 47 per cent of total crime, while

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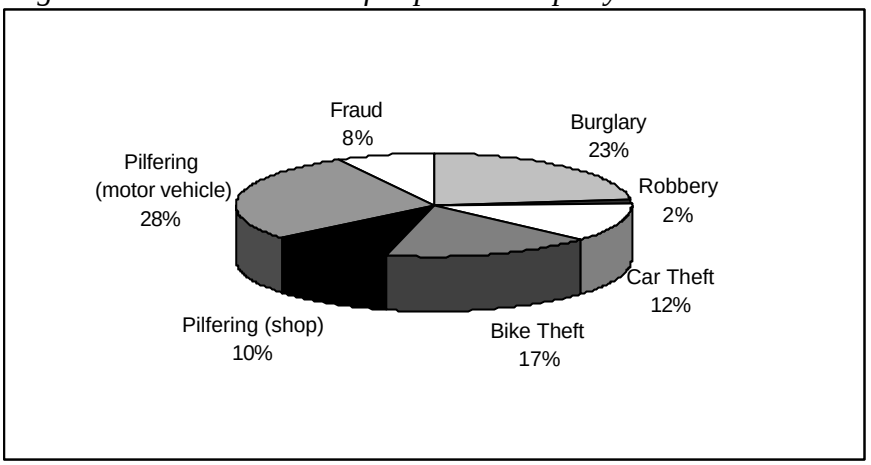
[6] The official community level crime statistics runs from 1996.

[7] The use of number of reported crimes as a measure of the crime rate can be discussed since is does not reflect the number of crimes that are actually committed but only those that are reported. The propensity to report a crime can be assumed to differ between crimes. For example it should be high when a report is necessary for insurance purposes, for example car theft, while it is generally lower for violent crime. According to "The National Council for Crime Prevention" comparative studies on the number of reported crimes and the number of victims suggest that the number of reported crimes relatively well mirror the changes of the true crime rates. However, during the 1990's the frequency of report seems to have diminished for fraud but increased for assault, (for example child assault and school violence). (The National Council for Crime Prevention , 2001)

[8] In addition, damage may be counted as a property crime, but since this type of crime does not yield any direct economic proceeds, damage is left out of this study. Correspondingly, robbery is here part of the property crimes, even though it is a crime that may lead to violence, since the main reason behind a robbery can be assumed to be the economic benefits (otherwise the individual could just as well commit "purely violent" crimes, such as assault or damage).

violent crime accounted for 6 percent. The remaining 47 percent consists of for example damage, traffic offence and drug-related crime.[9]

Figure 2 The Distribution of Reported Property Crimes in 1999



In addition to the factors that are motivated by economic theory a number of control variables are generally included in models on crime and unemployment, in order to decrease the risk that social and demographic factors distort the results (see for example Entorf and Spengler; Raphael-Winter-Ebmer; Ahmed, Doyle and Horn; Gould, Weinberg and Mustard; and Schuller).

The following control variables are included in this study: the proportion of divorced; population density; the proportion of the population with higher education (defined as college or higher levels); the proportion of persons on social allowance; the proportion of foreign citizens; the proportion of young men (15-24 years old); and sales of alcohol at the National Liquor Monopoly (Systembolaget).

The choice of these variables is motivated either by previous research or on theoretical grounds. Martens [1992] suggests that the propensity to commit crime may be higher among those growing up with divorced parents, hence motivating the inclusion of divorced as a control variable. Population density is included in the model since among half of the total amount of the reported crimes occur in the three "city-counties" (the counties of Stockholm, Malmöhus and Västra Götaland), even though the population of these counties constitute only one third of the total population. (The National Council for Crime Prevention, 2001).

[9] For definitions of the explanatory variables and descriptive statistics, see Appendix.

Several of the socio-demographic variables are indirectly motivated by economic theory. Education is included since a higher education level in general increases the returns to work. Further, it can be assumed that individuals on social welfare and foreign citizens, ceteris paribus, face lower returns to work. Persons on social welfare are by definition low-income earners, and Fritzell (2001) shows that average income during the 90's was lower for persons born abroad than for those born in Sweden. Foreign citizens may in addition be disadvantaged by discrimination at the labor market or by the mere fact that an education from a foreign university may not be considered valid in Sweden.

The proportion of young men is included in many investigations on crime and unemployment. Young men are over represented in the criminal records, and in addition, young individuals, who lack work experience and have not yet received any higher education, face lower returns to work.

Consumption of alcohol has well known effects on the behavior and judgment, which may increase the propensity to commit crime. In addition, abuse of alcohol may inhibit the abilities to obtain and to keep a job and hence be connected with lower returns to work.[10]

Table 1 presents descriptive statistics and expected sign on all variables.

[10] Closer definitions as well as sources for the data can be found in the Appendix.

Table 1 Descriptive statistics and expected sign, number of observations=252[11]

Variable	Average	Standard deviation	Min	Max	Expected sign
Property Crime	5781	1647	2872	12093	
Violent Crime	564	163	276	1103	
Burglary	1425	376	764	2656	
Robbery	38	35	10	211	
Car Theft	515	275	173	1926	
Bike Theft	1340	460	409	2889	
Theft/Pilfering in Shop	604	176	265	1606	
Theft/Pilfering from Motor Vehicle	1210	521	423	3396	
Fraud	648	551	232	6842	
Unemployment	5693	2959	820	12810	+
Clear upRate	29996	5514	18000	47000	-
Average Income (SEK 1,000)	103.82	6.92	89.07	136.00	+/-
Education	18009	3921	11011	31828	-
Males 15-24	6564	477	5535	7649	+
Foreign Citizens	4232	1885	974	10050	+
Persons on Social Allowance	6656	1518	3077	10400	+
Divorced	7056	1134	4801	10280	+
Sales of Alcohol (liters)	4.1	0.8	2.4	6.7	+
Population Density (persons/km^2)	41.6	54.4	2.6	278.0	+

[11] The clear up rate has been cleared from an extreme value and the number of observations for this variable is thus 251.

5 Result

5.1 An Analysis of Aggregate Data

Initially the model specification of equation (6), i.e. with time- and county-specific effects but without county-specific trends, is estimated. The results are presented in *Table 2.* To facilitate later discussion I denote this "model specification (1)".

Table 2 Fixed Effects Regressions of Aggregate Property Crime[12]

Variable (in logarithms)	**LnProperty Crime No County –Specific Trend (1)**
Unemployment	0.1064**
	(0.0442)
Clear UpRate	-0.3872***
	(0.0596)
Average Income	-0.3864
	(0.7915)
Education	-0.2818
	(0.2079)
Males 15-24	0.1038
	(0.3254)
Foreign Citizens	0.1333
	(0.1163)
Social Allowance	0.1905*
	(0.1069)
Divorced	0.6936*
	(0.3977)
Alcohol	0.0905
	(0.1332)
Population Density	-1.3547***
	(0.5202)

Values in parenthesis denote standard error.
***significant at the 1% level, **significant at the 5% level,
*significant at the 10% level

[12] The model controls for region- and time specific effects. The hypothesis that all fixed effects are equal to zero is rejected, as well as the hypothesis that all time effects equal to zero.

As can be seen in *Table 2*, the effect of unemployment on property crime is in line with the theoretical argument – the coefficient is positive and significant at the five percent level. The clear up rate is negative and significant at the one percent level of confidence. Furthermore the model yields positive coefficients for divorced and persons on social allowance. The coefficient of population density is relatively strong and negative in sign. This is contrary to what was expected according to the discussion on the control variables in the previous section. The reason for our result may be that the regression does not measure the effect of population density per se (any constant characteristics are incorporated into the county-specific effects), but rather the effect of *changes* in the variable. It may be the case that a negative development of the population density of a county is related to other factors that affect the crime rates, or perhaps, that some crimes in fact benefit from less population density (for example burglary in remote areas, or bank robberies in counties where the distance between the police stations is great).

The coefficients in *Table 2* shall be interpreted as elasticities. The unemployment coefficient thus implies that an increase of 1 percent in the unemployment rate is expected to increase the property crime rate by 0.11 percent. In Sweden, during the period under study, on average 596,697 property crimes were reported annually. The result thus implies that an increment in unemployment of 1 percent, ceteris paribus, is related to around 660 more property crimes. As an example, we assume an increase in the unemployment rate from 4 to 5 percent, i.e. of 25 percent. The estimated elasticity of 0.11 per cent can, by this somewhat simplified example, be assumed to increase property crime with around 2.75 per cent, which equals 16,400 more property crimes. It shall be pointed out that an increase from 4 to 5 percent in the unemployment rate is by no means an unrealistic figure. As was seen in *Figure 1*, during the period under study the unemployment rates spanned from 1.5 percent to 10.4 percent.

Does the result above really mirror the relation between unemployment and crime, or is it merely the result of the development of some unobserved county-specific trend that has not been included in the model? To answer this question, equation (7), including county-specific time trends, is estimated. Table 3 presents the results of the model including only linear trends as well as with both linear and quadratic trends. These are denoted model specification (2) and (3) respectively.

Table 3 Fixed Effects Regressions of Aggregate Property Crime[13]

Variable (in logarithms)	LnProperty Crime Linear Trends (2)	LnProperty Crime Linear and Quadratic Trends (3)
Unemployment	0.0737	0.0630
	(0.0487)	(0.0494)
Clear UpRate	-0.3257***	-0.3120***
	(0.0630)	(0.0652)
Average Income	-0.9537	1.9519
	(0.8858)	(1.4634)
Education	-0.2179	-0.2125
	(0.2148)	(0.2953)
Males 15-24	-0.4241	0.2394
	(0.9601)	(1.3028)
Foreign Citizens	0.0107	-0.0421
	(0.1683)	(0.2250)
Social Allowance	-0.0645	0.2153
	(0.1449)	(0.1915)
Divorced	1.5620	0.4772
	(1.3322)	(1.5347)
Alcohol	0.1892	0.1827
	(0.2125)	(0.2418)
Population Density	3.3925	6.7368
	(2.2696)	(5.1728)

Values in parenthesis denote standard error.
***significant at the 1% level, **significant at the 5% level,
*significant at the 10% level

As can be seen in the table, the inclusion of county specific time trends does not alter the sign of the coefficient estimates of unemployment – they are still positive in model specifications (2) and (3). The size of the coefficients however decreases – from 0.11 in the

[13] The model controls for region- and time specific effects, as well as county-specific time trends. The hypothesis that all fixed and time effects are equal to zero is rejected, as well as the hypothesis that all time trends are equal to zero.

specification without county-specific trends to 0.07 in the model with linear trends and 0.06 in the model with both trends – and the relation is no longer significant. The p-value is 0.131 in the model with only linear trends and 0.205 when both linear and quadratic trends are included.

The clear up rate is negative at the one percent level of confidence for both model specifications. The coefficients for divorced and persons on social allowance turn insignificant. The coefficient of population density changes in sign and becomes highly insignificant when state-specific time trends are included. This supports the hypothesis that this variable is correlated with some unobserved county-specific trend variable, which effect is now incorporated by the county-specific time trend variables.

The analysis of aggregate data might however be problematic. The reason is that the effect of unemployment may differ between crimes. We hence risk that unemployment effects are "blurred" or even cancel out in aggregate data. In the next section, an analysis on disaggregate data will therefore be conducted.

5.2 An Analysis of Disaggregate Data

As described above, the category "property crime" is composed of several different crimes, namely burglary, robbery, theft/pilfering from shops and motor vehicles respectively, car and bike theft, and fraud. It is possible that the effect of unemployment differs between these crimes. For example the possibilities to commit fraud may be better for those who hold certain types of jobs, which implies that unemployment could be negatively correlated with this specific crime. It can also be the case that increased unemployment implies less people in movement and less money in circulation, which decreases the supply of crimes that demand a personal meeting (for example personal robbery, which constitute the majority of reported robberies). Hence it is motivated to conduct an analysis on the specific property crimes.

The estimated unemployment coefficient of the extended fixed effects-model, including all socio-demographic variables, for all property crimes is presented in *Table 4*.[14] The unemployment coefficient of the three model specifications for aggregate property crime is, for the sake of comparison, reproduced in the first row of table.

[14] The result including all explanatory variables (except dummy variables) is available in the Appendix.

Table 4 Fixed Effects Regressions of Specific Property Crimes: Unemployment Coefficients[15]

Crime (in logarithms)	No trends (1)	Linear Trends (2)	Linear and Quadratic Trends (3)
Aggregate Property Crime	0.1064**	0.0737	0.0630
	(0.0442)	(0.0487)	(0.0494)
Burglary	0.1465***	0.1227**	0.1249**
	(0.0498)	(0.0501)	(0.0485)
Car Theft	0.1593**	0.1532**	0.1744**
	(0.0793)	(0.0760)	(0.0770)
Bike Theft	0.0715*	0.0606	0.0575*
	(0.0387)	(0.0381)	(0.0342)
Pilfering Motor Vehicle	0.0783	-0.0052	-0.0148
	(0.0526)	(0.0541)	(0.0543)
Pilfering Shop	0.0686	-0.0933	-0.1120 ¤
	(0.0756)	(0.0856)	(0.0898)
Robbery	-0.0599	-0.0454	-0.0032
	(0.0933)	(0.1057)	(0.1054)
Fraud	0.2166	0.2226 ¤	0.1672 ¤
	(0.1563)	(0.1844)	(0.1902)

¤ The hypothesis that all time trends are equal to zero is not rejected (at the 10 % level)

The result in *Table 4* confirms the connection between unemployment and crime for burglary, car theft and bike theft respectively. The two former are significant (at the five percent level) in all model specifications, and the latter is significant at the ten percent level in specifications (1) and (3). The effect is strongest for car theft and burglary (around 0.16 per cent and 0.12 per cent respectively). The coefficient for car theft is even increasing when linear and quadratic trends are included. If we repeat the hypothetical example of the previous section regarding the effect of a one-percentage point change in unemployment, the estimates in *Table 4* imply that a change in the unemployment rate from 4 to 5 percent will yield approximately a 3-percentage increase in burglary a 4-percentage increase in car theft.

[15] The model controls for region- and time specific effects. The hypothesis that all fixed and time effects are equal to zero is rejected, as well as the hypothesis that all time trends are equal to zero (except for the cases where otherwise is stated).

The remaining crimes have insignificant unemployment coefficients and the sign of the estimates vary. One explanation for the insignificant and sometimes negative coefficients can be given by the argument regarding decreased opportunities above, i.e. that the positive effects of increased unemployment on the economic incentives for crime are eliminated by negative effects on the supply of property crimes that demand a personal meeting. Another plausible explanation may be that the insignificant result for example for robbery stems from a lack of variation in data, as the number of observations in some regions grows small when property crime is divided into separate groups.

The results in *Table 4* indicate that the effect of unemployment on property crime does vary across the different crimes. Hence we can conclude that it is not suitable to sum specific crimes into an aggregate measure when the aim is to explain crime.

6 Discussion and Concluding Remarks

The results of this study give strong evidence that unemployment has a positive effect on some property crimes. From the disaggregate analysis we obtain significant unemployment coefficients in all model specifications for burglary and car theft, and significant effects are obtained in model specifications (1) and (3) for bike theft. The risk of omitted variable bias is minimized through the inclusion of a wide range of control variables, dummies for fixed- and time-effects and county-specific trends. It is furthermore plausible that the estimated relation does mirror a causal effect from unemployment to crime, and not the other way around. The analysis hence strengthens the belief that unemployment is an explanatory factor for at least some property crimes. None of the other property crimes are significantly affected in any of the model specifications.

The results of this study regarding the connection between unemployment and aggregate property crime is, however, somewhat ambiguous. Model specification (1) (without county-specific time trend variables) yields positive and significant estimates for aggregate property crime, but the inclusion of county-specific time trend variables weakens the result and the relation between unemployment and crime is no longer significant. One could hence argue that the significant result in the model without state specific trends is affected by some omitted variable related to unemployment, which effect is incorporated by the inclusion of state-specific trends.

The inclusion of trend variables, however, remarkably reduces the number of degrees of freedom – twenty additional parameters are added to the model as model specification (2) is estimated, and forty as both linear and quadratic trends are included. Considering this, the fact that the p-values increase does not necessarily mean that we should dismiss the connection between unemployment and crime, but could be the result of the decreasing number of degrees to freedom. Further investigation with an augmented data set seem to be the correct way of establishing which of these cases is the more plausible.

In addition, as was indicated in the section above, a problem with aggregate data is that the effect of unemployment differs across crimes. Effects of unemployment on certain property crimes may hence "be blurred" or even cancel out in an aggregate specification. We conclude that unless the variation in the separate crimes is too small, disaggregate data is to be preferred.

It is interesting to compare these results to those of similar studies. In the study of separate property crimes in West German Bundesländer by Entorf & Spengler [2000], the estimated unemployment elasticities are in general around zero. Their analysis of united Germany however yields elasticities that are significantly higher, around one percent for robbery and theft.

The corresponding elasticities for burglary and car theft obtained in this study – the crimes that are significant in all model specifications – are around 0.12 and 0.16 respectively in all model specifications. For aggregate property crime, the corresponding estimate, obtained in model specification (1), is 0.11. One shall keep in mind though, that this estimate is not robust for the inclusion of county-specific time trends. The estimated elasistities of this study are hence within the interval of the estimations of Entorf & Spengler.

Several studies use log-linear models, which means that the coefficient value shall be interpreted as the percentage effect of a 1-percentage point change in the unemployment rate. In Raphael & Winter-Ebmer [2001] an increase of 1-percentage point in the unemployment rate is estimated to raise property crime by 1.6-5 percent, depending on the model specification. The highest values are obtained in models where instrumental variables have been used for unemployment. Gould, Weinberg & Mustard [1998] estimate the corresponding effect among males without higher education (non-college) to 2.2-2.8 percent. In Levitt's

investigation [1996], a 1 percentage point increase in unemployment is estimated to yield around 1 percent's higher property crime rates.[16] In conclusion the estimated effect on property crime in these studies lies between 1-5 percent, which is well in accordance with the results of this study; an increment of 3 percent in burglary and 4 percent in car theft as unemployment rates rise from 4 to 5 percent. The corresponding number for aggregate crime, based on the result of model specification (1), is 2.75 percent.

The clear up rate is highly significant in all aggregate property crime model specifications and its coefficient is larger than that of unemployment. This suggests that the clear up rate is an important explanatory variable for the crime rates. It is, however, likely that, in addition to the expected deterrent effect of the clear up rate on crime, there is also an effect the other way around – from crime to clear up rates. We cannot, from the results of this study, draw any conclusions on the relative sizes of these simultaneous effects.

It shall not be forgotten that the unemployment rate is not the only possible measure of the situation on the labor market. Doyle, Ahmed & Horn [1999] use a broader definition of the labor market situation when measuring its effect on crime, which in addition to unemployment rates also includes wage levels and unemployment benefits. It is possible that such a measure is more appropriate to use in economics of crime-related investigations. An interesting task for future studies could thus be to develop a method to measure the over all Swedish labor market situation and its effects on crime.

In summary, the results of the panel data analysis yields strong evidence that unemployment has a positive effect on certain specific property crimes. Highly significant coefficients are obtained for burglary and car theft in all model specifications, and bike theft is significant at the ten percent level in model specifications (1) and (3). Estimating the effect on total property crime however yields a more ambiguous result. Significance is obtained in the basic model specification with time and county-specific effects, but not as time trend variables are included. It shall however be noted that the inclusion of time trend variables greatly reduces the number of degrees to freedom.

The results of this study may have consequences for the view on the cost of unemployment. Increased unemployment does not solely lead to expenses that are directly

[16] Property crime is in the above three studies defined as burglary, theft/pilfering and motor vehicle theft.

related to unemployment, but has also indirect effects in the form of increased property crime. The effects on crime should therefore be included in decisions regarding labor market measures.

Appendix

Explanatory Variables and Descriptive Statistics

All explanatory variables in this study, except for the clear up rate, average income, sales of alcoholic beverages and population density, are indicated per 100,000 persons. Data on unemployment has been collected from The National Labour Market Board (www.ams.se) and measures the number of persons in "open unemployment". The clear up rate measures the number of cleared crimes per 100,000 reported crimes during a year and is collected from The National Council for Crime Prevention. Data on average income, higher education, males 15-24, divorced and population density is from the Statistics Sweden database "Sveriges statistiska databaser" (see www.scb.se). Average income is defined as average deflated income from work in SEK1,000 before tax.[17] (The measure includes income from work pensions, unemployment benefits and sick pay). Higher education is defined as the number of persons 16-74 with college or higher education and population density is measured as population per km^2. Data on social allowances is from The National Board of Health and Welfare and measures the number of persons benefiting from social allowances in the ages 20-64. Alcohol is defined as the sales at the National Liquor Monopoly (Systembolaget) in liters of 100-percent alcohol per person 15 years and older, and the data is from the sales statistics of the National Liquor Monopoly (data until 1998 is collected from The National Board of Health and Welfare's database "Hur mår Sverige", while data for 1999 has been gathered directly from the National Liquor Monopoly).

[17] Because of changes in the tax regulations that were put in force following the tax reform in 1991 the definition of average income differs before and after the reform. For the years 1988-90, apart from income from work, capital income is also included, while average income of the years after the reform only measures income from work. Data before 1991 furthermore measures the income for all persons 20 years and older, while data for the later years measures the income of all persons 16 years and older. To the extent that the effects of these changes are equal between the regions, they are incorporated by the time specific effects.

Regression result

Tables A.2-A.4 present the result model specifications 1-3 for the specific property crimes (estimates for dummy variables are excluded).

Table A.2 FE Specific Crimes, No Trends[18]

LnVariable	LnBurglary	LnCar Theft	LnBike Theft	LnPilfering Motor Vehicle	LnPilfering Shop	LnRobbery	LnFraud
LnUnemployment	0.1465***	0,1593**	0.0715*	0.0783	0.0686	-0.0599	0.2166
	(0.0498)	(0.0793)	(0.0387)	(0.0526)	(0.0756)	(0.0933)	(0.1563)
LnClear upRate	-0.117*	-0,2119**	-0.1933***	-0.1395**	0.0042	-0.3338***	-0.762***
	(0.0671)	(0.107)	(0.0522)	(0.0709)	(0.1019)	(0.1258)	(0.2107)
LnAverage Income	-0.6012	-1.0309	-0.1206	-0.8731	1.631	-1.7158	-3.0707
	(0.8909)	(1.4197)	(0.6924)	(0.9409)	(1.3521)	(1.6702)	(2.7968)
LnEducation	-0.4081*	0.2805	0.0377	0.1252	-0.5043	-0.3707	-0.8238
	(0.234)	(0.3729)	(0.1818)	(0.2471)	(0.3551)	(0.4387)	(0.7345)
LnMales 15-24	0.0816	0.751	0.5753**	-0.4888	0.9542*	0.2471	0.8179
	(0.3663)	(0.5837)	(0.2847)	(0.3868)	(0.5559)	(0.6867)	(1.1499)
LnForeign Citizens	0.154	-0.1582	-0.3897***	0.5711***	0.0362	0.4287*	0.4654
	(0.1309)	(0.2086)	(0.1017)	(0.1383)	(0.1987)	(0.2454)	(0.411)
LnSocial Allowance	0.0825	0.2546	0.2806***	0.3124**	-0.0311	0.2504	-0.2872
	(0.1204)	(0.1918)	(0.0936)	(0.1271)	(0.1827)	(0.2257)	(0.3779)
LnDivorced	1.5043***	1,6646**	-0.3095	1.6781***	0.0537	1.32	-1.7346
	(0.4477)	(0.7134)	(0.3479)	(0.4728)	(0.6794)	(0.8393)	(1.4054)
LnAlcohol	-0.0238	0.0703	-0.1931*	-0.1801	0.6495***	0.441	0.0791
	(0.15)	(0.239)	(0.1166)	(0.1584)	(0.2276)	(0.2812)	(0.4708)
LnPopulation Density	-2.3073***	-1,993**	-2.4905***	-2.7716***	0.8113	1.4805	-2.2284
	(0.5856)	(0.9932)	(0.4551)	(0.6184)	(0.8887)	(1.0979)	(1.8384)

Values in parenthesis denote standard error.
***significant at the 1% level, **significant at the 5% level,
*significant at the 10% level

[18] The model controls for region- and time specific effects. The hypothesis that all fixed and time effects are equal to zero is rejected.

Table A.3 FE Specific Crimes, Linear Trend[19]

LnVariable	LnBurglary	LnCar Theft	LnBike Theft	LnPilfering Motor Vehicle	LnPilfering Shop	LnRobbery	LnFraudϕ
LnUnemployment	0.1227**	0.1532**	0.0606	-0.0052	-0.0933	-0.0454	0.2226
	(0.0501)	(0.0760)	(0.0381)	(0.0541)	(0.0856)	(0.1057)	(0.1844)
LnClear upRate	0.0073	0.1090	-0.0958*	-0.1018	0.0250	-0.3029**	-1.0199***
	(0.0649)	(0.0985)	(0.0493)	(0.0701)	(0.1108)	(0.1369)	(0.2388)
LnAverage Income	-2.1594**	-3.2933**	-1.2327*	-2.1390**	-0.0986	-0.7486	0.3135
	(0.9127)	(1.3841)	(0.6930)	(0.9856)	(1.5577)	(1.9246)	(3.3571)
LnEducation	-0.5869***	0.1044	0.1389	0.0969	-0.3469	-0.3775	-0.6156
	(0.2214)	(0.3357)	(0.1681)	(0.2390)	(0.3778)	(0.4668)	(0.8142)
LnMales 15-24	-0.1884	-1.0327	0.0971	-2.2185**	0.5807	0.6504	2.9695
	(0.9893)	(1.5002)	(0.7512)	(1.0682)	(1.6884)	(2.0861)	(3.6387)
LnForeign Citizens	0.1011	0.0016	-0.2425*	0.1931	-0.2877	-0.1196	0.5032
	(0.1735)	(0.2630)	(0.1317)	(0.1873)	(0.2960)	(0.3658)	(0.6380)
LnSocial Allowance	-0.5076***	-0.3482	0.3304***	-0.0710	0.1619	-0.2440	-0.5792
	(0.1493)	(0.2264)	(0.1134)	(0.1612)	(0.2548)	(0.3149)	(0.5492)
LnDivorced	4.4278***	4.5702**	1.3134	5.3075***	-3.0899	1.7341	-8.1747
	(1.3727)	(2.0816)	(1.0423)	(1.4823)	(2.3428)	(2.8946)	(5.0490)
LnAlcohol	-0.0324	-0.0485	-0.2512	0.3445	0.6366*	-0.5333	0.6750
	(0.2190)	(0.3321)	(0.1663)	(0.2365)	(0.3738)	(0.4618)	(0.8056)
LnPopulation Density	3.2019	7.4387**	1.1699	3.9393	2.1910	2.1388	-11.1134
	(2.3386)	(3.5464)	(1.7757)	(2.5252)	(3.9912)	(4.9314)	(8.6017)

Values in parenthesis denote standard error.
***significant at the 1% level, **significant at the 5% level,
*significant at the 10% level
ϕ The hypothesis that all time trend variables are equal to zero is not rejected (at the 10 % level)

[19] The model controls for region- and time specific effects. The hypothesis that all fixed and time effects are equal to zero is rejected, as well as the hypothesis that all time trends are equal to zero (except for the cases where otherwise is stated).

Table A.4, FE Specific Crimes, Linear and Quadratic Trends[20]

LnVariable	LnBurglary	LnCar Theft	LnBike Theft	LnPilfering Motor Vehicle	LnPilfering Shopϕ	LnRobbery	LnFraudϕ
LnUnemployment	0.1249**	0.1744**	0.0575*	-0.0148	-0.1120	-0.0032	0.1672
	(0.0485)	(0.0770)	(0.0342)	(0.0543)	(0.0898)	(0.1054)	(0.1902)
LnClear upRate	0.0470	0.1774*	-0.0492	-0.0829	0.0384	-0.2577*	-1.0839***
	(0.0639)	(0.1015)	(0.0451)	(0.0715)	(0.1184)	(0.1390)	(0.2506)
LnAverage Income	-1.9816	-4.2340*	-0.2441	-0.5898	0.7946	5.4008*	9.3145
	(1.4351)	(2.2796)	(1.0126)	(1.6063)	(2.6579)	(3.1209)	(5.6283)
LnEducation	-0.5938**	-0.2590	-0.1238	0.2004	0.0353	0.3325	-0.0902
	(0.2896)	(0.4600)	(0.2043)	(0.3241)	(0.5363)	(0.6297)	(1.1357)
LnMales 15-24	-1.8203	-2.9451	-1.2701	-3.2527**	0.1298	5.7777**	8.7586*
	(1.2775)	(2.0293)	(0.9014)	(1.4299)	(2.3661)	(2.7782)	(5.0103)
LnForeign Citizens	-0.2119	-0.3845	-0.3809**	-0.0184	-0.4138	0.1664	0.9810
	(0.2206)	(0.3504)	(0.1557)	(0.2469)	(0.4086)	(0.4797)	(0.8652)
LnSocial Allowance	-0.3090	-0.4703	0.3281**	-0.0425	-0.0144	-0.3067	0.2691
	(0.1878)	(0.2983)	(0.1325)	(0.2102)	(0.3478)	(0.4084)	(0.7365)
LnDivorced	3.5201**	3.5978	1.3803	5.4115***	-1.6131	2.9914	-13.2153**
	(1.5050)	(2.3906)	(1.0619)	(1.6845)	(2.7873)	(3.2728)	(5.9023)
LnAlcohol	0.1589	0.0483	-0.0680	0.2912	0.7726*	-1.0452**	0.2666
	(0.2371)	(0.3767)	(0.1673)	(0.2654)	(0.4392)	(0.5156)	(0.9299)
LnPopulation Density	11.1078**	9.0484	8.9867**	11.6268**	18.2924*	15.0130	-15.8054
	(5.0727)	(8.0578)	(3.5792)	(5.6777)	(9.3949)	(11.0313)	(19.8943)

Values in parenthesis denote standard error.
***significant at the 1% level, **significant at the 5% level,
*significant at the 10% level
ϕ The hypothesis that all time trend variables are equal to zero is not rejected (at the 10 % level)

[20] The model controls for region- and time specific effects. The hypothesis that all fixed and time effects are equal to zero is rejected, as well as the hypothesis that all time trends are equal to zero (except for the cases where otherwise is stated).

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