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A NOTE ON FINNISH PROPERTY CRIMINALITY

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ABSTRACT

This note presents new evidence on Finnish property criminality. The analysis is based on Earlich's (1973) model; the empirical analysis makes use of annual Finnish data for the period 1951 - 1986. The estimation results strongly support the notion that both the apprehension rate and the severity of punishment have a strong deterrence effect on larcenies and robberies.

CONTENTS

1 INTRODUCTION

The standard framework applied in analyzing the economics of criminal behavior (introduced by Becker (1968)) implies the following type of supply of offences equation in the time domain (see e.g. Erlich (1973) for details):[1]

$$c_{it} = a_{i0} + a_{i1}p_{it} + a_{i2}s_{it} + a_{i3}w_t + \sum a_{ij}d_{jt}, \tag{1}$$

where c_i is the number of offences of type i, p_i is the (expected) probability of apprehension to the commitment of crime i, s is the (expected) sentence for crime i, w is household wealth and d is a vector of socio-economic indicators.

In the present study this model is estimated from Finnish annual data using some alternative dynamic model specifications based on equation (1). Thus, we use a simple stochastic difference equation (with the lagged dependent variable as an additional regressor) to account for possible habit persistence effects. Alternatively, we utilize the nowadays well-known co-integration technique. Equation (1) is then used as the point of departure in seaching for the co-integrating vector. The final dynamic specification follows the familiar error-correction specification. All these models are estimated separately for larcenies (l) and robberies (r). Both the OLS, SUR and Huber's (1981) robust M-estimator are used here.

Before turning to the estimation results, some comments on the data merit note. c (= l, r) is measured by the number of offences known to the police in a given year (excluding cases in which no offence was actually committed), p is measured as the ratio of persons captured and indicted to the total number of offences known to the police, s is measured by an average punishment rate which is expressed in terms of unconditional prison sentences,[2] and, finally, w is proxied by the average amount of leisure time. It, in turn, is measured by average annual working hours in manufacturing industry and is denoted by wt.[3] Graphs of most of the data are presented at the end of this paper.

2 ESTIMATION RESULTS

As mentioned above, the final estimating specification was derived either by introducing the lagged dependent variable into (1) or by applying the co-integration and error-correction representation. In the latter case, equation (1) was used as a point of departure in searching for the co-integrating vector. The set of socio-economic indicators included: Un = rate of unemployment, L = total population, L1 = population aged 15 - 24 and M = urban population. It turned out, however, that these variables performed rather poorly and so that they were not included in the final estimating specifications (the importance of these variables is tested later; see Table 2 below). The only exception in terms of additional variables is a dummy variable for 1955. The residual sensitivity analysis (including tests for outlier observations; see Krämer and Sonnberger (1986) and Sonnberger et al (1986) for details)) suggested that this observation is indeed an outlier. On the other hand, there are some reasons to believe that the basic data are somewhat deficient for this year. Thus, a dummy variable was introduced (this did not, however, affect the basic results in any way). As an alternative solution for this outlier problem we used Huber's (1981) M-estimator.[4]

We start by scrutinizing the results from the "habit persistence" models reported in Table 1 (see equations (2), (4), (6), (8), (10) and (12)). The dependent variable is either log(l) = larcenies or log(r) = robberies. In all cases the explanatory variables perform strikingly well: the coefficients are of expected sign and magnitude. Thus, an increase in the apprehension probability and in the severity of punishment clearly decrease the number of offences while an increase in leisure time increases them. As far as the "long-run" (semi-)elasticities are concerned we may notice that in the case of SUR estimation the following values can be obtained for larcenies and robberies, respectively: $e(p_l) = -.896$, $e(p_r) = -4.136$, $e(s_l) = -.096$ and $e(s_r) = -.045$. Thus, a one per cent increase in the apprehension probability (a one month increase in sentences) decreases larcenies by about one (ten) per cent.[5]

Before interpreting this result we take a look at the results from the co-integration analysis. First, we analyzed the time series properties of the key time series l, r, p_l, p_r, s_l, s_r and wt using the set of tests proposed, for instance, by Engle and Granger (1987). This analysis clearly showed that all of these series are of I(1) -type (to save space we refrain from reporting these test results here; they are, however, available upon request from the author). Next, we estimated a co-integration model, which turned out be a stochastic version of equation 1 except for the fact the socio-economic variables were not included. The relevant estimation results are also in presented in Table 1 (see equations (1) and (7)).[6] The relatively high values of the Durbin-Watson statistic (not to mention other co-integration test statistics) are clearly in accordance with the null of co-integration. Hence, the final estimating specification takes the error-correction form, that is:

$$(2) \qquad \Delta\log(c_{it}) = b_{0i} + b_{1i}\Delta p_{it} + b_{2i}\Delta s_{it} + b_{3i}\Delta\log(wt_t) + b_{4i}d55 + b_{5i}u_{it-1} + e_{it}, \qquad i = l, r$$

where u is the co-integrating vector obtained from the corresponding co-integrating model (to save space, the latter models for equations (5) and (11) are not presented here).

The estimation results from the error correction model are reported in Table 1 (cf. equations (3), (5), (8) and (10)). It is noticeable that there is no striking difference between these results and the results from the "habit persistence" model. Thus, the short-run and long-run elasticities are very similar. The only noticeable difference concerns the elasticity of robberies with respect to the severity of punishment. The long-run elasticity is much higher in the "habit persistence" model than in the error-correction model.[7]

The good performance of our basic specification is reinforced by the results from a set of diagnostic tests (cf. Sonnberger at al. (1986); a complete set of results is available upon request from the author) and by the results from testing for omitted variables (see Table 2). These latter results indicate that some standard additional explanatory variables have a very low explanatory power

TABLE 1

OLS and ROB Estimation Results for Larceny and Robbery

Eq.	1	2	3	4	5	6	7	8	9	10	11	12
Const.	13.942	8.336	.035	7.404	.032	8.156	13.310	5.056	.027	4.595	.025	5.060
	(43.94)	(5.38)	(2.06)	(3.58)	(2.08)	(4.70)	(53.38)	(2.97)	(1.24)	(2.42)	(0.97)	(3.21)
p	-.638	-.464	-.813	-.438	-.964	-.523	-3.301	-1.717	-1.574	-1.519	-1.910	-1.676
	(3.79)	(2.70)	(1.87)	(1.56)	(1.90)	(2.30)	(5.02)	(2.91)	(3.43)	(2.74)	(3.76)	(3.64)
s	-.094	-.058	-.032	-.051	-.031	-.056	-.014	-.017	-.017	-.017	-.010	-.018
	(5.38)	(3.20)	(1.64)	(2.52)	(1.32)	(3.34)	(2.33)	(3.23)	(2.00)	(2.89)	(1.27)	(3.73)
log(wt)	-3.467	-1.966	-1.919	-1.652	-1.996	-1.902	-7.056	-1.671	-5.356	-1.531	-4.726	-1.661
	(6.02)	(3.19)	(3.19)	(2.14)	(2.09)	(2.97)	(9.96)	(1.50)	(3.31)	(1.14)	(2.46)	(1.48)
log(c(-1))		.402		.487		.416		.598		.634		.594
		(3.69)		(3.44)		(3.37)		(4.88)		(4.65)		(5.26)
u(-1)			-.608		-.529				-.182		-.130	
			(3.92)		(3.46)				(1.23)		(1.25)	
d55	-.283	-.203	-.202			-.200	-.424	-.425	-.560			-.425
	(13.52)	(10.50)	(8.55)			(3.18)	(9.15)	(10.90)	(9.62)			(3.62)
R2	.991	.993	.350	.991	.285	.993	.977	.987	.612	.982	.343	.987
SEE	.068	.061	.065	.068	.068	.068	.160	.123	.108	.141	.139	.137
DW	1.636	1.749	1.823	1.467	1.675	1.767	0.951	1.737	1.860	1.845	2.118	1.771
LM1	.159	.185	.373	.065	.224	..	.001	.203	.351	.337	.314	..
Estimator	OLS	OLS	OLS	ROB	ROB	SUR	OLS	OLS	OLS	ROB	ROB	SUR
Dep.var	log(l)	log(l)	Δlog(l)	log(l)	Δlog(l)	log(l)	log(r)	log(r)	Δlog(r)	log(r)	Δlog(r)	log(r)

Heteroskedasticity-adjusted t-ratios are in parentheses. LM1 denotes the marginal significance level of Godfrey's LM test statistics for first-order autocorrelation (the presence of the lagged dependent variable is taken into account). ROB denotes Huber's robust M-estimator and SUR the FIML system estimator for l and r. The tuning constant in robust estimation is set at 1.345. t-ratios are not heteroskedasticity-adjusted in the case of ROB and SUR estimation.

or their effect on l or r is either incorrect or inconsistent. Therefore, the results presented in Table 1 can be considered final.

TABLE 2

T-test statistics for omitted variables

	Eq. (2)	Eq. (7)	Eq. (3)	Eq. (8)
Un	0.57	-1.87	0.77	-1.46
L	3.38	-0.26	0.46	0.60
L1	2.37	2.30	1.56	-0.05
M	1.97	0.27	1.56	2.54
C	2.29	0.40	-0.57	2.60
T	2.23	-1.11	-	-

Each variable is introduced separately into the basic specification (the equation number refers to Table 1) and the t-ratio of the respective cofficient is computed. Un is the rate of unemployment, L total population, L1 population aged 15 - 24, M urban population, C volume of consumption and T the time trend. In the case of equations 2 and 7, a log transformation is made with L, L1, M and C. Accordingly, log differences are used in equations 3 and 8 (however, absolute differences with Un).

3 CONCLUDING REMARKS

This paper has demonstrated that the increase in larcenies and robberies in Finland can be well explained by a Beckerian "economics of crime" model. Thus, the apprehension probability and the severity of sentences play a key role in determining the level of and changes in property crime. The socio-economic indicators seem to be of lesser importance, which, in turn, indicates public policy in terms of the resources devoted to public safety and the criminal justice system can be very effective. This does not, of course, mean that the growth of crime can be completely prevented by the actions of public authorities. The growth of wealth, or leisure, still has a nontrivial autonomous effect on crime.

FOOTNOTES

1 For an extensive survey of the relevant literature, see e.g. Heineke (1978). See also Koskela and Virén (1990) where this framework is extended by taking into account various sorts of taxes and income.

2 The average punishment rate indicator is obtained by weighting the alternative forms of sentences in the following way: unconditional prison: 1.00, conditional prison .33, unconditional penitentiary 1.33, conditional penitentiary .44, daily fines .25 (however, for 1951 - 1976, .17). A similar index for 1948 - 1975 has been constructed by Wahlroos (1981) but he made no difference between conditional and unconditional sentences. In addition, he converted daily fines to an equivalent amount of unconditional prison. The data are reported in Table 3. See also the corresponding figures 3 and 4.

3 Quite obviously, wt does not only reflect the wealth effect but may also correspond to the possible income tax rate effect on the allocation of time between legal and criminal activities. Unfortunately, it is difficult to derive an operational time series for household wealth for the period of investigation. In fact, we also used total consumption expenditure and GDP for alternative proxies of w but - as is pointed out in the next section - they performed rather poorly in this respect.

4 The potential endogeneity problems in terms of the right-hand-side variables were not considered in this study. Partly this is because we do not think that they are very important and partly because of some practical problems - for example, the relatively short sample period.

5 p_i and s_i were not (log) transformed because untransformed data produced somewhat better explanatory power. If, however, $\log(p_i)$ and $\log(s_i)$ were used instead of p_i and s_i, the coefficients of $\log(p_i)$ turned out to higher than those of $\log(s_i)$. This implies that certainty of punishment is indeed more effective than severity in lowering crime rates as suggested by Becker (1968).

6 Here we use a simple two-step procedure in deriving the co-integration vector(s). Although a great number of applications of the two-step estimator have been performed, some doubts can be raised about its (small sample) performance (cf. e.g. Banerjee et al. (1986)).

7 The explanatory power of the error-correction model is so much better that we might prefer that elasticity value.

REFERENCES

BANERJEE, A., DOLADO, J., HENDRY, D. and SMITH, G. (1986) Explaining Equilibrium Relationships in Econometrics through Static Models: Some Monte Carlo Evidence, Oxford Bulletin of Economics and Statistics 48 (3), 253 - 278.

BECKER, G.S. (1968) Crime and Punishment: An Economic Approach. Journal of Political Economy 76 (2), 169-217.

ENGLE, R. and GRANGER, C.W. (1987) Co-integration and Error Correction: Representation, Estimation, and Testing. Econometrica 55 (2), 251 - 276.

ERLICH, L. (1973) Participation in Illegimate Activities. A Theoretical and Empirical Investigation. Journal of Political Economy 81 (3), 521 - 565.

HEINEKE, J.M. (editor) (1978) Economic Models of Criminal Behavior. North-Holland, Amsterdam.

HUBER, P.J. (1981) Robust Statistics. John Wiley, New York.

KOSKELA, E. and VIRÉN, M. (1990) Taxes, Apprehension Rate and Severity of Punishment: Some Evidence from Auto Thefts in Finland, unpublished mimeo, Bank of Finland.

KRÄMER, W. and SONNBERGER, W. (1986) The Linear Regression Model under Test. Physica-Verlag, Heidelberg.

SONNBERGER, H. et al. (1986) IAS-SYSTEM User Reference Manual. Institute for Advanced Studies, Vienna.

WAHLROOS, B. (1981) On Finnish Property Criminality: An Empirical Analysis of the Postwar Era Using an Erlich Model. Scandinavian Journal of Economics 83 (4), 553 - 562.

TABLE 3

Time series data of the punishment rates

year	average punishment measured in terms of unconditional prison sentences, in months			average punishment measured in in terms of the share of unconditional prison sentences of all sentences, %		
	larcenies	robberies	total	larcenies	robberies	total
1951	10.238	33.427	10.674	0.617	0.818	0.621
1952	10.650	35.951	11.216	0.631	0.827	0.635
1953	10.090	35.014	10.543	0.612	0.864	0.617
1954	9.358	31.921	9.842	0.602	0.846	0.607
1955	8.794	23.496	9.099	0.601	0.788	0.605
1956	8.679	20.435	8.922	0.584	0.735	0.587
1957	9.233	22.354	9.575	0.587	0.780	0.592
1958	9.642	25.559	9.932	0.602	0.784	0.605
1959	8.376	26.978	8.794	0.586	1.000	0.595
1960	7.355	18.043	7.733	0.587	0.762	0.593
1961	7.020	19.551	7.444	0.589	0.768	0.595
1962	7.222	18.707	7.661	0.580	0.762	0.587
1963	5.492	15.344	5.859	0.595	0.772	0.602
1964	4.499	15.458	4.889	0.574	0.796	0.582
1965	5.272	14.214	5.547	0.561	0.751	0.567
1966	5.496	14.785	5.881	0.568	0.745	0.575
1967	5.602	12.670	5.938	0.572	0.702	0.578
1968	5.842	17.053	6.273	0.573	0.773	0.581
1969	5.028	13.383	5.458	0.529	0.732	0.539
1970	4.154	12.148	4.661	0.501	0.754	0.517
1971	3.805	10.208	4.152	0.504	0.754	0.517
1972	2.657	9.726	3.069	0.356	0.779	0.380
1973	2.571	12.143	3.161	0.360	0.793	0.387
1974	2.347	12.592	2.896	0.342	0.806	0.367
1975	2.484	10.377	2.926	0.350	0.784	0.374
1976	2.377	9.729	2.763	0.353	0.780	0.375
1977	1.912	12.027	2.390	0.267	0.738	0.289
1978	1.577	10.550	1.995	0.229	0.689	0.250
1979	1.436	9.219	1.793	0.212	0.664	0.232
1980	1.198	9.292	1.522	0.175	0.621	0.193
1981	1.159	9.898	1.500	0.170	0.641	0.188
1982	1.070	10.528	1.427	0.157	0.671	0.176
1983	0.973	9.693	1.257	0.154	0.642	0.170
1984	1.030	8.798	1.277	0.154	0.612	0.169
1985	0.861	10.096	1.116	0.136	0.686	0.151
1986	0.806	10.078	1.029	0.131	0.673	0.144

Figure 1

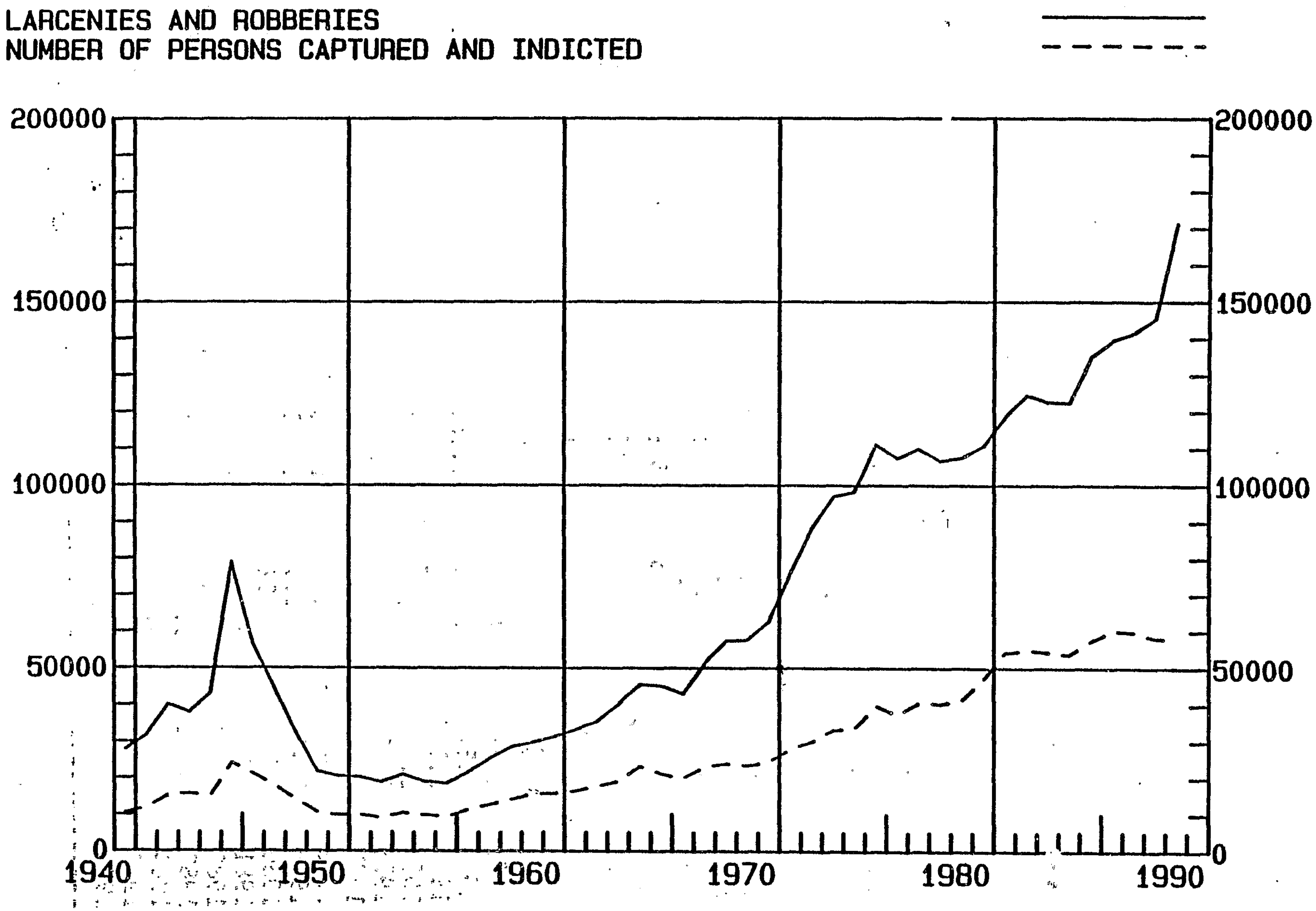

LARCENIES AND ROBBERIES
NUMBER OF PERSONS CAPTURED AND INDICTED
200000
150000
100000
50000
0
1940
1950
1960
1970
1980
1990

Figure 2

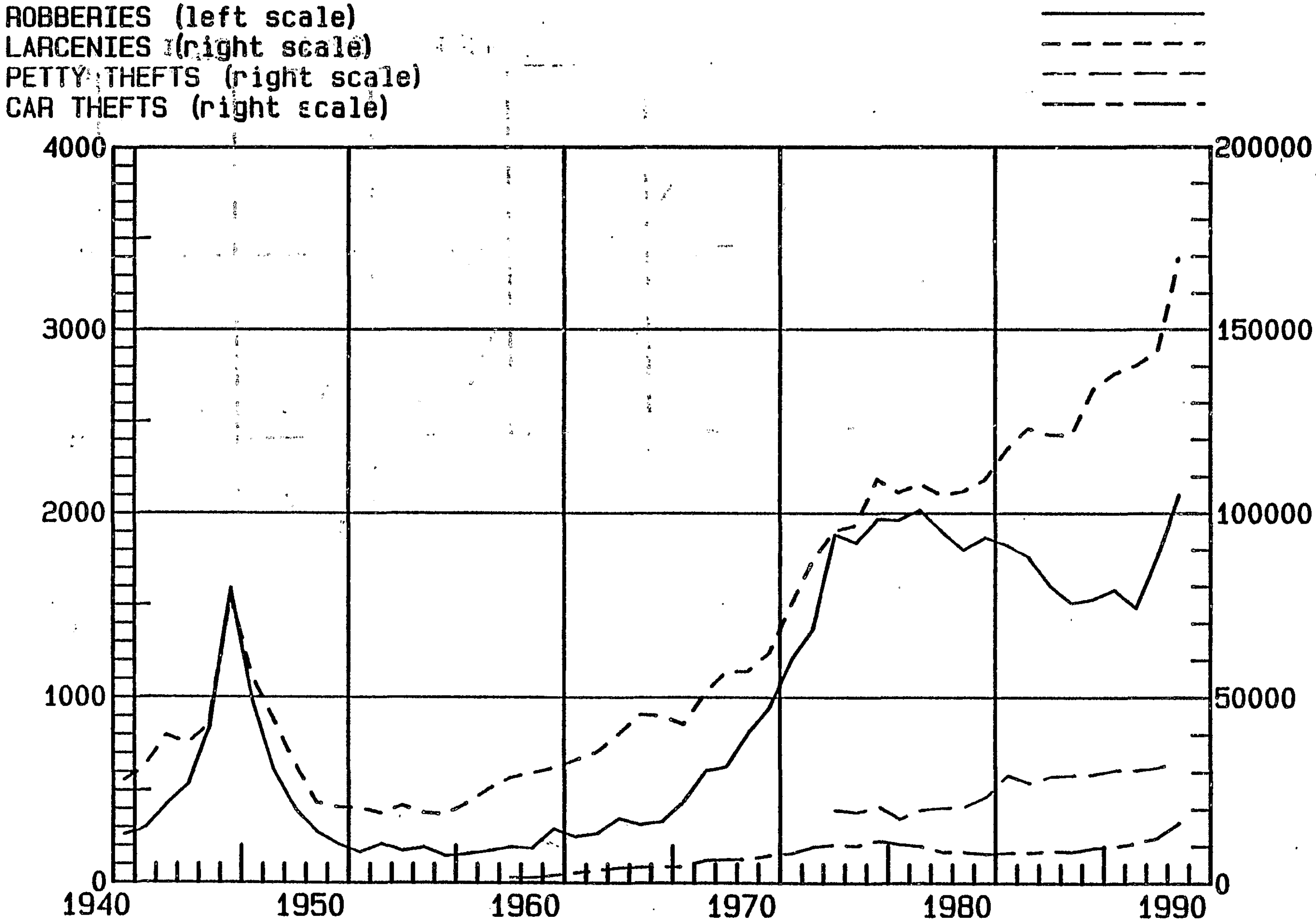
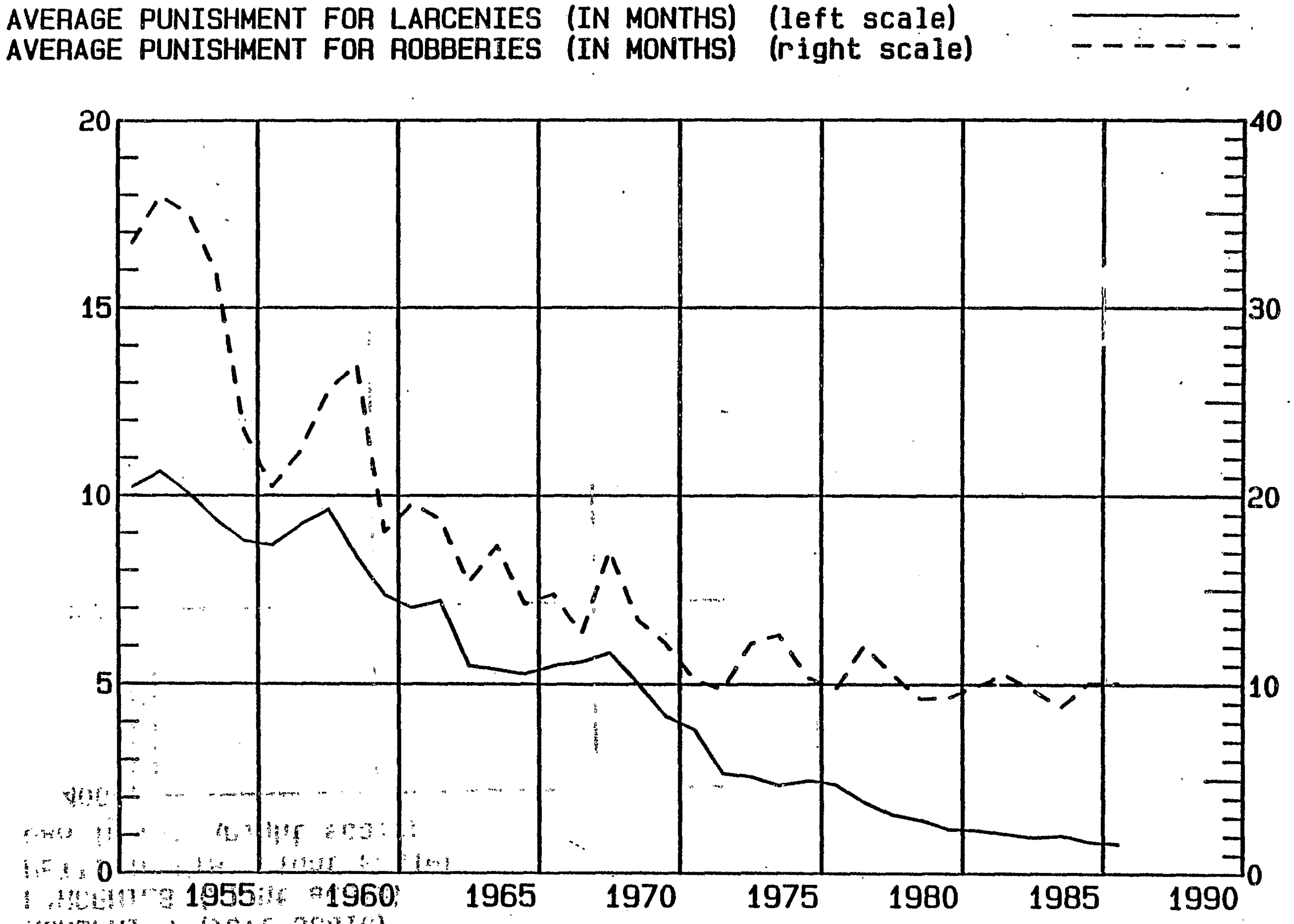

ROBBERIES (left scale)
LARCENIES (right scale)
PETTY THEFTS (right scale)
CAR THEFTS (right scale)
4000
3000
2000
1000
0
200000
150000
100000
50000
0
1940
1950
1960
1970
1980
1990

Figure 3



AVERAGE PUNISHMENT FOR LARCENIES (IN MONTHS) (left scale)
AVERAGE PUNISHMENT FOR ROBBERIES (IN MONTHS) (right scale)
20
15
10
5
0
40
30
20
10
0
1955
1960
1965
1970
1975
1980
1985
1990

Figure 4

SHARE OF UNCONDITIONAL PRISONS SENTENCES OF ALL SENTENCES, %

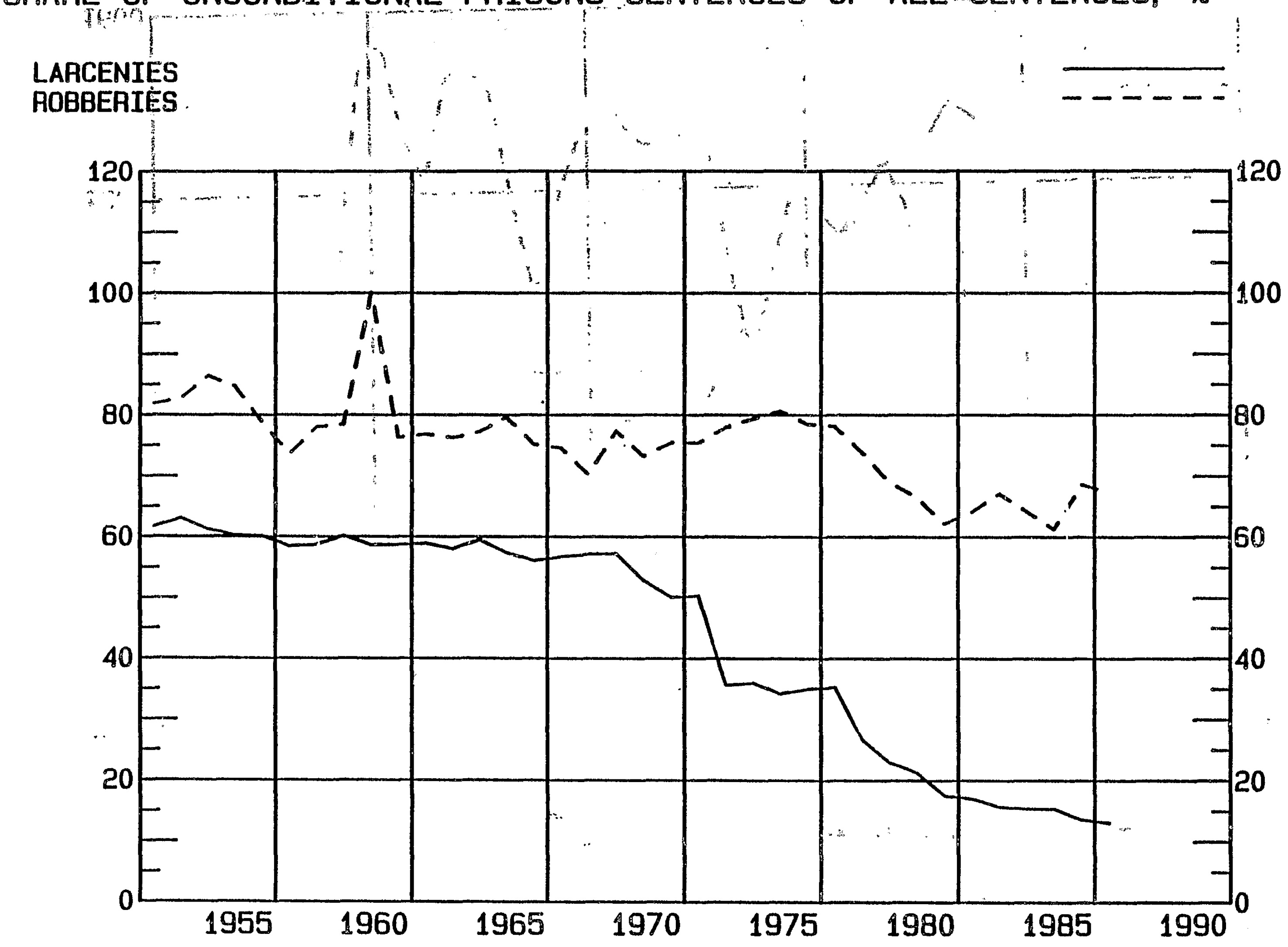


Figure 5

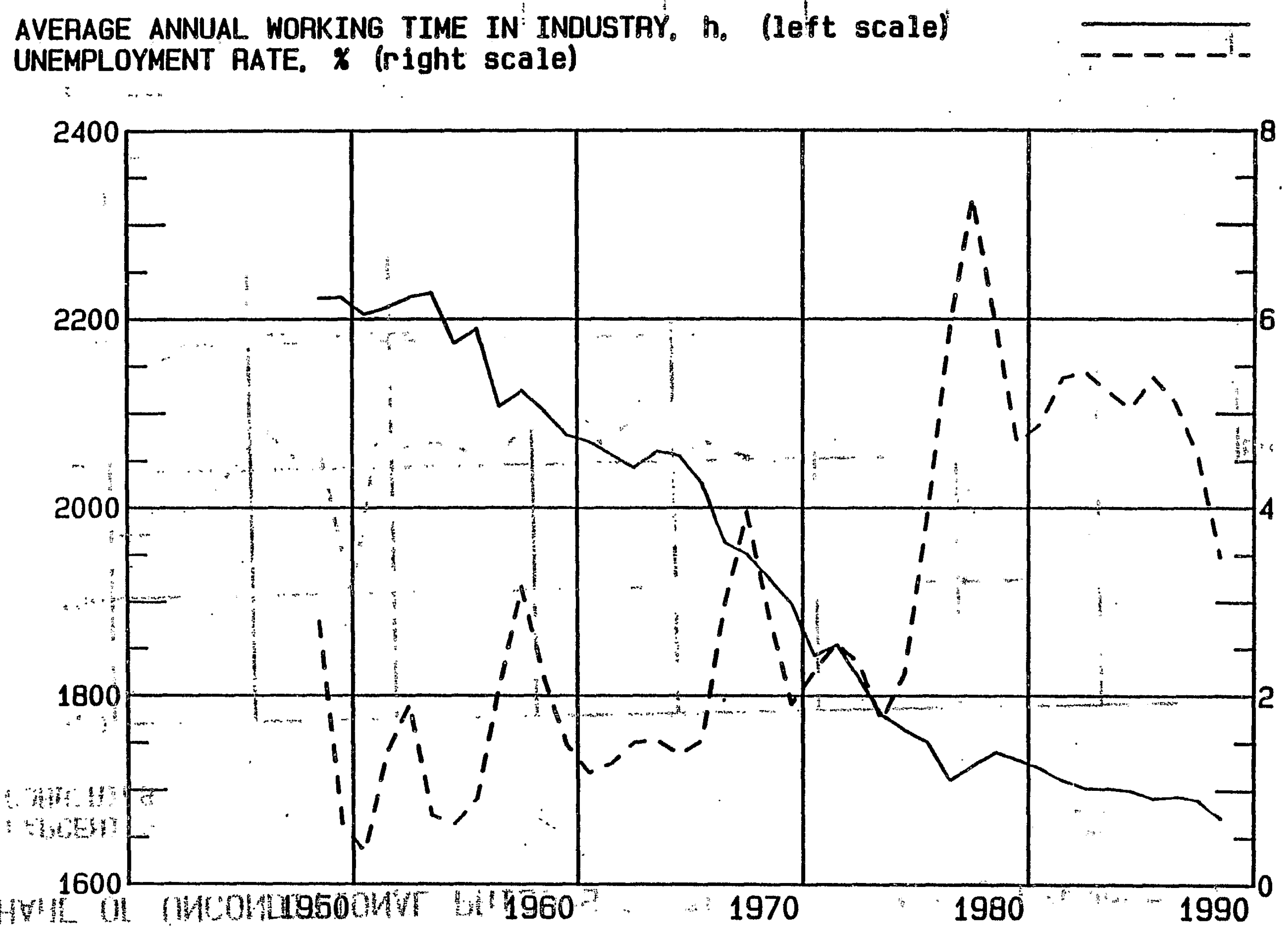
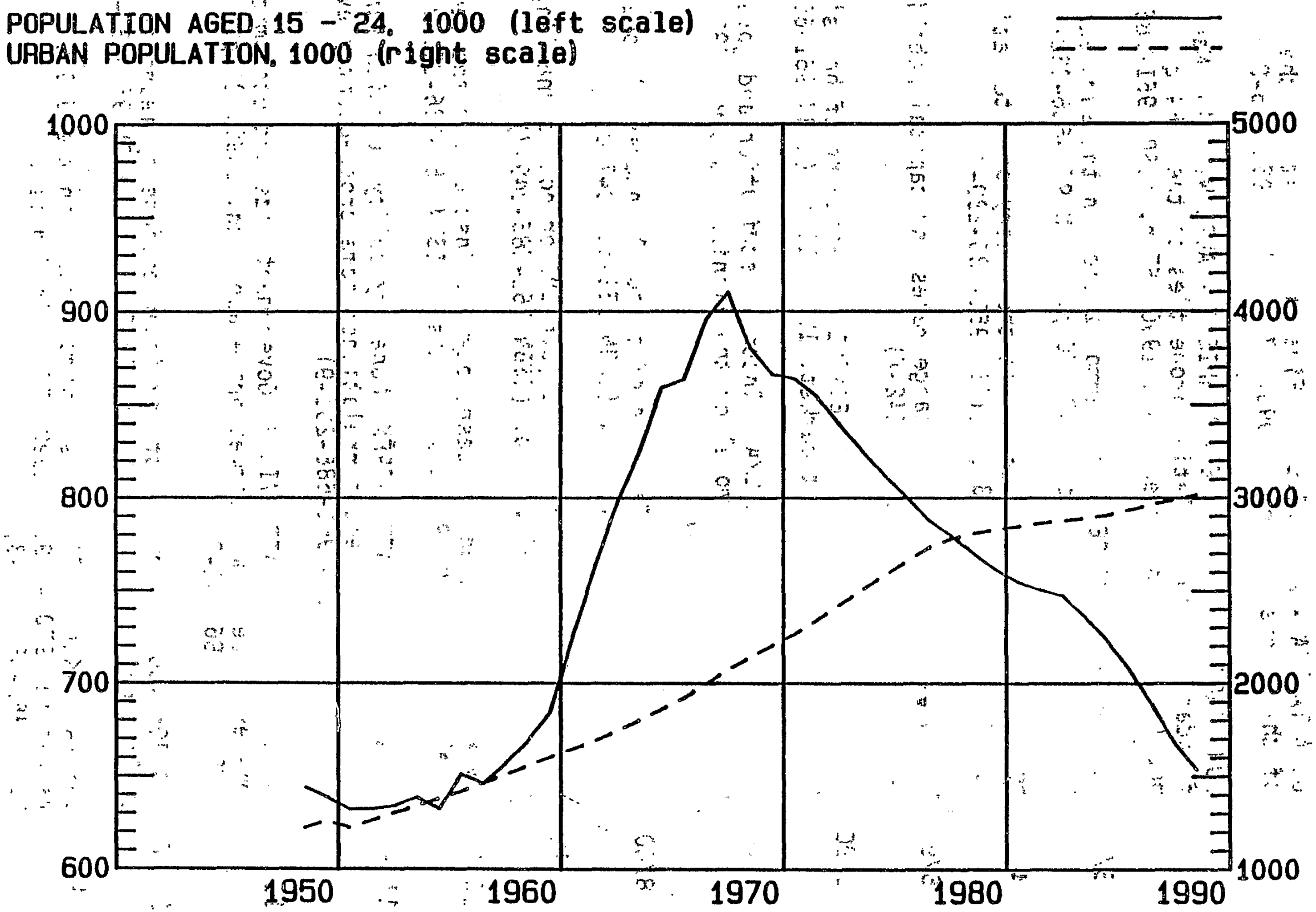

AVERAGE ANNUAL WORKING TIME IN INDUSTRY, h, (left scale)
UNEMPLOYMENT RATE, % (right scale)
2400
2200
2000
1800
1600
8
6
4
2
0
1950
1960
1970
1980
1990

Figure 6



POPULATION AGED 15 - 24, 1000 (left scale)
URBAN POPULATION, 1000 (right scale)
1000
900
800
700
600
5000
4000
3000
2000
1000
1950
1960
1970
1980
1990

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