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Impact Analysis of the Raised Legal Drinking Age in Illinois

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16. Abstract

This report contains an analysis of the impact of the raised legal drinking age in Illinois in 1980. Illinois raised its legal drinking age in January 1980 from 19 to 21. Monthly single vehicle night male driver involvements (in traffic accidents) from 1977-1980 were analyzed as the impact measure. Box-Tiao Intervention Analysis was used to develop impact assessment models relating the change in driver involvements to the implementation of the raised legal drinking age. An 8.8 percent reduction in single vehicle night male driver involvements was found for drivers in the affected age groups.

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METRIC CONVERSION FACTORS

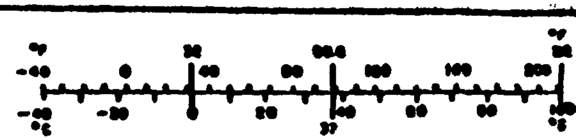
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in ≡ 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



I. BACKGROUND

Drivers between the ages of 16-25 are consistently overrepresented in traffic accidents, including fatal accidents. Young male drivers comprise a substantial portion of single vehicle accidents and alcohol involved fatal accidents.

Fatal accident involvement has been shown to be related to driver alcohol consumption. It has been determined that the risk of accident involvement increases as a function of driver blood alcohol content (BAC). In addition, alcohol related traffic accidents have been shown to be highly correlated with driver involvement age and sex. Also, studies show that most alcohol related accidents occur during nighttime hours. 1, 4/

Driver sex, driver age, and accident hour are characteristics with which alcohol involved accidents are identified. Previous work 4/ has shown that lowering the minimum legal drinking age increases the number of accidents involving drivers less than 25 years of age. Fourteen States since 1976 have passed legislation raising the minimum legal drinking age. Raising the legal drinking age has been found to reduce nighttime alcohol-involved accidents with younger drivers. 10, 11/

Eight States (Florida, Georgia, Iowa, Minnesota, Montana, New Jersey, Rhode Island, and Tennessee) raised their minimum legal drinking age from 18 to 19. Maine, Massachusetts, and New Hampshire have raised the age from 18 to 20. A recent study of the raised legal drinking age in Maine 8/ found a reduction in traffic accidents for drivers in the affected age groups.

Nebraska raised its minimum age from 19 to 20. In Michigan, where the legal drinking age was raised from 18 to 21, a recent study 10/ found a reduction of 31 percent in alcohol involvement for those drivers affected by the law change, the 18-20 year old drivers. Increases of 9 percent and 5 percent in alcohol involvement were found for drivers 21-24 years old and 25-45 years old, respectively.

Illinois raised its minimum legal drinking age in January 1980 from age 19 to 21 years. As a result, drivers age 19 and 20 who could previously purchase alcohol can no longer do so. This analysis attempts to determine what reduction, if any, in alcohol involvement can be attributed to the law change in Illinois.

II. LEGAL DRINKING AGE LAW--IMPACT ANALYSIS

Data for single vehicle male driver involvements (SVNMD) occurring between 8 pm - 3 am were obtained from the State of Illinois. SVNMD was used as a surrogate for alcohol related accidents. Surrogate measures for alcohol involvement are typically used since BAC reporting for driver accident involvement is often incomplete.

Figures 1-9 (see Appendix) are graphs of each SVNMD raw data series along with the 12-month moving average. Monthly involvements by age group for 1977-1980 were analyzed as an impact measure. A total of nine series, each consisting of 48 data points were used.

The nine age groups used are shown in Table 1.

TABLE 1

SVNMD Series

LT16	Driver Age Less Than	16
EQ16	Driver Age Equals	16
EQ17	Driver Age Equals	17
EQ18	Driver Age Equals	18
*EQ19	Driver Age Equals	19
*EQ20	Driver Age Equals	20
EQ21	Driver Age Equals	21
EQ22	Driver Age Equals	22
GT22	Driver Age Greater Than	22

*Ages affected by law change.

A statistical evaluation model was developed for each series (age group) to quantify the relationship between the impact measure (SVNMD) for the affected ages and a possible explanatory variable, the intervention of the legal drinking age law. The method used is a least-squares analysis technique known as Box-Tiao Intervention Analysis. 2, 3/ This approach has been used extensively to determine traffic safety program impact (e.g., the 55 MPH National Maximum Speed Limit) using State and National data. 6, 7, 8/

If a statistically significant reduction was found in the impact measure for the affected ages, 19-20 years old, and not found for the other age groups, we could reasonably conclude that these drivers exhibited behavior unlike the others. Therefore, this reduction is attributable to the law change.

The first step in the analysis was to develop a univariate model for each series. The univariate models would relate future SVNMD based on its own past. This was done to examine the time series characteristics exhibited in the raw data, which would serve as a basis for constructing impact assessment models 9/ relating changes in SVNMD to the intervention, i.e., law change.

Figures 1-9 were used to identify possible similarities in the behavior of SVNMD for the nine age groups.

Univariate models were estimated for each series and are summarized in Table 2. Eight of the series were characterized by nonstationary behavior, i.e., observations at time period show high correlation with observations 12, 24, 36, etc. months apart. Nonstationarity was accounted for by taking a seasonal (12-month) difference of the original series and estimating a moving average parameter of order 12. Box-Jenkins Time Series Analysis was used to arrive at univariate model estimates. 2/

All series except LT16 required a seasonal (12-month) difference and a seasonal moving average parameter. The EQ19, EQ20, EQ21, and GT22 univariate models also required a moving average parameter of order 1. All model parameters were significant and residual analysis indicated that the models were adequate.

TABLE 2
SVNMD Univariate Models

Series	Difference Required	θ_1	s.d. (θ_1)	θ_{12}	s.d. (θ_{12})
LT16	Regular				
EQ16	Seasonal	-	-	0.75	0.07
EQ17	Seasonal	-	-	0.73	0.07
EQ18	Seasonal	-	-	0.74	0.07
*EQ19	Seasonal	0.50	0.15	0.80	0.07
*EQ20	Seasonal	0.40	0.16	0.76	0.07
EQ21	Seasonal	0.49	0.15	0.73	0.07
EQ22	Seasonal	-	-	0.79	0.07
GT22	Seasonal	0.42	0.16	0.74	0.07

*Ages Affected by Law Change.

The next step in the analysis was to create a variable to represent the (intervention) raising of the legal drinking age in Illinois. The dummy variable LAW was created where:

$$LAW_t = \begin{cases} 0, & t < \text{January 1980} \\ 1, & t \geq \text{January 1980} \end{cases}$$

to represent the absence/presence of the new legal drinking age law.

Next, a model was developed for each series which would relate SVNMD and the intervention, LAW. This impact assessment model would provide a measure of the change associated with the raised minimum legal drinking age in Illinois. The following model form was entertained:

$$Y_t = w_0 \, LAW_{t-b} + N_t$$

where Y_t = SVNMD age group at month t

w_0 = impact of raised minimum legal drinking age, i.e., monthly average change in SVNMD

b = delay time before impact is "felt"

N_t = noise series, a function of normal, independently distributed error, $N(0, \sigma^2)$

Impact assessment models were estimated for each SVNMD age group. For driver age = 19 (EQ19) and driver age = 20 (EQ20) the following models were estimated:

EQ19 $$Y_t = \underset{(8.7)}{-17.7} \, LAW_t + N_t$$

where $$N_t = \frac{(1 - .69B^{12})}{(1 - B^{12})} a_t$$

EQ20 $$Y_t = \underset{(6.4)}{-11.2} \, LAW_t + N_t$$

where $$N_t = \frac{(1 - .77B^{12})}{(1 - B^{12})} a_t$$

Values appearing in parentheses represent the standard errors of the estimates.

The model parameters and their standard errors for each of the SVNMD age groups are given in the Appendix. The values for W_0, impact of the raised legal drinking age, are summarized in Table 3. Delay time for all series was 0.

TABLE 3
Impact Assessment Estimates

Series	Impact W_0	s.d. (w_0)	t-value
LT16	-11.5	15.1	0.76
EQ16	-4.6	6.6	-0.70
EQ17	-5.1	8.3	-0.61
EQ18	-5.7	9.7	-0.59
EQ19	-17.7	8.7	-2.03*
EQ20	-11.2	6.4	-1.75*
EQ21	11.3	7.6	1.49
EQ22	2.5	7.7	0.33
GT22	31.9	102.2	0.31

*Significant at $\alpha = 0.05$

Both impact estimates for the affected ages were statistically significant (using a one-sided t-test 5/) at the $\alpha = 0.05$ level. Impact assessment estimates for the other age groups were not statistically significant.

Analysis of the model residuals revealed no model inadequacies.

From these models, estimates can be made of the steady state reduction in single vehicle night male driver involvements for the affected ages attributable to Illinois legal drinking age law change. The steady state estimate of the reduction attributable to the law change for drivers age 19 and age 20 is 17.7 and 11.2 per month, respectively. Those reductions can be compared to annual SVNMD for EQ19 and EQ20. Annual SVNMD are shown in Table 4.

TABLE 4

Annual SVNMD

	1977	1978	Base 1979	Avg.	1980	All Yrs. Avg.
EQ19	2,145	2,243	1,965	2,118	1,897	2,063
EQ20	1,863	1,845	1,708	1,805	1,689	1,776
TOTAL	4,008	4,088	3,673	3,923	3,586	3,839

Thus, the 1980 reduction in single vehicle night male driver involvements, using the model estimates and comparing these to base year (before the law change) averages yields:

TABLE 5
1980 Reduction in SVNMD

	No.	%
EQ19	212	10.0
EQ20	134	7.4
TOTAL	346	8.8

III. CONCLUSION

From the above results, the raising of the legal drinking age law has been effective in the reduction of single vehicle night male driver involvements for drivers ages 19 and 20 in Illinois. Single vehicle night male driver involvements was used as a surrogate measure for alcohol involvement in accidents for these drivers.

The percent reduction attributable to the law change in Illinois in single vehicle night male driver involvements for 1980 totals 8.8 percent.

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Appendix A

Series: SVNMD, LT16

Impact Estimate, W_o	-11.5
s.d. (W_o) 15.1	
t-value	- 0.76

Model $Y_t = -11.5\ LAW_t + N_t$

$$\text{where } N_t = \frac{a_t}{(1 - .85B)}$$

Series: SVNMD, EQ16

Impact Estimate, W_o		-4.6
s.d. (W_o)	6.6	
t-value		-0.70

Model $Y_t = -4.6\ LAW_t + N_t$

$$\text{where } N_t = \frac{(1 - .81B^{12})}{(1 - B^{12})}\ a_t$$

Series: SVNMD, EQ17

Impact Estimate, W_o		-5.1
s.d. (W_o)	8.3	
t-value		-0.61

Model $Y_t = -5.1\ LAW_t + N_t$

$$\text{where } N_t = \frac{(1 - .46B^{12})}{(1 - B^{12})}\ a_t$$

Series: SVNMD, EQ18

Impact Estimate, W_o -5.7

s.d. (W_o) 9.7

t-value -0.59

Model $Y_t = -5.7\ LAW_t + N_t$

$$\text{where } N_t = \frac{(1 - .65B^{12})}{(1 - B^{12})} a_t$$

Series: SVNMD, EQ19

Impact Estimate, W_o -17.7

s.d. (W_o) 8.7

t-value - 2.03

Model $Y_t = -17.7\ LAW_t + N_t$

$$\text{where } N_t = \frac{(1 - .69B^{12})}{(1 - B^{12})} a_t$$

Series: SVNMD, EQ20

Impact Estimate, W_o -11.2

s.d. (W_o) 6.4

t-value - 1.75

Model $Y_t = -11.2\ LAW_t + N_t$

$$\text{where } N_t = \frac{(1 - .77B^{12})}{(1-B^{12})} a_t$$

Series: SVNMD, EQ21

Impact Estimate, W_o 11.3

s.d. (W_o) 7.6

t-value 1.49

Model $Y_t = 11.3\ LAW_t + N_t$

where $$N_t = \frac{(1 + .47B)}{(1 - B^{12})} a_t$$

Series: SVNMD, EQ22

Impact Estimate, W_o 2.5

s.d. (W_o) 7.7

t-value 0.32

Model $Y_t = 2.5\ LAW_t + N_t$

where $N_t = (1 + .48B)\ a_t$

Series: SNVMD, GT22

Impact Estimate, W_o 31.9

s.d. (W_o) 102.2

t-value 0.31

Model $Y_t = 31.9\ LAW_t = N_t$

where $$N_t = \frac{(1 - .67B)(1 + .58B^{12})}{(1 - B)} a_t$$

FIGURE 1

SVNMD-LT16

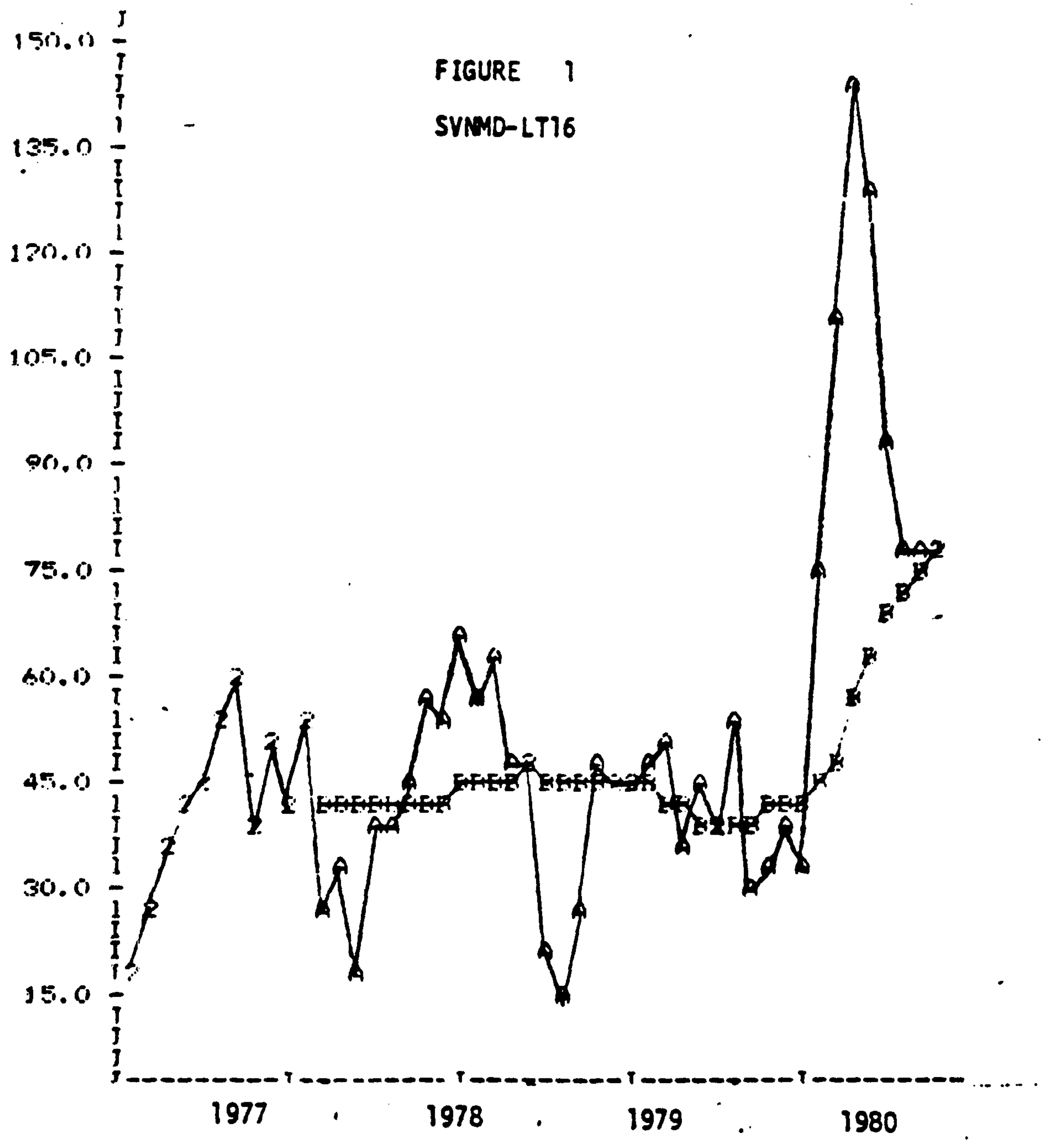

FIGURE 2

SVNMD-EQ16

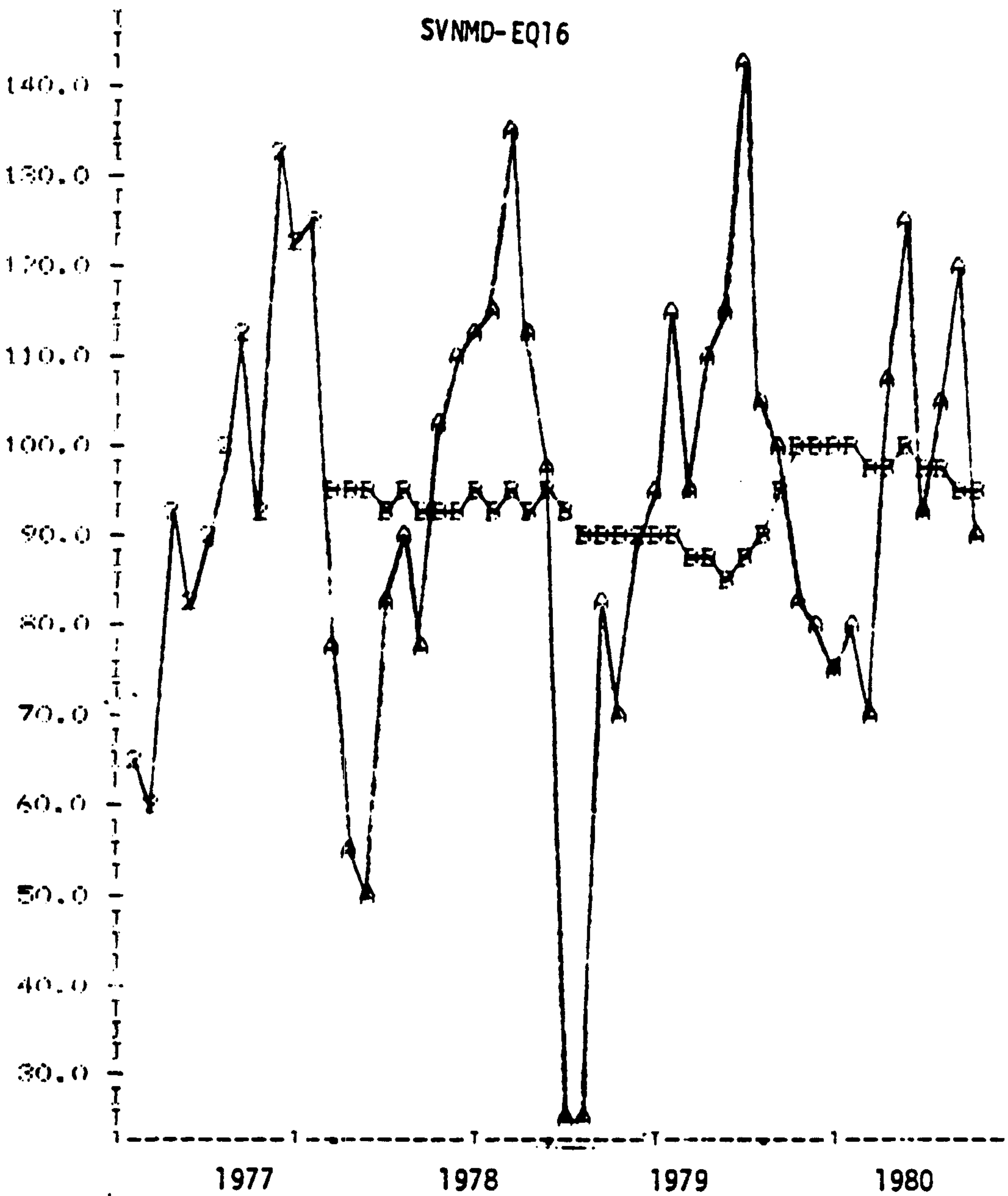

FIGURE 3

SVNMD-EQ17

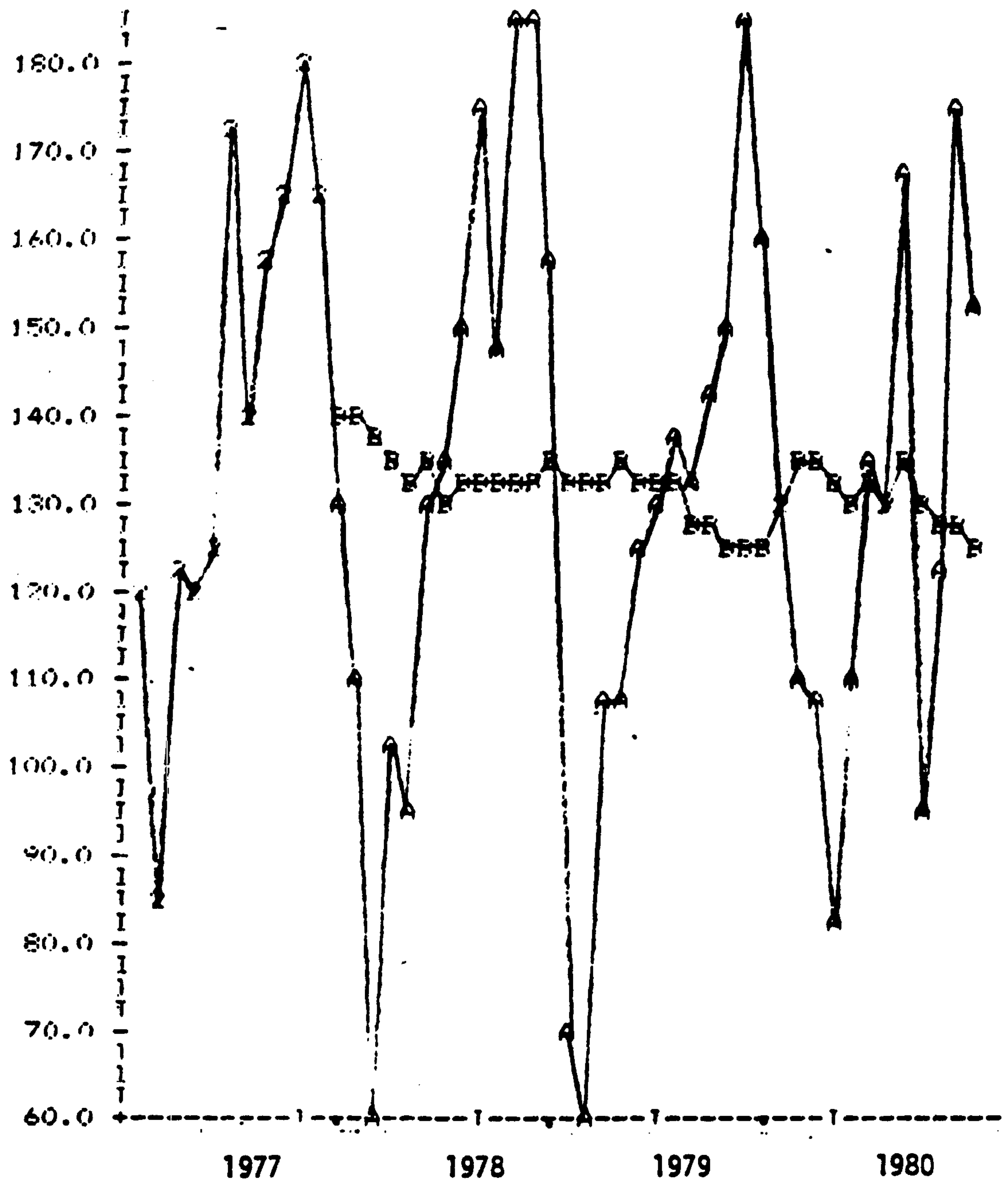

FIGURE 4

SVNMD-EQ18

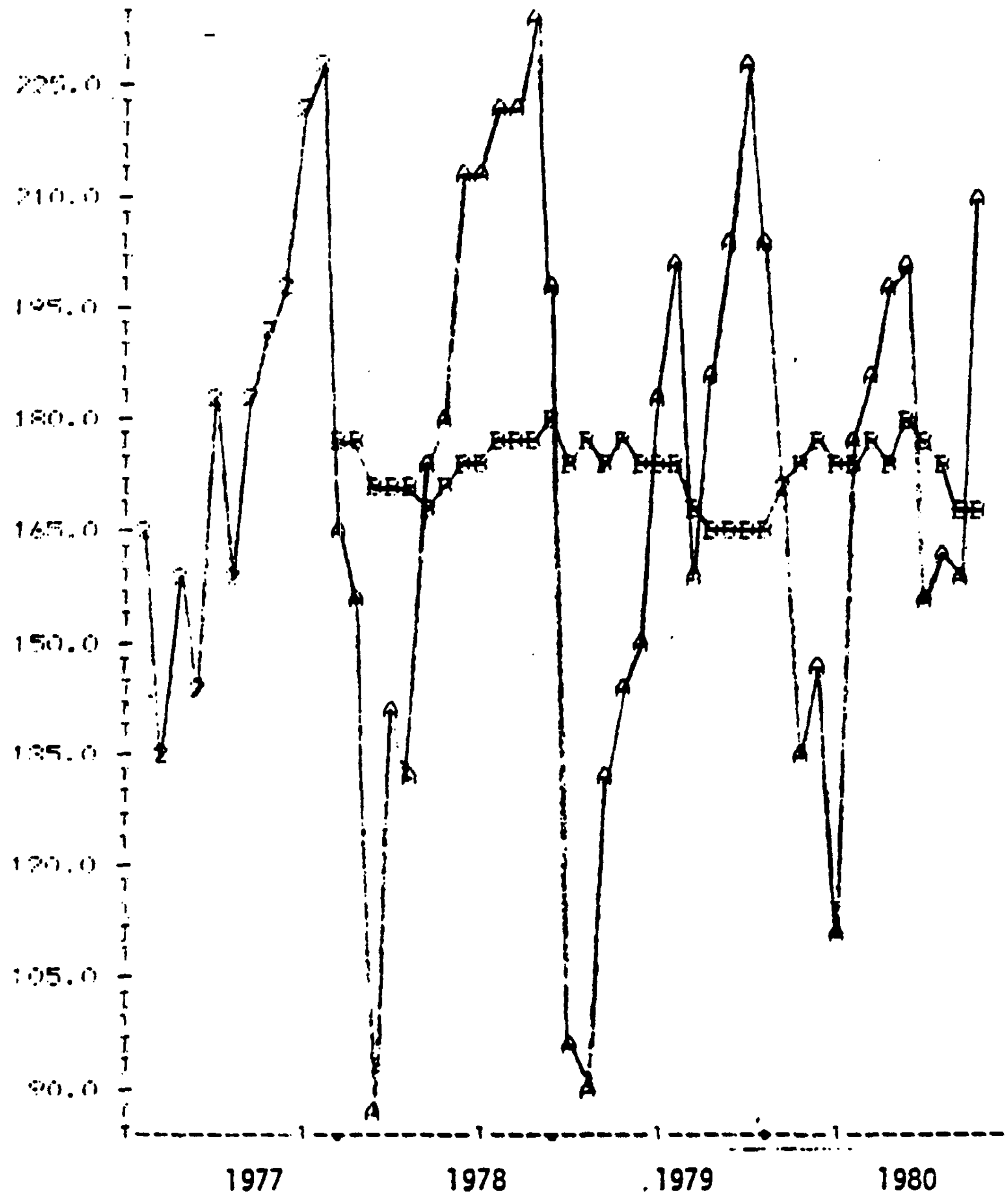

FIGURE 5

SVNMD-EQ19

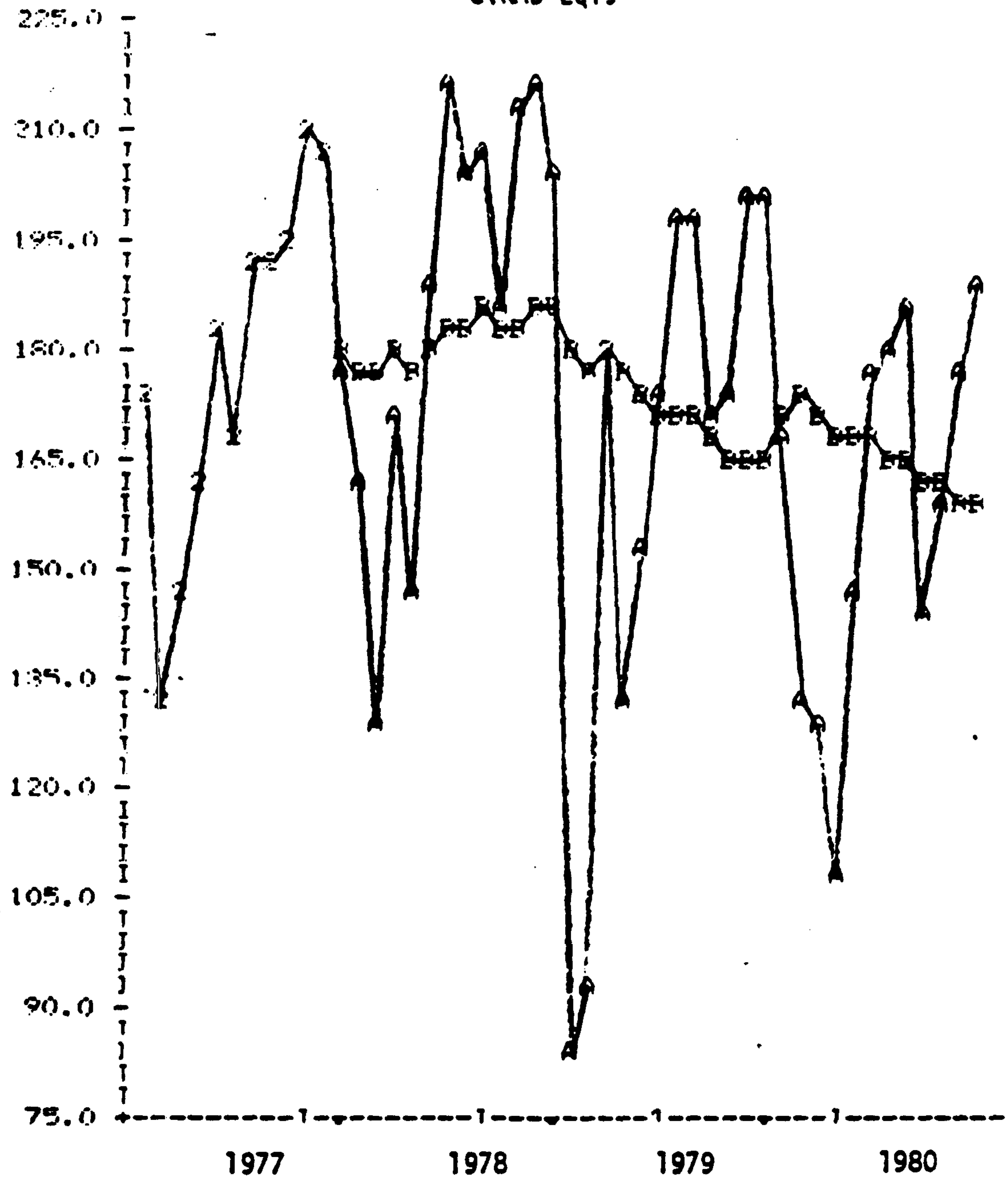

FIGURE 6

SVNMD-EQ20

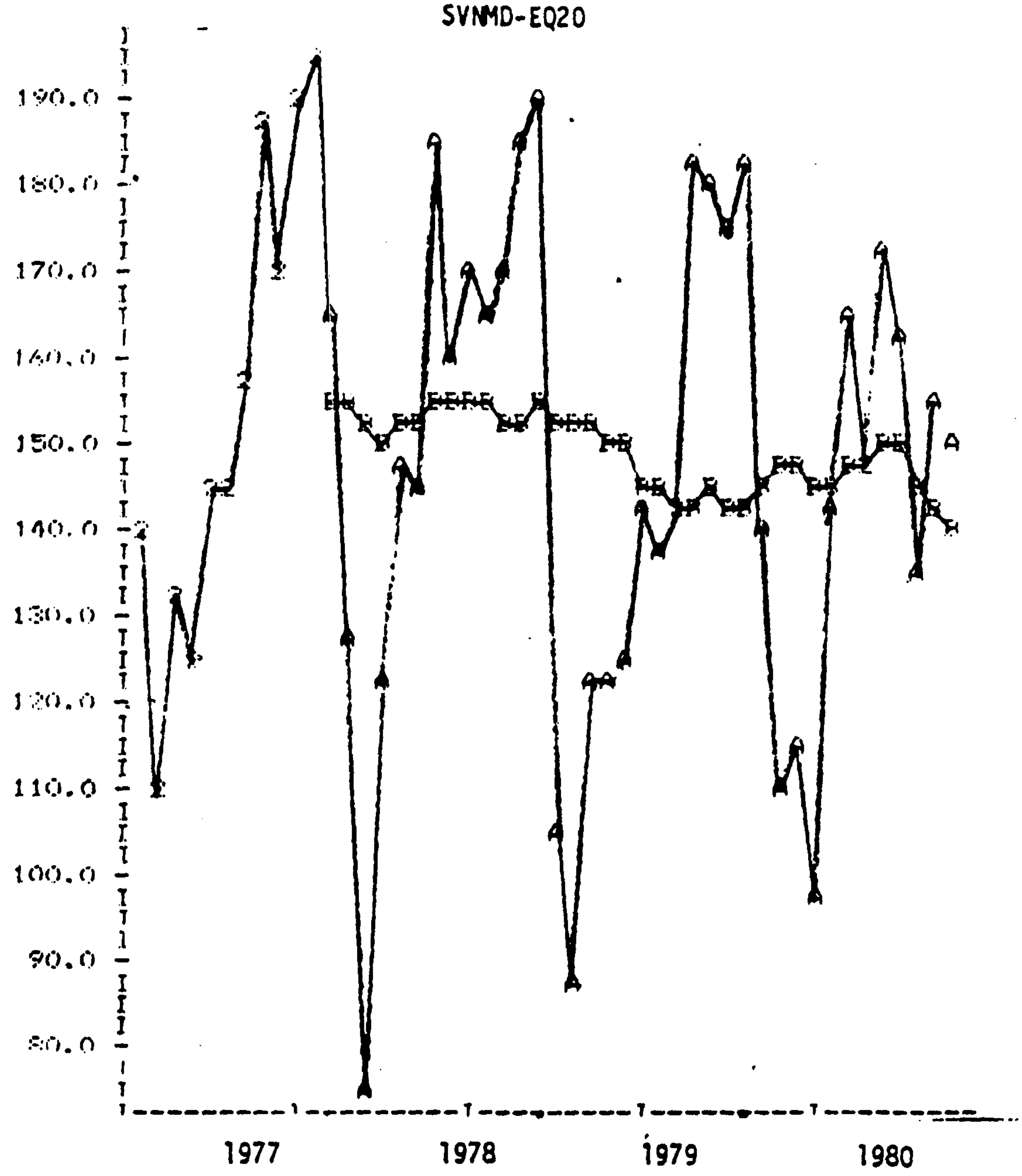

FIGURE 7

SVNMD-EQ21

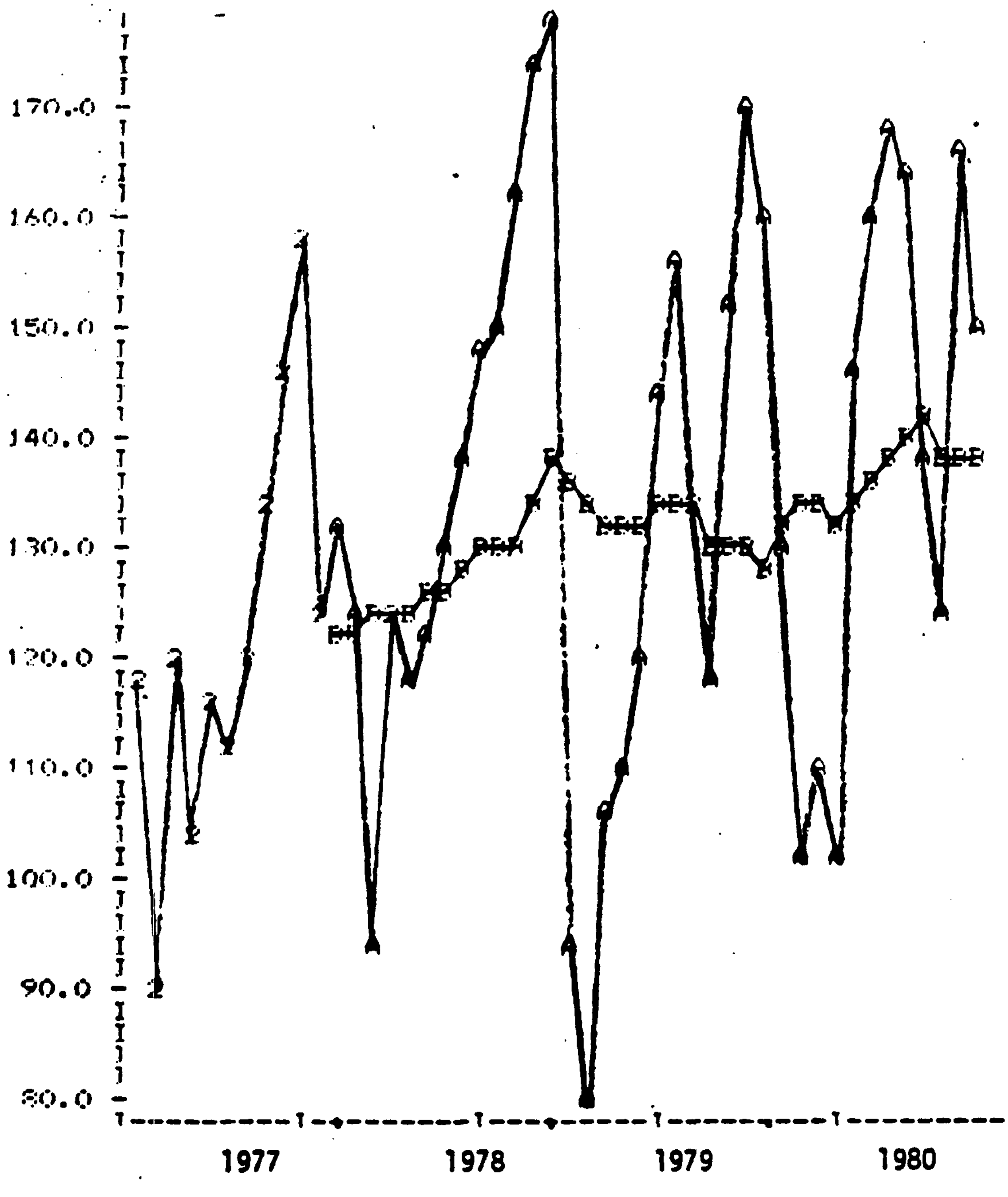

FIGURE 8

SVNMD-EQ22

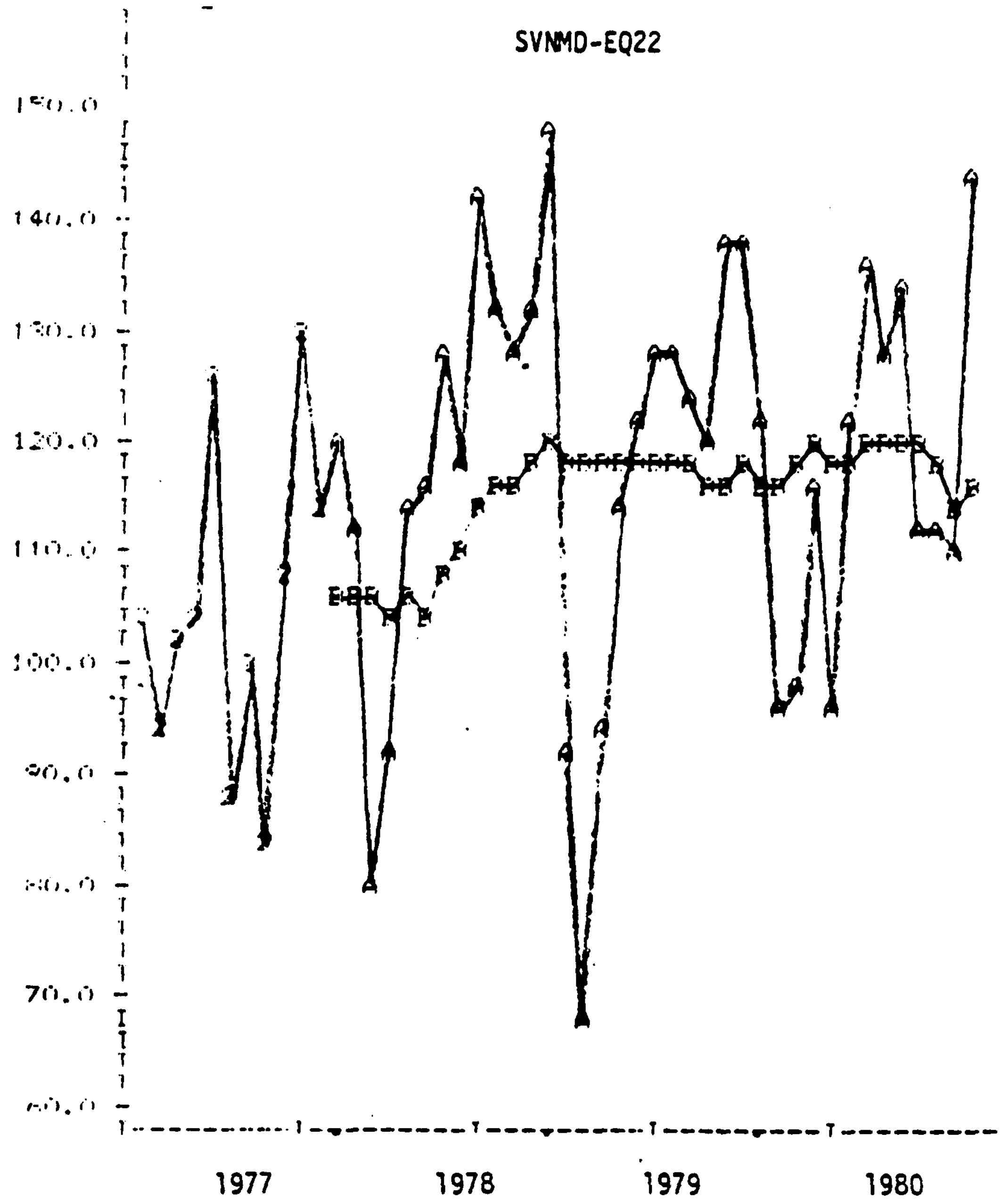

FIGURE 9

SVNMD-GT22