SOCIOLOGY AND SYSTEM DYNAMICS[1]

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ABSTRACT

The most basic problem of sociology as an empirical science is the difficulty of replicating studies within reasonable time limits and in genuinely comparable situations. It is the problem of controlled experimentation. Sociologists aspire to make correct predictions based on verifiable statements about causal relationships, but cannot, the nature of macro-social phenomena precluding experimental designs with adequate controls.

System dynamics promises a way out of this dilemma. Four things need to be done. (1) Formulate the sociological theory as a causal loop diagram, making all causal reasoning explicit. (2) State what variables are involved in the functioning of the system. Calibrate the model until it is internally consistent. (3) Refine and adjust the constants until the model can reproduce known time-series of relevant data. Repeat this on number of data-sets. (4) Systematically vary each constant in turn while controlling for the others. This is, in fact, the quasi-experimental procedure for testing the conditions under which the theory will stand or fall, and why.

An illustrative example of the proposed strategy is presented, with encouraging results.

[1]The authors wish to thank Richard Bronson for his helpful comments and criticism.

Ever since Durkheim and Weber, sociologists have concerned themselves with the methodology of their discipline as much as with its substantive content. Yet the great names in sociology are remembered primarily for their theoretical insights, rather than for their contributions to method. Not that their theorizing has always yielded nuggets of wisdom, nor that there has been no progress in methodology. Time has shown that many pronouncements of the classics have been too sweeping, biased, or plainly false.

We also have seen great improvements in the techniques of empirical social research. And still, our predictions of social events and processes are at best tentative, resting typically on a non-existent ceteris paribus, while our theoretical explanations remain time-specific and situation-bound, being frequently no better than those of competent journalists.

Part of the difficulty, of course, is valid operationalization and reliable measurement. These, however, are matters of degree, not of substance. Great strides have been made by generations of researchers towards greater sophistication and robustness of our data bases. The real problem, perhaps the most basic problem of sociology as empirical science, is that we have not yet found a way to make true replications of our studies within reasonable time limits and in genuinely comparable situations. In short, it is the problem of controlled experimentation. Until this problem is resolved, we shall continue to wallow in reams of theoretical sociology, while empirically tested sociological theory goes begging.

By way of contrast, consider social psychology. Once pioneers like Lewin and Sherif had shown the way to study social interaction and small group behavior in controlled experimental settings, this sub-discipline has surged forwards like no other field in the social sciences. It is fair to say, we think, that social psychology today is scientifically the most advanced branch of sociology, having spawned a technology based on systematic research for marketing, advertising, personnel management, teaching, and many other applied areas. Macro-sociology and the study of larger social systems have been left far behind.

We are in a dilemma. The nature of the phenomena that we study preclude setting up experimental situations with elaborate controls, reducing us to observational and survey techniques that at best lend themselves only to correlational analyses and their derivatives. Moreover, the data obtained in these ways are typically time and situation specific, making generalizations and extrapolations extremely hazardous, as economists have learned to their chagrin. We want to be able to make correct predictions about events and verifiable causal statements about the relationships between variables, but we know that with our data and analytical techniques it cannot be done with impunity.

Computer simulation in general, and system dynamics using DYNAMO in particular, seem to hold the promise of a way out of this dilemma. A number of features of S.D. methodology and DYNAMO make them especially suitable for sociological research. First, it is possible to handle a relatively large number of variables simultaneously and study their changes over time in steps small enough or large enough to suit the

researcher's purpose. Secondly, we can integrate multiple feedback loops into the system that is being investigated and study their mutual influences, again, over time. Furthermore, we do not have to stick to linear hypotheses, and can describe a wide variety of non-linear relationships between variables hypothesized by sociological theory. Another advantage is that S.D. stresses robustness rather than precision, which makes it more suitable than other modelling techniques for the imprecise measures that we normally have. Finally, and perhaps crucially for many practicing sociologists, S.D. and DYNAMO do not require great mathematical sophistication from the user. What they do require is analytical acumen and a familiarity with computers, both of which are by now stock-in-trade of most competent sociologists.

Not all sociologists are unaware of system dynamics and its applications. Forrester's work on industrial and urban dynamics [1][2], as well as the best-selling <u>The Limits to Growth</u> [3], have attracted the attention of social scientists specializing in organizational studies, urban planning, human ecology, demography, and similar areas. But we think it is correct to say that sociologists generally have tended to dismiss this approach, probably because it did not incorporate the knowledge available to them, and in some cases flatly contradicted it. This is unfortunate, because in so doing they have thrown the baby out with the bath water. We believe that there is great potential in S.D. methodology for sociology, once we make the effort to anchor it in social theory.

If sociologists have not accepted S.D., it may still seem puzzling why the system dynamics approach has not penetrated sociology from its own end. The main reason for this, we believe, is that system dynamicists have concerned themselves primarily with decision-making problems. While there is, of course, an implicit theory and any number of hypotheses in every S.D. model, these have tended to be, by and large, intuitive, common sense type of theories and hypotheses, based on the practical experience and specific expertise of the modelers or their clients. Using S.D. methodology explicitly to test theory has been done only rarely, and we have not been able to find a single example of an attempt to apply it to a sociological theory.

There are, however, many sociological theories that lend themselves to formulation as system dynamics models. Smelser's theory of collective behavior [4], for example, or Merton's theory of the self-fulfilling prophesy [5]. In fact, any theory that posits - either implicitly or explicitly, dynamic feedback loops of one sort or another, should be amenable to the system dynamics approach.

Strategy

The strategy we propose involves four phases. Each phase consists of an iterative process of refinement and elaboration, until the output satisfies the relevant logical and methodological requirements as follows:

Phase I - Deduction. Choose a dynamic sociological theory, that is one with an either explicit or implicit time dimension. Preferably it should be of the "middle range", so as to increase the chances of obtaining relevant data. Formulate the theory as a causal loop diagram, which is an excellent device of forcing implicit causal assumptions into the open,

and exposing flaws or contradictions in the deductive argument. Iterate this process until the theory is adequately expressed in the diagram and the causal loops are logically consistent.

Phase II - Internal Validity Testing. State what variables - endogenous as well exogenous to the system - are involved in its functioning over time. If there are serviceable operational definitions available for these variables, and perhaps also correlation coefficients for their hypothesized interrelations, so much the better. Define the levels, outline the flow diagram and write the equations, bearing in mind the necessity for dimensional consistency. Then run the model and see whether its behavior is consistent with the theoretical predictions. Adjust the relationships between the variables until the model reflects the theory as initially stated.

In our experience, this phase may involve the addition of variables which, in the written formulation of the theory, had been implicitly assumed or overlooked. This is all to the good, since it tightens the argument and makes it more explicit. Running the model for longer time horizons than had originally been anticipated may also reveal unexpected patterns and processes which do make theoretical sense.

Phase III - External Validity Testing. Once the model can produce output that tallies roughly with the theoretical predictions, that is to say, the major variables in the system vary in relation to one another as the theory would predict, real data must be substituted for the arbitrarily chosen initial values. The aim is to reproduce known time series of data to see whether the theory corresponds to reality. It is not to be expected that a very good fit will be obtained at first. In that case the constant multipliers in the model (which represent the situational assumptions of the theory) must be calibrated and adjusted to improve the fit.

It is at this stage that the simulation technique provides an answer to an important requirement of the scientific method. If the model does indeed represent the theory - and this should have been established in Phase II - but cannot reproduce known time series data, then the theory should be either revised or rejected. It is the empirical possibility of rejection that gives the successful model its external validity.

Phase IV - Boundary Testing. The final step to test the theory involves the systematic variation of each constant in turn, while controlling for the others. This is, in fact, the quasi-experimental procedure whereby we can establish the range of conditions under which the theory holds. The flow diagram in fig. 1 summarizes the phases of our proposed strategy.

We shall now illustrate this procedure with a social theory that seeks to explain the proliferation of norm evasions in contemporary societies (for a detailed exposition of the theory, see: Jacobsen 1979 [6]).

The Dynamics of Norm Evasions and Social Control

When social systems have to contend with structural impediments to their institutionalized mechanisms of social control, isolated cases of norm evasion tend to develop a pattern. For example, social settings which lend anonymity and transience to individuals are structurally conducive to norm-evasive patterns of behavior. Patterned evasions [7]

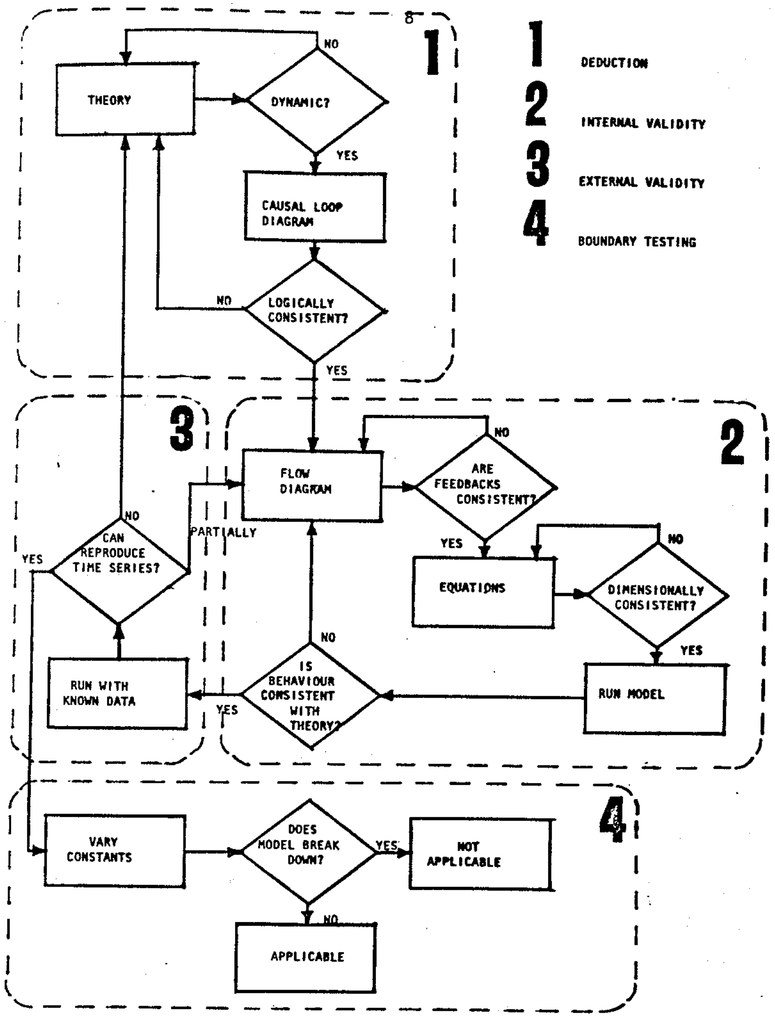

Figure 1. Strategy for Theory Testing

are widespread and frequently recurring, devious and deliberate violations of accepted norms, which elicit no perceptible reactions from their social audience. Tax evasions and building code violations are some cases in point. A pattern develops despite the surreptitious nature of the activities, because so many people do it, and do it regularly.

When patterned evasions continue for some time, normative ambiguity increases. More and more people become less sure about what the norm really is and how strigently it applies. If under such conditions, there is also structural strain in the system, then the patterned evasions will acquire partial legitimacy, and they will become institutionalized evasions [8]. Systemic structural strain may be expected in times of rapid technological change, in organizations where regulations are arbitrarily imposed and changed from above, or when patterned evasions have beeen allowed to persist for lengthy periods. Many traffic violations are examples of institutionalized evasions, as are illegal abortions, kickbacks to strategically placed agents or executives, and similar practices.

Social systems which have, in addition to patterned and institutionalized evasions, also some general beliefs and values that lend themselves to interpretation as legitimations of nonconformity, will gradually increase in permissiveness. In such societies we may now find an institutionalized social climate, wherein a person can violate accepted norms in public without incurring sanctions because social audiences are normatively expected not to react to norm evasions.

Toleration, cultural pluralism, liberalism, freedom of expression - these are some examples of beliefs and values that have the potential of fostering a permissive social climate.

Patterned evasions, institutionalized evasions and permissiveness frequently serve adaptive and tension-releasing functions for the social systems in which they occur. Indeed it may be argued that were it not for such facilitating functions, these phenomena would not grow and spread. But once a permissive social climate has become institutionalized, a positive feedback cycle of increasing evasions, legitimation and permissiveness is activated. Such a process, once started, must lead sooner or later to a crisis in social self-regulation.

But a negative feedback loop may also be activated through the manifestation of social dysfunctions which result from the decrease in predictability in social interaction, expecially if these dysfunctions are exacerbated by crises of one sort or another: political, economic, or military. In that case the system is likely to react in a spate of repressive coercion, neutralizing the beliefs and values that legitimized the permissiveness, and directly reducing the level of evasions and their legitimacy.

The Model

To simulate this theory we have developed a model that contains three levels, three constant multipliers, five auxiliary variables and one extraneous variable. In addition, there is an increase rate and a decrease rate for each of the three levels. These shall now be briefly described.

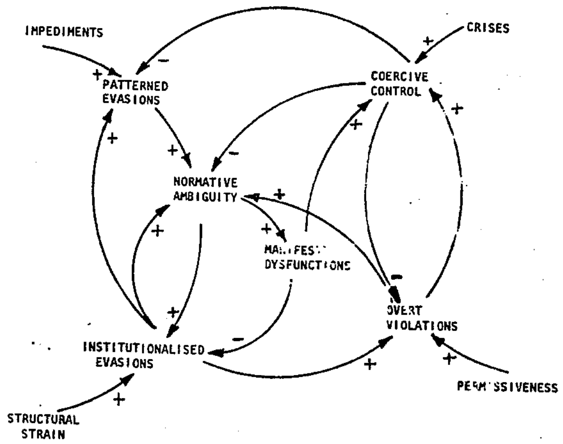

Figure 2. Causal Loop Diagram of Norm Evasions

Levels. (1) Patterned evasions (EVADRS) are measured by the percent of the population that surreptitiously evades the particular norm or norm-set under consideration. (2) Institutionalized evasions are indicated by the level of legitimacy that adheres to the evasions, and measured by the percent of a person's acquaintances whom he is willing to tell of his evasion of that particular norm or norm-set (PERIEL). (3) General norm violation in the social system is estimated by the percent of norms in the system that are being overtly infringed (INFRIN).

Constants. The increase rates of each of the levels have been modeled to depend on the given social-structural conditions assumed in the theory,

and represented in the model by constant multipliers. The increase rate of EVADRS is set off by the structural impediments to social control mechanisms that exist in contemporary industrial societies (IMPEDS). The increase of legitimacy leading to institutionalized evasions, PERIEL, depends on the amount of strain in the normative system, which is caused by the bureaucratic structure (BUREAU). For INFRIN the assumption is that it increases with the degree of permissiveness in the social climate brought about by the general beliefs and values that legitimize non-reaction to norm violations (GENBEL).

Auxiliary variables. These five variables represent the links in the causal chain of the theory. Two of these, structural strain and permissiveness, have already been mentioned. Structural strain (STRSTR) is indicated by the percent of people who feel constrained - due to the bureaucratic regulations - to evade the norms in question, while the presence or absence of permissiveness (PERMIS) is modeled by a dimensionless multiplier. The most relevant outcome of patterned evasions is normative ambiguity (NORAMB), which is measured by the percent of people who are unsure about the norm that is being evaded. The negative effects of normative ambiguity are indicated by the percent of people who become aware of manifest dysfunctions (DYSFUN) due to lack of predictability of others' behavior. The fifth auxiliary variable is coercive regulation (COERC), as measured by the percent of norms that are being coercively enforced.

Finally, there is one extraneous variable, CRISIS, which can be programmed to occur at given points for known time-series, or postulated to occur as the modeler sees fit. In addition, delays have been modeled to approximate the time-lapses between the different occurences in the system behavior. Fig. 3 presents this model as a flow diagram, and the DYNAMO equations are given in the appendix.

While there are still some inadequacies in the model - notably the absence of a feedback loop to simulate change in the norms themselves - we feel that it represents the main propositions of the theory without major distortions. The system behavior is shown in Fig. 4 (without crisis) and Fig. 5 (with crisis) for a period of 40 years.

An External Validation

As a first attempt at external validation, data were obtained from the Income Tax Division of the Israeli Treasury on the extent of income tax evasions for the period 1971-1980. These data are given in columns 1 - 3 of Table 1.

The initial value of this time-series (47.5%) was fed into the model as EVADRS, as well as estimated intial values for PERTEL and INFRIN. Two crises were programmed - one for 1973 (the Yom Kippur war), and a second for 1977 (first change of ruling party in 29 years). After calibrating the precise timing and duration of the crises, results were obtained as shown in Fig. 6.

To give some indication of the degree of fit between the real data and the model output, we computed the proportion of the variance (of the real data points around their initial value) which can be reproduced by

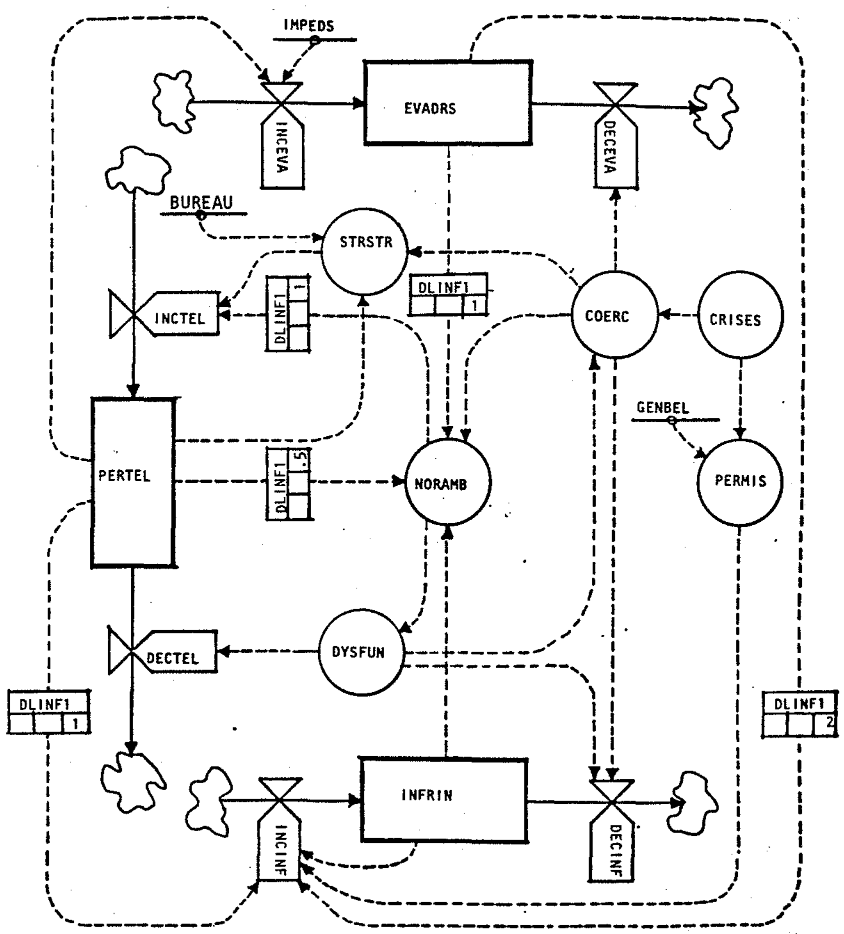

Figure 3. Flow Diagram of General Norm Evasion Model.

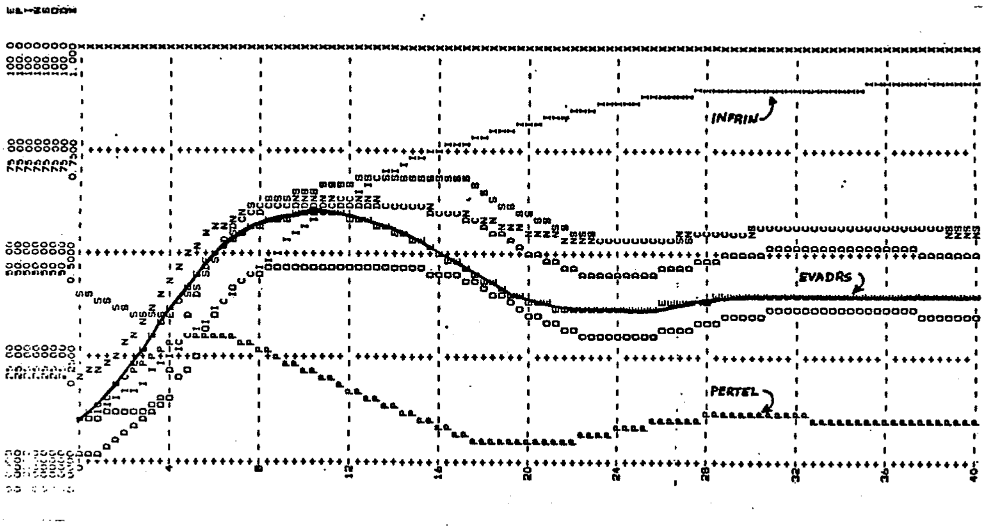

Figure 4. System Behaviour (without crises)

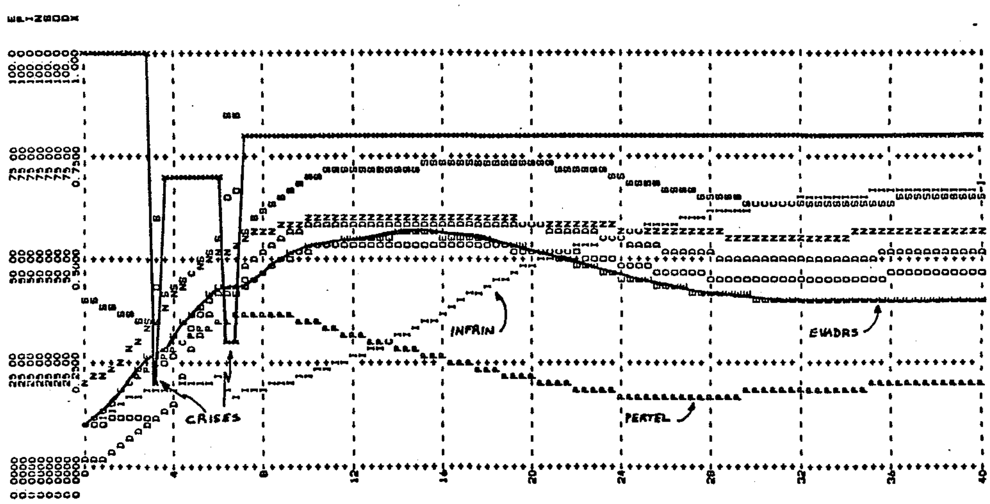

Figure 5. System Behaviour (with crises)

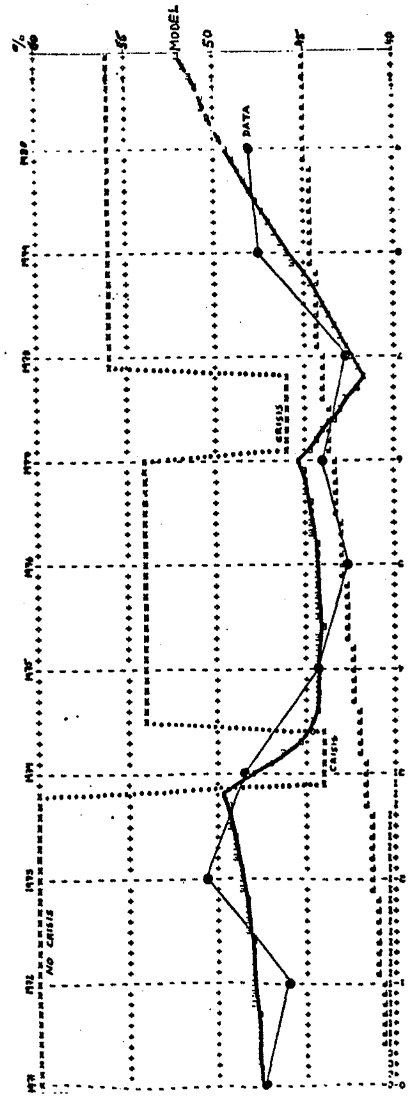

Figure 6. Plotted Output of the Tax Evasion Model (Real Data superimposed)

the model:

$$\frac{\Sigma (D_i - a)^2 - \Sigma (D_i - M_i)^2}{\Sigma (D_i - a)^2} = \text{proportion of variance reproduced}$$

were D_i = the data at time i,

M_i = the model value at time i, and

a = the initial value of the data.

The result for the run shown in Fig. 6 was as follows:

$$\frac{82.89 - 15.15}{82.89} = .817,$$ which we consider acceptable evidence of external validity. It remains to be seen, of course, whether we can obtain similarly acceptable results with other data sets. Until we do, the external validity of the theory cannot be taken as established.

Table 1. Number and Percentage of Income Tax Evaders in Israel, 1971-1980.

Year	Number of Taxable Incomes	Number of Approved Returns	Number of Evaders	Percent Evaders
1971	191,525	100,550	90,975	47.5
1972	207,091	111,622	95,469	46.1
1973	218,206	107,793	110,413	50.6
1974	229,163	118,248	110,915	48.4
1975	237,988	132,559	105,429	44.3
1976	261,107	149,614	111,493	42.7
1977	271,422	152,267	119,155	43.9
1978	279,520	160,444	119,076	42.6
1979	291,875	153,526	138,349	47.4
1980	313,887	163,221	150,666	48.0

Boundary Testing

To illustrate this final phase of the procedure, let us assume that external validity has been established on a number of data sets. Each constant has now to be systematically varied, all else being controlled, to see at what point the model no longer satisfies our criterion of external validity. We shall arbitrarily set this cut-off point at 50% reproduced variance. Tables 2 through 4 present the results of this procedure for each of the three constants in our model.

Table 2. Sums of squared deviations of model from data, and proportions of variance reproduced with different values for IMPEDS.

IMPEDS	1.85	1.90	2.00	2.05	2.1	2.2	2.25
$\Sigma(D_i - M_i)^2$	46.17	31.80	16.41	15.15	15.80	33.54	44.79
Proportion of var. reproduced	.443	.616	.802	.817	.809	.595	.460

Table 3. Sums of squared deviations of model from data, and proportions of variance reproduced with different values for BUREAU (IMPEDS = 2.05).

BUREAU	27	30	35	40	45	50	55	60
$\Sigma(D_i - M_i)^2$	41.49	30.98	18.78	15.15	19.00	24.83	32.22	38.61
Proportion of var. reproduced	.499	.626	.773	.817	.771	.700	.611	.534

Table 4. Sums of squared deviations of model from data, and proportions of variance reproduced with different values for GENBEL (when IMPEDS = 2.05; BUREAU = 40).

GENBEL	.01	1	3	6	8	9
$\Sigma(D_i - M_i)^2$	14.40	14.40	14.40	15.47	18.26	38.78
Proportion of var. reproduced	.826	.826	.826	.813	.800	.532

Thus the ranges within which the theory can be said to hold are, for IMPEDS: 1.90 through 2.2; for BUREAU: 28 through 60; and for GENBEL: 0.01 through 9. In other words, with the important proviso that additional tests of external validity will still have to be made, we may tentatively state the following. When the multiplier effect of the impediments to social control on the level of evaders is less than 1.9 or more than 2.2, the theory can no longer reproduce reality satisfactorily, and is therefore not applicable. A similar statement may be made about the multiplier effect of bureaucratic structure on the level of institutionalized evasion, where the boundaries are 28 and 60, respectively. There appears to be no comparable lower limit to the multiplier effect of general liberal values on permissiveness, but the upper limit lies somewhere between 9 and 10.

Conclusion

We must emphasize again that the model we have presented here is by no means final, and we are continuously working on its improvement. Our purpose in presenting it even in its tentative form has been to demonstrate the feasibility of the research strategy we have proposed. The results we have obtained so far are encouraging enough to suggest that here at last we may have found a quasi-experimental procedure for testing macro-sociological theories. An added fringe benefit is that S.D. models developed in this fashion are likely to be better grounded in social theory than some of the models that have been proposed in the past.

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Appendix

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         * GENERAL NORM EVASION MODEL -  VERSION  THREE (10.3.83)

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1.       NOTE      C O N S T A N T S
1.1      C      IMPEDS=2
1.11     NOTE      IMPEDIMENTS TO SOCIAL CONTROL (UNITS)
1.2      C      BUREAU=40
1.21     NOTE      BUREAUCRATIC STRAIN (% POP. CONSTRAINED TO EVADE)
1.3      C      GENBEL=6
1.31     NOTE      GENERALIZED BELIEFS LEGITIMIZING NONCONFORMITY (UNITS)
1.32     NOTE
2.       NOTE      E X O G E N O U S   V A R I A B L E S
2.1      A      CRISIS.K=1
2.11     NOTE      COERCION-PRECIPITATING CRISES (NO CRISIS=1,CRISIS<1)
2.12     NOTE
3.       NOTE      L E V E L S
3.1      L      EVADRS.K=EVADRS.J+DT*(INCEVA.JK-DECEVA.JK)
3.11     NOTE      EVADERS (% POPULATION EVADING THE NORM)
3.12     N      EVADRS=10
3.2      L      PERTEL.K=PERTEL.J+DT*(INCTEL.JK-DECTEL.JK)
3.21     NOTE      LEGITIMACY LEVEL (% OTHERS ONE TELLS OF THE EVASION)
3.22     N      PERTEL=10
3.3      L      INFRIN.K=INFRIN.J+DT*(INCINF.JK-DECINF.JK)
3.31     NOTE      INFRINGED NORMS (% OF NORMS OVERTLY INFRINGED)
3.32     N      INFRIN=10
3.41     NOTE
4.       NOTE      A U X I L I A R Y   V A R I A B L E S
4.01     A      DEVA1.K=DLINF1(EVADRS.K,1)
4.02     NOTE      ONE YEARS DELAY INFLUENCE OF EVADRS ON AMBIGUITY
4.03     A      DPER1.K=DLINF1(PERTEL.K,.5)
4.04     NOTE      HALF A YEAR DELAY INFLUENCE OF PERTEL ON AMBIGUITY
4.05     T      TAMB1=10/20/30/37/42/45/45/45
4.06     NOTE      EVADERS EFFECT ON AMBIGUITY (% UNSURE)
4.07     T      TAMB2=0/1/3/6/10/12/10/6/3/1/0
4.08     NOTE      LEGITIMACY EFFECT ON AMBIGUITY (ADDNL % UNSURE)
4.09     T      TAMB3=.5/1/3/7/9/9.5
4.10     NOTE      INFRINGEMENT EFFECT ON AMBIGUITY (ADDNL % UNSURE)
4.11     T      TAMB4=9/9/8.5/7.5/4.5/1
4.12     NOTE      COERCION EFFECT ON AMBIGUITY (ADDNL & UNSURE)
4.13     L      OLD.K=OLD.J+DT*(INCOLD.JK)
4.131    NOTE      AUX. LEVEL OF NORAMB FOR COMPUTING PURPOSES ONLY
4.14     N      OLD=21
4.15     R      INCOLD.KL=(NORAMB.K-OLD.K)/.1
4.151    NOTE      DENOMINATOR IS DT=.1
4.2      A      NORAMB.K=TABLE(TAMB1,DEVA1.K,10,80,10)+TABLE(TAMB2,
X               DPER1.K,0,100,10)+TABLE(TAMB3,INFRIN.K,0,100,20)
X               +TABLE(TAMB4,COERC.K,0,100,20)
4.21     NOTE      NORMATIVE AMBIGUITY (% PEOPLE UNSURE ABOUT THE NORM)
4.3      A      COERC.K=YES*(1-CRISIS.K)+(NO*CRISIS.K)
4.31     NOTE      COERCIVE ENFORCEMENT (% NORMS COERCIVELY ENFORCED)
4.32     A      YES=TABLE(TCOER1,DYSFUN.K,0,100,20)
4.33     NOTE      DYSFUNCTION INFLUENCE ON COERCION WITH CRISIS
4.34     T      TCOER1=40/60/80/90/95/95
4.35     A      NO=TABLE(TCOER2,DYSFUN.K,0,100,20)
4.36     NOTE      DYSFUNCTION INFLUENCE ON COERCION WITHOUT CRISIS
4.37     T      TCOER2=10/15/25/45/65/70
4.4      A      DYSFUN.K=TABLE(TDYS2,OLD.K,0,100,20)
4.41     NOTE      OTHERS MADE AWARE OF DYSFUNCTIONS ( % )
4.42     T      TDYS2=1/1/15/60/75/80
4.43     NOTE      AMBIGUITY EFFECT ON PEOPLES AWARENESS OF DYSFUNCTIONS
4.5      A      PERMIS.K=CRISIS.K*GENBEL
4.51     NOTE      PERMISSIVENESS (DLESS: PRESENT=3,ABSENT=ZERO)
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        * GENERAL NORM EVASION MODEL -  VERSION  THREE (10.3.83)

4.6     A       STRSTR.K=BUREAU-TABLE(TSTR1,PERTEL.K,0,100,20)
X               +TABLE(TSTR2,COERC.K,0,100,20)
4.61    NOTE       STRUCTURAL STRAIN (% POP.CONSTRAINED TO EVADE)
4.62    T       TSTR1=0/10/15/17.5/19/20
4.63    NOTE       STRAIN  REDUCTION (% POP.  RELIEVED OF STRAIN)
4.64    T       TSTR2=0/10/25/55/70/80
4.65    NOTE       ADDTNL.  STRAIN (% ADDTNL CONSTRAINED TO EVADE)
4.66    NOTE
5.      NOTE       I N C R E A S E   A N D   D E C R E A S E   R A T E S
5.1     R       INCEVA.KL=TABLE(TINEVA,PERTEL.K,0,80,10)*IMPEDS
5.12    NOTE       YEARLY INCREASE OF EVADERS (%EVADERS PER YEAR)
5.13    T       TINEVA=1/2.5/4/5.2/6.2/7/7.6/8/8
5.14    NOTE       LEGITIMACY EFFECT ON EVADER INCREASE (% PER YEAR)
5.2     R       DECEVA.KL=TABLE(TDCEVA,COERC.K,0,100,20)
5.21    NOTE       YEARLY DECREASE OF EVADERS (% EVADERS PER YEAR)
5.22    T       TDCEVA=0/2/6/12/16/18
5.3     R       INCTEL.KL=(TABLE(TINTEL,DNOR.K,0,100,20)
X               +TABLE(TINPST,STRSTR.K,0,100,20))/2
5.32    NOTE       YEARLY INCREASE OF LEGITIMACY (% OTHERS TOLD PER YEAR)
5.33    T       TINTEL=0/4/6/8/9/10
5.34    NOTE       AMBIGUITY EFFECT ON LEGITIMACY INCREASE (% OTHERS/YEAR)
5.35    T       TINPST=0/4/6/8/9/10
5.36    NOTE       STRUCTURAL STRAIN EFFECT ON LEGITIMATION
5.37    A       DNOR.K=DLINF1(NORAMB.K,1)
5.38    NOTE       DELAYED INFLUENCE OF NORAMB ON INCTEL
5.4     R       DECTEL.KL=TABLE(TDECTL,DYSFUN.K,0,100,20)
5.41    NOTE       YEARLY DECREASE OF LEGITIMACY (% OTHERS TOLD/YEAR)
5.42    T       TDECTL=0/2/5/10/16/24
5.43    NOTE       EFFECT OF AWARENESS ON LEGITIMACY DECREASE (% OTHERS)
5.5     R       INCINF.KL=(TABLE(TPERT,DPER2.K,0,100,20)+TABLE(TEVAD,DEVA2.K
X               ,0,100,20)+TABLE(TINFR,INFRIN.K,0,100,20))*PERMIS.K/3
5.52    NOTE       % INCREASE IN OVERTLY INFRINGED NORMS
5.521   A       DPER2.K=DLINF1(PERTEL.K,1)
5.522   NOTE       ONE YEAR DELAY INFLUENCE OF LEGITIMACY ON INFRINGEMENT
5.523   A       DEVA2.K=DLINF1(EVADRS.K,2)
5.524   NOTE       TWO YEAR DELAY INFLUENCE OF EVADERS ON INFRINGEMENT
5.53    T       TPERT=0/.2/1/2/2.8/3
5.54    NOTE       LEGITIMATION EFFECT ON INFRIN INCREASE
5.55    T       TEVAD=0/1/2.5/3.5/4/4
5.56    NOTE       DEMONSTRATION EFFECT OF EVADERS ON INFRIN INCREASE
5.57    T       TINFR=0/2/3/2/1/0
5.58    NOTE       DEMONSTRATION EFFECT OF INFRINGED NORMS ON INFRIN INCREASE
5.6     R       DECINF.KL=(TABLE(TDYS5,DYSFUN.K,0,100,20)+TABLE(TCOER3,
X               COERC.K,0,100,20))/2
5.62    NOTE       % DECREASE IN INFRINGED NORMS
5.63    T       TDYS5=0/2/5/7/8/8.5
5.64    NOTE       DYSFUN EFFECT ON INFRIN DECREASE
5.65    T       TCOER3=0/3/6.5/9/12/14
5.66    NOTE       COERCION EFFECT ON INFRINGEMENT DECREASE

        END
SPEC DT=.1/LENGTH=40/PRTPER=1/PLTPER=.4
PLOT EVADRS=E(0,100)/PERTEL=P(0,100)/INFRIN=I(0,100)/NORAMB=N(0,100)/
X STRSTR=S(0,100)/COERC=O(0,100)/DYSFUN=D(0,100)/CRISIS=X(0,1)
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