The 1900 Revision of German Divorce Laws

Analysis of Data as a Time-Series Quasi-Experiment

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In 1959, Wolf, Lüke, and Hax published *Scheidung und Scheidungsrecht (Divorce and Divorce Law),* dealing with the effects of revision of German divorce laws in 1900 on the rates of divorce and petition for divorce. This paper is a reanalysis of Wolf, Lüke, and Hax's data with newly developed inferential statistical models, and a reappraisal in light of appropriate statistical analyses of their conclusions and those of Max Rheinstein (1960) in his review of their work.

THE LEGISLATION

On January 1, 1900, the new Civil Code of the German Empire went into effect. The Civil Code brought about a general "tightening up" of divorce laws, having been drafted in a spirit of hostility toward divorce and with the intention of reversing the steadily increasing divorce rate. (Divorce per 100,000 inhabitants in Germany rose from 8.7 in 1881 to 17.0 in 1899.) Under the new law, divorce was to be granted only in the case of guilty misconduct; divorce was not to be allowed in cases where there

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was merely mutual agreement that the marriage should be dissolved or even where the marriage had been thoroughly disrupted.

The new Civil Code was uniform across the German states, whereas divorce laws in effect in the various states prior to 1900 were of three general types. The impact of the new Civil Code may have depended upon the particular divorce laws in effect before 1900; thus it is advisable to analyze the effect of the new Civil Code on the divorce rate for three groups of states—corresponding to the three types of pre-1900 legislation—as well as for the German Empire as a whole.

In approximately eight states, divorce was governed by laws of the Prussian General Code prior to 1900. The Prussian Code was the most lenient of the three as regarded divorce. Divorces were granted in cases of misconduct, mutual agreement, and even upon grounds of "insuperable aversion" of one party for the other. The Prussian Code recognized "disruption" of the marriage beyond repair as grounds for divorce.

In contrast to the lenient Prussian Code, the German common law embodied ecclesiastical law concerning divorce. Catholics were not allowed to divorce, and only grave misconduct was grounds for dissolution of a Protestant marriage. German common law was in effect in twelve states prior to 1900.

The Code Napoléon, similar in substance to the German common law, was in effect in approximately four states. Divorce was allowed only in cases of guilty misconduct; disruption of a marriage constituted insufficient grounds for divorce. (Divorce by mutual agreement was a legal possibility but rarely occurred in practice due to burdensome legal procedures.)

Under the new Civil Code, effective in January of 1900, divorce was to be granted solely on the grounds of guilty misconduct by one partner (adultery, desertion, extreme cruelty, and so on). Divorce by mutual agreement was abolished. The enlightened "disruptive" principle of the Prussian Code was totally displaced by the guilt principle in the new Civil Code. Presumably, divorce became far more difficult for those who formerly lived under the Prussian Code; it became generally easier to obtain for those formerly under the common law (divorce was legally available to Catholics in ex-common law states for the first time).

THE DATA AND THE DESIGN

Two sets of data are available which bear on the question of the effects, if any, of the revision of the divorce laws: decrees of divorce per 100,000 population (the divorce rate), and petitions for initiation of reconciliation proceedings per 100,000 population (mandatory under German law both before and after 1900). These data were reported by Wolf, Lüke, and Hax (1959) for the period 1881-1914. Neither index enjoys unassailable validity as a measure of marital accord. One with faith in the ability of marital partners to repair a disrupted marriage in due time will regard the divorce rate as most significant. To them, the prevention of broken homes at all costs is a worthy goal. Others may regard the rate of petition for reconciliation (which in reality is the initiation of divorce proceedings) as a more valid measure of marital accord; they would argue that marital accord is the more significant variable to attempt to measure since any country can reduce its divorce rate to zero by making divorce illegal (as witness, Italy in the past) without materially affecting the stability of the home. This is not the place to evaluate the social and human value of liberal divorce laws, although it is entirely within the means of the present-day social sciences to do so. Hence, analyses of both indexes will be performed here.

The period from 1881 through 1914 and the intervening revision of the divorce laws can be regarded as an interrupted time-series quasi-experiment (Campbell and Stanley, 1963; Lempert, 1966) for the purpose of assessing the effects of the legislative change. Diagrammatically, the design of the quasi-experiment is as follows:

$$O_1, O_2, \ldots, O_{n_1} \; T \; O_{n_1+1}, \ldots, O_{n_1+n_2},$$

where O_j represents the j^{th} successive observation of the divorce rate, say, and T represents the "treatment"—in this case, the revision of the divorce laws.

If the trend of the pre-T observations is altered sharply by the introduction of T, we are inclined to attribute the alteration (whether it be a change in level, change in direction of drift, or the

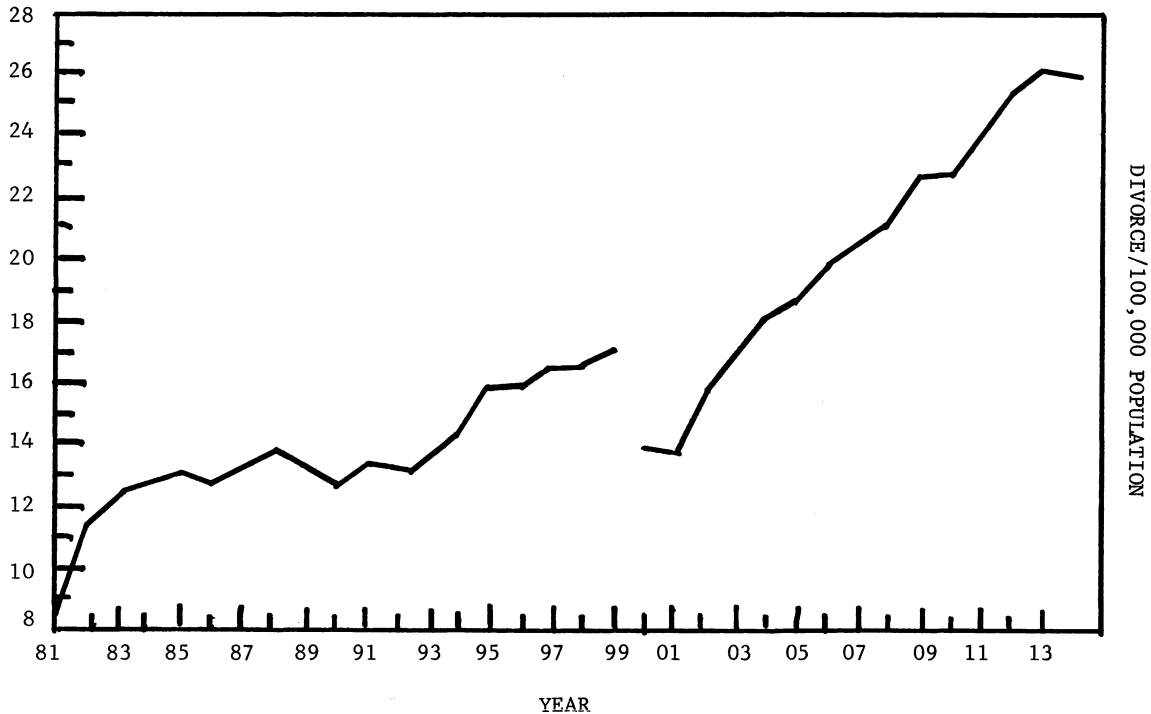

Figure 1: DIVORCE RATE FOR GERMAN EMPIRE (1881-1914).

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like) to T. A particularly important problem is to determine whether the activity of the time-series in the neighborhood of T indicates a genuine effect of T or whether it is merely an orderly continuation of an undisturbed time-series. We judge the problem to be particularly important because the inferential statistical intuitions of social scientists seem seldom to have been developed on nonindependent observations (as are in evidence in most time-series), thus formal statistical significance tests are a necessary overseer of "considered impressions" we might form of the data.

The divorce rate (divorce/100,000 persons) for all of Germany from 1881 through 1914 is plotted in Figure 1. In Figure 2 appears the rate of petitioning for reconciliation proceedings from 1881 through 1913. Both indexes are plotted in Figure 3 for those states under the Prussian Code prior to 1900; the same data appear in Figures 4 and 5 for the states under the common law and Code Napoléon prior to 1900, respectively.

STATISTICAL ANALYTIC TECHNIQUES

Finding an appropriate inferential statistical analysis for data from a time-series experiment has been recognized as an important problem (Campbell, 1963; Campbell and Stanley, 1963). The data in Figure 1 offer an excellent illustration of the need to perform a valid inferential statistical analysis in which the probabilities of incorrect decisions can be known exactly and controlled. Figure 1 seems to show the expected drop immediately after the change of legislation in 1900.[1] In fact, the movement of the divorce rate index is larger between 1899 and 1900 than between any other pair of years. However, the 3-point decline in that year is only 0.2 larger than the 2.8 rise between 1881 and 1882. It would seem incautious, then, to attempt to draw any conclusions by mere inspection of the data or by the application of intuitive judgment.

Wolf, Lüke, and Hax (1959) considered analyzing the data in Figures 1 through 5 by fitting least-squares regression lines (dependent variable–divorce rate; independent variable–year) to the pretreatment and posttreatment data separately and testing

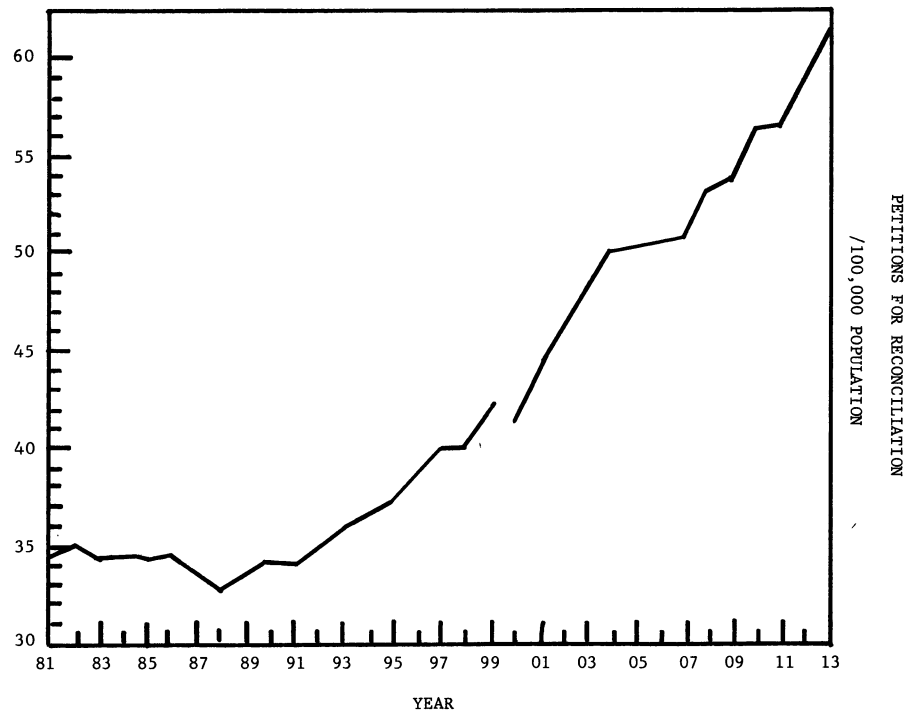

Figure 2: PETITION FOR RECONCILIATION RATE FOR GERMAN EMPIRE (1881-1913).

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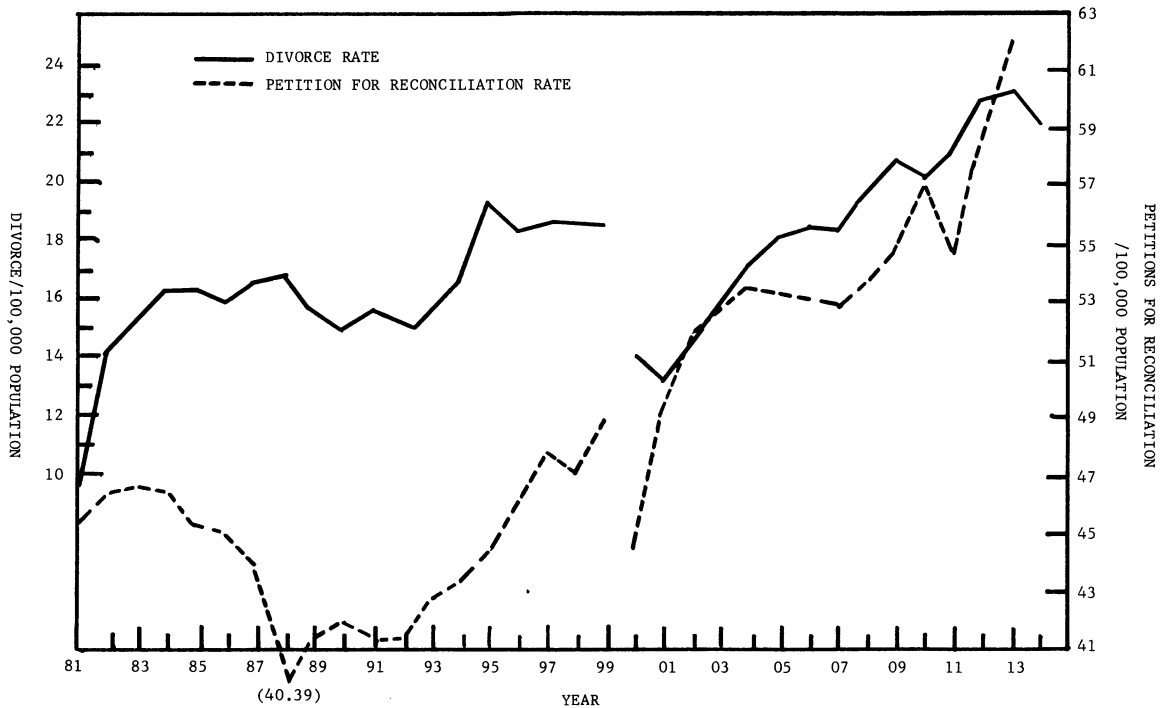

Figure 3: DIVORCE AND PETITION FOR RECONCILIATION RATES FOR STATES UNDER PRUSSIAN CODE PRIOR TO 1900.

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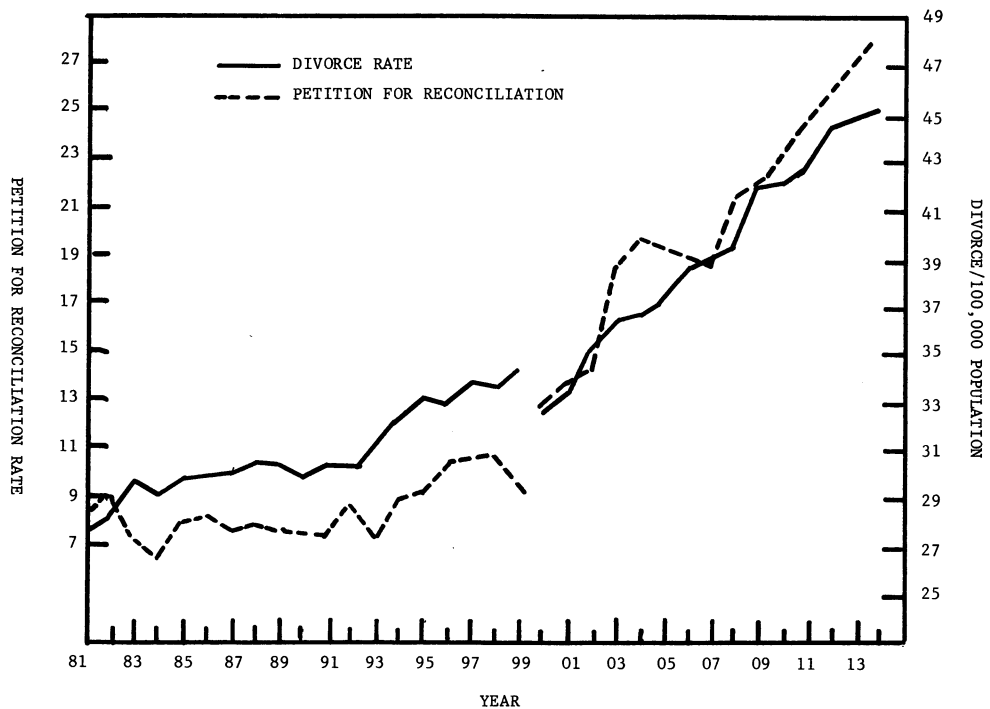

Figure 4: DIVORCE AND PETITION FOR RECONCILIATION RATES FOR STATES UNDER COMMON LAW PRIOR TO 1900.

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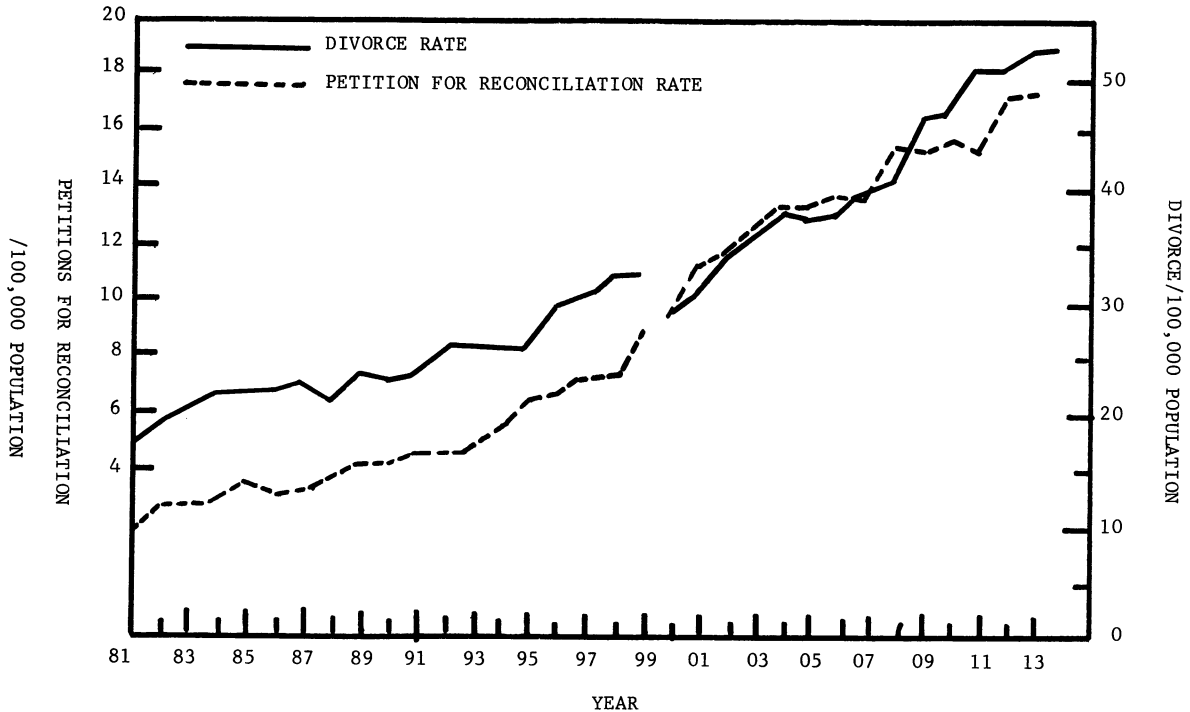

Figure 5: DIVORCE AND PETITION FOR RECONCILIATION RATES FOR STATES UNDER CODE NAPOLEON PRIOR TO 1900.

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"whether the two lines connect" or whether the datum for 1900 appears to be a simple extrapolation of the pretreatment regression line. Their suggestion is equivalent to the "Mood-test" suggested by Campbell and Stanley (1963: 213). Wolf, Lüke, and Hax recognized the shortcomings of their suggestion and refrained from any inferential statistical analysis. They stated their concerns about statistical procedures for analyzing their data as follows:[2]

> If the post-treatment regression line connects directly with the pre-treatment regression line, then the change of laws has not brought about a shift of level. If, however, it lies higher or lower, the possibility exists that we are dealing with an effect of the new laws. . . .
>
> Where, in fact, a material shift can be established, it is a question of ascertaining whether this shift is to be ascribed to the influence of the change of laws. This can only be accepted when the data show that the shift of level occurred exactly between 1899 and 1900.
>
> One could suppose that the data are randomly distributed around the regression line. The shift in level between 1899 and 1900 could be regarded as significant under this assumption if the datum for 1899 lay within the chance region surrounding the pre-treatment regression line, but the datum for 1900 fell outside this chance region. Onc could run the alternative test and establish whether the datum for 1900 lies within the chance region of the post-treatment regression line and the datum for 1899 lies outside of the chance region around this regression line.
>
> If one were to proceed in this way, then one would have to make use of the standard deviation, σ, in ascertaining the limits of the chance region. The standard deviation of a series of values is given by the quadratic mean of all deviations of the individual values from the arithmetic mean. In the case of a regression line, the deviations of the data from the corresponding predicted value take the place of the deviations from the arithmetic mean. If there exist reasons for assuming that the data are distributed as a Gaussian (normal) distribution, then the probabilities would amount to .6827, .9545, and .9973 that a value deviates less than one, two and three standard deviations, respectively, from the mean. For a deviation of a value from the mean of more than three standard deviations it could be assumed rather safely that a special influence instead of a chance fluctuation is being exhibited. The same conclusion would no doubt be clear if the deviation were merely two standard deviations from the regression line.
>
> It can not be assumed, however, that the process is representative of the present case. Can it be assumed that the fluctuations of the number of

> divorces are the result of a neutral and unchanging law of a random distribution? Is the number of divorces described as the result of a series of mathematically isolatable factors? Is the chance region into which this number must fall unequivocally determined when these factors remain constant? The answers to these questions have been given in part previously. [See page 12 in Wolf, Lüke, and Hax, 1959.] There exists little inducement to assume that the data are distributed around the regression line according to a constant mathematical distribution law let alone according to the law for the Gaussian normal distribution. Hence, the calculation of chance regions in this connection appears to be senseless.

Wolf, Lüke, and Hax seem overly concerned about the validity of the assumption of a normal distribution. And, in fact, in the passage quoted and on page 12 of their book they express reservations about the validity of any stochastic model as a representation of a social system. They appear to argue that "chance" is an inadequate explanation of social phenomena for which we can find explanations, and they appear to draw some gratuitous connection between the normal distribution and chance phenomena. We can with good success predict and "explain" human stature; the fact that height tends to be normally distributed in adults does not mean that stature is the result of unknown, chance influences.

A valid inferential statistical analysis is available for time-series experiment data, but it is more difficult than fitting and extrapolating least-squares regression lines.

Box and Tiao (1965) developed a method of evaluating the change in level between two successive points in time of a nonstationary time-series. Observations z_t are taken at equally spaced time intervals, and one wishes to make inferences about a possible shift in level of the time-series associated with the occurrence of an event at a particular point in time. If there is an abrupt shift in the level of time-series subsequent to the event, evidence of a treatment effect may exist.

The statistical model underlying the Box-Tiao analysis of change in level of a time-series was the integrated moving average model.

$$z_1 = L + \alpha_1 \text{ and } z_t = L + \gamma \sum_{i=1}^{t-1} \alpha_i + \alpha_t \qquad [1]$$

for the n_1 observations prior to the introduction of T, and

$$z_t = L + \delta + \gamma \sum_{i=1}^{t-1} \alpha_i + \alpha_t \qquad [2]$$

for the $n_2 = N - n_1$ observations following T, where:

z_t is the value of the variable observed at time *t*,

L is a fixed but unknown location parameter,

γ is a parameter descriptive of the degree of interdependence of the observations in the time-series and takes values $0 < \gamma < 2$,

α_t is a random normal deviate with mean 0 and variance σ^2,

δ *is the change in level of the time-series caused by T.*

Essentially the model implies that the system is subjected to periodic random shocks, α_t (with zero mean), a proportion (γ) of which are absorbed into the level of the series. Data which conform to the model in (1) and (2) are such that the graph of the time-series follows an erratic, somewhat random path with slight, *but no systematic drifts, trends, or cycles.* Data which show a systematic increase or decrease over time—such as population and various growth curves—violate the assumption of zero mean for the random variable α. For generality, the random variable portion of the model can be allowed to assume an expected value other than zero; thus "drifting" time-series—those showing a constant rise or fall over time—can be accommodated. The generalization of the model in (1) and (2) is called the "integrated moving average model with deterministic drift"[3] and takes the following form:

$$z_1 = L + \beta_1 \text{ and } z_t = L + \gamma \sum_{i=1}^{t-1} \beta_i + \beta_t, \qquad [3]$$

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for the n_1 observations prior to the introduction of T, and

$$z_t = L + \delta + \gamma \sum_{i=1}^{t-1} \beta_i + \beta_t, \qquad [4]$$

for the $n_2 = N - n_1$ observations following T,
where L, γ, and δ are interpreted as in the model in (1) and (2), but now β is a normal variable with variance of σ^2 *and mean equal to* μ. The parameter μ describes the rate of ascent or descent of the time-series.

It is illuminating to express β as $\mu + \alpha$ and manipulate (3) into a form similar to (1):

$$z_t = L + \mu\gamma\,(t\text{-}1) + \mu + \gamma \sum_{i=1}^{t-1} \alpha_i + \alpha_t \qquad [5]$$

One sees by inspection of (5) that the time-series in (3) will be expected to have "drifted" $\mu\gamma t$ units at time t.

In the setting of the time-series quasi-experiment, interest centers on estimating δ in (4) and testing its significance. The following steps lead to the least-squares estimate of δ and its distribution.

By setting $y_1 = z_1$, and $y_t = z_t - \gamma \sum_{j=0}^{t-2} (1\text{-}\gamma)^j z_{t-1-j}$, the model can be written as $Y = X\theta + e$ where X is defined as an N x 3 matrix of weights as follows:

$$X^T = \left[\begin{array}{cccc:ccc} 1 & 1 & \dots & 1 & 1 & \dots & 1 \\ 1 & (1-\gamma) & \dots & (1-\gamma)^{n_1-1} & (1-\gamma)^{n_1} & \dots & (1-\gamma)^{N-1} \\ 0 & 0 & \dots & 0 & 1 & (1-\gamma) & \dots & (1-\gamma)^{n_2-1} \end{array}\right]$$

θ is a 3 x 1 vector such that $\theta^T = (\mu\ L\ \delta)$; and e is an N x 1 vector of random normal deviates, $e^T = (\alpha_1 \dots \alpha_N)$, the elements of which have mean μ and variance σ^2.

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When γ is known, simple least-squares estimates of μ, L, and δ can be found from the familiar solution to the least-squares normal equations:

$$\hat{\theta} = \begin{bmatrix} \hat{\mu} \\ \hat{L} \\ \hat{\delta} \end{bmatrix} = (X^T X)^{-1} X^T Y \qquad [6]$$

The least-squares estimates in (6) each have a *t*-distribution with $N - 3$ degrees of freedom when divided by appropriate estimates of their standard error. In particular,

$$(\hat{\mu} - \mu) / (s\sqrt{c^{11}}) \sim t_{N-3}, \qquad [7]$$

$$(\hat{L} - L) / (s\sqrt{c^{22}}) \sim t_{N-3}, \text{ and} \qquad [8]$$

$$(\hat{\delta} - \delta) / (s\sqrt{c^{33}}) \sim t_{N-3}, \text{ where} \qquad [9]$$

$s^2 = (Y^T Y - \theta^T X^T X \theta) / (N-3)$ and c^{jj} is the j^{th} diagonal element of $(X^T X)^{-1}$.

The above results follow from the linear model $Y = X\theta + e$ in which the errors, *e*, are assumed to be normal, homoscedastic, and independent. The quantity s^2 is the residual variance, i.e., the variance of *y* after the model $X\hat{\theta}$ is fitted to it.

All of the above operations on the linear model are made for a given value of γ. When γ is unknown (as will generally be true) a Bayesian analysis using sample information about γ is used in making inferences about δ. The posterior distribution, $h(\gamma \mid z)$, of γ, given a set of *N* observations and assuming a uniform prior distribution, is known to within a constant of proportionality. The posterior distribution of γ, assuming a uniform prior distribution (in which case the posterior distribution is equivalent to the likelihood distribution of γ), is given to within a constant of proportionality by the following formula:

$$(\gamma \mid z) \propto |X^T X|^{-\frac{1}{2}} s^{-(N-3)}. \qquad [10]$$

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Illustrations of how the posterior distribution of γ in (10) is considered jointly with $\hat{\delta}$ in making inferences about δ for the simple integrating moving average model in (1) appear in Box and Tiao (1965) and Maguire and Glass (1967).

DATA ANALYSIS AND RESULTS

The data in Figure 1 were subjected to the analysis outlined in Section 3.[4] In Figure 6 appear graphs of the likelihood distribution of γ and the t-statistic in (7) for testing the significance of the deviation of $\hat{\delta}$ from a hypothesized value of 0. Nearly all of the mass of the likelihood distribution of γ is contained between the values 0.50 and 1.90. The maximum likelihood estimate of the unknown γ is approximately 1.13. The value of $t = \hat{\delta} / \hat{\sigma}(\hat{\delta})$ is clearly significant—it is never greater than -4.50—over the entire range of likely values of γ. The hypothesis $H_0 : \delta = 0$ can be confidently rejected in favor of the alternative that $\delta < 0$. If δ were truly zero, an abrupt shift in the time-series as great as that observed in Figure 1 would occur less than one time in 1,000. Thus we see that the downward shift of the rising divorce rate after 1900 is quite statistically significant; chance can safely be discounted as the explanation of the downward movement of the time-series after 1900. Inspection of Figure 1 seems to indicate that the effect of revision of the divorce laws was temporary. The conclusion that the effect of the change in legislation was temporary depends upon the perhaps gratuitous assumption that the trend from 1881 to 1913 would have been linear (as opposed to curvilinear) in the absence of legislative change. (We shall return to this point in the final section of the paper.)

The results of the analysis of the data in Figure 2 appear as Figure 7. The dotted lines on Figure 7 indicate the values below which t must fall to allow rejection of $\delta = 0$ in favor $\delta < 0$ at the .05, .025 and .005 levels of significance. The graphs of $h(\gamma \mid z)$ and t present a picture of somewhat marginal statistical significance. The value of t is significant at the .05 level and beyond for γ above 1.09. The fact that approximately 80% of the likelihood distribu-

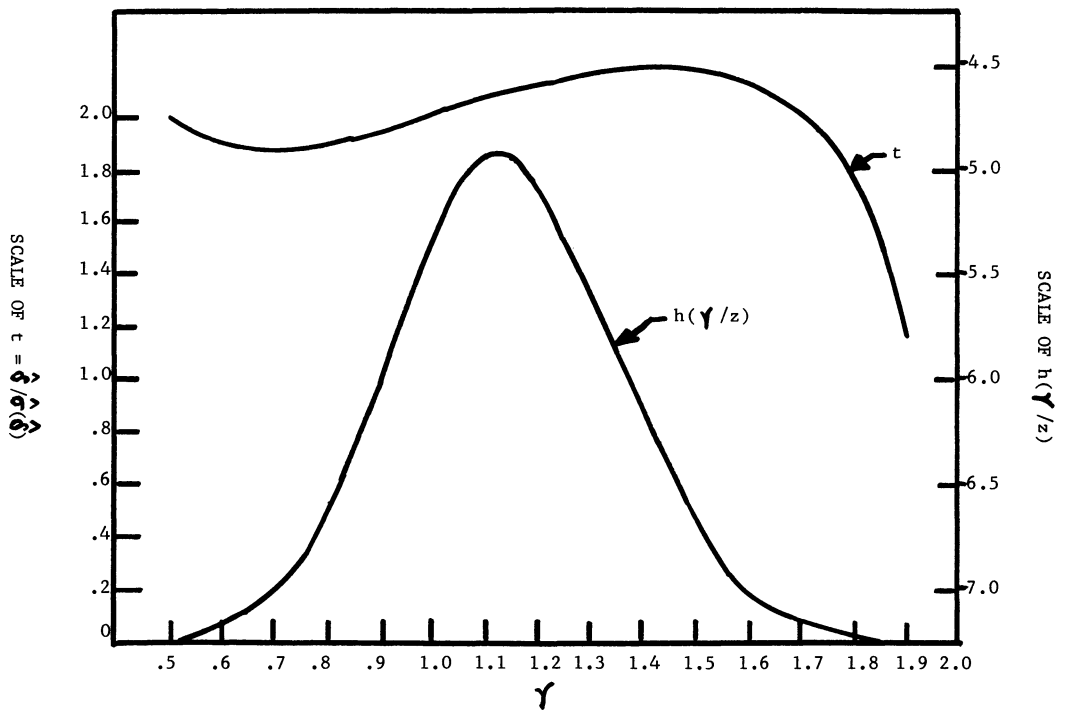

Figure 6: ANALYSIS FOR CHANGE IN LEVEL AT 1900 OF DIVORCE RATE FOR GERMAN EMPIRE (data in Figure 1).

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tion of γ exceeds 1.09 lends support to rejection of $\delta = 0$ in favor of $\delta < 0$ at a respectable level of significance.

The analysis in Figure 7 of the petition for reconciliation rate data in Figure 2 is particularly interesting in that visual inspection of the time-series leaves an impression of no treatment effect, which is at variance with the results of the statistical analysis. Wolf, Lüke, and Hax (1959) and Rheinstein (1960) concluded that the revision of the divorce laws in 1900 had no effect on the rate of petition for reconciliation. It is difficult to interpret whether these authors are using the terms "no effect" to mean "no statistically significant effect," "no socially significant effect," or "no permanent effect." In the first sense, one could reasonably take issue with the conclusion of "no treatment effect." It is not our purpose to argue the validity of conclusions of "no effect" in the second and third senses.

The average divorce and petition for reconciliation rates for the twelve Prussian Code states are graphed in Figure 3. The graphs of the data create a distinct impression of a strong effect due to the revision of legislation in 1900. The analyses performed on these data, but not reported here, substantiate the statistical significance of the observed downward shifts in the divorce rate and the petition for reconciliation rate. For the divorce rate, the value of $t = \hat{\delta} \,/\, \hat{\sigma}(\hat{\delta})$ is never greater than -3.90; t is approximately -4 at the maximum likelihood estimate of γ. It can be confidently concluded that the divorce rate shifted downward at 1900 in the twelve states under the Prussian Code prior to 1900. The petition for reconciliation rate also showed a significant downward shift at 1900; t was less than -3 for all likely values of γ. As was pointed out earlier, the new Civil Code instigated in 1900 constituted a tightening of divorce laws in those states previously under the Prussian Code. Introduction of the new legislation should have worked a negative effect upon the divorce and petition for reconciliation rates. Such effects are observable in the data in Figure 3, and the statistical analysis reveals the observations to be inferentially reliable.

The average divorce and petition for reconciliation rates for eight common law states are graphed in Figure 4. Inspection of the behavior of both time-series in the vicinity of 1900 would

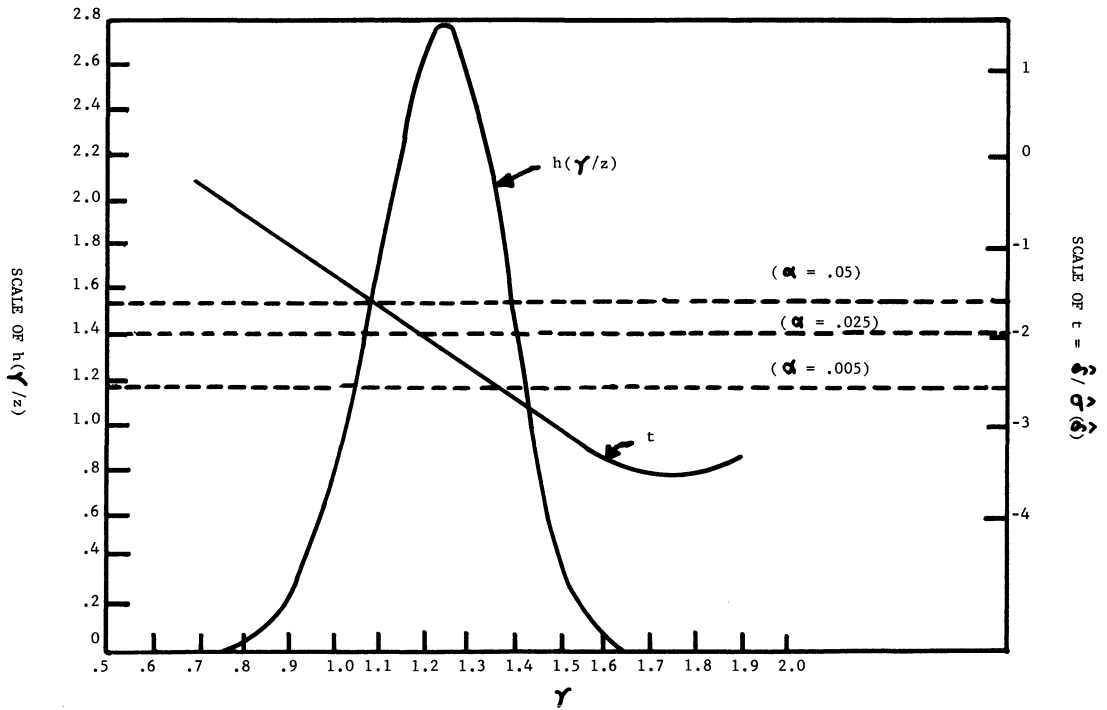

Figure 7: ANALYSIS FOR CHANGE IN LEVEL AT 1900 OF PETITION FOR RECONCILIATION RATE FOR GERMAN EMPIRE (data in Figure 2).

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probably lead to no confident conclusions about the possibility of treatment effects. The petition for reconciliation rate increases from 1899 to 1900, but not dramatically so. The decrement in the divorce rate from 1899 to 1900 is even less dramatic, and cannot by mere inspection be confidently ruled out as a chance occurrence. The analyses for change in level of the petition for reconciliation and divorce rates at 1900 were performed by the methods presented in the earlier portions of this paper. The value of t is less than -3 for all likely values of γ in the analysis for change in level of the divorce rate. Hence, the rather small downward shift in the divorce rate is nonetheless statistically significant and cannot reasonably be attributed to chance. The shift in level of the petition for reconciliation rate is equally statistically significant for the common law states; however, whereas there was a *decrement* in the divorce rate at 1900, there was a statistically significant *increment* in the petition for reconciliation rate. It should be recalled that under the new Civil Code, divorce became legal for Catholics in common law states for the first time. One might speculate that the data support the conclusion that the new Civil Code brought about petitions for reconciliation from Catholics in the common law states, but that the courts retained their unsympathetic attitude toward divorce. Of course, such speculation goes far beyond the data.

The average divorce and petition for reconciliation rates for four states under the Code Napoléon prior to 1900 are graphed in Figure 5. There appears to be a downward shift of level in the divorce rate at 1900; however, the petition for reconciliation rate does not appear to have been affected by the introduction of the new Civil Code. This latter observation is borne out by the failure of $t = \hat{\delta} \,/\, \hat{\sigma}(\hat{\delta})$ to attain significance in the test for a change in level at 1900 of the petition for reconciliation rate. Thus we observe no statistically significant drop in the rate of petitioning for reconciliation in the four states under the Code Napoléon prior to 1900. However, the data on the divorce rate for the Code Napoléon states do show a statistically significant downward shift at 1900.

CONCLUSIONS

The conclusions we shall draw from the above analyses are at variance with those drawn by Wolf, Lüke, and Hax (1959) and

Rheinstein (1960). With respect to petitions for reconciliation proceedings, Wolf, Lüke, and Hax concluded the following:

> The introduction of the new Civil Code [in 1900] has not reduced the increase of the number of petitions for conciliation proceedings and has thus not reduced the extent of the divorce desire. Preponderantly the new law has not had any effect in this respect. In some regions in which the divorce law was liberalized one can observe a certain increase of the trend. It is by no means certain, however, whether this increase would not have occurred independent of the change in the law. Nowhere was the progressive trend retarded. Even in the regions of the Prussian law, where the divorce law was tightened, the trend did not change in any significant way.[5]

Rheinstein (1960: 493) observed that Wolf, Lüke, and Hax were "certainly justified in concluding that the draftsmen of the new code have failed in their expectation of reducing the desire for divorce."

With respect to the divorce rate, Wolf, Lüke, and Hax concluded that "the shape of the law of divorce was neither the cause of the divorce wave nor even one of its essential conditions. In the face of other circumstances, the influence of the law did not make itself felt at all."[6]

Rheinstein (1960: 495: italics added) concurred:

> . . . before 1900 the [divorce rate] was rising in the districts of most and, since 1900, in those of all appellate courts. In a few court districts the trend shows a slight downward break in 1900. The majority of the latter districts belongs to the region of the Prussian Code, but there are among them also two districts of Protestant common law. In all these districts the break is small, and the trend rose continuously after 1900. While the break in the Prussian law districts may be attributed to the change of the law, *it was insignificant and without lasting effect.* Nowhere did the change turn the trend downward; and nowhere did it prevent its continuous rise.

Both *Scheidung und Scheidungsrecht* and Rheinstein's review leave us with the conclusion:

> The experiment made by makers of the Civil Code refutes the notice [sic] that a limitation of the statutory catalogues of grounds for divorce to situations of guilt could result in a reduction of the number of

> divorces or even in their rate of increase. On the other hand, the present Marriage Law [of 1938] has refuted the apprehension that the introduction of the disruption principle would naturally result in an increase in divorce. *No causal or even statistical connection exists in one direction or the other.*[7]

Rheinstein saw Wolf, Lüke, and Hax's work as confirmation of Willcox's conclusion that "the immediate, direct and measurable influence of legislation is subsidiary, unimportant, almost imperceptible" (Willcox, 1897).

We contend that the conclusions just stated make an unfortunate use of the word "significant" and that they depend for their validity upon extrapolations of pre-1900 trends for which there exist neither compelling logical reasons nor convincing empirical evidence. Furthermore, we feel that the only conclusion which may be drawn from the data with confidence is that the effect of the introduction of the new Civil Code in 1900 is clearly reflected in both the divorce rate and the petition for reconciliation rate.

In the past, social scientists all too frequently extended the meaning of the term "significant" beyond its strictly appropriate application to statistical hypothesis-testing and made unwarranted interpretations of social value, merit, or importance of data when they were merely inferentially reliable—the appropriate meaning of "statistically significant." Having been disabused of this confusion, contemporary social scientists now proceed quite cautiously in applying the words "significant" or "insignificant" to data; they are careful to read inferential reliability into the words and nothing else. Thus, Rheinstein risked serious misinterpretation of the facts when he chose to call the break in the divorce rate curve at 1900 "insignificant" without the benefit of a valid statistical analysis and without apprising the reader of the value system against which he judged the downward shift to be without social value or importance—the popular sense of "insignificant." We have shown that the changes in level of the divorce and petition for reconciliation rate around 1900 are statistically significant (with the exception of the petition for reconciliation rate in the Code Napoléon states). It does not seem justifiable to refer to the shifts in level as "insignificant" in any inferential statistical sense.

It was also concluded by Rheinstein that if any effect of the 1900 revision of the divorce laws did occur it was "temporary" or "without lasting effect." It was claimed that, granting a remote possibility of an effect of the new Civil Code, the graphs of the divorce rate and petition for reconciliation rate quickly returned to a trend line one could extrapolate from the pre-1900 trends. Such a casual impression can be read into the graphs in Figures 1-5, though in most instances it is equally easy to confirm an impression of the decrement accruing during 1900 lasting through 1914. However, both impressions are uncritical. Must one assume that a somewhat linear trend from 1881 to 1899 should continue from 1900 to 1913 or 1914? The answer is, of course, that one need not. In fact, to do so is a matter of faith. One could argue that the new Civil Code was instrumental in preventing an exponential increase of the divorce and petition for reconciliation rates after 1900.[8] But to argue either point goes beyond the data. Without comparable "control groups"—states like those in the German Empire whose divorce laws were not revised in 1900—no unequivocal answer can be given to the question "What would the post-1900 trend of the divorce and petition for reconciliation rates have been? "

However, a compelling argument can be advanced for the temporary nature of the effect of the legal revisions if one accepts the assumption that the pre-1900 and post-1900 divorce rate trends are comparable in terms of growth rate. An analysis like that reported in Figure 6 was performed on the data in Figure 1; but in this instance the four observations for the years 1900-1903 were removed. (This was done since visual inspection of the time-series supported a "temporary effect" of four years' duration.) If the impact of the revision of the divorce laws was temporary, the statistical analysis should yield no significant change in level of the time-series with the data for 1900-1903 deleted. The results of the analysis did in fact show every evidence of an uninterrupted time-series from 1881-1914 when the divorce rates for 1900-1903 were deleted. Hence, the argument that the effect of the revision upon the divorce rate for the entire nation was temporary is supported by the statistical analyses under the assumption that the acceleration of the time-series after 1900 should have been equal to the pre-1900 acceleration.

Previous discussions of the data in *Scheidung und Scheidungsrecht* by Rheinstein and Wolf, Lüke, and Hax have discredited the one conclusion which can be drawn with defensible validity. The time-series quasi-experiment rivals the completely randomized experimental design for validity in some instances. But the inference which enjoys a healthy measure of validity concerns an instantaneous shift in the level of the time-series at the introduction of the experimental treatment and not suppositions about how the time-series should behave long after the treatment has been introduced. Whether the effects were temporary or relatively permanent cannot be determined with a high degree of confidence from the available data. The possibility that the effects were temporary should not be cited as though it somehow calls into question the one conclusion for which convincing evidence exists, namely that both the divorce and petition for reconciliation rates show the effect of adoption of the new Civil Code in 1900.

NOTES

1. There are eighteen observations for the nineteen years from 1881 to 1899. Divorce data were not available for the entire German Empire in 1892 and 1893. The observation graphed halfway between 1892 and 1893 is an estimate determined in Wolf, Lüke, and Hax (1959).

2. Wolf, Lüke, and Hax (1959: 129-132). The following passage was rather freely rendered from the original German, but it is substantially correct.

3. The "integrated moving average model with deterministic drift" was presented by G. E. P. Box and G. M. Jenkins (1970: 119-120).

4. Before such analyses are performed, one should be satisfied that the model in (4) is a reasonably good representation of the data. One condition that data following the model in (4) must satisfy is stated in terms of the correlogram of the *differences* between successive observations, i.e., $z_{t+1} - z_t$. The lag 1 autocorrelation coefficient should approximate $-(1 - \gamma) / [1 + (1 - \gamma)^2]$, and lag 2 and greater autocorrelation coefficients of $z_{t+1} - z_t$ should approximate zero for the 18 pretreatment observations. The lag 1 autocorrelation of the 17 differences $z_{t+1} - z_t$ was 0.127, which corresponds reasonably closely to the expected value—calculated from the maximum likelihood estimate of γ—of 0.100. The lag 2 through lag 9 autocorrelations were .027, .033, -.419, -.013, .003, -.434, -.504 and .155, respectively.

5. The translation is due to Rheinstein (1960: 493).

6. Translation due to Rheinstein (1960: 495).

7. Translation due to Rheinstein (1960: 498).

8. In the United States, the divorce rate was rising at a faster rate during the second half of the period from 1887 to 1914 than it was during the first half of that period. The divorce rate rose 31 points (47 to 78) from 1887 to 1902, but it rose 42 points (78 to

120) from 1902 to 1917. A comparison of the pre-1900 and post-1900 trend lines for both the divorce rate and the petition for reconciliation rate in Germany reveals about the same acceleration of the rates after 1900. Thus the notion that an apparent "return" of the divorce rate to a line extrapolated from the pre-1900 trend is evidence of only a temporary treatment effect is called into question.

REFERENCES

BOX, G. E. P. and G. M. JENKINS (1970) Time Series Analysis: Forecasting and Control. San Francisco: Holden-Day.

BOX, G. E. P. and G. C. TIAO (1965) "A change in level of a non-stationary time series." Biometrika 52 (June): 181-192.

CAMPBELL, D. T. (1963) "From description to experimentation: interpreting trends as quasi-experiments," chapter 12 in C. W. Harris (ed.) Problems in Measuring Change. Madison: Univ. of Wisconsin Press.

--- and J. C. STANLEY (1963) "Experimental and quasi-experimental designs for research on teaching," pp. 171-246 in N. L. Gage (ed.) Handbook of Research on Teaching. Chicago: Rand McNally.

LEMPERT, R. (1966) "Strategies of research design in the legal impact study: the control of plausible rival hypotheses." Law and Society Rev. 1 (November): 111-132.

MAGUIRE, T. O. and G. V GLASS (1967) "A program for the analysis of certain time-series quasi-experiments." Educational and Psych. Measurement 27 (Autumn): 743-750.

RHEINSTEIN, M. (1960) "Divorce and the law in Germany: a review." Amer. J. of Sociology 65 (March): 489-498.

WILLCOX, W. F. (1897) The Divorce Problem: A Study in Statistics. New York: Columbia University.

WOLF, E., G. LUKE, and H. HAX (1959) Scheidung und Scheidungsrecht: Grundfrägen der Ehescheidung in Deutschland. Tübingen: J. C. B. Mohr.