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SIMULTANEOUS TRANSFER FUNCTION ANALYSIS OF OKUN'S MISERY INDEX: IMPROVEMENTS IN THE ECONOMIC QUALITY OF LIFE THROUGH MAHARISHI'S VEDIC SCIENCE AND TECHNOLOGY OF CONSCIOUSNESS

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This paper analyzes the time series behavior of Okun's economic "misery index," defined as the sum of the monthly inflation rate and unemployment rate, for the U.S. during the period 1979 to 1988. The misery index provides a useful summary measure of macroeconomic performance and the economic dimension of the quality of life. Using Liu's linear transfer function (LTF) approach to the identification of multiple-input transfer function equations, augmented by the use of the AIC criterion in model identification, we identify and estimate a three-equation simultaneous transfer function (STF) model of the misery index, monetary growth, and the rate of change of crude materials prices. The multiple time series model is used to assess the major factors contributing to the dramatic reversal in the early 1980s of the historical upward trend of the index. The principal focus of the empirical analysis is to examine the role of a key explanatory factor suggested by a field theory of consciousness and human behavior proposed by Maharishi Mahesh Yogi. The theory predicts that the collective practice of the Transcendental Meditation and TM-Sidhi program by a single group comprising the square root of one percent of the national population will lead to a measurable improvement in the quality of life of the whole society. Full information maximum likelihood estimates of the system of dynamic reduced-form equations found sizeable and highly significant effects of the field-theoretic variables in reducing both the misery index \( p = 8.7 \times 10^{-7} \) and the growth of crude materials prices \( p = 2.6 \times 10^{-5} \) after allowing for the dynamic interaction of the misery index, monetary growth, and the rate of change of crude materials prices. For a TM-Sidhi group of 1700 or more in size, the estimated long-run reduction in the misery index was 62.4 percent of the total decline of the index from its peak in 1980 to the end of the sample period in 1988. A likelihood ratio test indicates that the joint null hypothesis of no field effects of consciousness on all three economic variables must also be strongly rejected for these data \( p = 1.6 \times 10^{-12} \). The empirical analysis also found a significant positive effect of crude materials prices on the index, and a significant positive effect of money growth on crude materials prices.

1. INTRODUCTION

This paper analyzes the time series behavior of Okun's economic "misery index," defined as the sum of the inflation rate and unemployment rate, for the U.S. during the period 1979 to 1988. The behavior of the misery index is of interest because it is a useful summary measure of macroeconomic performance and of the economic
dimension of the quality of life. Okun's index measures the intensity of "stagflation"—simultaneous high inflation and unemployment—which was indisputably the primary economic problem of the 1970s and early 1980s in the U.S. and abroad (Bruno and Sachs, 1985). After ratcheting up markedly during the 1970s, the U.S. misery index peaked in January and March of 1980 at 24.5 percent, spiked again at 23.6 percent as late as June of 1982, thereafter falling irregularly to a level of 10.3 percent in April of 1988 as a result of substantial declines in both inflation and unemployment (see Figure 1). A primary purpose of this paper is to add to our understanding of this stagflationary episode, particularly focusing on the factors which helped to produce the dramatic improvement in overall U.S. economic performance since the early 1980s.

Two major issues are addressed. First, to analyze the behavior of the misery index and its determinants during this period, we use recently developed tools of multiple time series analysis to empirically identify and estimate an unrestricted reduced-form, simultaneous transfer function (STF) model (Liu and Hudak, 1985; Liu, 1985). This fully dynamic simultaneous equation model, with rational or linear distributed lags and autoregressive moving average (ARMA) errors, is used to assess the role played by shocks to aggregate supply and demand in the rise and subsequent substantial decline of the misery index during this period. The intensity of supply-side shocks is measured by the rate of growth of the crude materials component of the producer price index (PPI-CM), in which energy and food prices receive a heavy weighting. Aggregate demand influences are captured by the rate of monetary growth as measured by the rate of growth of the adjusted monetary base. These variables were selected because supply-side and monetary shocks have been widely hypothesized to be perhaps the leading causal factors in the worldwide stagflationary experience of the 1970s and 1980s (Helliwell, 1988; Bruno and Sachs, 1985).

A modified version of the linear transfer function (LTF) method for the identification of multiple-input transfer functions (Liu, 1985) is used to tentatively identify each of the individual transfer function equations of the three-equation system. We supplement the LTF method by using the Akaike information criterion (AIC) to provide an objective criterion for model selection (Akaike, 1973; Larimore, 1983). To improve the efficiency of the parameter estimates, the resulting system of "seemingly unrelated" transfer function equations is then jointly estimated using full information maximum likelihood (FIML).

The second, and most important, issue addressed by this paper is the empirical importance of an additional explanatory factor suggested by a field theory of consciousness and socioeconomic behavior. This novel, field-theoretic paradigm is based on an analysis of the fundamental nature of human consciousness and its relation to the behavior of the individual and society put forth by Maharishi Mahesh Yogi, the noted scholar, teacher, and authority on the ancient Vedic science of consciousness (1977, 1978, 1985, 1986). By integrating fundamental insights of the ancient Vedic tradition of knowledge with those of the modern natural and social sciences, Maharishi's Vedic Science has inspired a rapidly growing body of published theoretical and empirical research which is surveyed in Hagelin (1987); Dillbeck, Cavanaugh, Glenn, et al. (1987); Orme-Johnson and Dillbeck (1987); Orme-Johnson et al. (1988); and Dillbeck, Banus, Polanţí, et al. (1988).

A major purpose of this paper is to further examine one specific implication of this new paradigm for the field of economics. In this paper we test for nonlinear field effects of consciousness implied by Maharishi's Vedic Science, and extend and refine the empirical analysis of the time series behavior of the misery index given in Cavanaugh (1987). The tests are based on a multiple time series implementation of the impact-assessment analysis methodology for time series (Box and Tiao, 1975).

FIML estimates of the reduced-form parameters for this system of dynamic equations reveal highly significant negative effects of both field-theoretic variables on the misery index at several lags ($p = 8.7 \times 10^{-7}$). The long-run multipliers (or steady state gain) for the field-theoretic variables are negative, as hypothesized, and quite large in absolute value. Thus, empirical analysis of monthly data for the misery index over the period 1979 to 1988 indicates that after allowing for the impact of money growth and crude materials prices on the misery index, the null hypothesis of no field effects of consciousness must be strongly rejected for these data. These results are consistent with Cavanaugh's (1987) finding of significant field effects on the misery index for the U.S. and Canada. In addition, the field-theoretic variables were found to have significant and sizeable negative effects on the rate of growth of crude materials prices ($p = 2.6 \times 10^{-5}$). A likelihood ratio test indicates that the joint null hypothesis of no field effects of consciousness on all three economic variables must also be strongly rejected for these data ($p = 1.6 \times 10^{-12}$). The empirical analysis also found a significant positive effect of crude materials prices on the index, positive lagged effects of both crude materials prices and money growth on the misery index, and a significant positive effect of money growth on crude materials prices.
The remainder of this paper is organized as follows. Section 2 presents the motivation for this study, outlines the hypotheses to be investigated, and presents a brief discussion of previous research. Section 3 describes STF models and the linear transfer function approach to the identification of STF multiple-input transfer function equations. Section 4 summarizes the empirical results, and Section 5 presents concluding remarks.

2. STUDY OF THE MISERY INDEX—RATIONALE AND HYPOTHESES

The misery index measures the degree to which society is plagued by the “twin evils” of inflation and unemployment. Since the level of unemployment is negatively related to the rate of growth in real GNP through Okun’s law, movements in the misery index also reflect...
the performance of the macroeconomy in promoting real economic growth (Dornbusch and Fischer, 1988, p. 573). As noted by Maisel (1982, pp. 15–16), the sharp upward trend in this index for the U.S. beginning in the mid-1960s was reflected in a growing dissatisfaction with U.S. economic performance and a deterioration in the sense of well-being of the American people. That the misery index may be associated with broader measures of the quality of life is suggested by research showing a strong correlation between unemployment and several measures of social stress including increased mental and physical illness, suicide, homicide, cardiovascular mortality, and prison admissions (Brenner, 1979).

Previous empirical study of the misery index is limited. Tarantelli (1986) employed the misery index as a dependent variable in a regression analysis of cross-national economic performance. The first published study of the time series behavior of Okun's misery index was Cavanaugh (1987) who used Liu's LTF approach to estimate a single-equation, multiple-input transfer function model of the misery index for the U.S. and Canada. This paper extends Cavanaugh's approach by empirically testing the field-effect hypothesis in a multi-equation context which explicitly considers the role of additional important economic variables.

Space constraints permit only a few brief remarks about Maharishi's field-theoretic paradigm of consciousness and human behavior. A more detailed discussion of this paradigm and the hypothesis investigated in this paper is given in Cavanaugh (1987). The existence of field effects of consciousness in social systems was postulated as early as 1960 when Maharishi predicted that even a small fraction of the population, on the order of one percent, practicing a simple mental technique, Maharishi's Transcendental Meditation (TM) technique, would be sufficient to induce a measurable, holistic improvement in the quality of life in society. The predicted result of this effect, later named the "Maharishi Effect," was more positive trends in life quality as measured by, for example, decreased crime, accidents, and social conflict; improved physical and mental health; and more positive economic trends (Maharishi Mahesh Yogi, 1977, pp. 8–10).

These beneficial social effects are produced not by direct behavioral interaction between the TM practitioners and other individuals in society, but via a "field effect" mediated by a nonlocalized, unified field of "pure consciousness" experienced during the TM technique. Maharishi (1986) identifies the field of pure consciousness as the underlying source of all activity in nature, subjective and objective. According to Maharishi, the practice of this technology of consciousness generates improvements in the quality of life by neutralizing accumulated stress and tension in the collective consciousness of society (Maharishi Mahesh Yogi, 1986). This purification of collective consciousness results from the enlivenment of the unified basis of individual and collective consciousness, the field of pure consciousness, which Maharishi identifies with the unified field of natural law described in recent unified field theory in physics (Maharishi Mahesh Yogi, 1986; Hagelin, 1987). The enlivenment of pure consciousness by a small percentage of the individuals in society brings the thought and behavior of the entire society into greater attunement with natural law, leading to a holistic improvement in the quality of life (Maharishi Mahesh Yogi, 1986).

Maharishi later predicted that the same positive effects on society would be generated by approximately the square root of one percent of the population practicing a more advanced procedure, the TM-Sidhi program, together in a single group (Maharishi European Research University, 1979, p. 160). Maharishi's theory predicts that upon reaching the critical threshold level for the size of the TM-Sidhi group, a phase transition to a more ordered and coherent state of national and individual consciousness will be induced, resulting in a marked improvement in the overall quality of life.

The improvement in the quality of life through the Maharishi Effect results from bringing individual life into greater accord with natural law, since, according to Maharishi's Vedic Science, all social and economic problems have their basis in the violation of the laws of nature by the individuals in society. In this paper we test the hypothesis that the group practice of the TM and TM-Sidhi program contributed to a significant decline in the high inflation and unemployment which were widely seen as the most important national problems facing the U.S. in the late 1970s and early 1980s (Dornbusch and Fischer, 1988, p. 537).

According to one of the world's leading unified field theorists in physics, the Maharishi Effect is consistent with the proposed identity of the field of pure consciousness with the supersymmetric unified field of quantum physics (Hagelin, 1987). According to Hagelin (1987, p. 67) "the quadratic dependence of the intensity of the effect upon the size of the creating-coherence group is . . . characteristic of a field phenomenon in which the radiators are operating coherently." Hagelin further notes that the proposed identity between pure consciousness and the unified field is consistent with all known physical principles, but requires an expanded physical framework for the understanding of consciousness which leads to a more integrated picture of the physical world and the full range of human experience. (1987, p. 56)
The hypothesis that the quality of life in society may be positively affected through field effects generated by this technology of consciousness has been empirically investigated in more than 30 studies conducted over the past 14 years. A survey of these studies is given in Dillbeck, Cavanaugh, Glenn, et al. (1987); Hagelin (1987); and Orme-Johnson and Dillbeck (1987). In addition to the effect on the U.S. and Canadian misery index discussed above, these studies report evidence of field effects on such diverse measures of the quality of life as crime and suicide rates, automobile accidents, notifiable diseases, civil disorder, international conflict, and composite indices of life quality. One attraction of the field theory of consciousness as formulated by Maharishi is that it alone seems capable of offering a unified and parsimonious explanation of these diverse research findings.

Maharishi's field theory of consciousness implies a marked improvement in the quality of life when the size of the group practicing the TM and TM-Sidhi program reaches the critical threshold of approximately the square root of one percent of the population. Beginning in April 1979, a group was founded at Maharishi International University in Fairfield, Iowa, to practice the TM and TM-Sidhi program together twice a day (morning and afternoon) for the purpose of improving the quality of life in North America and the world. By analogy with the phenomenon of super radiance in physics, through which a phase transition process leads to the emission of coherent light by a laser, this group has been termed the "Super Radiance" group.

A time series plot of the monthly average size of the Super Radiance group for the afternoon session is shown in Figure 2 for the period April 1979 to April 1988. For the U.S. the critical threshold for the size of the TM-Sidhi group during this period ranged from approximately 1500 in 1979 to 1569 in 1988, based on mid-year population estimates (United Nations, 1989). In Figure 2 a horizontal line is drawn at the 1500 threshold level. The two large spikes in the plot of average group size in Figure 2 correspond to two large assemblies of participants (World Peace Assemblies) at MIU held in December 1983 to January 1984 and again in July 1984 when the average size of the group exceeded 3300.

The plot of the monthly misery index in Figure 1 shows that the peak of the misery index in January 1980 occurred four months after the Super Radiance group first exceeded the 1500 threshold in July and August of 1979. This initial reversal of the upward trend in the index also followed six consecutive months in which the average size of the Super Radiance group consistently exceeded 1000 for the first time. Figure 1 also suggests a possible downward shift in the mean level of the misery index beginning sometime in 1982, a year in which the 1500 threshold was exceeded for five months. Also apparent in Figure 1 is the continued decline of the index after 1982 and its ultimate stabilization substantially well below its peak level of 1980 as the Super Radiance group rose to a level consistently exceeding the approximate critical threshold of 1500. For the period April 1979 to April 1988 the contemporaneous correlation between the misery index and the size of the Super Radiance group is -.501.

To capture the possibly nonlinear relationship between group size and the misery index, an impact-assessment approach was used in which two binary indicator variables were included in the transfer function equations. These binary indicator variables represent months in which the average size of the MIU group was between 1500 and 1700 or 1700 and above. These threshold measures of the intensity of possible field effects of consciousness are nearly identical to those used in Cavanaugh (1987).

One could argue that the strong rejection of the null hypothesis of no field effects in Cavanaugh (1987) may be spurious, resulting from the effect of omitted explanatory variables on the misery index, where these omitted variables are correlated with the included binary impact-assessment variables. Any impact-assessment analysis study is open to this potential criticism, especially when the "treatment" is not under experimental control and the intervention periods are nonrandomly distributed over time. For example, it could be said that the sharp decline of the misery index in the 1980s is explainable solely by macroeconomic developments unrelated to the MIU group.

To deal with this potential criticism, we extend the analysis of Cavanaugh (1987) by testing for the existence of field effects of consciousness in an explicitly multivariate setting. The STF model allows us to estimate the effect of the growth of the monetary base and the rate of growth of crude materials prices on the U.S. misery index, allowing for potential feedback relationships between the misery index, crude materials prices, and the monetary base. These three variables are treated as endogenous in the model. The STF model permits a test of the hypothesis that, after allowing for the endogenous interaction of these three macroeconomic variables, the misery index was beneficially influenced by a single, large group in the U.S. practicing a subjective technology of consciousness—the TM and TM-Sidhi program.

Our interpretation of Maharishi's paradigm suggests that one should find evidence of a significant impact of the threshold variables on the misery index in the
reduced-form estimates. In particular, one should find negative long-run multipliers for the field-theoretic variables. This is the key testable implication of the theory. Negative long-run multipliers would indicate that a TM-Sidhi group which exceeded the critical square-root-of-one-percent threshold for a sustained period of time would produce a long-run decline in the misery index. The long-run multipliers for the exogenous field-theoretic variables are calculated from the so-called "final form" of the STF model which may be mathematically derived from the estimated reduced-form equations.

The assumption of exogeneity of the Super Radiance group seems justified in view of the implausibility of the alternative assumption that a significant number of individuals moved to Iowa to join the MIU group in response to movements in the misery index, crude materials prices, or the monetary base. Although hard evidence is not readily available, it is common knowledge in the MIU community that economic motives were rarely primary in the decision to relocate to Fairfield. A possible exception may be students, since the opportunity costs of schooling generally fall during recessions. But the stability of MIU enrollment over the period of this study seems inconsistent with such an economic interpretation of the size of the TM-Sidhi group. In any case, students comprise less than one-third of the total group. Finally, Cavanaugh, King, and Titus (1989) could not reject the hypothesized exogeneity of the MIU group with respect to the misery index, and they found no evidence of significant feedback from the misery index to the MIU group using transfer function analysis. Their findings imply a unidirectional influence of the TM-Sidhi group on the misery index with no feedback or reverse causation.

In calculating the misery index, the rate of inflation was computed from the month-to-month change in the consumer price index for all urban consumers (CPI), seasonally adjusted, BCD series 320c, as reported in Business Conditions Digest, March 1988 (p. 98) and July 1988 (p. 84). To annualize the rate and express it in percentage units, the compound rate was calculated as \(12\left[1 + \frac{d}{100}\right] - 1\) where \(d\) is the change in the CPI. Unemployment was measured by the civilian unemployment rate, seasonally adjusted, BCD series 43, from Business Conditions Digest, July 1988 (p. 62) and February 1988 (p. 99).

The measure of crude materials prices used in this study is the crude materials component of the producer price index (PPI-CM), seasonally adjusted, BCD series 331, as reported in Business Conditions Digest, July 1988 (p. 85) and March 1988 (p. 101). Fossil fuels receive a weight of approximately 36 percent in the index, crude nonfood materials 47 percent, and crude foodstuffs and feedstuffs 53 percent (Horrigan, 1986). In a multiple time series analysis of inflation, Horrigan (1986) found the growth rate of crude materials prices to be the best predictor of consumer-price inflation among several alternative commodity price measures. Monetary growth is measured by the adjusted monetary base, seasonally adjusted, from the Federal Reserve Bank of St. Louis. Horrigan (1986) also found the growth rate of the monetary base to be the best single predictor of future inflation. In the empirical analysis, compound annual growth rates for both variables, in percentage units, were approximated by the first difference of the natural logarithm for each variable multiplied by a factor of 1200.

### 3. STF MODEL

To investigate the dynamic interaction of the misery index, crude materials prices, the monetary base, and the field-theoretic threshold variables, we empirically identify and estimate an STF model consisting of three unrestricted reduced-form equations. STF models are a generalization of the standard single-equation transfer function model with multiple endogenous (or output) variables, multiple input variables, and the explicit modeling of dynamic feedback relationships (Liu, 1985; Liu and Hudak, 1985). The general form of the STF model examined in this paper is given by the following system:

\[
\begin{align*}
\text{MIS}_t &= c_1 + \beta_1(B)\text{MB}_t + \beta_2(B)\text{PCM}_t + \beta_3(B)\text{I}_t + \\
&\quad + \beta_4(B)\text{I}_{t-2} + N_{t1} \quad (1) \\
\text{PCM}_t &= c_2 + \beta_5(B)\text{MIS}_t + \beta_6(B)\text{MB}_t + \beta_7(B)\text{I}_t + \\
&\quad + \beta_8(B)\text{I}_{t-2} + N_{t2} \quad (2) \\
\text{MB}_t &= c_3 + \beta_9(B)\text{MIS}_t + \beta_{10}(B)\text{PCM}_t + \beta_{11}(B)\text{I}_t + \\
&\quad + \beta_{12}(B)\text{I}_{t-2} + N_{t3}. \quad (3)
\end{align*}
\]

In these equations, MIS, is the misery index at time \(t\), PCM, is the rate of change of the crude materials component of the producer price index, MB, is the rate of growth of the monetary base; these three variables are taken to be endogenous. I, and I, are binary indicator variables described below, the \(c_i\) are constant terms, and the \(N_{t_i}\) are stochastic disturbances which may take the form of stationary and invertible ARMA processes given (in the nonseasonal case) by

\[
N_{t_i} = \{\theta_i(B)/\phi_i(B)\}a_t. \quad (4)
\]

In equation (4), \(\{a_t\}\) is a Gaussian white noise process of independently and identically distributed random
variables with mean zero and variance $\sigma^2$, and $\theta_i(B)$ and $\phi_i(B)$ are polynomials in the backshift operator $B$ given by

$$
\phi_i(B) = 1 - \phi_1 B - \ldots - \phi_p B^p \quad \text{and}
$$

$$
\theta_i(B) = 1 - \theta_1 B - \ldots - \theta_q B^q,
$$

where the "i" subscripts have been omitted for simplicity and where $B^k Y_t = Y_{t-k}$ in equations (1) through (3) the $\beta_j(B)$ terms are transfer functions consisting of linear or rational polynomials in the backshift operator $B$. Omitting the "j" subscripts for simplicity, each of these transfer functions may be expressed in general as $\omega(B)/\delta(B)$ where

$$
\omega(B) = (\omega_0 + \omega_1 B + \ldots + \omega_p B^{p-1})B^q \quad \text{and}
$$

$$
\delta(B) = 1 - \delta_1 B - \ldots - \delta_q B^q,
$$

are polynomials in the backshift operator, $b$ is a delay parameter, and all roots of the polynomial $\delta(B)$ lie outside the unit circle. In the case of a reduced-form model, the parameter $\omega_0$ is constrained to zero for each endogenous input since contemporaneous endogenous relationships are not explicitly included in the reduced form.

The binary indicator variables in equations (1) through (3) are "pulse variables" which take the value zero except that $I_{11} = 1.0$ when the average size of the TM-Sidhi group at MIU was greater than or equal to 1500 but less than 1700, and $I_{2b} = 1.0$ when the size of the MIU group equalled or exceeded 1700.

After bringing all endogenous variables to the left-hand side of equations (1) through (3), the unrestricted reduced-form model can be written in matrix notation as

$$
\Phi_i(B) y_i = c + \Gamma_i(B) x_i + N_i,
$$

where $y_i$ is a 3 x 1 vector of the three endogenous variables at time $t$, $x_i$ is a 2 x 1 vector of the two exogenous variables at time $t$, $N_i$ is a 3 x 1 vector of the three ARMA noise processes whose individual elements are given by equation (4) above, and $c$ is a 3 x 1 vector of constant terms. For the 3 x 3 matrix operator $\Phi_i(B)$, the lag zero matrix coefficient, denoted by $\Phi_0$, will be an identity matrix since no contemporaneous endogenous relationships are represented in the reduced-form equations (Liu and Hudak, 1985). The 3 x 2 matrix operator $\Gamma_i(B)$ is a matrix of linear or rational transfer function coefficients $\beta_j(B)$ for the exogenous variables. The model is dynamically stable if the roots of the polynomial given by the determinant $|\Phi_i(B)|$ lie outside the unit circle (Liu and Hudak, 1985).

3.1 MODEL IDENTIFICATION—In the absence of cross-equation constraints on the parameters, the reduced-form equations (1) through (3) are a system of "seemingly unrelated" transfer function equations (Liu and Hudak, 1985). In this case, single-equation maximum likelihood estimates of the reduced-form parameters will be consistent, but not necessarily efficient (Liu and Hudak, 1985). Therefore, tentative model identification may proceed equation by equation prior to attempting joint estimation.

Liu's LTF method (1985) was employed for the purpose of tentative identification of the reduced-form equations. A major advantage of the LTF procedure is that, unlike the "prewhitening" approach to the identification of transfer function models developed by Box and Jenkins (1976), the LTF method is readily generalized to the case of multiple input series and to the identification of transfer functions for binary inputs in impact-assessment analysis. Thus for each transfer function equation, we use the same LTF procedure for identifying the form of the transfer functions for all input variables, including the binary impact-assessment variables.

The first step in the LTF procedure was estimation of the impulse response weights for the transfer functions $\beta_j(B)$ in equations (1) through (3). If all roots of the denominator polynomial $\delta_j(B)$ lie outside the unit circle, the rational transfer function $\omega_j(B)/\delta_j(B)$ may be approximated by a linear function $v_j(B)$ with a finite number of terms (Box and Jenkins, 1976). Following Liu (1985), initial estimates of the impulse response weights were based on maximum likelihood estimates of equations (1) through (3), letting $\beta_j(B) = v_j(B)$, where the $v_j(B)$ are linear transfer functions given by (suppressing the "j" subscripts)

$$
v(B) = v_0 + v_1 B + v_2 B^2 + \ldots ,
$$

with a sufficient number of terms to avoid truncation bias. For all endogenous input variables, the lag-zero transfer function parameter $v_0$ was set equal to zero to avoid possible simultaneous equation bias. At the estimation stage, each polynomial $v_j(B)$ was truncated at 10 lags. Estimates of each equation were obtained by maximum likelihood employing an approximation to the likelihood function due to Hillmer and Tiao (1979) as implemented in the SCA time series analysis software, version 3.2 (Liu, Hudak, Box, et al., 1986).

Following Liu (1985), at the outset of the identification stage, the noise term in each equation was tentatively assumed to follow a first-order autoregressive process. The tentative assumption of an AR(1) noise process, which may be modified later, generally improves the efficiency of the initial estimates and allows a check for the necessity of differencing. Differencing of all variables in the model would be indicated if the estimated autoregressive parameter were close to 1.0 (Liu,
The estimates of equations (1) through (3) with an AR(1) noise specification produced AR parameter estimates far from 1.0, suggesting no need for differencing.

The next step in the LTF procedure was tentative identification of the noise model based on the estimated autocorrelation, partial autocorrelation, and extended autocorrelation functions of the estimated noise process of the initial model. For each of the three equations, a variety of plausible alternative noise model structures were estimated. Because typically more than one stationary and invertible model was found which yielded white noise residuals, the choice between alternative noise models was based on the minimization of the AIC criterion described below.

After identifying the noise model for each equation, equations (1) through (3) were then reestimated in order to obtain more efficient estimates of the impulse response weights. Once satisfactory estimates of the impulse response weights were obtained, the pattern of the impulse response weights was examined to identify the form of the rational transfer function for each input series. The apparent cutoff pattern found for all input series suggests that all transfer functions are linear and include only numerator parameters \( \omega_2(B) \), with \( \delta_1(B) = 1.0 \) (Liu, 1985). In the case of a decay pattern in the estimated impulse response function, the corner method may be used to help identify the orders \( b, r, \) and \( s \) in the rational transfer functions for each input variable (Liu and Hanssens, 1982).

Using the tentatively identified transfer functions and noise model, each reduced-form equation (1) through (3) was then estimated and diagnostic checks were used to suggest possible alterations in the model. Nonsignificant transfer function coefficients were gradually deleted from the model at this stage, with higher order coefficients being deleted first.

At each step in the identification process, the LTF approach to model identification was supplemented by use of Akaike's information criterion as the fundamental criterion in model selection. The AIC is defined as

\[
AIC = -2 \log_{e} (\text{maximum likelihood}) + 2k, \quad (6)
\]

where \( k \) is the number of model parameters estimated (Akaike, 1973). The AIC is an entropy- or information-based measure of model adequacy which has generally been justified on rather ad hoc grounds. However, Larimore (1983) has shown that, for both large and small samples, use of the AIC as a measure of model-approximation error can be justified on the basis of sufficiency and an asymptotic likelihood principle for the evaluation of model order, model structure, and parameter estimates. Because use of the AIC is based on statistical principles more fundamental than that of "order consistency," Larimore and others (Larimore, 1983; Larimore and Mehra, 1985; Shibata, 1983) take the position that the well-known inconsistency of the AIC criterion in estimating model order does not provide a compelling objection to its use in model identification. Shibata (1983, p. 238) demonstrates that while order-consistent criteria can involve large risks of underfitting which may significantly increase bias, the AIC "satisfactorily balances both underfitting and overfitting risks, and is asymptotically efficient for selecting one model from a family of models, each specified by many parameters."

Because the AIC is proportional to sample size, all alternative models were estimated using the same number of effective observations to allow precise comparison of the AIC across model structures. All models were estimated over the sample period April 1979 through April 1988, a sample of 109 monthly observations. The AIC for each model was computed using the approach of Ozaki (1977).

After identifying the minimum-AIC reduced-form equation for each endogenous variable, the resulting system of equations was jointly estimated by FIML (Wall, 1976) to provide more efficient estimates of model parameters. For both the estimation of individual equations and joint estimation, the SCA "exact" likelihood option was employed to obtain more efficient estimates of moving average noise parameters (Liu, Hudak, Box, et al., 1986).

3.2 MULTIPLIERS AND THE FINAL FORM—A complete description of the dynamic effect of the exogenous inputs on each endogenous variable in the system is given by the dynamic multipliers (Dhrymes, 1974). The dynamic multipliers are derived from the final form of the model which describes the time evolution of the endogenous variables as a function of the exogenous inputs and stochastic disturbances only. The final equations are the simultaneous solution of the estimated reduced form, which is a system of stochastic difference equations (Dhrymes, 1974; Wallis, 1977). Thus the final form may be derived by solving the reduced-form equations (5) for the endogenous variables \( y_n \), where this solution is given by

\[
y_i = \Phi(B)^{-1}c + \Phi(B)^{-1}\Gamma(B)x + \Phi(B)^{-1}N, \quad (7)
\]

where \( \Phi(B)^{-1} \) is the inverse of the matrix \( \Phi(B) \), and the elements of the 3 x 2 matrix \( \Phi(B)^{-1}\Gamma(B) \) are rational polynomial final-form coefficients.

In scalar notation, the final-form equations may be written as
where the $b_j(B)$ are rational polynomials in the backshift operator. The lag coefficients of the linear form of $b_i(B)$ are the dynamic multipliers which describe the average current and lagged effect on the endogenous output of a unit increase in the exogenous input. As described in the appendix, the dynamic multipliers may be analytically derived from the final-form coefficients. Of particular interest are the long-run multipliers which show the ultimate impact on a given endogenous variable of a one-unit change in a particular exogenous variable, where the increase is maintained indefinitely (Dhrymes, 1974). Like the dynamic multipliers, the long-run multipliers (or steady-state gain) allow for all contemporaneous and lagged feedback relationships among the variables in the system. The long-run multiplier for an exogenous input is the limit approached by cumulative sum of the dynamic multipliers as the time lag increases. This cumulative sum at lag $k$ is referred to as the cumulative multiplier, or interim multiplier, for $k$ periods (Chow, 1983).

4. EMPIRICAL RESULTS

The iterative model identification and estimation procedure described in the previous section led to the unrestricted reduced-form model shown in Table 1. The FIML estimates of equations (1) through (3) are presented in Tables 2–4 and the estimated covariance and correlation matrix of residuals in Table 5. The estimated STF model is stable and all noise models are stationary and invertible.

With respect to tests of the field theory of consciousness, the reduced-form estimates in Table 2 indicate a significant negative effect of the two threshold variables on the misery index at lags ranging from zero to nine months. The estimated reduced-form parameters for the threshold variables $I_1$ and $I_2$ in Table 2 are all negative and highly significant taken together, as shown by the likelihood ratio test for the joint significance of the estimated field-effect parameters ($p = 8.7 \times 10^{-7}$).

The long-run multipliers implied by the reduced-form estimates of the field-effect parameters shown in Table 2 are also very large in absolute value. These estimated multipliers allow for the simultaneous and lagged interaction of the misery index with the growth of crude materials prices and the monetary base. Both multipliers are negative, consistent with the prediction of the field theory of consciousness (see Table 6). These multipliers give the estimated long-run effect on the misery index of a maintained average group size of 1500 or more, approximately the square root of one percent of the U.S. population. The multiplier for a group of 1500 to 1699 is -4.1 points, equivalent to a decline of 16.6 percent from the peak level of 24.5 points for the index during the period 1979 to 1988. For a group of 1700 or more, the estimated multiplier is -8.8 points, equivalent to a decline of 36.1 percent from the peak value of the misery index. These estimated reductions of 4.1 and 8.8 points in the misery index also represent 28.8 percent and 62.7 percent, respectively, of the total decline (14.1 points) of the misery index from its peak in 1980 to the end of the sample period in 1988.

<table>
<thead>
<tr>
<th>Table 1. STF Model: Estimated Reduced-Form Equations</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $MIS_t = c_1 + \omega_1 B^4 MB_t + (\omega_2 B + \omega_3 B^3) MCM_t + (\omega_4 + \omega_5 B^4) I_{1t} + (\omega_6 B^2 + \omega_7 B^4 + \omega_8 B^5 + \omega_9 B^9) I_{2t}$</td>
</tr>
<tr>
<td>$+ (1 - \theta_1 B - \theta_2 B^2) a_{1t}$</td>
</tr>
<tr>
<td>(2) $PCM_t = (\omega_{10} B + \omega_{11} B^3 + \omega_{12} B^4 + \omega_{13} B^8) MIS_t + (\omega_{14} B^3 + \omega_{15} B^5 + \omega_{16} B^{10}) MB_t$</td>
</tr>
<tr>
<td>$+ (\omega_{17} B^7 + \omega_{18} B^8) I_{1t} + (\omega_{19} B^2 + \omega_{20} B^5 + \omega_{21} B^9) I_{2t}$</td>
</tr>
<tr>
<td>$+ (1 - \theta_3 B - \theta_4 B^2) a_{2t}$</td>
</tr>
<tr>
<td>(3) $MB_t = c_2 + (\omega_{22} B + \omega_{23} B^3 + \omega_{24} B^4) MIS_t + (\omega_{25} B + \omega_{26} B^9 + \omega_{27} B^{10}) PCM_t + (\omega_{28} + \omega_{29} B^6) I_{1t}$</td>
</tr>
<tr>
<td>$+ (\omega_{30} B^5 + \omega_{31} B^{10}) I_{2t} + (1 - \phi_1 B - \phi_2 B^5 - \phi_3 B^{11})^{-1} a_{3t}$</td>
</tr>
</tbody>
</table>
Plots of the cumulative multipliers for both of the TM-Sidhi impact-assessment variables are shown in Figures 3 and 4. The plots indicate that most of the reduction of the misery index attributed to the effect of the TM-Sidhi group occurs within 10-12 months, by which time the cumulative decline in the index stabilizes at approximately the level of the long-run multiplier. Such dynamic effects are commonly found at lags of this order.

### Table 2. STF Model Estimates, Equation 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Variable</th>
<th>Parameter Type</th>
<th>Lag</th>
<th>Parameter Estimate</th>
<th>Std. Error</th>
<th>T Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 c₁</td>
<td>Const.</td>
<td></td>
<td>0</td>
<td>15.094</td>
<td>0.739</td>
<td>20.42&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 ω₁</td>
<td>MB</td>
<td>Num.</td>
<td>4</td>
<td>0.120</td>
<td>0.067</td>
<td>1.78</td>
</tr>
<tr>
<td>3 ω₂</td>
<td>PCM</td>
<td>Num.</td>
<td>1</td>
<td>0.078</td>
<td>0.015</td>
<td>5.20&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 ω₃</td>
<td>PCM</td>
<td>Num.</td>
<td>3</td>
<td>0.037</td>
<td>0.015</td>
<td>2.52&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>5 ω₄</td>
<td>I₁</td>
<td>Num.</td>
<td>0</td>
<td>-1.247</td>
<td>0.572</td>
<td>-2.18&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>6 ω₅</td>
<td>I₁</td>
<td>Num.</td>
<td>4</td>
<td>-1.847</td>
<td>0.695</td>
<td>-2.66&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 ω₆</td>
<td>I₂</td>
<td>Num.</td>
<td>2</td>
<td>-1.726</td>
<td>0.733</td>
<td>-2.36&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>8 ω₇</td>
<td>I₂</td>
<td>Num.</td>
<td>4</td>
<td>-2.057</td>
<td>0.797</td>
<td>-2.58&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>9 ω₈</td>
<td>I₂</td>
<td>Num.</td>
<td>5</td>
<td>-1.954</td>
<td>0.754</td>
<td>-2.59&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>10 ω₉</td>
<td>I₂</td>
<td>Num.</td>
<td>9</td>
<td>-1.617</td>
<td>0.720</td>
<td>-2.25&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>11 θ₁</td>
<td>MIS</td>
<td>MA</td>
<td>1</td>
<td>-0.559</td>
<td>0.094</td>
<td>-5.96&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>12 θ₂</td>
<td>MIS</td>
<td>MA</td>
<td>2</td>
<td>-0.278</td>
<td>0.095</td>
<td>-2.94&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

- Residual Sum of Squares............... 662.81
- R-Square..................................... 71.0
- Effective Number of Observations ...... 109
- Residual Standard Error ................. 2.47
- Ljung-Box Q Statistic (10 d.f.)<sup>d</sup> .. 5.3
- Likelihood Ratio Statistic (6 d.f.)<sup>d</sup> .. 38.57<sup>c</sup>
- A.I.C....................................... 532.09

<sup>a</sup>p ≤ .05;  <sup>b</sup>p ≤ .01;  <sup>c</sup>p ≤ .001 (two-tailed tests except for the Ljung-Box Q and likelihood ratio statistics).  <sup>d</sup>Test statistic is a chi-squared variable with indicated d.f.
Table 3. STF Model Estimates, Equation 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Variable</th>
<th>Parameter Type</th>
<th>Lag</th>
<th>Parameter Estimate</th>
<th>Std. Error</th>
<th>T Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ( \omega_{10} )</td>
<td>MIS</td>
<td>Num.</td>
<td>1</td>
<td>-1.094</td>
<td>0.394</td>
<td>-2.77(^b)</td>
</tr>
<tr>
<td>2 ( \omega_{11} )</td>
<td>MIS</td>
<td>Num.</td>
<td>3</td>
<td>-1.487</td>
<td>0.409</td>
<td>-3.63(^b)</td>
</tr>
<tr>
<td>3 ( \omega_{12} )</td>
<td>MIS</td>
<td>Num.</td>
<td>4</td>
<td>0.913</td>
<td>0.435</td>
<td>2.10(^*)</td>
</tr>
<tr>
<td>4 ( \omega_{13} )</td>
<td>MIS</td>
<td>Num.</td>
<td>8</td>
<td>0.907</td>
<td>0.375</td>
<td>2.42(^b)</td>
</tr>
<tr>
<td>5 ( \omega_{14} )</td>
<td>MB</td>
<td>Num.</td>
<td>3</td>
<td>0.754</td>
<td>0.321</td>
<td>2.35(^*)</td>
</tr>
<tr>
<td>6 ( \omega_{15} )</td>
<td>MB</td>
<td>Num.</td>
<td>5</td>
<td>0.902</td>
<td>0.316</td>
<td>2.85(^b)</td>
</tr>
<tr>
<td>7 ( \omega_{16} )</td>
<td>MB</td>
<td>Num.</td>
<td>10</td>
<td>1.002</td>
<td>0.327</td>
<td>3.07(^b)</td>
</tr>
<tr>
<td>8 ( \omega_{17} )</td>
<td>( I_1 )</td>
<td>Num.</td>
<td>7</td>
<td>-5.824</td>
<td>3.079</td>
<td>-1.89</td>
</tr>
<tr>
<td>9 ( \omega_{18} )</td>
<td>( I_1 )</td>
<td>Num.</td>
<td>8</td>
<td>-6.765</td>
<td>3.070</td>
<td>-2.20(^*)</td>
</tr>
<tr>
<td>10 ( \omega_{19} )</td>
<td>( I_2 )</td>
<td>Num.</td>
<td>2</td>
<td>-8.171</td>
<td>3.565</td>
<td>-2.29(^*)</td>
</tr>
<tr>
<td>11 ( \omega_{20} )</td>
<td>( I_2 )</td>
<td>Num.</td>
<td>5</td>
<td>-6.857</td>
<td>3.773</td>
<td>-1.82</td>
</tr>
<tr>
<td>12 ( \omega_{21} )</td>
<td>( I_2 )</td>
<td>Num.</td>
<td>9</td>
<td>-7.285</td>
<td>3.767</td>
<td>-1.93</td>
</tr>
<tr>
<td>13 ( \theta_3 )</td>
<td>PCM MA</td>
<td>1</td>
<td>-0.276</td>
<td>0.087</td>
<td>-3.16(^b)</td>
<td></td>
</tr>
<tr>
<td>14 ( \theta_4 )</td>
<td>PCM MA</td>
<td>2</td>
<td>-0.370</td>
<td>0.090</td>
<td>-4.12(^c)</td>
<td></td>
</tr>
</tbody>
</table>

Residual Sum of Squares........................................... 18038.00
R-Square ........................................................................... .41
Effective Number of Observations .................................. 109
Residual Standard Error ............................................... 12.86
Ljung-Box Q Statistic (10 d.f.)\(^d\)..................................... 3.7
Likelihood Ratio Statistic (5 d.f.)\(^d\)............................... 28.77\(^e\)
A.I.C. .................................................................................. 896.20

\(^a\) p ≤ .05; \(^b\) p ≤ .01; \(^c\) p ≤ .001 (two-tailed tests except for the Ljung-Box Q and likelihood ratio statistics). \(^d\) Test statistic is a chi-squared variable with indicated d.f.
Table 4. STF Model Estimates, Equation 3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Variable</th>
<th>Parameter Type</th>
<th>Lag</th>
<th>Parameter Estimate</th>
<th>Std. Error</th>
<th>T Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$c_2$</td>
<td>Const.</td>
<td>0</td>
<td>12.005</td>
<td>1.686</td>
<td>7.12c</td>
</tr>
<tr>
<td>2</td>
<td>$\omega_{22}$</td>
<td>MIS</td>
<td>Num.</td>
<td>1</td>
<td>-0.315</td>
<td>0.090</td>
</tr>
<tr>
<td>3</td>
<td>$\omega_{23}$</td>
<td>MIS</td>
<td>Num.</td>
<td>3</td>
<td>-0.244</td>
<td>0.102</td>
</tr>
<tr>
<td>4</td>
<td>$\omega_{24}$</td>
<td>MIS</td>
<td>Num.</td>
<td>4</td>
<td>0.268</td>
<td>0.099</td>
</tr>
<tr>
<td>5</td>
<td>$\omega_{25}$</td>
<td>PCM</td>
<td>Num.</td>
<td>1</td>
<td>0.066</td>
<td>0.018</td>
</tr>
<tr>
<td>6</td>
<td>$\omega_{26}$</td>
<td>PCM</td>
<td>Num.</td>
<td>9</td>
<td>0.039</td>
<td>0.017</td>
</tr>
<tr>
<td>7</td>
<td>$\omega_{27}$</td>
<td>PCM</td>
<td>Num.</td>
<td>10</td>
<td>-0.051</td>
<td>0.017</td>
</tr>
<tr>
<td>8</td>
<td>$\omega_{28}$</td>
<td>I$_1$</td>
<td>Num.</td>
<td>0</td>
<td>2.236</td>
<td>0.702</td>
</tr>
<tr>
<td>9</td>
<td>$\omega_{29}$</td>
<td>I$_1$</td>
<td>Num.</td>
<td>6</td>
<td>-2.669</td>
<td>0.711</td>
</tr>
<tr>
<td>10</td>
<td>$\omega_{30}$</td>
<td>I$_2$</td>
<td>Num.</td>
<td>5</td>
<td>-3.429</td>
<td>0.849</td>
</tr>
<tr>
<td>11</td>
<td>$\omega_{31}$</td>
<td>I$_2$</td>
<td>Num.</td>
<td>10</td>
<td>2.333</td>
<td>0.907</td>
</tr>
<tr>
<td>12</td>
<td>$\phi_1$</td>
<td>MB</td>
<td>AR</td>
<td>1</td>
<td>0.246</td>
<td>0.087</td>
</tr>
<tr>
<td>13</td>
<td>$\phi_2$</td>
<td>MB</td>
<td>AR</td>
<td>5</td>
<td>0.170</td>
<td>0.090</td>
</tr>
<tr>
<td>14</td>
<td>$\phi_3$</td>
<td>MB</td>
<td>AR</td>
<td>11</td>
<td>-0.381</td>
<td>0.093</td>
</tr>
</tbody>
</table>

Residual Sum of Squares: 1073.93
R-Square: .37
Effective Number of Observations: 109
Residual Standard Error: 3.14
Ljung-Box Q Statistic (9 d.f.): 3.3
Likelihood Ratio Statistic (4 d.f.): 28.57c
A.I.C.: 588.69

*p ≤ .05;  b p ≤ .01;  c p ≤ .001 (two-tailed tests except for the Ljung-Box Q and likelihood ratio statistics).  d Test statistic is a chi-squared variable with indicated d.f.
The long-run multipliers found in this study are very similar to the comparable estimates for the U.S. reported in Cavanaugh (1987). That the larger MIU group had a bigger effect on the misery index is also consistent with Cavanaugh's earlier findings for both the U.S. and Canada.

Large negative effects on the growth of crude materials prices were also found for the field-theoretic variables (Tables 3 and 6). In the long run, a TM-Sidhi group of 1500 to 1699 was estimated to reduce the percent rate of growth of crude materials prices by 8.8 percentage points, with an estimated reduction of 13.7 points for a group of 1700 or more. The likelihood ratio test reported in Table 3 for the joint significance of the estimated coefficients for the TM-Sidhi variables in equation (2) is highly significant \( (p = 2.6 \times 10^{-4}) \). These results for crude materials prices suggest that the collective practice of the TM and TM-Sidhi program may have contributed to the substantial easing of negative supply-side shocks during this period. Such negative supply shocks are widely believed to increase both inflation and unemployment in the short run, thus elevating the misery index.

Small but significant long-run effects of the field-effect measures were also found on the growth rate of the monetary base \( (p = 9.6 \times 10^{-6}) \) (see Table 4). No \textit{a priori} prediction about the sign of the effect of the TM-Sidhi group on this variable seems to be implied by the field theory of consciousness. The reason is that the effect of the Super Radiance group on the growth rate of the monetary base, which is completely controlled by the Federal Reserve, would be expected to differ according to specific economic circumstances. These circumstances were changing very dramatically over the period of the study. The contrasting signs for the reduced form parameter estimates for all input variables suggest that the Federal Reserve was altering its reaction to economic conditions over the period 1979–1988.

Finally, as shown in Table 5, a likelihood ratio test of the hypothesis that all estimated parameters for the field-theoretic variables in the STF model are jointly equal to zero indicates that the hypothesis is strongly rejected for these data \( (p = 1.6 \times 10^{-15}) \).

The misery index equation reported in Table 2 also shows highly significant reduced-form estimates for the crude materials price variable at lags 1 and 3. The positive sign of these estimates is consistent with the standard textbook analysis which predicts that inflation and unemployment will move in the same direction in response to aggregate supply shocks (Dornbusch and Fischer, 1988), but the estimated effect is small. A positive effect on the misery index at lag 4 was also found for the monetary growth variable, but the estimate is small and not significant. The standard analysis of the short-run effect of a stimulus to aggregate demand yields no unambiguous prediction about the effect of monetary growth on the misery index. The ambiguity arises because inflation and unemployment are predicted to move in opposite directions in response to aggregate demand shocks, as reflected in the short-run Phillips curve relationship (Dornbusch and Fischer, 1988).

Significant positive effects of monetary growth on the misery index via the lagged effect of money growth on the rate of increase of crude materials prices are also suggested by the results in Table 3. Evidence of significant lagged feedback from the misery index to crude materials prices, where this feedback is first negative, then positive, is also apparent in Table 3.

All diagnostic checks for the model are satisfactory. Inspection of the cross-correlation matrices of the vector residual series shows virtually no significant autocorrelation or cross correlation of the residuals, consistent with the null hypothesis of a white noise vector process. As shown in Tables 2–4, the null hypothesis of white noise residuals cannot be rejected for any of the residual series using the Ljung-Box joint test for autocorrelation at lags 1 to 12 (Ljung and Box, 1978); this result also holds for higher order lags. No instability of variance, gross non-normality, or extreme outliers are apparent in

| Table 5. STF Model Error Covariance and Error Correlation Matrices |
|-------------------|------------------|
| Error Covariance Matrix | Error Correlation Matrix |
| [6.081] | [1.000] |
| [1.742 165.486] | [.055 1.000] |
| [−220 8.838 9.855] | [−.028 .219* 1.000] |

STF Model Log Likelihood: \(-662.06\)
STF Model AIC: 1410.12
STF Model Likelihood Ratio Test Statistic: 88.84*  

| Table 6. Estimated Long-Run Multipliers (Steady-State Gain) |
|-------------------|-----------------|
| Output Variable: | Misery Index | PPI-CM (Growth Rate) | Monetary Base (Growth Rate) |
| Input Variable: | I_1 | I_2 |
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* \( p \leq .05 \); \( * p \leq .01 \); \( * p \leq .001 \) (two-tailed test except for likelihood ratio test)

* Standard error for correlations is approximately 0.096.

* For test of null hypothesis that all estimated field-effect parameters are jointly zero.

Test statistic is distributed as a chi squared variable with 15 degrees of freedom.
the histogram or time series plot of residuals.

5. CONCLUSION

Using Liu's (1985) linear transfer function approach to the identification of multiple-input transfer functions, supplemented by use of the AIC in model identification, we empirically identify a three-equation system of simultaneous transfer function equations to investigate the factors contributing to the rise and subsequent substantial decline of Okun's misery index in the U.S. over the period 1979 to 1988.

With respect to the tests of Maharishi's field theory of consciousness and human behavior, the results of this

FIG. 3. CUMULATIVE MULTIPLIERS FOR SUPER RADIANCE GROUP OF 1500 TO 1699.

FIG. 4. CUMULATIVE MULTIPLIERS FOR SUPER RADIANCE GROUP OF 1700 OR MORE.
study indicate that the null hypothesis of no field effects of consciousness on the time series behavior of the U.S. misery index must be strongly rejected for these data. The estimated effect of the TM-Sidhi group on the U.S. misery index first reported in Cavanaugh (1987) remains large and highly significant after controlling for the influence of other key explanatory variables suggested by economic theory. In addition, the field-theoretic variables were found to have significant negative lagged effects on the growth of crude materials prices, suggesting that increased coherence in collective consciousness may have helped to ease negative supply-side shocks, thereby contributing to lower inflation and unemployment. The empirical tests reported in this paper, therefore, offer strong support for the hypothesis that the collective practice of Maharishi’s Transcendental Meditation and TM-Sidhi program by a single group in the U.S. comprising approximately the square root of one percent of the national population contributed to a significant improvement in the economic quality of life over the period 1979 to 1988. The magnitude and statistical significance of the estimated effects of the TM-Sidhi group on these key economic measures suggest that Maharishi’s Vedic Science and Technology may have profound implications for economic theory and policy.

APPENDIX: STF MODEL FINAL-FORM COEFFICIENTS

The final-form coefficients of equations (8) through (10) are functions of the estimated reduced-form coefficients. As shown in Table 1, all estimated transfer function polynomials are linear for equations (1) through (3), and, thus, the estimated reduced-form equations may be written as

\[ \text{MIS}_t = c_1 + v_1(B)\text{MB}_t + v_2(B)\text{PCM}_t + v_3(B)\text{I}_{11t} + v_4(B)\text{I}_{21t} + N_{11t} \]  
\[ \text{PCM}_t = v_5(B)\text{MIS}_t + v_6(B)\text{MB}_t + v_7(B)\text{I}_{11t} + v_8(B)\text{I}_{21t} + N_{21t} \]  
\[ \text{MB}_t = c_3 + v_9(B)\text{MIS}_t + v_{10}(B)\text{PCM}_t + v_{11}(B)\text{I}_{11t} + v_{12}(B)\text{I}_{21t} + N_{11t} \]

where the \( v_i(B) \) in this context are linear transfer functions given by the corresponding polynomials in the estimates of equations (1) through (3). Thus, for example, \( v_1(B) = \omega_0B^3 \), etc. For compactness of notation also let \( v_2(B) = v_r \). Then after much tedious algebra it may be shown that the final-form coefficients describing the dynamic effect of each exogenous variable on each endogenous variable may be written as follows:

The final-form coefficient giving the impact of \( I_{11t} \) on the misery index \( \text{MIS}_t \) is given by

\[ b_2(B) = \frac{[(v_1 + v_2 v_6)(v_7 v_{10} + v_{11}) + (1 - v_6 v_{10})(v_2 v_7 + v_3)]}{d_1(B)} \]  
\[ d_1(B) = (1 - v_2 v_3)(1 - v_6 v_{10}) - (v_1 + v_2 v_6)(v_2 + v_5 v_{10}). \]

The final-form coefficient giving the impact of \( I_{21t} \) on the misery index \( \text{MIS}_t \), is given by

\[ b_5(B) = \frac{[(v_1 v_5 + v_8)(v_3 v_9 + v_{11}) + (1 - v_1 v_9)(v_3 v_5 + v_7)]}{d_2(B)} \]

where

\[ d_2(B) = (1 - v_2 v_3)(1 - v_1 v_9) - (v_1 v_5 + v_8)(v_2 v_9 + v_{10}). \]

The final-form coefficient giving the impact of \( I_{11t} \) on the growth rate of the index of crude materials prices \( \text{PCM}_t \), is given by

\[ b_9(B) = \frac{v_9(v_2 v_7 + v_3) + v_{10}(v_3 v_5 + v_7) + (1 - v_2 v_7 v_{10})}{d_3(B)} \]

where

\[ d_3(B) = (1 - v_2 v_5 - v_6 v_{11})(v_1 + v_2 v_6) - v_{10}(v_1 v_5 + v_6). \]
\[ b_{10}(B) = [v_3(v_4 + v_5) + v_9] + v_{12}(1 - v_3)]/d_3(B). \]

The coefficients for each power of B in the linear form of \( b_3(B) \) give the dynamic multipliers which describe the average current and lagged effect of a one-unit step increase in the specific exogenous variable on the time path of the endogenous variable. The dynamic multipliers may be derived from the final form by first taking the mathematical expectation of each endogenous variable, conditional on the exogenous variables, and then partially differentiating the resulting equation with respect to each lag of the exogenous input (Dhrymes, 1974).

The long-run multipliers may be calculated from the estimated \( b_3(B) \) final-form coefficients simply by setting \( B = 1 \) (Dhrymes, 1974).

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