Investigating suicidal trend and its economic determinants: evidence from India

Pandey, Manoj K. and Kaur, Charanjit

Institute of Economic Growth, University of Delhi Enclave, Delhi-110007, INDIA

15 April 2009

Investigating Suicidal Trend and its Economic Determinants: Evidence from India

Manoj K. Pandey[1]
Institute of Economic Growth, Delhi, INDIA
Charanjit Kaur
Institute of Economic Growth, Delhi, INDIA

Abstract

This paper examines the trend and economic determinants of the suicidal deaths in India. Time-series data over the period 1967-2006 is used from various sources. The paper analyzes the suicidal trend and exploratory relationships between suicide rate and some of the demographic and other economic variates. Further, we use ARDL model to find out the association between suicide and some economic variables. We find that inflation, per capita real GDP and industrial growth encourages the incidences of suicides whereas increased per capita household income helps in reducing suicidal deaths in India.

Keywords: Suicide, Economic factors, Trends, Time series, ARDL model
JEL Classification: C22, I12

[1] Corresponding address: Manoj K. Pandey, Institute of Economic Growth, University of Delhi Enclave, Delhi-110007, INDIA. Email: manojkp23@gmail.com. We are most grateful to Prakash Singh for his useful comments and suggestions. The views expressed are, however, personal and not necessarily of the institution to which authors are affiliated. Any deficiencies are the sole responsibility of the authors

Investigating Suicidal Trend and its Economic Determinants: Evidence from India

1. Introduction

Unprecedented growth in the past couple of years due to outstanding performance in services and manufacturing sector has led India to enter in to the league of fastest growing economies. Statistics on Indian economy suggest that real per capita gross domestic product (GDP) grew at 3.95 per cent annually during the period 1980-2005, and at 5.4 per cent annually from 2000 to 2005 (RBI, 2008). At the same time, National Crime Records Bureau (NCRB) 2007 estimate suggests that each year over one lakh Indians commit suicide that leads to deaths and the suicide rate has been more or less increasing over the time. According to recent NCRB report during the last decade (1997–2006), suicide rate has been increased by 8% while the population has increased only by 19%. Further, India alone contributes more than 10% of the total suicides in the world and majority of suicides occur among men and in younger age groups[2].

Most of the studies in the Indian Context, related to the suicide so far have investigated the sociological aspect of the problem only. However, with globalization countries are facing economic problems like losses incurred in the markets and changes occurring in the income. This raises a very important question on the link between suicide and its economic determinants. Therefore, after analyzing the suicidal trends across different demographic composition of population the paper undertakes econometric exercise to examine the role of the economic determinants of suicidal deaths in India by using the time series data over the period 1967-2006.

The paper is novel in many ways. In our the best of knowledge, there is no other study which deals with the issue of suicide rate in view of economic conditions and have used both exploratory and have applied dynamic econometric method such as Auto-Regressive Distributed Lag (ARDL) model, especially in Indian context.

[2] See http://www.maithrikochi.org/india_suicide_statistics.htm

The rest of the paper is structured as follows: Section 2 deals with the existing literature on suicide. Section 3 describes the data used in the analysis. Trends in suicide rate across demographic indicators and economic variates are established in section 4. Section 5 deals with the estimation methodology and empirical results. Finally, paper concluded with concluding remarks and policy implications in section 6.

2. Review of Literature

Since Durkheim's Le[3] (1897), a number of studies have been done to explain the behaviour of suicide: both theoretically and empirically. However, most of the studies till early 70's only covered sociological aspect of suicide and therefore, were not able to attract economists' attention and in this sense, economic theory of suicides floored (christened) only after seminal work by Hamermesh and Soss in the year 1974. With an intention to provide economic theory as the tool to analyse the behaviour of suicide, this study started a debate over the intrusion of economic factors in sociological underpinning of the study to explain the behaviour of individuals who commit suicide. Later, Yang (1989, 1992) investigates the socio-economic determinants of suicide by integrating sociological approach to that of economic. Moreover, most of the recent empirical studies support the hypothesis that suicide cannot be explained away as irrational behaviour and establishes the link between socio-economic factors and suicide rates.

2.1 International Experience

In an early study for Japan, Hamermresh (1974) found that the social capital enhances community integration and has a greater effect upon the suicide of females than that of males. It argues that it could be probably due to the fact that females are less likely to have full-time jobs and thus have more spare time, leading them to seek social involvement in their neighborhoods and encouraging them to participate in community activities. Later Yang (1992) showed that the effect of labour force participation on suicide rate is sensitive to the gender and race. Further, it was found that welfare and

[3] Durkheim proposed that suicide was an outcome of social/societal situations. In his book 'Suicide' Durkheim found out that suicide rates are higher for widowed, single and divorced than married; for persons without children than with children and among Protestants than Catholics and Jews (http://en.wikipedia.org/wiki/Suicide_(Durkheim))

unemployment are related to suicide (Yang and Lester, 1995) and the role of cyclical component is important in understanding the suicide (Oswald, 1997). Viren (1996) analyzes the relationship between suicide and business cycles using long Finnish time series data for the period 1878-1994 and put forward that suicide increases along with age and is related to both GDP growth (inversely), bankruptcies and unemployment. Using cross-sectional heteroscedastic and time-wise autoregressive technique, Chuang and Huang (1997) find that in Taiwan, apart from many socio-economic correlates, the level of per capita income have a greater impact on suicide rates at regional level than the sociological correlates. Using cross-section study for 30 countries, Jungeilges and Kirchgassner (2002) showed that increase in real income per capita and real income growth increases the likelihood of the suicide rate. However, it is sensitive to the age-group and gender. While suicide rate of middle age group increased with increase in the role of real income per capita; it is elderly segment of population where increased role of economic growth is significant. Additionally, older women hold stronger to real income growth than older men.

Chuang and Huang (2003) shows that economic factors such as income, inflation and consumption along with social factors such as age, religion, and divorce rates are also responsible for change in the suicide rates. In an empirical study Rodriguez (2005) find that economic growth, fertility rate, and alcohol consumption have a significant impact on male and female suicide rates but contrary to prior studies, suicide rates were not sensitive to the income levels, female labour participation rates and unemployment. Yang and Lester (1995) find that in the case of United States of America (USA), unemployment and suicide rate are strongly associated, though this effect is weak or non-existent in other nations case. The study of Watanabe et al. (2006) confirms that in Japan the risk effect of suicide due to unemployment among men are reduced by the unemployment insurance.

2.2 Indian Experience

The issue of suicidal deaths is under researched in India. However, in last few years, the issue of suicidal deaths has been receiving renewed social and policy attention. While

suicides of students, farmers, professional and married make news headlines, a significant proportion of suicidal deaths remain unreported. In the recent years, many cases of farmer's suicide have been reported in a number of states, particularly Andhra Pradesh, Karnataka, Kerala, Punjab and Maharashtra (Mishra, 2006). Therefore, most of the studies in Indian context revolve around farmers' suicide. For instance, Iyer and Manick (2000) try to identify the socio economic profile of the suicide victims. Study also examined the economic and social factors of suicides using data from the three highly suicide prone blocks of Sangrur district namely Lehragaga, Andana and Barnala and suggested for the preventive measures in the suicide prone blocks and general measures to prevent further recurrence of suicide. Mishra (2006) documents that in the state of Maharashtra, the suicide mortality rate for farmers has increased from 15 in 1995 to 57 in 2004; whereas, for the state of Punjab, Satish (2006) examine possible linkage between institutional credit, indebtness and farmers' suicides. Both the studies find that indebtness is one of the major cause of suicide among farmers but warns that it cannot be taken as the sole cause as the data showed no direct causal relationship between institutional credit, indebtedness and suicides Satish (2006)[4].

Using a panel data with 22 Indian states for 5 time point during 1977-2001, Mitra and Shroff (2008) find that relative unfreedom of women (measured by the male-female suicide ratio) is increasing over time after controlling the effect of per capita income. The study shows that increased female literacy and number of bed availability per 1000 people also lower the relative unfreedom of women. In a study for elderly Indians, Shah et al. (2009) showed that income inequality (measured in terms of gini coefficients) independently determines the suicides rate for elderly male and female. Gururaj et al. (2004) find that domestic violence, lack of religious belief is also a major risk factor for suicide, in a study of Bangalore city in India and in a recent study with psychology and mental health angle, Vijaykumar (2007) emphasizes on the role of mental health professionals to prevent suicides[5].

[4] Also see Assadi (2008), Gruère et al. (2008), Habar (2007), Chamaria (2006)
[5] For suicide trend in northern India, see Sharma et al. (2006)

3. Data

The paper uses yearly time series data on suicide and economic variables from different sources. These include various NCRB reports, Reserve Bank of India (RBI)[6], and Census of India[7]. A time series data on suicide rate[8] for the period 1967-2006 has been culled from annual publications of NCRB on Accidental Deaths and Suicides in India[9]. Economic variables like per capita GDP, per capita GDP growth rate, per capita GDP cyclical component are taken from RBI website and other demographic variables like population and aged population (age 65 years and above) have been taken from Census of India.

4. Trends in Suicide Rate across Demographic Indicators and Economic Variates

4.1 Suicide Rate and its Trend: 1967-2006

After a brief review of literature, we move to explain the trends of suicidal deaths in India since 1967 to have a basic idea of nature and composition of suicide in India. Trend behaviour of the rate of suicidal deaths in India in last 4 decades suggests that rate of suicide increases from 7.77 percent in 1967 to 9.06 in the year 1970 and then started falling until 1979 with all time minimum of 5.87 percent in that year (see Figure 1). Post 1980 shows bad experience in the form of increase in suicide. Overall, there is increase in the suicide rate that has been recorded by 3% during 1967-2006[10].

<Figure 1 about here>

4.2 Suicide Rate and Gender: 1967-2006

The percentage share of male in the suicide rate is always higher than female in the considered period (see Figure 2). However, during the last decade the suicide rate gap

[6] Available at http://www.rbi.org.in

[7] The Indian Census is the largest single source of a variety of statistical information on different characteristics of the people of India every 10 years

[8] defined as the number of suicides per 100,000 estimated mid year population

[9] The suicide rate may suffer from under-reporting problem as it is based only on police records. However, this is the most reliable data source available in India and have been utilized in many studies (see, Mishra, 2006)

[10] Average decadal suicide rate by means adopted and by major causes is reported in Annex Table A.1 and A.2, respectively

between male and female has increased tremendously with all time high of 28% in the year 2006. While, the proportion of male suicide victim has increased from 58% to 64% during 1996 to 2006; the proportion of female suicide has dropped continuously from 42% to 36% during the same. This indicates that the tendency to commit suicide has increased among male while in female it has gone down during 1967 to 2006.

<Figure 2 about here>

4.3 Suicide rate and age-group: 1967-2006

Trend of Suicides for persons below 30 and above 30 years of age[11] shows that suicide rate is increasing for persons in later age group while declining for the former (see Figure 3). Significance of this trend could be that the tendency to commit suicide among children and young adults is declining over the period while it is increasing among middle and elderly age group. Moreover, in the recent years the rate is decreasing for both the age bands.

<Figure 3 about here>

4.4 Suicide rate and educational status[12]: 1995-2006

Share of illiterate people among victims of suicide have declined sharply from about 29% in 1995 to 21% in 2006 while percentage of people, who commit suicide, increased from 62% to 67% in the education bracket primary to matriculate during 1995-2006. The same increasing trend can be visualized in higher secondary educated persons. However, the overall proportion of highly educated, Diploma and above, people is very small and ranges from 3% to 4%. Thus, it seems that over the time the tendency to commit suicide

[11] NCRB reports for year 1967 to 1970 divide age group as: up to 18 years, 18 to 30 years and above 30 years. From 1971 to 1994, age is categorized as below 18 years,18-30 years, 30-50 years and 50 years & above whereas 1995 onwards data is given as up to 14 years, 15 to 29 years,30 to 44 years, 45 to 59 years and 60 years & above. Therefore, below 30 years and above 30 years were the possible age-groups which can be produced for the entire period. Also, data is not available for the period 1981 and 1988

[12] Though our study is based on data from 1967-2006, for this section we restrict our analysis for the period 1995-2006 only due to non-availability of data

among educated people is increasing while decreasing among illiterate people. This could be possibly due to increased professional and social pressure among highly educated persons (see Figure 4).

<Figure 4 about here>

Table 1: Percentage of suicidal deaths according to marital status: 1995-2006

Year	% of suicidal deaths according to marital status				
	Never Married	Married	Widowed/Widower	Divorcee	Separated
1995	22.58	67.20	5.17	1.26	3.79
1996	23.31	64.27	6.56	1.70	4.15
1997	23.38	66.00	5.48	1.58	3.57
1998	23.36	66.57	5.00	1.46	3.61
1999	22.56	66.64	5.10	1.72	3.98
2000	21.94	69.04	4.50	1.20	3.32
2001	22.18	69.23	4.54	1.25	2.81
2002	21.96	68.24	5.75	1.23	2.82
2003	21.77	69.60	4.95	1.02	2.66
2004	21.63	70.07	4.17	1.05	3.08
2005	20.99	70.82	4.45	0.98	2.76
2006	20.67	72.24	3.91	0.93	2.24

4.5 Suicide rate and marital status[13]: 1995-2006

Further, it is clear from Table 1, that the suicidal deaths among married people is the highest in all the marital classes with a minimum of 64% in overall suicides for the year 1996 which increased to 72% in the year 2006. However, the trend is not strictly increasing and the proportion of never married shows declining trend in suicidal deaths over the period 1995-2006. It can be readily observed that the percentage of never married in total suicidal deaths was 23% in 1995; it declines slightly to 21% in the year 2006. The same diminishing trend is followed by widowed/widower, divorcee and separated, however, with a lower suicide rate. Further, Table 2 indicates that the

[13] Though our study is based on data from 1967-2006, for this section we restrict our analysis for the period 1995-2006 only due to non-availability of data

proportion of male suicide in overall suicide has increased in all the marital classes during the year1995-2006.

Table 2: Percentage of male suicides to total suicidal deaths according to marital status: 1995-2006

Year	% male to total suicides according to marital status					
	Never Married	Married	Widowed/Widower	Divorcee	Separated	Total
1995	60.82	58.80	50.18	43.89	61.11	58.71
1996	60.57	57.95	51.63	45.17	60.38	58.03
1997	61.26	58.77	49.48	46.75	60.92	58.73
1998	60.52	59.02	49.83	50.59	62.33	58.91
1999	59.86	60.08	47.33	46.92	61.74	59.22
2000	61.37	61.56	47.68	44.27	65.19	60.81
2001	60.18	62.35	48.26	52.41	62.65	61.12
2002	61.96	64.25	52.37	50.33	60.66	62.79
2003	63.55	64.22	53.20	52.17	61.99	63.35
2004	64.12	64.80	49.85	55.56	63.74	63.90
2005	63.96	65.06	52.53	49.87	61.06	64.01
2006	63.91	64.99	51.84	46.64	65.46	64.09

While the percentage share of never married, married, widowed/widower, divorcee and separated males were 61%, 59%, 50%, 44% and 61% in 1995, respectively; their respective share have increased to 64%, 65%, 52%, 47% and 65% in 2006. This suggests that the increased share of male suicides in all the marital categories is on the cost of reduced share of female suicide in the corresponding marital classes.

4.6 Suicide rate and unemployment rate[14]: 1973-2004

The relationship between suicide rate and unemployment rate has shown in figure 5, which depicts the positive relationship between suicide rate and unemployment rate for all the time points, except for the year 1983 where unemployment has dipped while

[14] As National Sample Survey (NSS) collects data on employment and unemployment every 5 year, we avoid use of interpolated data for the years in between two consecutive surveys and restrict our analysis only for those years.

suicide rate has gone up as compared to the year 1977. The correlation coefficient is positive but small in magnitude.

<Figure 5 about here>

4.7 Suicide rate and GDP per capita growth rate: 1967-2006

We observe a very interesting trend from the Figure 6 which entails a positive association between suicide rate and GDP per capita growth rate and suggests that except for some early years and 1990s both moves together which is interesting in the sense that except for male suicide rate the results of ARDL estimation comes out to be affecting suicide negatively. This means that in spite of increase in GDP per capita growth rate over a period of 1967-2006, suicide rate does not reduced at least prima-facie.

<Figure 6 about here>

4.8 Suicide rate and industrial growth rate: 1967-2006

Figure 7 depicts how suicide rate and industrial growth moves simultaneously over a period of 1967-2006. It can be seen that, though there is no clear story to tell about their association, both have increasing trend. It can be noted that industrial growth rate in the year 1979 was -1.6.

<Figure 7 about here>

4.9 Suicide rate and Urbanization[15]: 1971-2006

Figure 8 shows again that over the said period both the percentage of urban population in total population and suicide rate has gone up though the rate of later is always higher than that of former rate.

<Figure 8 about here>

[15] Data is available only for census years 1971, 1981, 1991 and 2001 and therefore, we could not use this variable in the next estimation stage

5. Estimation Methodology and Results

After the trend analysis, according to the demographic variables like age, gender, marital status etc. and economic variables like unemployment rate and income related variables, we now try to analyze the impact of economic variables on the suicidal deaths and rate of suicide econometrically. Accordingly, we have used here four variables describing suicide: total suicide, male suicide, female suicide and suicide rate; economic and demographic variables as explanatory variables.

5.1 Estimation Strategy: ARDL Model

Given the nature of data and objective of the paper, we use time-series models to investigate the economic and demographic correlates of suicide in India, especially the long run relationship. For this type of analysis, Autoregressive Distributed Lag Models (ARDL hereafter) method of estimation proposed by Shin and Pesaran (1997) and Pesaran, Shin and Smith (1996) is an obvious choice. The virtue of relative handiness and superiority of this model over many other models for the investigation of existence of long run equilibrium between the variables when the order of integration of the variables is not same naturally attract applied econometricians. In VECM approach of estimation of long run relationship all the variables has to be integrated of the order of 1 i.e. I (1). It is not always possible that the economic variables under particular study will be integrated to the order of one I(1), possibilities remain open for getting variables which are integrated of I(0) and I(1) order. ARDL method of co-integration analysis is also useful when there is presence of structural break in the series. Thus ARDL method of estimation can be used irrespective of whether the regressors are purely I(0), purely I(1) or mutually co-integrated (Pesaran and Pesaran, 1997). Second advantage of ARDL method of testing co-integration is that it works better than other method testing existence of long run relationship even if the data set small[16]. And finally, the model executes sufficient no lags to capture the data generating process in a general to specific modeling framework.

[16] See Haug, A., (2002)

5.2 Hypothesis Testing Criterion under ARDL model

In the ARDL model estimation, first we check the presence of co-integration in the model by applying the Bond test for the presence of no co-integration. The F-statistic of the estimated and result of the model is compared with the tabulated critical values presented in Pesaran and Pesaran (1997) or Pesaran et al. (2001) with upper and lower bound. If the calculated value is more than upper bound critical value presented in Pesaran and Pesaran (1997) and Pesaran et al. (2001) then null of no co-integration is rejected but if the calculated values are less the lower bound values that null of no co-integration is not rejected regardless of the order of integration of the variables i.e., I (0) or I (1).

In case the calculated values falls in-between then upper and lower bound values, the result is inconclusive and depends upon the order of integration of the variable i.e. whether the variables are I(0) or I(1). At this stage unit root testing of the individual series is required. In order to decide the optimal number of lag length of each variable ARDL method regresses (n+1)q number of regression, where n is maximum number of lag and q is the number of variables in the equation. Second stage involves the estimation long run relationship of ARDL model based on the restriction for optimal lag on the basis of criterion such as R- bar square, AIC and SBIC. AIC gives model with maximum number of relevant lag length where as SBIC give parsimonious model. And finally at the third stage ECM is estimated. In the ARDL model also, coefficient of the ECM term indicates speed of adjustment to the shock in the long run relationship of the variables to the deviation from its long run relationship.

A general ARDL model can be represented as:

$$\Phi(L,p)Y_t = \sum_{i=1}^{n} \beta_i(L,q_i)x_{it} + \delta w_t + \varepsilon_t \quad \text{.....(1)}$$

where,

$$\Phi(L,p) = 1 - \phi_1 L - \phi_2 L^2 - ..... - \phi_p L^p \quad \text{.....(2)}$$

$$\beta_i(L,q_i) = \beta_{i0} + \beta_{i1}L + ... + \beta_{iq_i}L^{q_i}, i = 1,2,3.....n \quad \text{.....(3)}$$

L is the lag operator such that $Ly_t = y_t - y_{t-1}$, and w_t is a $k \times 1$ vector of deterministic variables such as the intercept, seasonal dummies, time trend or exogenous variables with fixed lags. Y_t is the dependent variable and X_t's the explanatory variables.

Now in order to estimate the coefficient of long run relationship, equation (1) can be written in the form

$$Y_t = w + \sum_{i=1}^{n} \beta_i X_{it} + \varepsilon_t \quad \text{.....(4)}$$

where

$$\hat{w} = \frac{\alpha_0}{1 - (\phi_1 + \phi_2 + ... + \phi_p)}$$

$$\hat{\beta} = \frac{\beta_{i0} + \beta_{i1} + \beta_{i2} + ...\beta_{iq}}{1 - (\phi_1 + \phi_2 + ...\phi_p)} \qquad i = 1, 2, 3 \ldots \text{ n}$$

The ECM form of the model can be put in the following way

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{n} \beta_{i1} \Delta X_{it} - \sum_{i=1}^{\hat{p}-1} \phi_{i1} \Delta Y_{t-j} - \sum_{i=1}^{n} \sum_{i=1}^{\hat{q}-1} \beta_{ij} \Delta X_{it-1} - \phi(1, \hat{p})(Y_t - \sum_{i=1}^{n} \hat{\beta}_i \Delta X_{it}) + u_t \quad \text{.....(5)}$$

where

$Y_t - \sum_{i=1}^{n} \hat{\beta}_i \Delta X_{it}$ is the ECM term and $\phi(1, \hat{p})$, measures the speed of adjustment to reach the long run equilibrium position. Now once the theoretical model of ARDL method is clear, econometric model for the estimation of the objective can be easily set. Following the literature review and economic theory, the study specifies the following model in order to assess the long run effects of economic variables on incidences of male, female and all people's suicidal deaths and suicide rate.

We have data on per capita GDP, GDP growth rate, per capita real household consumption, inflation, percentage share of elderly in the total population (those age 65 years and above), industrial growth rate and per capita GDP cyclic component. However, we can not use all the explanatory variables in the same model due to theoretical and multicollinearity problems. Therefore, we decided to use these variables in two different specifications: One with per capita real household consumption, inflation and industrial growth rate and other specification is with per capita GDP, per capita GDP cyclic

component and industrial growth rate. We tried for various combinations of explanatory variables and finally, found following two feasible models:

Model 1:

$$S_i = \alpha_i + \beta_{i1} * \text{LPCRHC} + \beta_{I2} * INF + \beta_{i3} * \text{INDUSTGR} + \beta_{i4} * \text{t} + \varepsilon_{\text{i}} \quad \text{.....(6)}$$

Model 2[17]*:*

$$S_i = \eta_i + \gamma_{i1} * \text{LPCGDP} + \gamma_{I2} * \text{LPCGDPCC} + \gamma_{i3} * \text{INDUSTGR} + \phi_{\text{i}} \quad \text{.....(7)}$$

where $S_i (i = 1,2,3,4)$ refers to natural logarithms of $S_1 = TotalSuicide$, $S_2 = SuicideRate$, $S_3 = MaleSuicide$, $S_4 = FemaleSuicide$, respectively. $\alpha's$, $\beta's$, $\eta's$ and $\gamma's$, are the coefficients and ε and ϕ's are the error terms included in the models. All the variables are defined in Table 3.

Table 3: Unit root tests for variables

	Variable(s)	Augmented Dickey Fuller (ADF) Test		Philips-Perron (PP) Test	
		Level	1st Difference	Level	1st Difference
S1	Log of total incidences of suicide	-2.4066	-3.1075**	-1.5476	-6.1173***
S2	Log of suicide rate	-2.4225	-3.0744**	-1.5527	-6.1617***
S3	Log of total incidences of male suicide	-1.3948	-5.7270***	-1.4146	-5.7598***
S4	Log of total incidences of female suicide	-2.2136	-3.3843**	-1.7486	-6.6844***
LPCGDP	Log of per capita GDP	-0.2638	-5.2998***	0.9078	-5.4069***
LPCGDPCC	Log of per capita GDP cyclic component[18]	-5.9676***	-	-3.5897**	-
GDPCGR	GDP per capita growth rate	-5.5897***	-	-9.0206***	-
LPCRHC	Log of per capita real household consumption	-4.3992***	-	-5.0409***	-
INF	Inflation rate	-5.1964***	-	-4.4165***	-
INDUSTGR	Industrial growth rate	-5.3776***	-	-5.3035***	-

Note: *, ** and *** indicates significance at 10%, 5% and 1% level of significance, respectively.

Now, before estimating the time–series models for suicide, Augmented Dickey Fuller (ADF) and Philips-Perron (PP) tests are used to test the unit root properties for individual series used in the analysis. Results of the unit root test are reported in Table 3. Results of the unit root test suggest that all the four dependent variables are stationary only after first difference. Again, all the possible explanatory variables are stationary at their level

[17] Though initially we included time trend variable in the model 2 also but in that case no variable was turning out significant. So, deliberately we dropped it from the final equation

[18] It is used as a measure of volatility in the per capita GDP

except log of per capita GDP. Here it can be noted that there are tests of unit root which allow for structural break in the series but we have not used it to keep unit root test results simple and also use of ARDL bound test of co-integration does not require unit root test at first.

Schwarz Bayesian Criterion (SBC) is used to select the lag length for individual series participating in the co-integrated relationship[19]. Further, F-test is applied to test the null hypothesis that there is no co-integration against the alternative hypothesis of co-integration among the variables. Here, we find that former is rejected at 1% level of significance suggesting that there is co-integration in all the 8 equations (2 models with 4 dependent variables each) and therefore, we are able to proceed further to find the long run coefficient of each of the individual variables. Again, for the sake of simplicity, in this paper we will report only long run coefficients and its standard errors and given our interest in the long run association of the variables affecting suicide in male, female and all persons we have not included the results and any discussion on the issue on error correction mechanism.

Table - 4. ARDL estimation results for total suicide and suicide rate

Dep. variable	Log of total incidences of suicide		Log of suicide rate	
Exp. variables	Coefficient (Standard Error)		Coefficient (Standard Error)	
	Model 1	Model 2	Model 1	Model 2
INF	0.041 (0.021)*	-	0.043 (0.022)*	-
LPCRHC	-3.301 (1.930)*	-	-3.435 (2.015)*	-
INDUSTGR	0.029 (0.017)*	0.036 (0.048)	0.031 (0.018)*	0.022 (0.025)
LPCGDP	-	1.213 (0.339)***	-	0.572 (0.230)*
LPCGDPCC	-	-4.106 (6.604)	-	-1.431 (3.913)
Constant	35.132 (14.596)**	-0.357 (3.169)	27.491 (15.227)*	-3.392 (2.177)
Time trend	-0.066 (0.060)*	-	-0.089 (0.063)*	-

Note: *, ** and *** indicates significance at 10%, 5% and 1% level of significance, respectively. Also, lag lengths are selected through Schwarz Bayesian Criterion (SBC).

[19] results are similar however if we select lag length using Akaike Information Criterion (AIC) or Hannan-Quinn Criterion (HQC) and we restrict ourselves to SBC only

Results of the ARDL estimates of both the models for total number of suicide and rate of suicide are reported in table 4 and for the male and female suicides are presented in Table 5.

Table - 5. ARDL estimation results for total male and female suicide

Dep. variable	Log of total incidences of male suicide		Log of total incidences of female suicide	
	Coefficient (Standard Error)		Coefficient (Standard Error)	
Exp. variables	Model 1	Model 2	Model 1	Model 2
INF	0.043 (0.022)*	-	0.041 (0.021)*	-
LPCRHC	-3.435 (2.015)*	-	-3.301 (1.930)*	-
INDUSTGR	0.031 (0.018)*	0.021 (0.028)	0.029 (0.017)*	0.060 (0.085)
LPCGDP	-	1.348 (0.283)***	-	0.878 (0.545)
LPCGDPCC	-	-2.714 (4.450)	-	-6.445 (10.894)
Constant	27.491 (15.227)*	-2.124 (2.619)	35.132 (14.596)**	1.814 (5.174)
Time trend	-0.089 (0.063)*	-	-0.066 (0.060)*	-

Note: *, ** and *** indicates significance at 10%, 5% and 1% level of significance, respectively. Also, lag lengths are selected through Schwarz Bayesian Criterion (SBC).

Estimation results show that while incidences and rate of suicide increases with increase in inflation, per capita GDP and industrial growth rate; they decline as the per capita real household consumption increases. However, the effect the volatility in the per capita GDP is not significant on the suicidal incidences and rate. The same results hold for male and female suicidal deaths (see Table 5). Furthermore, the plots of actual and fitted values of all the indicators of suicide $S_i (i = 1,2,3,4)$ are presented in the Annex (see Plot A.1-A.8).

6. Concluding observations

This paper investigates how economic conditions are associated with suicide rates and incidences of suicidal deaths among male, female and general population in India over the period 1967-2006. The analysis done in the paper is in two folds: trend analysis using graphical and tabular approach and estimation using ARDL model used in time series analysis to estimate long run relationship between suicide and its economic correlates. Graphical analysis suggests that the percentage share of male in overall suicidal deaths is higher than female. This implies that the likelihood of male population to commit suicide

is higher than their female counterparts. Also, while the rate of suicide is declining for younger population (age below 30 years), the tendency to commit suicide is continuously increasing for population over 30 years. This means that suicide is somehow linked with the ageing process. Further, increasing rate of suicides are noticed in the education bracket, literate up to matriculation and beyond higher secondary education whereas the tendency to commit suicide among illiterate and uppermost education level is consistently going down over the years. Again, suicide rate increases with increase in unemployment rate, however, the relationship is weak. Interestingly, GDP per capita growth rate and suicide rates are almost analogous, except for some periods during 1967-2006.

Now, we discuss the findings of the ARDL models. The positive and significant coefficients of inflation shows that as the incidence and rate of suicide increases with increase in inflation rate and this is confirmed by recent incidences of farmers suicides in India. Further, we see that the increase in household consumption (an indicator of household income, see Deaton (1997)) reduces the likelihood of suicidal deaths. Moreover, the positive and significant coefficient of industrial growth rate suggests that industrial growth encourages the incidences of suicide to happen. This is probably because industrial growth requires skilled labour and those who are unskilled and traditional may lose their job and in this way chance of suicide may increase. However, we do not have any evidence in support of this hypothesis. Again, the positive coefficient of the per capita GDP supports the findings of few recent studies (see for example, Viren, 1999; Barstad, 2008). Also, this relationship was explained by Suzuki (2008) using a concept of income uncertainly. Also, contrary to study due to Ludwig and Marcotte, (2005), our estimates suggest that increased share of the elderly population is negatively associated with suicide.

Apart from the fact that we have done the analysis with care, the study is not free from certain caveats. One, the data on incidences of suicidal deaths could be affected from under-reporting. Secondly, many socio-demographic variables are missing from the analysis because of lack of time-series data. Thirdly, we do not have full-proof logical evidences on why some of economic variables affect suicide rate or incidences while

some of them do not. Going forward, the result of this study is supportive for additional and complementary work on economic determinant of suicide rate in India.

References:

Assadi, M. (2008): Farmer's Suicide in India: Agrarian Crisis, Path of Development & politics in Karnataka, available on http://viacampesina.net/downloads/PDF/ Farmers_suicide_in_india(3).pdf

Barstad, A. (2008): Explaining Changing Suicide Rates in Norway 1948-2004: The Role of Social Integration, Social Indicators Research, 87.

Chamaria, A. (2006): Society and Suicide, 22 September, 2006, available at www.countercurrents.org

Chuang, W. L., and W. C. Huang (1997): Economic and Social Correlates of Regional Suicide Rates: A pooled Cross-section and Time-series Analysis, Journal of Socio-Economics, 26(3), 277-289.

Chuang, W.L., W.C. Huang (2003): Suicide and unemployment: Is there a connection? An empirical analysis of suicide rates in Taiwan, Working Paper 0217E, Department of Economics, National Tsing Hua University.

Deaton, A. (1997): The Analysis of Household Surveys: A Microeconometric Approach to Development Policy, Johns Hopkins University Press, Baltimore, London.

Durkheim, E. (1897): Le Suicide: etude de sociologie, Paris: Alcan, (Translated by J. A. Spaulding, J. A. and G. Simpson, Suicide: A Study in Sociology, New York: Free Press, 1951).

Gruère et al. (2008): Bt. Cotton and Farmer Suicides in India, IFPRI Discussion Paper 00808, October 2008.

Gururaj G, M Isaac, DK Subhakrishna and R. Ranjani (2004): Risk factors for completed suicides: A case-control study from Bangalore, India, Inj Control Saf Promot 2004; 11:183-91.

Hamermersh, D, S. (1974): The Economics of Black Suicide, Southern Economic Journal, 41, 188-99.

Hamermesh, D. S., and N. M. Soss., (1974): An Economic Theory of Suicide, Journal of Political Economy, 82, 83-98.

Haug, A. (2002): Temporal Aggregation and the Power of Cointegration Tests: A Monte Carlo Study, Oxford Bulletin of Economics and Statistics, 64, 399-412.

Hebar, R. (2007): Human Security and the Case of Farmers' Suicides in India: An Exploration. Paper presented in a panel on Rethinking Development in a Conference on 'Mainstreaming Human Security- an Asian Perspective' (October 3-4, 2007) organised by Chulalongkorn University, Bangkok. Available at: http://www.searo.who.int/LinkFiles/Alcohol_and_Substance_abuse_5BangaloreSt.pdf.

Iyer, K. G. and M. S. Manick (2000): Indebtedness Impoverishment and Suicides in Rural Punjab, Indian Publishers Distributors, India.

Jungeilges, J. and G. Kirchgassner (2002): Economic Welfare, Civil Liberty, and Suicide: An Empirical Investigation, Journal of Socio-Economics, 31, 215-231.

Ludwig, J. & Marcotte, D. E. (2005): Anti-depressants, suicide, and drug regulation. Journal of Policy Analysis and Management, 24, 249 –272

Mishra, S. (2006): Suicide Mortality Rates across States of India, 1975-2001: A Statistical Note, Economic and Political Weekly, 41.16 (2006): 1566-1569.

Mitra, S. and Shroff, S. (2008): What suicides reveal about gender bias, Journal of Socio-economics, 37: 1713-1723.

National Crime Records Bureau (NCRB): Accidental Deaths & Suicides in India, National Crime Records Bureau organisation, various annual publications 1967-2007.

Oswald, A.J. (1997): Happiness and economic performance, Economic Journal, 107: 1815-1831.

Pesaran, M. H. and B. Pesaran (1997): Working with Microfit 4.0: Interactive Econometric Analysis, Oxford: Oxford University Press.

Pesaran, M. H. and Y. Shin (1997): Generalised Impulse Response Analysis in Linear Multivariate Models, Cambridge Working Papers in Economics 9710, Faculty of Economics, University of Cambridge.

Pesaran, M. H., Y. Shin, and R. J. Smith (1996): Testing for Existence of A long-Run Relationship, University of Cambridge Department of Applied Economics Working Paper, no. 9622.

Pesaran, M.H., Y. Shin and R. J. Smith (2001): Bounds testing approaches to the analysis of level relationships, Journal of Applied Econometrics, 16: 289-326.

RBI (2008): Handbook of Statistics on Indian Economy, RBI.

Rodriguez A. (2005): Income Inequality, Unemployment, and Suicide: A Panel Data Analysis of 15 European Countries, Applied Economics, 37, 439-451.

Satish, P. (2006): Institutional Credit, Indebtedness and Suicides in Punjab, Economic and Political Weekly, 2754-2761.

Shah, A., R. Bhatt, S. Mckenzie, and C. Koen (2009): Relationship between elderly suicide rates and life expectancy, and markers of socio-economic status and health: multivariate analysis, Journal of Chinese Clinical Medicine, 4(4).

Sharma et al. (2006): Suicides in Northern India: Comparison of trends and review of literature.

Suzuki, T. (2008): Economic Modelling of Suicide under Income Uncertainty: For Better Understanding of Middle-Aged Suicide. Australian Economic Papers, 296-310.

Vijaykumar, L. (2007): Suicide and its prevention: The Urgent need in India, Indian J Psychiatry, 49:81-84.

Viren, M. (1996): Suicide and Business Cycles: Finnish Evidence, Applied Economics Letters, 3, 737-738.

Viren, M. (1999): Testing the "Natural Rate of Suicide" Hypothesis. International Journal of Social Economics, 26 (12), 1428-1440.

Watanabe, R., M. Furukawa, R. Nakamura, and Y. Ogura (2006): Analysis of the Socioeconomic Difficulties Affecting the Suicide Rate in Japan, Kyoto Institute of Economic Research Discussion Paper No. 626.

Yang, B. (1989): A real income hypothesis of suicide: A cross-sectional study of the United States in 1980, Paper presented at the 15th Annual Convention of the Eastern Economic Association.

Yang, B. (1992): The Economy and Suicide: A Time Series Study of the U.S.A, American Journal of Economics and Sociology, 51(1), 87-99.

Yang, B. and D. Lester (1995): Suicide, Homicide, and Unemployment, Applied Economics Letters, 2: 278-279.

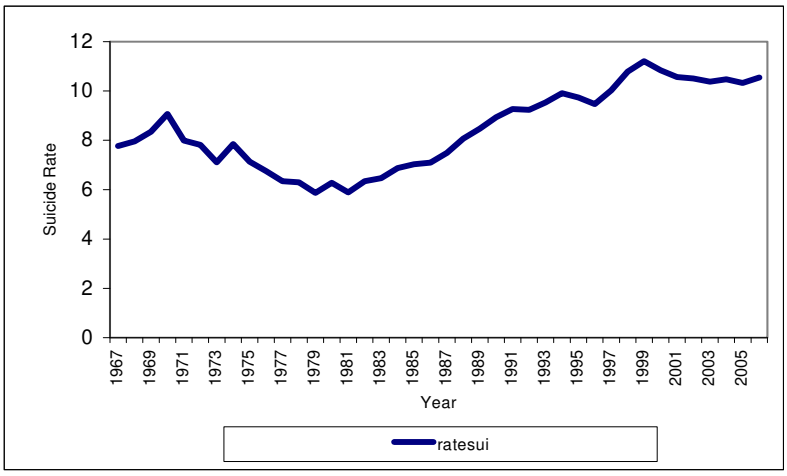


Figure 1: Trend in suicides rates

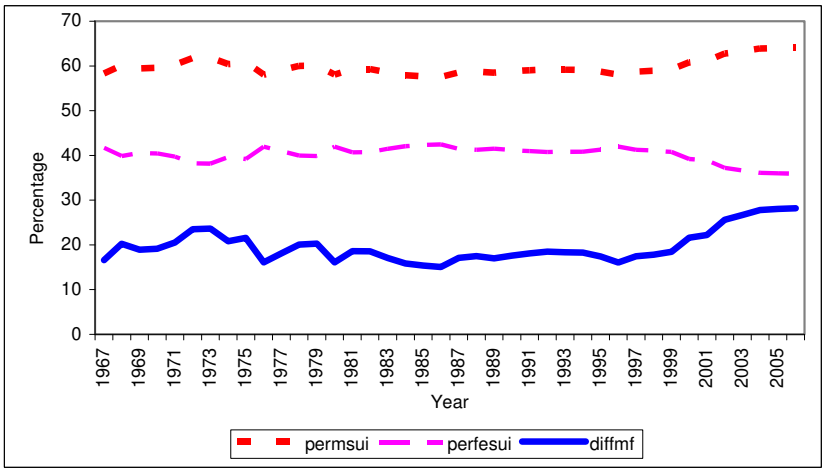


Figure 2: Percentage share of male, female and their difference in the suicide rate

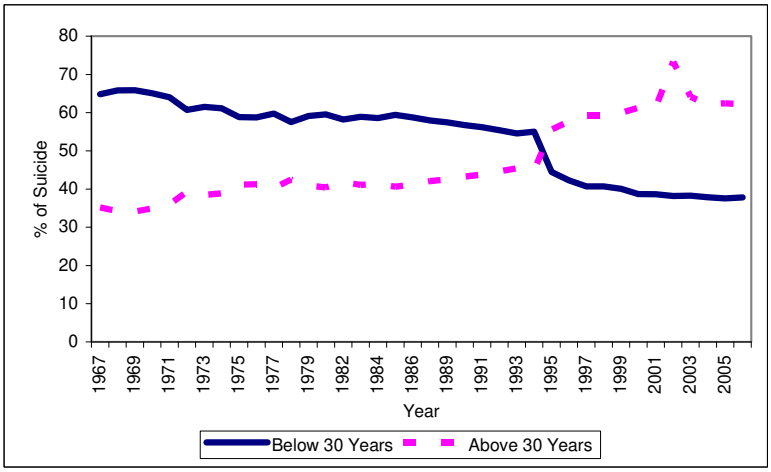


Figure 3: Percentage of suicides according to age group: 1967-2006

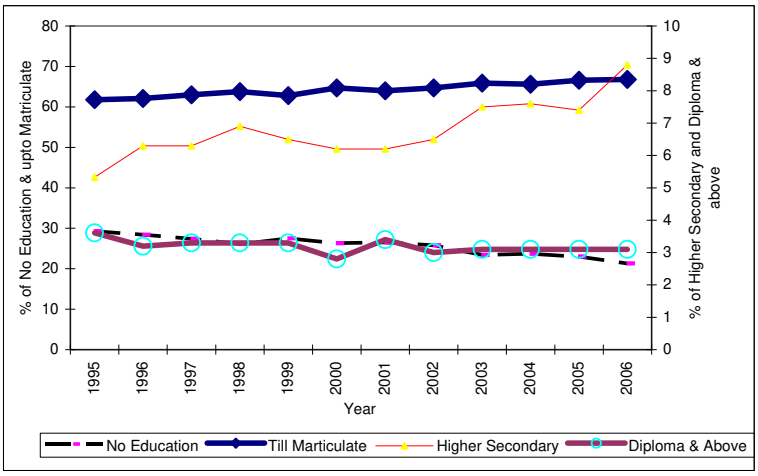


Figure 4: Percentage of education level of suicide victims for the year 1995-2006

Figure 5: Unemployment and suicide rate for different periods

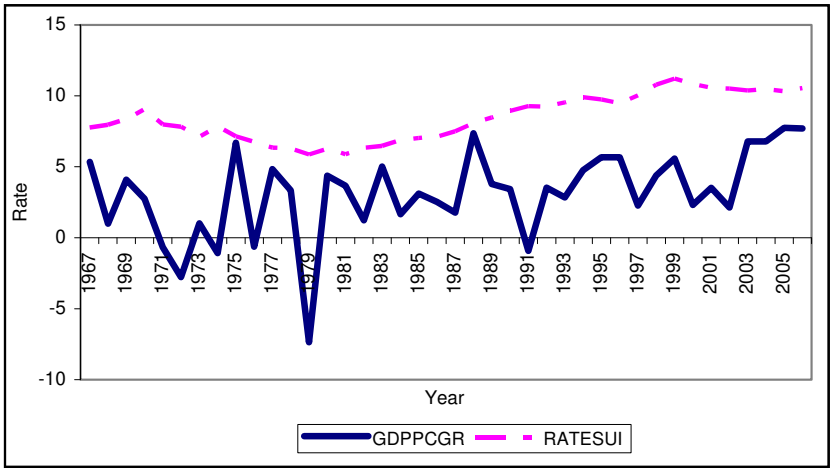


Figure 6: GDP per capita growth rate and suicide rate for different periods

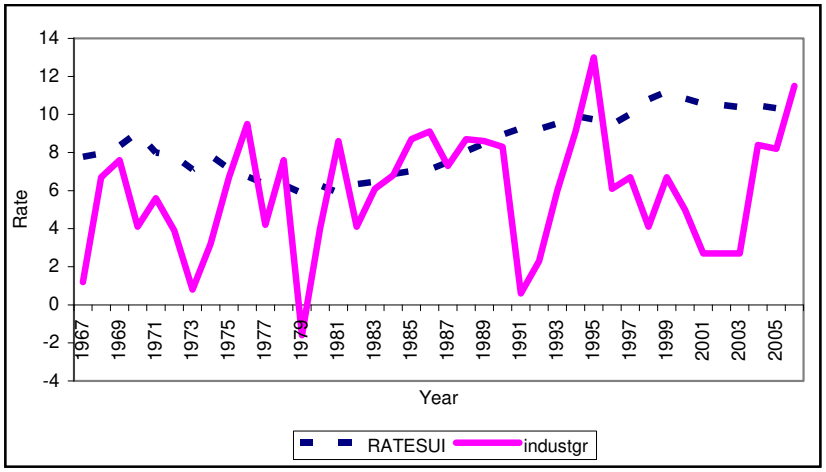


Figure 7: Suicide rate and industrial growth rate for different periods

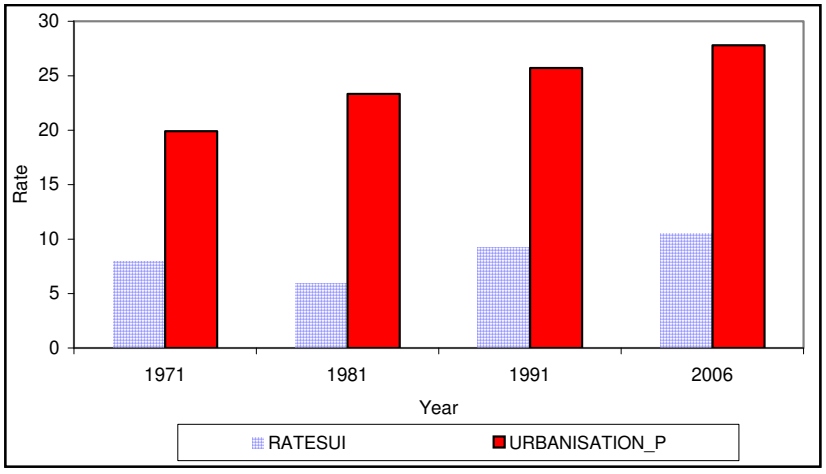


Figure 8: Suicide rate and urbanisation for different periods

Annex

Table A.1: Average decadal suicides rate by means adopted: 1967-2006

Year	Major means adopted for suicide					
	Drowning	Fire/ Self immolation	Hanging	Poison	Coming under running vehicles/train	Others*
1967-1976	19.58	5.85	18.43	25.66	6.71	23.77
1977-1986	16.37	8.07	23.21	27.20	6.24	18.91
1987-1996	10.49	10.18	24.34	33.36	3.81	25.23
1997-2006	7.74	9.65	28.50	37.29	3.02	13.81
1967-2006	13.55	8.40	23.61	30.77	4.94	20.34

*others include suicide by fire arms, self infliction of injury, jumping from buildings and other sites, machine and other means.

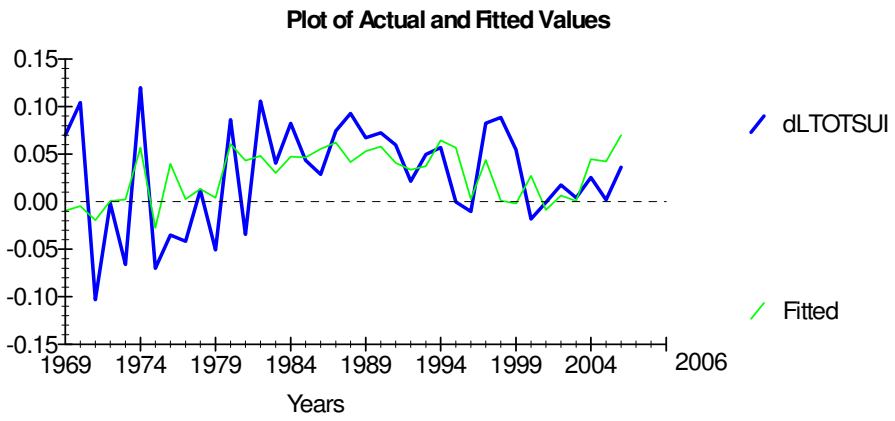
Table A.2: Average decadal suicides rate by causes: 1967-2006

Year	Major cause of suicides				
	Health*	Economic reasons**	Personal / Social reasons***	Other causes	Causes not known
1967-1976	19.63	5.67	26.58	48.11	-
1977-1986	18.43	5.01	27.09	45.94	10.57
1987-1996	17.11	5.74	27.61	32.50	17.04
1997-2006	21.82	7.92	38.33	14.56	17.40
1967-2006	19.26	6.07	29.81	35.62	16.27

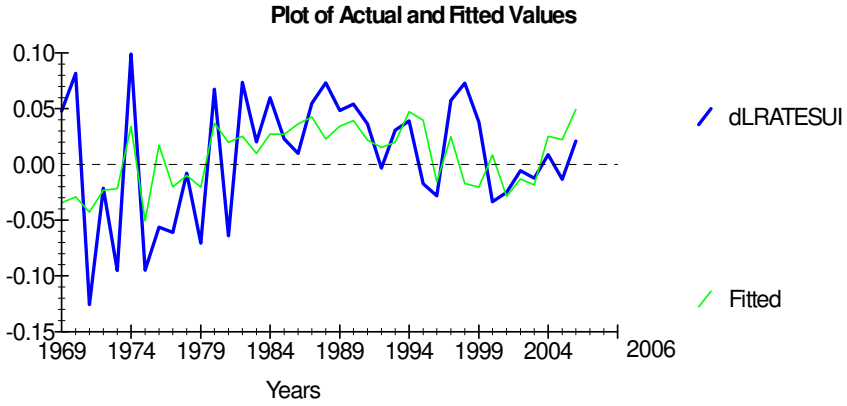
*****Health includes dreadful disease, illness-a. AIDS/STD, b. cancer, c. paralysis, d. insanity/ mental illness & e. other prolonged illness

**Economic reasons include bankruptcy or sudden change in economic status, poverty, professional/career problem & unemployment

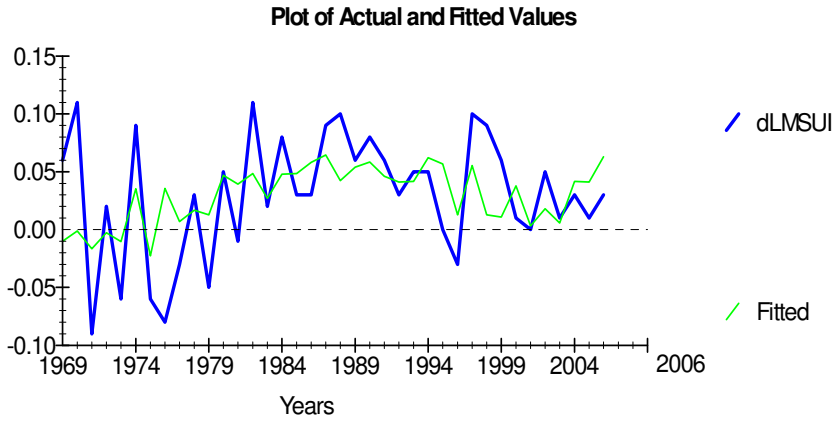
***Personal / Social Reasons include Frustration, Quarrel with Parents in Law, Quarrel with spouse, suspected/illicit relation, cancellation/non-settlement of marriage, not having children (barrenness/impotency), death of dear person, dowry dispute, divorce, drug abuse/addiction, failure in examination, fall in social reputation, family problems, ideological causes/hero , worshipping, illegitimate pregnancy, love affairs, physical abuse (rape, incest etc.) & property dispute



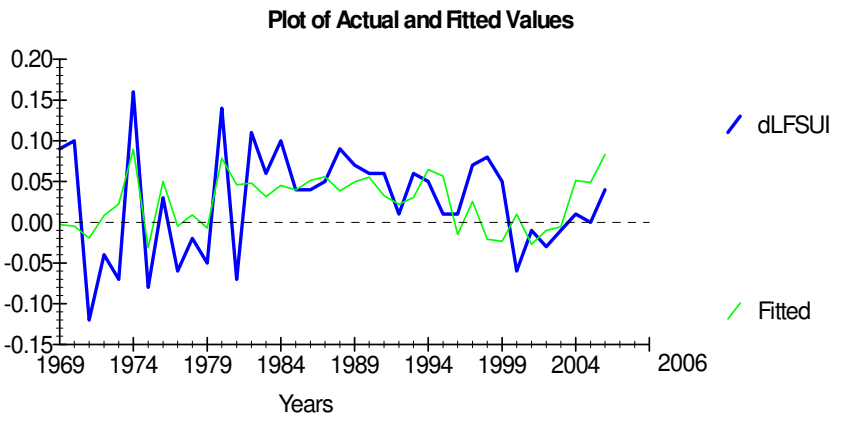
Plot A.1: Actual and predicted total number of suicides in model 1



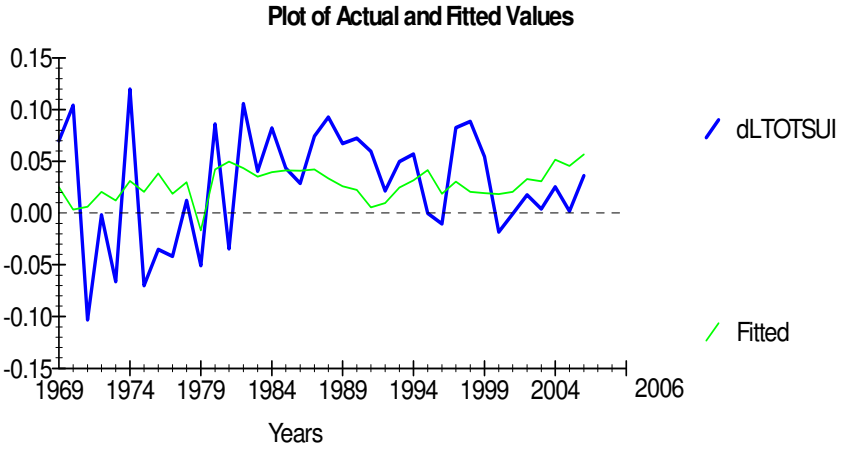
Plot A.2: Actual and predicted rate of suicides in model 1



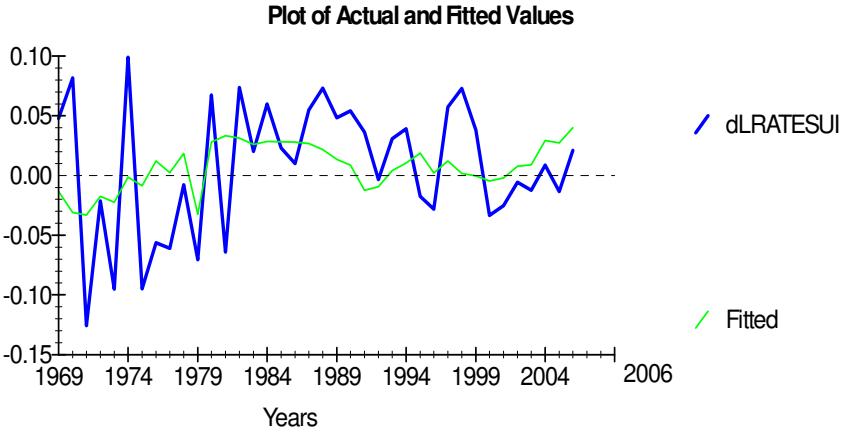
Plot A.3: Actual and predicted male suicides in model 1



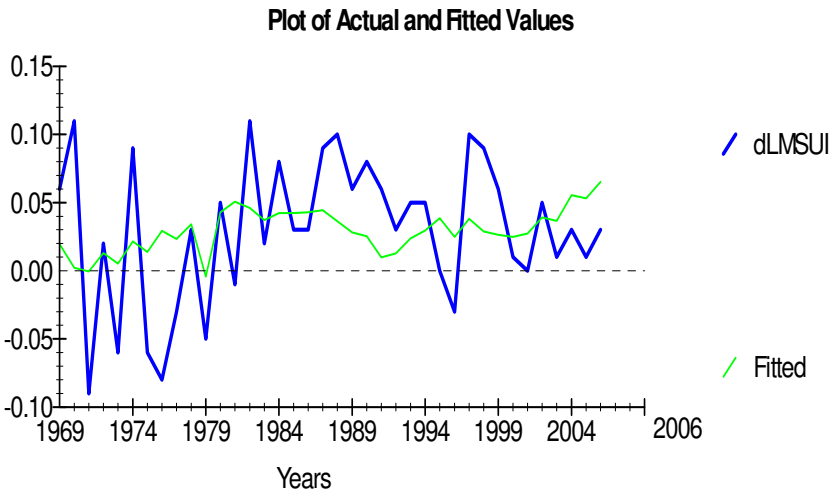
Plot A.4: Actual and predicted female suicides in model 1



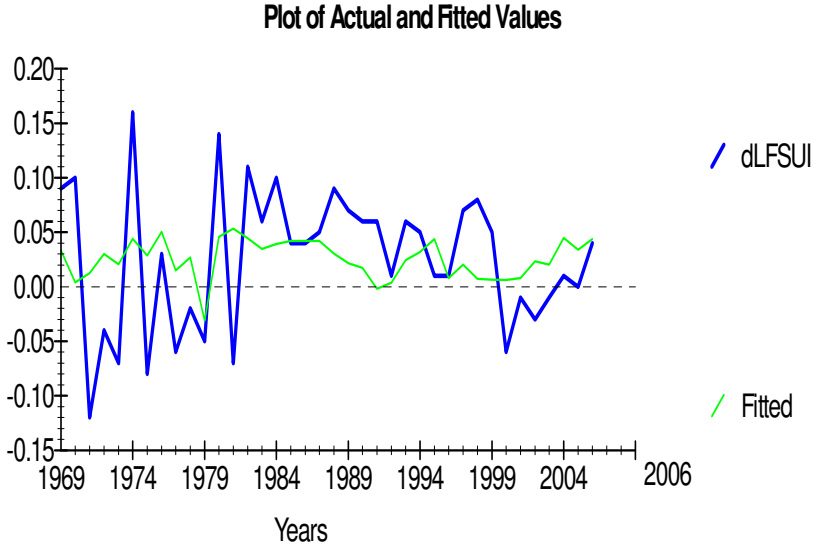
Plot A.5: Actual and predicted total number of suicides in model 2



Plot A.6: Actual and predicted rate of suicides in model 2



Plot A.7: Actual and predicted male suicides in model 2



Plot A.8: Actual and predicted female suicides in model 2